Digital Transformation in Tax Risk Management: A Paradigm Shift through Advanced Technologies

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Abstract: With the advancement of information technology and the transformation of tax collection and management methods, the role of digital technology in tax risk management is becoming increasingly significant. By leveraging digital technology, tax authorities can effectively address challenges such as the growing number of taxes involved and the emergence of more covert tax sources, while also facilitating data screening and risk prevention and control. It is evident that reliance on digital technology and the utilization of data to advance tax risk management reform have emerged as critical topics. This article examines the current challenges in tax risk management against the backdrop of digital technology and the obstacles faced in future development. By thoroughly drawing on the successful experiences of tax risk management in developed countries and continuously enhancing China's tax risk management system, this study aims to explore tax risk management pathways that align with China's national conditions, ultimately seeking to improve the comprehensive governance capabilities of tax authorities and better support the country's economic development.

1. Introduction

As a quintessential representative of modern science and technology, digital technology has permeated various fields, including politics and economics, after an extensive period of exploration and development. This penetration has significantly influenced and transformed people's lifestyles and cognitive frameworks. The promotion and dissemination of digital technology herald the advent of the information age. Consequently, how government departments can capitalize on the unprecedented opportunities presented by digital technology, continuously enhance the tax risk management system, and advance the evolution of tax risk management concepts has emerged as a formidable challenge for tax authorities.Tax revenue serves as the primary source of government finance, and the effectiveness of

tax collection directly impacts social and economic development, as well as the efficient operation of government departments[1]. With the integration of risk management across various sectors, including tax administration, state agencies have begun to acknowledge the theoretical and practical significance of risk management. In recent years, China's economy has experienced rapid growth, leading to a sharp increase in the number of taxpayers, which has resulted in increasingly complex taxation processes. Therefore, in the context of the information age, it is imperative for tax authorities to embrace digital thinking, adapt effectively to the evolving environment, confront challenges, rigorously manage tax risks, and achieve effective tax risk management, which remains an urgent issue that requires resolution.

Faced with this dilemma, the academic community has conducted beneficial explorations from a theoretical perspective. Regarding the challenges in tax risk management, Chen Bing et al. (2018) assert that the original tax management system is experiencing unprecedented impacts and challenges due to the influence of information technology, necessitating active improvements in the construction of the tax credit system to meet new requirements. Yuan Jiao et al. (2018) contend that the impact of new technologies, formats, and models is substantial, leading to significant challenges in tax collection and management, which in turn constrains the enhancement of tax risk management levels. Jiao Ruijin (2016) highlights that, in this new context, issues such as the difficulty in separating tax sources, defining tax rights, and identifying profit attribution have become prominent, presenting major challenges for information tax management. Liu Guangqiang et al. (2019) argue that in the Internet era, the extensive and real-time data sources available due to big data impose new demands on the quality of tax governance. Based on these insights, scholars have proposed the following main suggestions: Secondly, there is a need to promote risk management and tax system reform. Sun Kai et al. (2015) assert that in the era of big data, the volume of data resources accessible to tax authorities has greatly exceeded previous levels, and the strength of technical support has also been unprecedentedly enhanced. Consequently, the capabilities for filtering, analyzing, and screening tax-related information have improved, warranting active promotion of tax source monitoring and tax risk management. Qiao You (2016) suggests that cutting-edge technologies such as big data and cloud computing necessitate continuous improvements in the risk management capabilities of tax authorities and the establishment of risk warning mechanisms.

Thirdly, it is essential to optimize the top-level design. Wang Aiqing (2018) asserts that to enhance the quality of tax management services, the advancement of artificial intelligence applications in this domain must be expedited, and the socialization of tax management should be elevated to a new level. Ma Caichen et al. (2018) argue that the evolution of information technology has mitigated the issue of information asymmetry, leading to corresponding changes in existing tax declaration and payment methods. Although the academic community has initiated research on the application of artificial intelligence, reaching some consensus at theoretical, model, and functional levels, there remains a lack of systematic discussion regarding the effectiveness of artificial intelligence in tax risk management grounded in theoretical analysis frameworks. While theoretical research on tax risk management exists, the fundamental connotations and external requirements of digital transformation within this context, from the perspective of digital technology, have not been adequately addressed. This gap complicates the explanation of why digital technology has garnered international favor and why it has not been fully

popularized and promoted in the realm of tax risk management in China. In light of this, this article aims to incorporate digital technology theory into the study of tax risk management, critically reflect on the traditional logic of national tax risk management, and identify the current demand for digital technology within this field. Furthermore, it seeks to explore the implementation mechanisms of digital technology theory in tax risk management and examine how to enhance its effectiveness in the future to elevate the level of tax risk management in China[2].

