Research on Innovation in Internal Control and Risk Management of Financial Enterprises in the Digital Intelligence Era

Authors: Zhou Xiaodong, Zhou Xiaodong

Date: 2025-09-05T00:00:00+00:00

Abstract

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Full Text

Research on Innovation in Internal Control and Risk Management of Financial Enterprises in the Era of Digital Intelligence

Xiaodong Zhou
(School of Accounting, Guangdong Technology College, Zhaoqing, Guangdong 526100, China)

Abstract

Establishing a comprehensive risk management system and a sound, effective internal control mechanism constitutes a critical prerequisite for the survival and healthy development of financial enterprises. This paper analyzes the lessons from Société Générale' s 2008 case, where severe deficiencies in internal monitoring mechanisms triggered financial shocks across Europe. It expounds on the influencing factors and implementation pathways of internal control in the digital intelligence era, identifies key points for constructing a risk management-based internal control system, and proposes the main methods and six major technologies for internal control in this era. The paper explains how the digital transformation of auditing helps achieve internal audit objectives and enhances internal audit effectiveness. It introduces the main pathways and key points of auditing digital transformation, noting that intelligent auditing represents the major trend in future audit development, and presents applications of digital twin technology in commercial bank auditing. The paper points out that auditing digital transformation also entails organizational and talent upgrading, requiring vigorous cultivation and recruitment of auditing professionals to support its successful implementation. Financial enterprises should continuously innovate their internal control mechanisms, constantly improve and strengthen internal control and risk management functions, progressively enhance internal control effectiveness, and thereby facilitate high-quality corporate development.

Keywords: Internal control; risk management; digital transformation; artificial intelligence; intelligent audit

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In modern financial enterprise management, strengthening and standardizing internal control constitutes an important condition for enhancing management standards and risk prevention capabilities, as well as promoting sustainable development of financial enterprises. Internal control refers to the methods, procedures, and measures established among functional departments to organize, constrain, evaluate, and regulate business activities for the purpose of achieving management objectives and organizing internal operations.[1] In the era of digital intelligence, market competition intensifies and various risks are ubiquitous. To prevent risks before they occur and resolve them in a timely manner, financial enterprises must advance internal control construction. Through training

and education, management at all levels and all employees should cognitively and ideologically recognize the significance of internal control in corporate governance, comprehensively and thoroughly understanding its necessity and vital role for enterprises. This involves establishing organizational structures, systems, and processes that are timely, enable efficient operation, cost savings, profit generation, and risk control, and can be effectively implemented across all business segments, departments, and positions within financial enterprises.

2. Strengthening and Standardizing Internal Control: An Important Condition for Sustainable Development of Financial Enterprises in the Digital Intelligence Era

Erwin Schrödinger, the Austrian theoretical physicist and Nobel Prize laureate, wrote in his 1944 book *What Is Life?*: "The entropy of an isolated system or a system in a uniform environment increases, approaching the inert state of maximum entropy sooner or later. We now recognize that this fundamental law of physics is precisely the natural tendency of all things toward chaos, unless we intervene" (Erwin, 2020).2 Any isolated system (including enterprises and other organizations), if left unmanaged, uncontrolled, and allowed to develop naturally, will evolve toward a state of chaos and disorder. "The objective of internal control is to provide reasonable assurance regarding the legality and compliance of enterprise operations, the safety of assets, the truthfulness and completeness of financial reports and related information, the improvement of operational efficiency and effectiveness, and the promotion of strategy implementation." [3] The Chinese Ministry of Finance stated in its December 2021 Notice on the Accounting Informatization Development Plan (2021-2025) (Cai Kuai [2021] No. 36): "Improve the informatization supporting construction of internal control systems to promote effective implementation of internal control systems." Therefore, financial enterprises should timely identify and assess internal and external risks related to control objectives, and reasonably determine risk response strategies. Based on risk assessment results, they should conduct corresponding control activities to keep risks within acceptable limits. Countless facts and lessons repeatedly prove that establishing a comprehensive risk management system and a sound, effective internal control mechanism constitutes a critical prerequisite for the survival and healthy development of financial enterprises.

(1) Société Générale' s "Severe Deficiency" in Internal Monitoring Mechanisms Triggering Financial Shocks Across Europe

Founded in May 1864, Société Générale is a veteran European bank with nearly 150 years of history, listed on stock exchanges in Paris, Tokyo, and New York. It employs 55,000 staff, operates 2,600 domestic outlets, maintains 500 branches in up to 80 countries worldwide, and serves 5 million private and corporate clients. The bank provides comprehensive, professional financial services ranging from traditional commercial banking to investment banking, and was once consid-

ered one of the world' s best risk-controlled banks. However, in January 2008, Société Générale' s futures trader Jérôme Kerviel made massive unauthorized purchases of European stock index futures, creating a huge shortfall of €4.9 billion (approximately US$7.1 billion). This represents the largest single loss in banking history caused by employee misconduct. "This earth-shattering fraud case also triggered financial shocks in France and across Europe, and spread to global stock market declines. In terms of both nature and scale, it can be called the greatest financial tragedy in history." [4]

(2) Post-Incident Emergency Measures and Actions by French Regulatory and Judicial Authorities

1. Analysis of Post-Incident Emergency Measures Although this crisis exposed deficiencies in Société Générale' s internal risk management and the loss amount was enormous, the bank immediately implemented a series of emergency risk measures after the incident was revealed, avoiding the fate of bankruptcy that befell Barings Bank and minimizing risk losses.

(1) Prudent Operations to Maintain Market Confidence After detecting signs of Kerviel' s fraudulent trading on January 18, Société Générale immediately took measures to remedy part of the losses. On January 20, the bank identified all of Kerviel' s positions and closed out the unauthorized trades over the next three days, exercising extreme caution in its operations to maintain market confidence. Specific measures included: controlling the liquidation trading volume below 10%; rapidly establishing a special investigation team and introducing external auditors to announce investigation progress to the public, establishing an image of openness and transparency to avoid investor panic; to stabilize market confidence, Société Générale activated an "emergency communication mechanism" worldwide to visit clients individually; launching a capital strengthening plan with attached preemptive subscription rights to raise €5.5 billion through capital increases; and proceeding as planned with the acquisition of a majority stake in Russia' s Rosbank to salvage the continuously declining market confidence.

(2) Diversified Business Playing a Role Unlike Barings Bank' s single business structure (which went bankrupt in 1995 due to unauthorized derivatives trading by its Singapore subsidiary manager Nick Leeson; see Nick Leeson' s *Rogue Trader*, translated by Zhang Youxing, Chen Hongsheng, and Wang Chaohui, China Economic Publishing House, 1st edition, October 1996), Société Générale' s business covers personal retail banking, investment banking, and asset management services, with investment banking being the main profit source. After the crisis, "Société Générale announced unaudited financial statements showing that, after deducting subprime mortgage and Kerviel factors, the group' s net profit was €947 million. Although the investment banking business incurred losses, strong growth in other business units compensated for these losses." [5]

2. Actions by Regulatory and Judicial Authorities On July 4, 2008, the French banking regulator—the French Banking Commission—imposed a €4 million fine on Société Générale for the "severe deficiency" in its internal monitoring mechanism that led to the massive fraud. On October 5, 2010, a Paris court ruled that Jérôme Kerviel, the protagonist of the largest unauthorized trading case in financial history and former "rogue trader" at Société Générale, was guilty on all counts including breach of trust, forgery, and use of false documents. Kerviel was sentenced to five years in prison and ordered to pay Société Générale €4.9 billion in damages, making him the most indebted individual in history.[5]

(3) Analysis of Société Générale' s Risk Management Problems

1. High-Performance Culture Ignoring Risk Warnings A major cause of this crisis was Société Générale' s overly aggressive corporate culture. Because previous unauthorized operations had brought substantial profits to the bank, management relaxed its necessary vigilance, resulting in management inaction and absence. From June 2006 to January 2008, 11 types of risk control systems across 28 departments—including the operations department, equity derivatives department, and over-the-counter trading—automatically issued 75 alerts regarding Kerviel' s various transactions. In November 2007, the European futures exchange also questioned Kerviel' s trading positions, but Société Générale focused solely on pursuing profits, ignored various internal and external warning signals, and lacked a sound information exchange mechanism and upward reporting system, ultimately leading to disaster.

2. Loopholes in Limit Management Société Générale focused its risk limit monitoring on the net position measurement of traders, neglecting the scale of all transactions and the risk exposure of one-sided trades. Consequently, Kerviel used fictitious transaction data to create the illusion that his portfolio' s net exposure was hedged, evading the limit management system' s monitoring. Additionally, European exchanges provided Société Générale with aggregated transaction data without breaking it down by individual trader. Since Société Générale's derivatives trading volumes were traditionally huge, Kerviel's massive transactions did not raise excessive suspicion.

3. Systemic Loopholes in Information Firewalls Banks' front-office trading departments, risk management departments, and back-office settlement departments should be completely independent. However, Société Générale neglected the sensitive information mastered by middle and back-office personnel during internal staff rotations. Kerviel' s five-year work experience in middle and back-office departments gave him intimate knowledge of how the internal control system operated and allowed him to develop good personal relationships with certain middle and back-office staff. He exploited his understanding of internal control system vulnerabilities to successfully evade system monitoring and cross-departmental inspections for his unauthorized front-office operations.

4. Technical Vulnerabilities in Information Systems Operational management errors occur in details, while success depends on systems. Any minor technical defect could expose a bank to enormous risks. According to Société Générale' s disclosures, the bank' s system developers, acceptance personnel, and IT managers failed to take effective measures against system technical vulnerabilities over an extended period, allowing them to be exploited by traders. It can be said that Kerviel had the criminal motive, while the bank' s information system technical vulnerabilities provided him with the opportunity and tools to commit the crime.

3. Risk Management as the Main Content of Internal Control

Inherent risk refers to all potential risks an enterprise faces after setting an objective but before implementing any risk control activities. Residual risk refers to the potential risks that remain after an enterprise, having identified potential risks, reduces, avoids, or transfers them through a series of control activities. Among these control activities, those controlling internal operations are called internal control. COSO (The Committee of Sponsoring Organizations of the Treadway Commission) believes internal control provides reasonable assurance for achieving three major objectives: first, operational effectiveness and efficiency; second, reliability of financial reporting; third, compliance with laws and regulations. To achieve these internal control objectives, enterprises must establish effective internal control systems.

The promulgation of the U.S. Sarbanes-Oxley Act on July 30, 2002, marked the recognition by regulators in developed capital markets worldwide that establishing, maintaining, evaluating, and reporting on internal control systems constitutes an important responsibility of operators. On May 22, 2008, China' s Ministry of Finance and four other ministries jointly issued the *Basic Norms for Enterprise Internal Control* (Cai Kuai [2008] No. 7), effective July 1, 2009, for listed companies and encouraging implementation by large non-listed enterprises. This marked the official launch of China's version of the "Sarbanes-Oxley Act." In April 2010, China's Ministry of Finance and four other ministries jointly issued the *Notice on Issuing Supporting Guidelines for Enterprise Internal Control* (Cai Kuai [2010] No. 11), releasing 18 application guidelines including *Enterprise Internal Control Application Guideline No. 1—Organizational Structure*, as well as the *Enterprise Internal Control Evaluation Guideline* and *Enterprise Internal Control Audit Guideline* (collectively referred to as the supporting guidelines for enterprise internal control), effective January 1, 2011, for companies listed both domestically and abroad, and January 1, 2012, for companies listed on the Shanghai and Shenzhen Stock Exchange main boards;[6] implementation for small and medium-sized board and ChiNext board listed companies was to be timed accordingly, with encouragement for early implementation by large non-listed enterprises. In July 2017, China' s Ministry of Finance announced the *Notice on the Internal Control Norms for Small Enterprises (Trial)* (Cai

Kuai [2017] No. 21), effective January 1, 2018.[7] With the advancement of social legalization and intensifying competition in the financial industry, financial enterprises can only achieve sustained and stable development by establishing, improving, and effectively implementing internal control systems.

(1) The Relationship Between Enterprise Internal Control and Risk Management

Internal control and risk management (Enterprise internal control and risk management) are both distinct and interconnected. The essence of internal control is risk control, and risk management constitutes the main content of internal control. Risk includes internal and external risks; control of internal risks is internal control. In this sense, risk management is an important component of internal control, enterprise risk management encompasses internal control, and internal control is the means of enterprise internal risk management. A basic function of financial enterprise internal control is to control risk; risk management involves identifying, assessing, and controlling risks that enterprises may face during service operations, with the ultimate goal also being risk control. In summary, risk management represents the development of internal control, expanding its connotation and evolving it into risk-oriented internal control.

(2) Main Problems in Current Financial Enterprise Internal Control and Risk Management

1. Understanding Internal Control and Risk Management as Merely System Establishment Internal control and risk management are not merely rules and regulations, such as regulatory documents, technical specifications, and application models, nor are they additional separate control activities like information exchange, review and supervision, and risk assessment. Therefore, internal control and risk management should not be viewed as static but should be embedded within the daily service and management activities of financial enterprises to form a regular management and service operation mechanism. Internal control and risk management represent both an institutional arrangement and a management process, as well as the lawful and compliant self-disciplined behavior of all departments and employees in financial enterprises.

2. Considering Internal Control and Risk Management as Unrelated The connotations of internal control and risk management have many overlapping aspects, such as numerous identical elements and similar methods. However, their specific application needs to be implemented according to the characteristics, development stage, industry features, technical conditions, and external environment of the financial enterprise itself.

3. Exaggerating the Role of Internal Control and Risk Management Whether internal control or risk management, both are management activities of financial enterprises. No matter how advanced their methods or how perfect

their systems, they can only provide relatively reasonable rather than absolute assurance for enterprises to achieve their objectives. That is, internal control and risk management are necessary but not sufficient conditions for financial enterprises to win markets (customers) and achieve healthy development. Especially when the character, beliefs, capabilities, or responsibilities of financial enterprises or key position employees are lacking, one must not pin the enterprise' s success on internal control and risk management.