2.Theoretical framework

2.1. Concept and Principle of Digital Technology

Digital technology, as the foundation for the development of artificial intelligence, has emerged as one of the three cutting-edge technologies of the 21st century and has been a focal point of global attention for the past 30 years. Its rapid advancement has captivated worldwide interest. The initial aim of creating artificial intelligence was to simulate human cognitive processes through computer algorithms, thereby liberating the human brain for deeper thought. Currently, artificial intelligence has evolved to mimic the neural systems of the human brain, constructing artificial neural networks. These internal networks consist of interconnected neurons that facilitate learning, and there are generally two approaches to creating artificial intelligenc[e[3]].The first approach simulates only the primary functions of the brain, mimicking its capabilities without replicating its internal structure or processes. This method is widely employed in fields such as online translation and computer chess. Implementing this intelligent approach necessitates meticulous regulation of program logic, and the complexity of this logic significantly influences the feasibility of implementation. For instance, in computer chess, variations in processing methods can lead to markedly different outcomes. The nature of chess entails that each move is based on clear judgments, which requires relatively straightforward program logic, given the finite number of chess pieces. Conversely, the game of Go demands a more nuanced analysis of each move, necessitating more complex program logic. This complexity results in a substantial increase in the number of potential moves and the breadth of the game space, with an effectively infinite number of positions. The renowned British neurologist and father of AlphaGo, Demis Hassabis, conducted experiments revealing that the possible Go board configurations can reach an astonishing magnitude of 10 to the power of 170, far surpassing the total number of atoms in the universe.

The second approach involves a comprehensive simulation of the brain, encompassing not only cognitive processes but also the recreation of its internal structures. Adopting this intelligent methodology necessitates that each role possesses an independent intelligent system. The enhancement and development of this system resemble the growth trajectory of a developing infant, requiring a process of learning, growth, and maturation to navigate various complex challenges, including setbacks. When the system encounters such challenges, it records and assimilates these experiences to prevent the recurrence of similar mistakes in the future. Alpha dogs exemplify this intelligent approach; after undergoing millions of training sessions, they become acutely aware of potential errors, thereby enabling them to avoid such pitfalls[4]. This continuous mechanism of trial and error optimization closely parallels human activities.The advancement of technology has progressively broadened the applications of digital technology. However, the current technological landscape dictates that digital technology can only achieve intelligent creation through simulation and cannot fully replace

the human brain. In comparison to the human brain, the primary advantage of digital technology lies in its ability to recognize and filter information, extracting hidden patterns and insights from vast datasets through comparative analysis.

2.2 Digital Tax Risk Management: Applications and Feasibility

2.2.1 Application analysis

The first step is to leverage digital technology in establishing a tax risk management system. The implementation of the Golden Tax Phase III project signifies the completion of a taxation framework characterized by 'one platform, two levels of processing, three coverage areas, and four systems' nationwide. The extensive data held by tax authorities is systematically, procedurally, and standardly integrated into the information system, heralding the onset of the information management era in tax administration[5]. Core departments, such as taxation and industry and commerce, are continuously enhancing their collaboration to bolster joint risk governance capabilities, particularly in monitoring high-risk enterprises. Concurrently, efforts are underway to further advance the socialization of tax processes, which includes the centralized management of dispersed tax sources, specialized oversight of tax intermediaries, and refined management of industry associations. There is a concerted effort to actively harness the role of social organizations within the tax risk framework, thereby establishing a new mechanism for collaborative risk governance across society.

The second objective is to promote digital technology and establish a new platform for tax risk management. In recent years, the development of data management platforms has garnered positive responses from tax authorities across various regions. These platforms facilitate the sharing of risk data, thereby enhancing data analysis and risk identification capabilities. The establishment of a tax risk management platform will inevitably drive the comprehensive development of an intelligent data analysis system, creating an integrated risk management chain that encompasses risk identification, data analysis, task processing, and more, with data collection serving as the entry point. The core focus is the entire process of tax-related risks, which includes risk identification, risk categorization, and risk mitigation. Based on this foundation, it is essential to formulate risk response and handling protocols. Pilot tax authorities have initiated a preliminary tax source monitoring plan aimed at advancing the construction of a risk management platform. This plan identifies risks within taxpayer declaration data and submits problematic enterprises to a diagnostic database for further analysis. Consequently, a closed-loop management and monitoring model for tax risks has been established, facilitating a new form of positive interaction and continuous improvement and development.

Thirdly, by leveraging digital technology, we explore new models of tax risk management. In recent years, tax authorities nationwide have boldly sought to promote and apply big data technology within the tax domain, achieving significant results. The Shanghai tax system has capitalized on the Golden Tax Phase III project to initiate the application of digital technology in taxation. Furthermore, the reform and adjustment of the national tax system have further facilitated the adoption of digital technology, particularly through the merger of national and local tax systems, which has entirely removed the boundary between the two and maximized the utilization of digital technology. To achieve information sharing, Wuhu City in Anhui Province has successfully established interconnectivity with various departments, including industry and commerce, land, and transportation, resulting in the exchange and

sharing of data among these entities. This city is at the forefront of the nation in the collection and classification of tax-related information. Consequently, tax revenue—encompassing value-added tax and personal income tax—has seen significant increases across multiple tax categories. Based on the types of tax-related information available, it is evident that the primary sources of taxation in China currently include data on property transactions, vehicle registrations, enterprise registrations, and equity transfer applications. The promotion of digital technology in taxation not only addresses the challenges of information collection faced by tax authorities but also enhances their capabilities and effectiveness in tax collection and management.

2.2.2 Feasibility Assessment

In recent years, digital technology has developed rapidly, leading to significant advancements across various fields, including finance and taxation. The integration of digital technology into tax risk analysis is particularly crucial. Currently, there exists a feasible opportunity to incorporate digital technology into the realm of tax risk analysis, which can be highlighted through four key aspects:Firstly, the maturity of digital technology provides robust support for tax risk management. At the level of tax analysis, overly complex digital technologies are unnecessary. By leveraging taxpayer data and applying big data principles, the construction of indicator systems emerges as a core element, with technical indicators generated based on changes in tax policies. Initially, digital technology assesses its environment and establishes development goals. Subsequently, in real-world scenarios, it selects the optimal option based on the outcomes of system operations. Ultimately, the choice of digital technology can induce changes in the environment, guiding the direction of development trends and forming the basis for decision-making after receiving feedback from stakeholders.

The second aspect is policy support. The current tax risk management aligns with the transformation of management methods advocated by the Central Committee of the Communist Party of China, serving as a concrete manifestation of the implementation of "streamlining administration and delegating power." As a critical component of risk management, the significance of tax risk has been validated through practical experience. Concurrently, the concept of tax risk management has received substantial recognition from relevant departments and tax-paying enterprises. The comprehensive integration of digital technology into tax risk management corresponds with contemporary development trends and national tax management requirements[6].The third aspect is the talent pool. In recent years, the construction of a talent pool within the tax system has gradually improved. Since 2006, the State Administration of Taxation has initiated the "115" Talent Project, aimed at enhancing the talent system for national economic and social development from 2006 to 2010. This initiative has laid a solid foundation for talent pool development and has trained a significant number of outstanding tax system officials. Currently, over 40% of the 800,000 tax officials are engaged in frontline tax management, including tax risk analysis and management personnel, as well as experts and key figures across various tax sectors. Although frontline management personnel remain relatively scarce, effective team building presents opportunities for the promotion and application of digital technology, providing valuable experience for the integration of digital technology in tax analysis systems.The fourth aspect is the availability of data reserves. The technological application of the tax system has evolved from the early CTAIS system to the current Golden Tax Phase III. Continuous upgrades and iterations have significantly

enhanced the system's database reserves. The extensive data resources enable tax management departments to conduct comprehensive analyses and comparisons. For instance, Alibaba has established a developed credit system by organizing and categorizing sales data from tens of thousands of Taobao and Tmall stores, subsequently creating applications based on this data. Similarly, the tax system extracts relevant information from various types and forms of taxpayer sales data following the same principle.

2.2.3 Reclassification of Tax Risk

In tax practice, tax risks within the digital technology framework can be classified into three categories based on varying search objectives: abnormal enterprise risk, abnormal business risk, and abnormal behavior risk.The first category is abnormal enterprise risk, defined as the risk associated with identifying different types of abnormal enterprises through big data analysis. The specific steps involved include: first, selecting a particular industry as the search target and choosing enterprises within that sector as samples; next, establishing criteria such as net profit or debt-to-asset ratio, followed by calculating a threshold. Finally, by comparing values against this threshold, enterprises that significantly exceed or fall below the established limits are classified as abnormal. For instance, when investigating abnormal enterprises in the catering sector, a common approach is to select 1,000 catering enterprises as samples, set a net profit indicator, and automatically calculate a threshold of 7% for these enterprises using an information system. If a catering enterprise reports a net profit of only 2%, which is substantially below the 7% threshold, the system will flag this enterprise as having a hidden high tax risk. The identification of abnormal enterprise risks relies on enterprise reports, while the data from accounts outside of these reports offers finer granularity, including accounting subjects, vouchers, books, and statements.The second category is abnormal business risk. This risk pertains to the anomalies detected after analyzing account set data within the specific production and operational processes of certain enterprises[7]. As per the previously mentioned methodology, no tax risks were initially identified. However, a deeper analysis of the accounting entries revealed more nuanced issues at levels two and three. For example, if an enterprise's management expenses consistently total 5,000 yuan, but a single expenditure spikes to 50,000 yuan, this deviation raises suspicions that the enterprise may have engaged in capitalization practices.The third category is abnormal behavior risk, which is prevalent under the digital technology framework[8]. This risk primarily refers to enterprises that fail to accurately record their actual business operations. Verification of this type of risk typically involves third-party data and invoice information. Traditionally, tax management has relied on the principle of "controlling taxes through invoices," evidenced by the stringent, standardized requirements for value-added tax invoices. This includes not only the standardization of basic information but also explicit guidelines for the remarks section of invoices. If an enterprise consistently purchases invoices for more than three consecutive months without declaring any long-term income, there is a clear potential risk of unrecorded invoices. Additionally, data from relevant government departments can corroborate the information declared by enterprises.The classification of tax risks outlined above is facilitated by the implementation of tax information systems within the digital technology framework. The identification of risks across the three categories — enterprise, business, and behavior — is continuously refined, updated, and enhanced alongside advancements in information systems.