4. Disconnect Between Risk Control Theory and Practice Financial enterprise internal control and risk management must achieve unity of knowledge and action. Management personnel must integrate risk management concepts and internal control and audit frameworks into daily service management activities. Moving from knowledge to action and from theory to practice requires ideological recognition and conscious action by financial enterprise employees.

5. Inadequate Implementation of Systems and Processes Systems that are not implemented or are poorly implemented serve no purpose, no matter how advanced they are. Internal control targets "matters" rather than "people," representing an "impersonal" control mechanism whose control objects include not only the controlled party but also the controlling party. Financial enterprise internal control requires participation from all staff, parallel participation, and equal participation, which is quite different from traditional hierarchical and bureaucratic systems.

(3) Implementation Pathways for Financial Enterprise Internal Control in the Digital Intelligence Era

The widespread application of new-generation information technologies such as cloud computing, big data, the Internet of Things, mobile internet, artificial intelligence, and blockchain provides new technical means for financial enterprise internal control construction while also presenting many new challenges. How to implement internal control in financial enterprises is an urgent problem for both financial enterprises and the market. Practice has proven that based on new-generation information technologies, financial enterprises can effectively achieve internal control through business process reengineering and management transformation. First, enterprises should build a sound internal control environment and reengineer internal control processes, systems, and measures. Second, they should digitize and intelligize processes to ensure explicit, accurate, and truthful internal control, helping financial enterprises achieve transparent and data-based management of finance, assets, human resources, and knowledge. Third, based on process digitization, they should improve data middle platform functions to solve the effective and timely collection and communication of internal information.

4. Six Technologies for Enhancing Financial Enterprise Internal Control Levels in the Digital Intelligence Era

Whether creating a world-class financial enterprise financial management system or enhancing internal control levels, digital technology serves as the key driving force. In March 2022, China' s State-owned Assets Supervision and Administration Commission (SASAC) issued the *Guiding Opinions on Accelerating the Construction of a World-Class Financial Management System by Central Enterprises*, proposing that enterprises should "proactively apply new technologies such as big data, artificial intelligence, mobile internet, cloud computing, and blockchain, give full play to the advantages of finance as a natural data center, promote the transformation of financial management from informatization to digitalization and intelligence, and achieve the conversion from accounting scenarios as the foundation to business scenarios as the core." [8]

(1) "Cloud" as Infrastructure in the Digital Economy Era

"Cloud" constitutes indispensable infrastructure in the digital economy era. Cloud infrastructure comprises three major components: computing resources, network resources, and storage resources, integrating numerous tools and solutions to form an important foundation for successful cloud application deployment. Financial enterprise system applications such as financial sharing and tax sharing typically adopt cloud deployment architectures. Enterprises should fully utilize national opportunities to promote coordinated cloud-network and computing-network development, accelerating the construction of a nationally integrated big data center system with collaborative computing power, algorithms, data, and application resources. Faced with accelerated digital transformation in financial enterprises, adopting flexible cloud deployment methods can provide advantages such as professional operation and maintenance, rapid deployment, and elastic resource scaling, while simultaneously addressing financial enterprises' requirements for security and stability in steady-state businesses involving core data and agility and adaptability in high-growth, rapidly changing businesses—meeting the adaptation conditions for financial enterprises' dual-mode IT.

(2) Low-Code Development Lowering Application Development Thresholds

Low-code development means financial enterprises can quickly generate applications through visual drag-and-drop methods by directly reflecting business needs in data models and page logic design, without writing code or with minimal coding. This supports rapid response of financial enterprise digital applications according to business needs, offering advantages such as faster development and deployment, lower barriers, more agile operation and maintenance, and higher security. It is widely applied in financial enterprise-level system platforms such as financial sharing, procurement sharing, and audit supervision. Low-code development also has disadvantages such as lower operational efficiency and

development freedom, and is not irreplaceable. However, facing increasingly intense market and business demand changes, low-code development applications will become more widespread.

(3) Data Middle Platform Providing a Platform for Finance and Audit Digitalization

The data middle platform is a set of mechanisms and applications that, under the background of the DT (Data Technology) era, integrates enterprise data to achieve the goal of fast, accurate, and low-cost empowerment of business development. It uses big data platforms to complete unified data processing and provides data services externally. First, the data middle platform can break down data barriers between financial enterprise decision-making and business layers and among departments, achieving real-time data flow and sharing across all dimensions, fields, processes, and operation service cycles. Second, financial enterprises can build data governance systems based on the data middle platform to achieve data standardization and transform data into valuable assets. Third, financial enterprises can conduct data modeling and processing based on the data middle platform, providing a solid foundation for rich scenario-based applications in various management accounting fields such as budgeting, expenses, and performance. Fourth, it enables timely and efficient internal control information communication.

(4) RPA Assisting Financial Enterprise Finance and Audit Automation

RPA (Robotic Process Automation) offers advantages such as rapid deployment and scaling, quick results, low cost, and greater suitability for operating closed heterogeneous systems. However, it is not economical for scenarios with complex business rules or high-performance requirements and can be replaced by rule engines and APIs (Application Programming Interfaces). For example, Deloitte' s "financial robot" can replace manual operations in some financial processes within financial shared service centers, completing information entry, data consolidation, summary statistics, and management monitoring of various automated financial processes, and even performing some business compliance audit work. This saves significant manpower, reduces communication costs, and improves work efficiency.[9] Over 500 commercial banks in China have already used RPA or RPA platforms.

(5) Multi-Dimensional Modeling and Calculation for Financial Enterprise Audit Intelligence

Multi-dimensional modeling and calculation establishes a database model based on factual analysis and multiple dimensions to meet financial enterprises' needs for data query and analysis from various angles and levels, achieving OLAP (Online Analytical Processing). Data models encapsulate financial and audit management concepts and business decision-making demands, serving as the

core means of data value mining. During the design and application of digital audit models, it is necessary to evaluate the accuracy of big data audit models based on various risk evaluation algorithms such as precision-recall methods, cost-sensitive error rate methods, and mean square error methods, judging the reasonableness and accuracy of audit clues and issues discovered through data analysis. Through multi-faceted model validation, model results are summarized, invalid models are eliminated, model thresholds are adjusted, model logic and data cleaning rules are optimized, and model accuracy and effectiveness are enhanced.

(6) From RPA to IPA: A Booster for Intelligent Finance and Intelligent Auditing in Financial Enterprises

The artificial intelligence (AI) technologies mainly applied in financial and audit digital transformation fall into three categories: Natural Language Processing (NLP), knowledge graphs, and Machine Learning (ML). NLP technology possesses the ability to perceive and cognitively understand natural language, enabling real-time and efficient interaction with system data. Knowledge graphs and intelligent reasoning technologies enable systems to automatically retrieve and read information and conduct intelligent Q&A with users, achieving the transformation from people finding data to data finding people. Applying machine learning allows systems to scientifically predict, reasonably control, and intelligently analyze based on business knowledge understanding.