3.Necessity and practical significance

3.1 Necessity of Digital Tax Risk Prevention

The rapid development of internet technology has a direct impact on the advancement of tax risk management, particularly in the challenges posed by an influx of tax-related information. In tax practice, core activities centered around tax risk include identifying abnormal enterprises, unusual business transactions, and atypical behaviors. Thus, there is an urgent need to promote and apply digital technology to enhance management levels.

3.1.1 Necessity of Digital Tax Risk Prevention

In recent years, the promotion of information technology, particularly the introduction of digital technology in the tax field, has revolutionized the recording of taxpayer information. Traditional paper materials, which have long been the norm, are gradually being replaced by electronic financial information. For instance, transaction data, asset details, and paper-based documentation such as transaction vouchers and financial records have all transitioned to digital formats. While electronic data offers clear advantages, such as reduced storage costs and more convenient data transfer, it also presents significant risks, including a heightened potential for tampering, which complicates the verification of data integrity. Consequently, the issue of electronic data leakage has become increasingly prominent in the digital age. Protecting electronic data through technological means, preventing leakage and loss, and ensuring the accuracy, objectivity, and authenticity of this data have thus become urgent challenges[9].

3.1.2 Challenges in Tax Information Quality

Currently, a significant challenge faced by tax authorities is the asymmetry of tax information, characterized by inconsistencies between tax data and actual taxpayer transactions. Therefore, verifying the authenticity of transactions is a critical step in tax risk management. As the primary entities involved, the financial and tax information generated during business operations serves as the most vital data source for tax risk management. These data sources can be categorized into internal and external enterprise data as well as operational data.At present, tax authorities rely on relatively limited channels for information acquisition, primarily depending on self-reported declarations from taxpayers. Third-party data resources, including industrial, commercial, financial, and land information, are not effectively shared. Moreover, tax authorities often encounter issues such as incomplete information in the declarations submitted by taxpayers. Various subjective and objective factors can lead to discrepancies between reported data and actual circumstances, raising public concerns regarding the authenticity and accuracy of tax disclosures. The roots of these issues are multifaceted:1. The lack of dynamic monitoring by tax authorities, reflected in an inadequate oversight and control mechanism for the entire process of tax risk generation.2. The absence of a proactive prevention mechanism, as tax authorities frequently resort to post-factum remedial measures rather than establishing preemptive strategies, which remain in exploratory stages. Therefore, the implementation and service of digital technology in economic activities will inevitably alleviate the current passive approach to tax risk management to some extent[10]. On one hand, the phenomenon of "data silos" will be eliminated, allowing taxpayers' tax-related data to be publicly accessible and shared among institutions such as industry, commerce, and finance, as well as within the tax system. Concurrently, appropriate data

protection mechanisms will be established to ensure data integrity and traceability. On the other hand, tax authorities can leverage digital technology to obtain timely, accurate, and truthful information, facilitating better screening and tracking of data, thus enhancing their understanding of the underlying content, sources, and evolution of the data.

3.1.3 Urgency for Risk Monitoring and Management

The promotion and proliferation of digital technology in taxation are leading to a transformation where previously limited third-party data becomes "shared data," particularly concerning taxation, which will be closely monitored. This not only aids tax authorities in gaining a comprehensive understanding of tax-related information but also assists large enterprises in achieving tax compliance in accounting and fostering efficient and rigorous tax management. Tax revenue is not only directly tied to tax-related businesses but is also indirectly influenced by the operations of other administrative agencies such as customs and land. Currently, due to coordination issues between multiple departments, obtaining such data requires extended timeframes and higher costs. Even when acquired, some data remains underutilized. The introduction of digital technology simplifies the data acquisition process, enabling both administrative agencies and taxpayers to effectively utilize data resources. The characteristics of distributed data — high credibility, ease of verification, and non-deletion — are fully realized. In tax declarations, the evaluation and verification processes are streamlined, allowing for direct application.

3.1.4 Limitations in Internal Oversight

InformationTax enforcement risk, as a crucial component of tax risk management, has consistently been a focal point for research and control by tax authorities. With the aid of digital technology, tax enforcement data and network data can be interconnected, achieving synchronization and interoperability of data resources. This enhances the transparency and data-driven nature of workflows and standards within tax authorities. Under digital supervision, tax enforcement becomes more scientific and credible. Presently, tax informatization efforts are steadily advancing, yielding significant results. The push for public disclosure of tax-related information is continually increasing, allowing taxpayers across various regions to access relevant matters and information through diverse channels. However, due to inadequate internal supervision mechanisms and technical limitations, substantial loopholes still exist in authority oversight. Incidents of unauthorized tampering with information in tax management systems and the refusal to implement preferential policies due to performance pressures are not uncommon. To address these issues effectively, digital technology can be employed to meticulously record tax law enforcement details in databases, implementing encryption measures to prevent tampering. By sharing database resources, higher-level tax authorities or case handlers can gain a comprehensive understanding of specific situations, enabling targeted management interventions. Timely corrections and actions against violations by tax authorities can be undertaken, while also facilitating the screening and verification of the authenticity of tax law enforcement actions within the database, thereby fundamentally reducing tax enforcement risks and enhancing the credibility of administrative law enforcement.