RPA, as a pioneering application of AI technology in finance and auditing, has gained widespread recognition in financial enterprises. However, RPA does not represent the top development technology of AI nor the advanced mode of "intelligent finance" or "intelligent auditing." With the in-depth development of AI technology and increasing demand for intelligence in financial enterprises, the application of IPA (Intelligent Process Automation) will become the general trend. Based on RPA, IPA integrates the complexity of AI and expands the robot' s scope of work through auxiliary technologies such as NLP, OCR (Optical Character Recognition), and ML, further unleashing the potential and value of automation. Compared with traditional RPA, IPA enhanced by AI has greater advantages in reading unstructured data, making decisions, ensuring task accuracy, and connecting human-machine interactive tasks. With the deep development of AI technology, based on powerful deep learning, computing, and response capabilities, "following RPA and IPA, AI technology applications in finance and auditing will even autonomously collect and analyze information and replace humans in making business decisions like humans do." [10] Through the systematic application of new-generation internal control software development and information technology, it is hoped that internal control design defects like those at Société Générale can be resolved and information system technical vulnerabilities can be plugged.

5. Digital Transformation of Financial Enterprises Enables Precise Internal Control and Enhances Risk Management Effectiveness

Digital transformation utilizes new-generation information technology to reshape and transform enterprise business models. Researchers Jiao Zongshuang and Zhang Xueying from the China Academy of Information and Communications Technology (2020) believe that digital transformation is driven by new-generation information and communication technologies such as big data, cloud computing, artificial intelligence (AI), and blockchain, with data as the key element. By achieving production intelligence, marketing precision, operational datafication, and management wisdom, it spawns new business forms, models, and drivers, realizing high-quality industrial development driven by innovation and synchronized development across fields.11

Audit digitalization represents the organic integration of digital technology and audit work. During enterprise audit digital transformation, the focus should be on enhancing audit attention to the security, reliability, and economy of information technology, accelerating the construction of an audit digital capability system, and promoting the development of digital audit standards and talent teams. If computer-assisted auditing and internet auditing under the influence of information technology are considered internal auditing in the informatization era, then stepping into the digital economy era, the development and widespread application of new-generation information technologies represented by big data, AI, mobile internet, cloud computing, the Internet of Things, and blockchain have moved society from the informatization era to the digital intelligence era, and the era of internal audit digital intelligence has arrived. "Internal audit digital intelligence is the collective term for internal audit digitalization and internal audit intelligence, representing an iterative upgrade of internal audit informatization in the informatization era. Internal audit digitalization is the data foundation for internal audit intelligence; without the datafication brought by internal audit digitalization, there would be no internal audit intelligence." [12] By carrying out business, financial, and audit digital transformation, financial enterprises continuously strengthen business, financial, and audit functions, enrich internal control audit perspectives, and enhance risk control effectiveness. Digital transformation has become the inevitable path for financial enterprise internal control and risk management to adapt to the major trend of digital intelligence and improve enterprise development quality.

(1) Strengthening Audit Supervision and Promoting Automation, Real-Time Capability, and Intelligence in Internal Auditing

In May 2018, President Xi Jinping emphasized at the first meeting of the Central Audit Committee: "We must persist in strengthening auditing through technology and enhance audit informatization construction."We must strengthen the application of audit supervision technology, obtain resources from informatization

and efficiency from big data, actively expand the use of digital technologies such as "Internet Plus," cloud computing, big data, AI, and blockchain in internal audit work, vigorously promote digital audit models, and use digital technology to promote full coverage of internal auditing. Internal auditing should strengthen digital audit supervision capability construction and promote the automation, real-time capability, and intelligence of audit methods and content.

In August 2020, the General Office of the State Council issued the *Notice on Accelerating the Digital Transformation of State-Owned Enterprises*, proposing digital transformation concepts such as "data-driven, integrated innovation, and win-win cooperation," [13] clarifying the foundation, direction, focus, and measures for digital transformation of state-owned enterprises. Financial enterprises in the digital economy era should accurately recognize changes, scientifically respond to changes, and actively seek changes, accelerating transformation and actively cultivating new development drivers. In September 2020, the Supervision Bureau of the State Council issued the *Implementation Opinions on Deepening Internal Audit Supervision Work in Central Enterprises*, proposing that big data auditing at the current stage needs to promote the construction and application of internal audit informatization. By building an "business-audit integration" informatization platform that integrates decision-making, investment, finance, funding, operation, and internal control business information systems, data sharing can be achieved. On this basis, big data, cloud computing, AI, and other methods can be actively applied to carry out big data-assisted audit work, while exploring the establishment of real-time audit supervision platforms to achieve real-time audit supervision and improve audit quality.[14]

(2) Main Pathways for Audit Digital Transformation

Audit digital transformation must not only align with financial enterprises' internal audit strategic planning but also proceed gradually in coordination with the overall digitalization level of the enterprise.

1. Top-Down Approach Through top-level design of audit informatization, plan and design an audit business support and analysis application system that functionally supports online interconnection, in-depth analysis, and immediate warning, and architecturally supports multi-level management and advanced technology routes. Fully consider the business and information linkage between risk control work and internal auditing, clarify the development direction and implementation route of internal audit informatization, and clearly define the audit digitalization direction from the top down. Fully evaluate the feasibility of the informatization and digitalization support required for internal audit digitalization, comprehensively plan the support needed for audit digital transformation from both business and technical levels, plan before implementation, ensure current plans are implementable, and future implementations are effective.

2. Pilot-Then-Promote Approach Through pilot verification, carry out pilot programs in business areas and user promotion scopes, selecting high-risk business areas and scopes with high informatization levels for pilot promotion of audit informatization. Combine audit project on-site verification, internal and external expert verification, and other methods to comprehensively and multi-dimensionally verify the efficiency and effectiveness of audit digital transformation, providing an 论证 foundation for comprehensive promotion of audit digital transformation, ultimately achieving full-domain and full-user scope audit digital transformation.

This pathway suits large enterprises, adopting a big data perspective to achieve overall monitoring across the entire business chain, truly focusing on high-risk areas. Through pilot programs across multiple fields and subsidiaries, it effectively enhances audit efficiency and significantly improves audit coverage. Based on the visualization design principle of "overview + detail display," for pilot areas, it uses big data analysis and AI technology for data mining, builds big data audit models, conducts visual design of big data models, and displays audit results and risk content more profoundly and concisely. Finally, it promotes from the group level across the entire group and multiple fields to achieve audit transformation.

3. Following the Trend Approach Some industries have high IT maturity, such as the telecommunications and internet industries. Therefore, with the arrival of the mobile internet era and explosive growth in data volume, traditional auditing can no longer meet industry risk identification needs in the big data era. To adapt to development, these industries fully leverage internal audit functions while "keeping pace with the times" with informatization and digitalization development, continuously upgrading audit digital thinking and technical levels to maintain a leading edge in audit digital technology.

4. Mechanism Precipitation Approach The mechanism precipitation digital transformation pathway forms a closed-loop management of the entire audit lifecycle by combining operational activity importance evaluation for planning and assessment, conducting data auditing through data exploration and mining, and applying and managing digital audit results through continuous audit projects and data audit projects. Enterprise internal audit departments implement full-lifecycle management of data auditing from planning and assessment, data mining, topic selection and modeling, development and implementation, application promotion, to audit follow-up for known risks and issues, solidifying big data auditing into audit mechanisms.

5. Data Focus Approach Professional organizations are an important component for achieving audit digital transformation. The development of big data audit work also requires strong support from professional teams, but audit digitalization demands often do not match audit talent capabilities. Professional

audit institutions have professional data analysis talents that can assist enterprises in continuously exploring "remote + on-site" data audit models, supporting normalized audit projects through big data analysis to promote sharing and improve efficiency. They can enhance risk identification in key areas, conduct risk analysis and prediction more comprehensively, efficiently, and intelligently, and continuously promote the improvement of the company' s overall refined management level.

(3) Key Points for Financial Enterprise Audit Digital Transformation Work

Financial enterprises should conduct comprehensive assessments from three aspects—business, data, and systems—to establish suitable audit digital transformation pathways, fields, and methods that align modern audit work with audit demands and match informatization levels.

1. Feasibility Analysis Conducting audit digital transformation must begin with feasibility analysis. Based on the financial enterprise' s business and risk assessment situation, clarify the business scenarios and rules of the audited field, and comprehensively determine executable big data audit areas by combining the systems and data support involved in financial business. From the system aspect, comprehensively evaluate system functional completeness, data transmission integration level, logical configuration rationality, and business support effectiveness. From the data aspect, comprehensively evaluate data structurization level, data granularity, data accuracy, and data completeness.

2. Audit Model Design The foundation of big data audit model design is to use various methods such as comparative analysis, keyword search, behavioral characteristics, trend analysis, cluster analysis, decision tree analysis, structural analysis, hierarchical analysis, and neural network analysis to mine anomalies in financial data and business processing, as well as associated scenarios and risks between business and financial data. Combined with technologies such as process automation, machine learning, and unstructured data analysis, audit model judgment capabilities are enhanced.

3. Business Data Preparation Design data access specifications according to different data sources, including data extraction methods, data cleaning rules, and integration logic. Formulate data access, storage, and preprocessing rules to create data templates. Through data screening and collection from multiple channels, access various operational and financial data required by models during the audit period to form an audit data warehouse.

4. Model Optimization and Application During the design and application of financial enterprise digital audit models, it is necessary to evaluate the accuracy of big data audit models based on various risk evaluation algorithms

such as precision-recall methods, cost-sensitive error rate methods, and mean square error methods, judging the reasonableness and accuracy of audit clues and issues discovered through data analysis. Through multi-faceted model validation, model results are summarized, invalid models are eliminated, model thresholds are adjusted, model logic and data cleaning rules are optimized, and model accuracy and effectiveness are enhanced.

5. Data Audit Platform Construction By building a big data audit platform, audit models are solidified, and appropriate visualization forms are selected to vividly and intuitively display semantic features contained in data. Financial enterprise audit digitalization models are embedded in visualization tools and can penetrate audit project details to support visualization results, enabling auditors to comprehensively assess business risks from both "macro" and "micro" perspectives and improving audit efficiency and effectiveness.

6. Continuous Audit Process Solidification Coordinated with big data audit construction, continuous audit operation processes should also be solidified. For audit matters automatically generated by financial enterprise audit models, definitions should be established for "who is responsible, who follows up, who rectifies, and who closes the item," forming a closed-loop management mechanism for audit matters to improve the timeliness of audit rectification. This truly transforms big data auditing into continuous auditing and integrates it into daily internal audit workflows, empowering internal auditing in financial enterprises.

6. Intelligent Auditing: A Heavy Weapon for Future Financial Enterprise Internal Control and Risk Management

The *Regulations on Internal Audit Work* (Audit Office Decree No. 11) issued by China' s National Audit Office in 2018 requires internal audit responsibilities to cover twelve items. In 2019, the General Office of the National Audit Office issued the *2019 Internal Audit Work Guidance* (Shen Ban Nei Shen Fa [2019] No. 39), proposing that internal audit institutions should play the role of main force in achieving full audit coverage by innovating audit methods, optimizing organizational methods, highlighting audit priorities, striving to achieve full audit coverage, ensuring all that should be audited is audited, eliminating audit supervision blind spots, and intensifying audit supervision efforts.[15] Through technological innovation to further improve audit efficiency, focusing on core risks within financial enterprises, and expanding audit coverage has become an important topic for current internal audit innovation and quality improvement. We should actively innovate audit methods and work models, improve data storage management efficiency and standardization levels, accelerate the deep integration of digital technology and audit business, accelerate the pace of audit digital transformation, strengthen reusable data audit methods, achieve intelligent auditing on this basis, and shift from "human auditing" as the main

approach to "machine auditing" as the main approach.

(1) Realistic Problems in Data Auditing

Currently, the fields where data auditing is applied are mostly concentrated in banking, insurance, and securities enterprises. Faced with a big data audit environment, traditional data auditing methods of constructing audit intermediate tables and audit analysis models have gradually transitioned to professional data mining algorithm technologies. Data auditing still has many application effectiveness problems. First, insufficient big data processing capability: current data auditing objects are mainly structured data, unable to process unstructured data such as text, images, and geographic locations. Second, low automation level in execution: many repetitive audit procedures in daily audit project execution lack automated inspection tools and still rely on manual sampling methods, resulting in low efficiency. Third, lack of intelligent applications: "existing data auditing methods cannot provide auditors with intelligent decision-making suggestions such as risk prediction and model expansion. Against this background, there is an urgent need to comprehensively apply and integrate big data analysis automation, artificial intelligence, and other technologies to explore a brand-new intelligent audit ecosystem based on existing data auditing" (Zhang Qinglong, He Jianan, Rui Baisong, 2021).16

(2) Digital Intelligence Technology Empowering Financial Industry Audit Transformation

Audit digital transformation affects the future pattern of auditing. The emergence of various intelligent technologies has broken the limitations of traditional data auditing in terms of data scale, scope, and type. Intelligent audit applications integrating new technologies such as advanced data analysis, cognitive technology, intelligent prediction, agile methods, and robotic process automation will provide comprehensive digital empowerment for financial enterprise internal auditing to reach higher levels. Intelligent auditing can not only reduce the time for audit data collection and analysis and greatly decrease repetitive operations in audit work but also allow auditors to devote more time and energy to important issues and timely provide valuable management recommendations to decision-makers. The advantages of intelligent auditing are mainly manifested in three aspects:

1. Comprehensive Analysis Capability for Big Data Intelligent auditing uses a Data Lake architecture (a system or storage that stores data in its natural/raw format, usually object blocks or files, typically a single storage for all enterprise data, which can be built in local data centers or on the cloud), constructs a big data audit platform and audit data operation and management mechanism, collects and stores various structured and unstructured data from inside and outside the enterprise, and achieves professional processing of various data, including collection, processing, conversion, storage, exchange,

association, sharing, and management. For example, for internal auditing of banks, by comprehensively analyzing various data such as retail customers' expenditure patterns, payment channels, and consumption habits, auditors can comprehensively, dynamically, and truthfully obtain overall information about audit objects, providing valuable reference basis for internal audit departments to conduct credit evaluations of relevant customers.