3.2 Practical Implications of Risk Management

3.2.1 Evolution of Management Philosophy

Big data serves as the foundation and guarantee for digital technology. The premise for summarizing and utilizing the underlying laws of data lies in the application of various algorithms for data analysis, comparison, and training. The integration of digital technology into tax risk management necessitates a departure from traditional thinking constraints, thereby fostering the development of a new paradigm in big data tax management. This paradigm emphasizes data as the core, correlation analysis as the primary objective, and objective prediction through rational analysis.Firstly, utilizing data as the core enables effective risk classification and management. Big data is characterized by the principle that "everything can be quantified." This encompasses not only traditional financial documents and registration records but also unstructured data, such as video footage and action records. Digital technology allows for an in-depth exploration and summarization of the inherent laws and essential connections within this data. By leveraging abundant data resources and diverse data connections, the current state of tax risk management can be significantly transformed, altering the core processes, links, and matters involved. The application of digital technology can revitalize previously obscure data, providing a clearer representation of risk distribution and severity, and facilitating the identification of risk levels and categories based on observable patterns.Secondly, prioritizing correlation analysis is crucial. Historically, traditional thinking has constrained the exploration of risk causes in tax risk management, particularly regarding the insufficient and unnecessary relationships between causes and outcomes, leading to a low risk analysis rate[10]. In the digital technology era, the advantages of storage capacity and computational algorithms enable the digitization of vast amounts of audio, video, and images. Events that were previously deemed to have low correlation can now exhibit strong correlations. This shift in perspective allows tax risk management to transcend traditional concepts and experiences, liberating it from entrenched thinking patterns and significantly enhancing the capability and efficiency of tax risk management.Lastly, the primary objective is to facilitate objective predictions. Big data possesses distinct characteristics and attributes, with unconventional changes often originating from specific indicators. By comprehending the underlying patterns, accurate judgments and predictions can be made. Consequently, in the context of big data, tax risk management has transitioned from post-event responses to pre-event strategies, evolving from risk mitigation to proactive prevention and control, thereby achieving true prevention before risk materializes.

3.3.2 Optimization of management systems

The first step is to promote the optimization of tax information systems. With the advancement and application of cutting-edge information technologies, such as digital technology, new requirements have emerged for tax-related data within the tax management process. Generally, big data refers to datasets on the order of petabytes (PB) or higher. To establish a comprehensive database, it is essential to create a robust collection of tax-related data. In the context of digital technology, achieving effective deep data mining and extraction necessitates the sharing and verification of data from diverse sources. The requirement for this data-sharing mechanism is to uncover hidden value from data sources that may be incomplete, ambiguous, or even noisy and fragmented. As digital technology continues to evolve, the construction of tax information systems must also adapt accordingly. In the future, a new paradigm will

emerge, supported by big data resource platforms and compatible with multi-scenario layouts. Consequently, the development model will transition from a traditional vertical approach to a modern, expansive framework.

The second objective is to enhance the optimization of tax risk management processes. The integration of digital technology facilitates a seamless combination of tax business and tax data, effectively achieving 'tax business dataization.' This term refers to the systematic collection, organization, transformation, and accumulation of tax data, while 'tax data commercialization' involves the screening, analysis, and application of this data. Current tax risk management has evolved beyond its initial fragmented state, and intensive treatment methods have been implemented. Digital technology has significantly augmented the analytical and application capabilities for unstructured data, thereby clarifying the pathway for data value enhancement[11]. On one hand, it is essential to integrate data management throughout the tax risk management lifecycle, encompassing data collection and storage in the initial phase, processing and analysis in the intermediate phase, and exchange and verification in the final phase. On the other hand, leveraging digital technology allows for the analysis and refinement of generated tax data, which is subsequently reintegrated into the tax collection and management process, fostering a complete and sustainable closed-loop management structure.

3.2.3 Transformation of Management Methods

The first innovation pertains to the risk analysis method. The identification of tax risks is intrinsically linked to advancements in digital technology, which facilitate the expansion of taxpayer behavior patterns based on traditional indicator methods. Specifically, this approach involves conducting risk analyses on taxpayer behavior patterns by integrating various aspects such as objects, subjects, methods, and driving factors. At the object level, both structural and unstructured data are considered. At the subject level, machine learning is adopted as a substitute for traditional manual learning. Methodologically, contemporary digital technology analysis techniques, including neural networks and random forests, are incorporated. Furthermore, at the driving factor level, a data-driven core model is constructed, utilizing clustering analysis as the foundational algorithm while resetting weight thresholds and defining risk characteristics. The second innovation focuses on risk response methods. In the digital technology era, the impact of traditional linear outcome relationships has diminished, giving way to multidimensional correlations. Risk analysis now emphasizes risk characteristics and their analytical outcomes, prioritizing the correlation between these characteristics and analysis results—particularly the multidimensional correlations—over traditional linear causal relationships. This shift is expected to optimize risk response strategies and methodologies[12]. With the application of digital technology in tax risk management, algorithms will autonomously construct risk models, facilitating the identification of suspicious enterprises and the rectification of samples. The third innovation addresses the model correction mode. Digital technology models demand high accuracy and effective risk responses, making the promotion of meaningful interaction between the analysis and response stages a hallmark of these models. The most effective method for validating the accuracy of digital technology models is through proactive risk responses. High-quality responses are essential for constructing samples that refine and optimize digital technology models, enabling precise identification of risk characteristics and categorization of enterprise models. In light of the digital technology trend, an interactive mechanism

between risk analysis and risk response has been established, highlighting the increasingly prominent role of risk response in model construction[12]. This has fostered a new paradigm of mutual promotion and collaborative development between the two.