2. Efficient Automated Processing Capability Intelligent auditing uses audit robotic process automation (Robotic Process Automation, RPA; a business process automation technology based on software robots and AI; an RPA system is an application that automates end-user manual operation processes by mimicking how end-users manually operate computers) to replace manual execution of repetitive and deterministic audit actions with clear definitions and minimal exceptions. This achieves savings in audit manpower costs and rational allocation of audit resources, forming a focused audit resource capability. This technology can help auditors complete repetitive transactional work such as external data mining, data collection, data comparison and analysis, system security checks, and audit working paper preparation. Additionally, using AI technologies such as pattern recognition (text recognition, facial recognition, speech recognition) can provide auditors with full-sample inspection of unstructured data.

3. Intelligent Insight Capability into Financial Business Risks Intelligent auditing applies machine learning technology to directly process and analyze large amounts of audit object data, helping auditors reveal hidden data relationships. Intelligent auditing is neither purely information technology development and computer network application nor purely human brain function development, but rather the collaborative development of auditors' intelligence and tool intelligence. Intelligent auditing is a process of continuously enhancing audit value and a new generation of auditing that has developed during audit digital transformation and intelligent application processes. It uses high technologies such as AI as infrastructure and core elements to achieve comprehensive integration of AI and auditing and continuously empower audit organizations. In the era of intelligent auditing, transactional and repetitive work in financial enterprise auditing will shift from "manual" to "artificial intelligence," with various intelligent audit software automatically completing audit data collection, data preprocessing, data analysis, clue verification, and audit report generation according to auditors' thinking.

(3) Three Types of Intelligent Auditing

1. Assisted Intelligent Auditing Assisted intelligent auditing primarily uses machine intelligence to support auditors' decision-making or corresponding actions, which can be called audit process automation. When using assisted intelligent auditing systems, auditors' experience and thinking still play a decisive role, and auditors retain final decision-making authority. Assisted intelligent

auditing systems support and help auditors fully identify possible anomalies and risks, provide valuable and insightful consulting recommendations to management, assist financial enterprise risk management and control, and improve operational performance.

2. Augmented Intelligent Auditing Augmented intelligent auditing can demonstrate excellent audit analysis intelligence and learning capabilities, serving as an important supplement to auditors' decision-making. In this case, auditors and intelligent auditing systems make decisions together, performing audit work that was difficult to complete in the past. For example, using machine learning modeling methods to mine clues or analysis dimensions that are difficult to discover relying solely on auditors' thinking, thereby more deeply identifying financial risk scenarios and data sources and designing data indicators and analysis models.

3. Autonomous Intelligent Auditing Autonomous intelligent auditing often does not require auditors' assistance or participation. It adapts to different audit situations through autonomous learning and can make decisions or take actions independently, in which case auditors delegate decision-making authority to the intelligent auditing system. Such intelligent auditing systems can creatively and effectively adapt to new audit environments, understand possible situations of audit objects, make appropriate responses and decisions based on judgment, and conduct productive interactions with audit objects without intervention. For example, in financial product marketing audit scenarios, "intelligent systems can adaptively carry different marketing method media such as voice, images, and text, autonomously analyze marketing personnel' s language including sensitive word recognition, sentiment analysis, and evaluation scoring, and use AI perception technology to independently audit and evaluate marketing content." [16]

(4) RPA Application Scenarios in Auditing

RPA is a set of software-based business processes that use various forms of AI to perform repetitive tasks or tasks that can be learned through software algorithms. Historically, RPA initially emerged as a form of "data scraping" that obtained data from fixed-format outputs such as screens or paper printouts. Robot software has evolved into enhanced graphical visualization software and underlying data collection technology. With enhanced data collection capabilities, the software's logic primarily addresses repetitive activities such as tracking, matching, and guaranteeing. Subsequently, a layer of software learning intelligence and analysis of exceptions, anomalies, and hidden rule-based patterns was added.

Today, RPA is applied in universal big data applications such as banking, mortgage application processes, sales, OCR, and data extraction, and is increasingly used in auditing. "A 2017 article by PricewaterhouseCoopers estimated that 45%

of global labor tasks could be automated. In November 2019, Deloitte disclosed that it widely uses RPA in financial audit processes. The rapid application of RPA from 2017 to 2019 not only indicates a near-perfect match between technology and demand but also demonstrates that the return on investment argument has been fully proven." [17]

RPA applications in auditing are similar to many intelligent software applications; it is a layered framework that begins with data collection (a simple, repetitive task) and ends with visual deliverables (a constantly evolving intelligent task):

1. Rule-Based Activities Rule-based activities are matching, guaranteeing, and tracking that can be performed after data collection. For example, once a set of invoices and delivery reports is obtained through OCR or extraction from ledgers, rule-based software can create a matching set between them without manual matching. The software can also be programmed to attempt matching multiple deliveries to a single invoice (or vice versa) by obtaining details such as delivery dates from underlying paper documents or assuming a close date. Of course, for entities using Extensible Markup Language (XML) or its business derivative Extensible Business Reporting Language (XBRL), OCR relevance is reduced, and direct data extraction will reduce errors in underlying processes and subsequent rule-based applications.

2. Sample Selection for Auditor Actions Sample selection for auditor actions is one of the top actionable stages that RPA can provide. By creating explicit rules or setting exceptions for guarantees, tracking, or matching, a risk-ranked set of exceptions can be provided for human interaction. Guarantees, tracking, and matching are simple RPA repetitive tasks that either produce perfect results or imperfect results (with exceptions). These exceptions can be executed by humans in manual business processes or by auditors. This stage is suitable for auditing through creating implicit rules, which can also be an audit process because it can determine expected behavior of data sets and then find anomalies. By nature, exceptions can be either breakdowns of internal controls or the basis for substantive testing of specific transactions. For example, the implicit rule "adjust the timestamp of journal entries to 20 days after the period they claim to adjust" makes sense. "Month-end closing typically occurs about three weeks after month-end. However, if adjusting journal entries appear significantly later than 20 days, auditors may be suspicious of these exceptions to implicit rules and select them for additional analysis by the audit team." [17]

3. Visual Delivery to Decision-Makers Visual delivery to decision-makers stems from decision-makers' visualization of static historical data, unmodified data, or data that changes rapidly during analysis. Visual deliverables can be superimposed on RPA, for example, by providing financial risk-based visualization to assist in financial enterprise audit processes. Color, shape, and volume can help audit teams identify areas with increased misstatement risk and areas

where audit procedures have addressed such risks. RPA algorithms can learn different problems from fixed asset auditing than from revenue auditing. Once the algorithm knows how to discern which implicit rules and exceptions are more vulnerable to risk, it can provide a smarter, more focused deliverable for auditors to review. For example, for most financial enterprise financial audits, revenue overstatement and premature recognition are persistent risks. If 10 implicit rules are derived with a constant rule class, RPA may be able to rank them based on past audit responses. If the implicit rule for delayed recording of revenue through adjusting journal entries has consistently attracted auditor attention, RPA will learn to maximize its efforts in this area. Auditors typically are not suspicious of rounding errors due to large invoice amounts, so RPA is relatively more sensitive to such errors.

7. Future of Banking Risk Control Driven by Digital Intelligence

(1) AI Empowering Transformation of Banking Internal Auditing

Thanks to the rapid development of new technologies such as big data, cloud computing, and AI, off-site monitoring and management scenarios in the banking industry are becoming increasingly rich. Most institutions have established off-site monitoring systems serving business operations, internal control compliance, risk management, and audit supervision, and are gradually moving toward full-business, full-scenario, full-data, continuous, dynamic, and intelligent off-site monitoring systems. While digital transformation enhances bank customer experience, it also brings many challenges to risk control and internal auditing in the banking industry. Driven by the digital wave, operational risks such as market risk, business risk, financial risk, and compliance risk continue to increase, becoming more hidden and difficult to control, making internal auditing increasingly important and audit departments paying more attention to internal control auditing and risk management auditing.

Domestic banking development is changing rapidly, and a small number of institutions still have imperfect internal control compliance systems. In addition, “due to the diversification of internal bank violation methods and the complexity and variability of illegal activities, bank auditors have always lacked a tool to effectively mine hidden information beneath surface information from massive business data and huge customer groups. Traditional audit tool systems are increasingly difficult to match internal control and compliance requirements in the digital era, and establishing an intelligent, flexible, and efficient audit supervision platform is urgently needed.” [18] With continuous innovation in banking financial technology, remote audit models and various intelligent audit tools are gaining increasing favor among auditors. Effective intelligence leads to a wise future. Audit digital intelligence affects the future pattern of auditing. The emergence of various intelligent technologies has broken the limitations of traditional data auditing in terms of data scale, scope, and type. Intelligent

audit applications integrating new technologies such as advanced data analysis, cognitive technology, intelligent prediction, agile methods, and robotic process automation will provide comprehensive digital empowerment for internal auditing to reach higher levels.

(2) Application of Digital Twins in Commercial Bank Auditing

"The metaverse can be regarded as a new world integrating the physical world and the digital world, called the third-generation Internet (Web3.0), which can be subdivided into three-dimensional Internet and value Internet" (Fang Jun, 2022).19 The metaverse provides a new path for digital transformation of human society. Its comprehensive intersection with "post-human society" creates a new era with the same historical significance as the Age of Great Navigation, the Industrial Revolution, and the Space Age (Song Zhenglong, 2022).20 The metaverse will empower all industries, stimulate new development functions in traditional industries, and achieve high-quality industry development. Zhang Lijun, Enterprise Technology Strategy Architect at Dell Technologies Greater China, believes that the metaverse' s foundational technologies, namely the generation logic supported by AI, include application scenarios such as significantly improving computing performance, generating non-repetitive massive content to achieve spontaneous organic growth of the metaverse, driving virtual digital humans to present content to users in an organized manner, and massive content review. Digital twin technology plays the role of realizing the blueprint of the metaverse' s technological world, with main application scenarios including: "establishing dynamic digital twins of physical objects in virtual space, mapping all characteristics of objects from micro to macro in real-time through integration with external sensors, showing the evolution process of product life cycles, and achieving seamless integration covering product design, production, and operation and maintenance." [21]

In the 2021 scientific research project application study organized by the Jiangsu Provincial Audit Department, Jiangsu Bank' s internal audit department (stock code: 600919) continuously conducted research-based auditing, closely focusing on big data audit characteristics, innovatively introducing digital twin theory and technology, proposing application models of digital twins in commercial bank big data auditing, exploring future development directions of commercial bank internal auditing driven by digital twins, and improving audit service capabilities. "Digital twins are digital shadows of physical products. Through integration with external sensors, they reflect all characteristics of objects from micro to macro, show the evolution process of product life cycles, and achieve seamless integration covering product design, production, and operation and maintenance" (Sun Yanming et al., 2020).[22]

1. Combining Experts and Internal Audit Backbones, Conducting Research and Application Promotion in Parallel To ensure the smooth and orderly implementation of research work, Jiangsu Bank established a project

leading group headed by the chairman of the supervisory board, who is responsible for overall planning and providing policy support and theoretical guidance for the research; the general manager of the internal audit department is responsible for progress planning and implementation process management. A project research team composed of five audit backbones from the internal audit department is responsible for implementing the leading group' s work requirements, investigating the current status of big data audit research in commercial banks domestically and internationally, conducting theoretical research on digital twins and big data technology, and promoting the practical application of new-generation information technology in Jiangsu Bank' s internal auditing, with research results directly transformed into real value. "Jiangsu Bank also specially invited Vice President Wang Huijin and Deputy Dean Li Tingliao from Nanjing Audit University as expert group members to guide the research team." [23]

2. Innovating Internal Audit Models with Prominent Application Effects Jiangsu Bank' s research and practice show that during data collection, one should first clarify the internal logic of business to form a data resource view, then use multiple collection and conversion methods from inside and outside the bank, such as automatic data loading, external data crawling (crawling, a computer science term announced in 2018; a means of obtaining relevant World Wide Web resources based on web page links), and unstructured data conversion, to integrate data with non-uniform standards and structures. Then, data governance should be carried out regularly, data quality should be evaluated periodically, data governance issues should be resolved promptly, and system capacity and performance should be monitored and optimized to lay a high-quality data foundation.

During digital modeling, one should combine data analysis, data statistics, and data prediction modeling technologies to continuously establish and optimize audit models that simulate risk levels and evolution patterns under business operation states, helping achieve audit objectives such as monitoring non-performing assets, strengthening case prevention, evaluating duty performance, and promoting innovation. In model management, a professional model system should be constructed and improved from multiple dimensions, continuously strengthening model development process control, increasing model promotion and sharing efforts, and strengthening model lifecycle management to provide a model foundation for big data auditing that can truly simulate business risk states.

During interactive application, attention should be paid to the effective feedback of audit results to business and their deepening application in business. Audit model thinking should be embedded into the bank' s intelligent risk control system to promote real-time risk warnings. "Audit monitoring model results are automatically pushed to business departments to achieve pre-event blocking of risk matters. Rectification problem ledgers, reconciliation and write-off, and project audit tracking are used to promote audit problem rectification, fully

leveraging the auxiliary role of internal auditing in commercial bank risk management." [22] Jiangsu Bank's 2024 annual report shows that in 2024, it achieved operating revenue of 80.82 billion yuan, a year-on-year increase of 8.778%; net profit of 31.84 billion yuan, a year-on-year increase of 10.76%; and return on net assets of 13.59%. From January to June 2025, total operating revenue was 44.86 billion yuan, a year-on-year increase of 7.782%; net profit was 20.24 billion yuan, a year-on-year increase of 8.05%.[24]

Financial enterprise audit institutions should take big data auditing as the core, use key technical means such as AR/VR/XR (Augmented Reality/Virtual Reality/Extended Reality), cloud computing, blockchain, and digital twins, accelerate audit digitalization and intelligentization construction, adapt to the formation and development of smart banks, fully leverage the important role of internal auditing as the "economic physical examination" in the financial industry, and assist enterprises in achieving high-quality development.