4. Challenges in Tax Risk Management

4.1 Constraints of Traditional Approaches

Under the traditional regulatory model, tax authorities employ a "person-to-person" approach to supervise and manage tax-related companies and individuals. With the development of the economy, particularly following the reforms to commercial registration conditions after the amendment of the Company Law, the number of taxpayers has surged dramatically. The limitations of the traditional model have become increasingly evident, leading to the urgent issue of ineffective management in tax supervision. This is primarily reflected in two aspects:First, the traditional regulatory model significantly undermines the effectiveness of tax risk management. Influenced by conventional thinking, tax management personnel often lack a comprehensive understanding of fundamental tax source management and specialized risk management matters within the framework of risk management level classification evaluation. They continue to rely on conventional methods and means in management systems, such as telephone communication, on-site surveys, interviews, and inquiries. Their proficiency in modern risk management techniques supported by digital technology is notably inadequate, particularly regarding the analysis and comparison of tax-related data, the positioning analysis of risk uncertainties, and the in-depth monitoring of risk issues, all of which lag significantly behind current standards.Secondly, risk management has not been integrated throughout the entire tax management process. Tax risk management, as a complete and systematic engineering approach, should be reflected in every link and stage of tax collection and management activities[13]. This includes the "three lines of defense" in tax collection and management before, during, and after events, as well as the "three systems" concerning tax collection and management business, job responsibilities, and information management. Even the "two-dimensional control" of law enforcement risks and taxpayer tax risks by tax authorities constitutes a component of tax risk management. However, it is important to note that current tax risk management is often supplanted by tax assessment, serving merely as a tool for tax collection and management, thereby failing to achieve the objective of strict and comprehensive risk control.

4.2. Talent Shortages

At present, the establishment of tax risk management institutions in China is gradually improving and developing based on tax source management institutions. Tax authorities construct risk analysis and management models based on relevant laws and regulations and accounting systems. At the same time, taking into account the operational situation of various companies, fully utilizing professional knowledge and skills, and comprehensively utilizing various methods and approaches, in order to predict and identify tax risks. It should be noted that this must be based on the reserve of professional talents and the cultivation mechanism of composite talents.

However, the current responsible personnel in risk management positions in grassroots tax authorities generally have problems such as an unreasonable age structure and a lack of awareness in mastering new skills, which can no longer meet the needs of the increasingly professional and refined

development trend of modern tax risk management. Due to the fact that digital technology is based on big data operations and has the characteristics of being cumbersome and mixed, it requires more professional and versatile talents to ensure the research and development of more data products. The insufficient ability of risk management personnel in tax authorities to learn new knowledge and master new skills has increased the difficulty of promoting digital technology in the field of tax risk management, leading to insufficient efficiency in the application of digital technology and ultimately seriously affecting the management of tax risks. The shortage of professional tax management talents has become a difficult problem that troubles tax authorities in risk management. Specifically reflected in the following aspects:

The first is excessive reliance on traditional knowledge and subjective judgment. However, the analysis and application of tax related data still remain at the primary level, manifested in the general analysis and simple application of basic data, as well as the basic description of problems encountered in taxation.

The second is the extreme shortage of frontline digital technology talents. At present, most grassroots tax workers do not have the ability to establish models and conduct data statistics, so the supervision and control of tax risks are clearly insufficient.

The third issue is the low recognition rate and efficiency of tax risks. The shortage of talent in tax risk management has led to a low level of digital technology application, which cannot fundamentally meet the current needs of tax risk management, let alone the development direction of fine and professional tax risk management in the future.

4.3 Methodological Limitations

The first issue pertains to the insufficient recognition capabilities of digital technology. Specifically, there are significant concerns regarding two primary indicators: the overall quality of tax risk indicators and monitoring indicators. Currently, tax authorities respond to various types of tax risks with distinct risk points and adopt different monitoring indicators for the same risk points. Additionally, due to limitations in data sources, tax authorities struggle to leverage digital technology for the analysis, comparison, reading, and processing of tax-related data, which also hampers the establishment of tax risk monitoring indicators. Although the construction of tax risk indicators is largely complete, their overall quality and effectiveness fall short of expectations. The underlying issue is that the application of digital technology has not yet been effectively integrated with tax risk supervision, significantly impacting the efficacy of tax risk identification, particularly in terms of timeliness and accuracy.The second issue involves the inadequacy of the tax risk analysis mechanism. Currently, the integration of digital technology within tax risk analysis mechanisms is suboptimal during application, leading to diminished effectiveness. This shortfall stems from a lack of specialization in risk analysis mechanisms. Furthermore, there is a noticeable heterogeneity among tax authorities in the application of indicators within tax risk management, which restricts the potential of digital technology in tax risk identification. This is particularly evident in the limited capabilities and methodologies available for risk identification by tax authorities[14].

4.4 Impact of Data Resources

The collection and organization of tax-related data and information is crucial for effective tax risk management. However, tax management departments often face significant challenges in integrating, applying, and collaboratively governing data resources. Firstly, the foundational data is weak. The quantity of tax-related data is insufficient, with a notable issue being the lack of comprehensive tax information. Taxpayer data held by tax authorities is primarily concentrated in registration and declaration processes, which limits the data available for tax risk management. Consequently, there exists a substantial gap between the volume and scope of data required under digital technology and what is currently available, failing to meet the demands of effective tax risk management. Secondly, the quality of tax-related data is subpar. The overall quality of the data possessed by tax authorities is relatively low, with significant discrepancies from practical requirements. Moreover, there has been a clear trend toward increasingly complex and diverse tax-related data, encompassing structured, semi-structured, and unstructured formats, which have yet to establish a complete and unified standard. Secondly, the application of data technology remains insufficient[15].

The advancement of information technologies — such as the Internet, the Internet of Things, and cloud computing—has transformed social and economic life. Consequently, taxpayers' business models and operations exhibit complex and diverse characteristics. Paperless accounting methods based on digital technology are gradually being implemented. This new technology can significantly enhance the efficiency and capabilities of tax departments. However, the understanding and practical experience of tax personnel remain indispensable when addressing tax risk issues. Currently, the application of digital technology is limited to data inference, calculation, and recording stages, without extending to risk identification and evaluation processes. Thus, the full potential of digital technology has not been realized, which restricts the advancement of tax risk management. Thirdly, a new paradigm of tax co-governance has yet to emerge. Presently, cooperation between tax authorities and relevant organizations in tax risk management is inadequate, often characterized by a solitary approach. Tax authorities frequently encounter difficulties in obtaining comprehensive and authentic data, which predominantly resides with taxpayers.

As the central tax department in risk management, tax authorities find themselves in a relatively disadvantaged position. In practice, the data held by tax authorities, such as basic management and accounting data, is often subject to processing and modification by taxpayers, raising concerns about its authenticity and accuracy. Furthermore, third-party data, such as fund and foreign exchange transactions, which are crucial for tax risk management, cannot be collected promptly due to various constraints. Third-party organizations frequently decline to provide relevant data for numerous reasons. Consequently, tax authorities are unable to access core data in a timely manner, adversely affecting the execution of tax risk management initiatives. It is evident that the weaknesses in foundational data, the lack of data application technology, and the challenges of tax co-governance are interrelated issues stemming from information asymmetry and data opacity between tax authorities and taxpayers. In conclusion, the challenges associated with collecting and organizing tax-related data are becoming increasingly pronounced, with issues such as incomplete data information and low data acquisition rates emerging as significant barriers. These challenges hinder the effectiveness of modern tax risk

management systems. Additionally, the data entry and statistical processes performed by internal personnel within tax authorities often contain various errors, undermining credibility and trust, and severely impacting the effectiveness of data application and utilization efficiency.

5.Pathways to Digital Transformation

5.1 Conceptual Level: Data-Driven Frameworks

As the theoretical cornerstone and technological prerequisite of digital technology, big data represents a continuous induction and summarization of relevant knowledge and laws derived from various algorithms. To enhance the application of digital technology, it is essential to reformulate traditional risk management concepts and abandon long-standing empiricism. This involves establishing a digital technology tax risk management framework grounded in data, scientific analysis, and objective prediction.The first principle is to utilize data as the foundation. In the context of the information age, big data is characterized by the notion that "everything can be quantified." With the advent of digital technology, the inherent connections among existing data can be thoroughly explored, leading to significant transformations in both traditional and unstructured data forms, thus expanding the scope of tax risk management. The original tax risk management processes and nodes have been redefined and reallocated[16]. An algorithmic mechanism, supported by digital technology, facilitates insights into underlying risk situations, evaluates risks, and promotes precise and categorized risk management.The second principle is grounded in scientific analysis. Historically, the influence of causal thinking has led to a focus on exploring the reasons behind risks in tax risk management. However, due to various factors, risk analysis has often operated at low efficiency. In the digital technology era, tax risk management has experienced substantial improvements in both storage and computational capabilities compared to previous methods. Consequently, it is imperative to abandon prior thinking patterns and concentrate more on "what" rather than "why." Digital technology fosters greater correlations between previously unrelated data. The transformations brought about by digital technology primarily manifest in breaking through existing empiricism, thereby enhancing risk management capabilities and operational efficiency.The third principle is to employ objective prediction as the primary method. Under digital technology, there are tangible traces and records of tax-related situations. Unconventional changes often emerge based on specific signs, and with advanced information technology, the relationships between signs and changes can be accurately explored. This enables proactive predictions, shifting the focus of risk management from reactive measures to preventive strategies, ultimately maximizing the effectiveness of risk management and controlling risks in the future.