(3) Cultivating Intelligent Auditing Talents and Accelerating Intelligentization of Financial Industry Internal Auditing

The rapid development of AI has profoundly changed human social life and the world. After more than 60 years of evolution, especially driven by new theories and technologies such as mobile internet, big data, supercomputing, sensor networks, and brain science, as well as strong demand from economic and social development, AI has accelerated its development, presenting new characteristics such as deep learning, cross-boundary integration, human-machine collaboration, group intelligence openness, and autonomous control. Big data-driven knowledge learning, cross-media collaborative processing, human-machine collaborative enhanced intelligence, group integrated intelligence, and autonomous intelligent systems have become development priorities for AI. Brain-inspired intelligence inspired by brain science research achievements is poised to take off, and the trend toward chip-based, hardware-based, and platform-based solutions is more obvious, with AI development entering a new stage. Currently, new-generation AI is triggering chain breakthroughs, promoting all fields of economy and society to accelerate the leap from digitalization and networking to intelligence.

1. AI Changing Corporate Governance Mechanisms Including Internal Control and Auditing Regarding future directions and priorities that may trigger paradigm changes in AI, China' s State Council pointed out in its July 2017 Notice on Issuing the New Generation AI Development Plan (Guo Fa [2017] No. 35): "Advanced machine learning theory should focus on breakthroughs in adaptive learning, autonomous learning, and other theoretical methods to achieve AI with high interpretability and strong generalization capabilities. Brain-inspired intelligent computing theory should focus on breakthroughs in brain-inspired information encoding, processing, memory, learning, and reasoning theories, forming theories and methods for brain-inspired com-

plex systems and brain-inspired control, and establishing new models for large-scale brain-inspired intelligent computing and brain-inspired cognitive computing models. Quantum intelligent computing theory should focus on breakthroughs in quantum-accelerated machine learning methods, establishing hybrid models of high-performance computing and quantum algorithms, and forming efficient, accurate, and autonomous quantum AI system architectures." [25]

As the core driving force of a new round of industrial transformation, AI will spawn new technologies, products, industries, business forms, and models, trigger major changes in economic structure, profoundly change human production and lifestyle and thinking patterns, and achieve an overall leap in social productivity. "By 2030, AI theory, technology, and applications will reach world-leading levels overall, becoming a world major AI innovation center, with intelligent economy and intelligent society achieving obvious results, laying an important foundation for becoming an innovative country and economic power." [25] The rapid development of AI will profoundly change and enhance corporate and social governance mechanisms, including finance and auditing businesses.

2. Intelligent Auditing Talents as the Backbone of Financial Industry Risk Prevention and Control With the development and widespread application of new-generation information technologies such as cloud computing, big data, the Internet of Things, and AI, human society has entered the digital intelligence era. The development of new-generation information technologies and explosive data growth are driving major changes in financial enterprises' management architecture, management methods, business organizational forms, and information systems. The core of financial enterprise management has shifted to managing data, understanding data, and making decisions based on data. Traditional risk control and auditing methods can hardly meet the needs of financial enterprise management improvement. Therefore, innovating audit methods and tools, developing intelligent auditing technology, and building intelligent risk control and auditing systems that conform to big data management models are important tasks in the current audit field and the development direction of audit practice.

Intelligent auditing talents are a necessary condition for developing intelligent auditing. The whole society should attach importance to cultivating compound talents, including both vertically compound talents who master AI theory, methods, technology, products, and applications, and horizontally compound talents who master "AI+" economics, society, management, standards, and law. Universities should be encouraged to form new compound professional training models of "AI+X," emphasizing the cross-integration of AI with mathematics, computer science, physics, biology, psychology, sociology, law, and other disciplines. Industry-academia-research cooperation should be strengthened, encouraging universities, research institutes, and enterprises to cooperate in AI discipline construction and vigorously cultivate compound talents in intelligent finance and accounting and intelligent auditing.

The Intelligent Auditor is both a new professional title and a compound talent of "AI+." It refers to compound talents who can innovate audit methods and tools, master and develop IT auditing and big data auditing technologies, build intelligent risk control and auditing systems that conform to informatized big data management models, and use digital and intelligent technologies to support internal audit operations. Intelligent auditors are intelligent audit management personnel who can assist enterprise audit transformation and upgrading and promote development in audit fields and practice. To effectively solve the problem of scarce risk control and auditing talents in big data, informatization, and intelligent environments, the China Commercial Accounting Society has launched an "Intelligent Auditor" training program aimed at cultivating professional talents who meet the requirements of future audit digital intelligence work. The "Intelligent Auditor" is a compound talent who can master information technology means, data mining and analysis technology, and intelligent auditing technology and skillfully apply them to audit practice. The "Intelligent Auditor" will contribute to the development of intelligent auditing in China.

8. Conclusion

In April 2020, the National Development and Reform Commission and the Cyberspace Administration issued the *Notice on Promoting the "Cloud-Data-Intelligence" Action to Cultivate New Economic Development* (Fa Gai Gao Ji [2020] No. 552), requiring: "Further accelerate industrial digital transformation, cultivate new economic development, assist in building a modern industrial system, and achieve high-quality economic development." [26] Digital transformation is the cornerstone for improving financial enterprise operational efficiency. Digital transformation is an important means to enhance and stimulate the driving force of financial enterprises and an important pathway to cultivate new enterprise development drivers. We should further strengthen digital transformation concepts such as data-driven, integrated innovation, and win-win cooperation, promote the digitalization, networking, and intelligence development of financial enterprises, enhance competitiveness, innovation, control, influence, and risk resistance, and continuously strengthen financial enterprises' internal control and risk management.

The State Council emphasized in its January 2022 "*14th Five-Year Plan" for Digital Economy Development* that it is necessary to "guide enterprises to strengthen digital thinking, improve employees' digital skills and data management capabilities," "vigorously develop digital commerce, comprehensively accelerate the digital transformation of service industries such as commerce, logistics, and finance, optimize management systems and service models, and improve the quality and efficiency of the service industry." [27] Based on comprehensive consideration of financial enterprises' own business models, corporate philosophy, management operations, and technical capabilities, we should do a good job in overall planning of digital transformation and formulate stage goals and construction paths. As an important foundation and guarantee for financial enterprise gov-

ernance, auditing plays an important role in the digital economy era. Financial and audit digital transformation is also organizational and talent upgrading and transformation, requiring capability upgrading of existing organizations and talents as well as vigorous cultivation and recruitment of professional talents to truly support the successful achievement of digital transformation.

In summary, the essence of internal control management in the financial industry lies in risk control. Therefore, financial enterprises should maintain risk prevention and control awareness under the background of "Internet+" and "Intelligence+," achieve effective risk identification and evaluation, summarize potential factors causing enterprise risks based on existing internal control problems, analyze their specific impact levels, compile specific risk lists, and establish risk case databases based on their own risk prevention practical experience to further improve financial enterprise internal control risk system construction.

"Accelerating digital development and building a digital China" is an important part of the national "14th Five-Year Plan" and 2035 long-term goals outline. Financial enterprise internal control and risk management also face opportunities and challenges brought by digital transformation. Digitalization, networking, and intelligence will help financial enterprise internal control become more rigorous, timely, accurate, and efficient. In digital transformation, financial enterprises should continuously improve and strengthen internal control and risk management functions, continuously enhance internal control effectiveness, and assist enterprises in achieving high-quality development.

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Note: Figure translations are in progress. See original paper for figures.