5.2 Foundational Level: Talent Development and Institutional Refinement

The cultivation of tax professionals is of paramount importance in the development of tax risk management. Therefore, it is essential to enhance the talent system from three perspectives and establish a new mechanism for nurturing grassroots tax talents. Firstly, there should be a continuous increase in the allocation of resources for tax risk management. Given the distinct characteristics of tax professionals, it is crucial to differentiate the allocation of business projects, providing resource support and preferential treatment to professionals with exceptional comprehensive abilities and specific expertise. Job allocation should be tiered according to the varying professional needs, ensuring that high-quality resources are applied to high-risk and large-scale areas. Secondly, the supporting role of

education and training in tax risk management must be emphasized. As a critical aspect of tax risk management, education and training carry significant responsibilities[16].

On one hand, it is necessary to establish a professional talent training mechanism, continuously enhancing the quality of tax officials, improving the construction of talent hierarchies, and effectively reserving professional talents. On the other hand, we must promote skills training in tax risk management for tax officials to develop a well-rounded team equipped with strong professional knowledge, rich practical experience, and excellent adaptability. Thirdly, it is vital to continuously refine the tax risk management model to effectively respond to economic changes and challenges in the evolving landscape. The division of labor and collaboration among various departments and professional teams within the tax system should always be prioritized, fully utilizing the functions of the tax enterprise information exchange platform. Furthermore, a thorough analysis of the causes and direct impacts of tax risks should be conducted to identify and address the weak links faced by tax administration. A linkage mechanism for tax risk prevention should be established, continuously enriching and enhancing risk identification capabilities and methods, thereby comprehensively improving the quality and effectiveness of tax collection and management.

5.3 Technical Level: Advanced Technological Integration

The first objective is to utilize the Golden Tax Phase III and digital technology systems to achieve comprehensive electronic tax collection and management. This approach aims to fully leverage the benefits of informatization and intelligence while promoting a development strategy centered on scientific and technological innovation. To accurately assess risk factors, it is essential to employ advanced technological means to develop and enhance tax risk management analysis tools. This includes a focused comparison and analysis of relevant data from tax-related enterprises, such as their operational status, tax information, penalty records, and other significant data. Concurrently, we will persistently enhance the application of digital technology to track and explore dynamic data, promptly identify deficiencies in tax management, and continuously elevate the standard of tax risk management through comprehensive and precise oversight.The second objective is to advance the promotion and application of digital technology in the domain of tax risk management. Digital technology, grounded in information technology, plays a crucial role in managing tax risks. On one hand, it minimizes tax risks and control costs; on the other hand, it significantly contributes to the accurate and complete construction of transaction processes. Consequently, both tax authorities and tax-related enterprises must prioritize the promotion and application of digital technology. Building on this foundation, we will continuously enhance our exploration of new technologies to ensure that the detection of tax-related data is more transparent and accessible.

5.4 Application Level: Resource Sharing and Ecosystem Development

The first priority is to strengthen resource integration and sharing, thereby promoting the construction of data standards and comprehensive tax governance. Firstly, it is essential to enhance the incentive mechanisms for tax-related data and encourage the open sharing of data resources. Governments at all levels should actively promote transparency, mutual benefit, and the sharing of tax-related data, thereby fostering a new paradigm of comprehensive tax governance that encourages active participation from the entire society. Secondly, it is crucial to integrate the tax system and

establish a standardized data platform. This involves creating an open data sharing platform and implementing a mechanism for sharing tax-related data resources. Continuous efforts should be made to strengthen the construction of tax data, ensuring standardization and normalization to guarantee the sufficient, efficient, and sustainable utilization of these resources. Additionally, a tax industry data asset database should be established, complete with a clear asset catalog, to form a standardized tax industry database that is unified across the nation and society. Finally, it is necessary to establish a security mechanism for tax-related resources and enhance the data confidentiality system. Regular sampling reviews of tax-related information should be conducted, and necessary monitoring should be implemented based on the quality and safety of data resources to ensure the quality and efficiency of tax-related resources.The second priority is to build a new ecosystem for tax applications. Specifically, we aim to leverage modern technological means to address long-standing challenges in big data applications and create a tax ecosystem for the 'post-Jin era', with the goal of achieving inclusive and intelligent taxation.

Firstly, by relying on digital technology, we will build a process reengineering system for big data. This will involve addressing both the source and flow of data while further exploring the potential value embedded within the data. Secondly, using the Golden Tax Phase III as a foundation, we will establish a tax-related data sharing mechanism. Through collaborative efforts among departments, we aim to create a business process system characterized by broad coverage and strong connectivity. The tax-related data sharing mechanism will facilitate the creation of an ecosystem, utilizing information technology as a vehicle to achieve new developments in tax services through management transformation. This initiative will guide the transformation of tax services both online and offline, emphasizing decentralization and intensification. Concurrently, we will actively implement a data-based sharing system that encompasses five major systems: services, information, technology, knowledge, and data. With tax authorities at the core and sharing concepts as the foundation, we will link government entities, government agencies, third-party institutions, and other stakeholders to construct a complete and organic unity. This will promote the transformation of tax collection and management models and establish a new platform for efficient and orderly shared services in a systematic manner.

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