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The Preliminary Analysis of Pathways and Technologies in Digital Audit Transformation

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Abstract: This dissertation commences from the background and significance of digital audit, dissecting the new challenges of the digital transformation of internal audit. It thoroughly analyses the new characteristics of digital audit in the context of big data, including informatization of audit methods, full quantification of audit samples, diversification of audit verification, and the proactive positioning of audit checkpoints. A preliminary analysis explores the application of technologies such as Excel, Python, SQL statement analysis, visualization, BI tools, unstructured data conversion, robotic process automation, machine learning, web crawling, and knowledge graph in digital auditing. The dissertation anticipates the development prospects and future of digital auditing.

1. Introduction

In May 2018, during the first meeting of the Central Audit Committee pointed out the need to "persist in strengthening audits through technology and enhance the informatization construction of audit." In September 2020, the State-owned Assets Supervision and Administration Commission of the State Council issued "Opinions on Deepening the Internal Audit Supervision Work of Central Enterprises," advocating for the acceleration of informatization construction and application in internal audits. In June 2021, the National Audit Office's "14th Five-Year National Audit Work Development Plan" emphasized the need to "strengthen the innovation of audit techniques and methods and fully utilize modern information technology in conducting audits." The newly revised "Audit Law of the People's Republic of China" in October 2021 explicitly states, "Audit institutions must comprehensively analyze the electronic data and other materials obtained, and intensify the supervision of the business activities and data acquisition range of the audited entities, as well as their information systems." the first meeting of the 20th Central Audit Committee emphasize the unique role of auditing in promoting the self-revolution of the party and advancing the high-quality development of audit work in the new era.

The strategic positioning of audit work in the new era is an important part of the party and national supervision system and a significant force in promoting the modernization of the national governance system and capabilities. It should focus on the economic supervision positioning, concentrate on global, long-term, and strategic issues, and strengthen strategic planning and top-level design in the audit field. Based on the positioning of economic supervision and focusing on core responsibilities, auditing plays a unique role in advancing the party's self-revolution.

Thus, it has become imperative to accelerate the construction of a multidimensional and

comprehensive audit supervision system, to expedite the digital transformation of auditing, and to position auditing as a powerful tool for daily supervision, a microscope for detecting problems, and a compass for preventing risks.

2. Adapting to the New Challenges of Digital Transformation in Internal Auditing

In economic activities, the importance of technology and data as traditional factors of production such as land, capital, and labor has gradually increased. The "Global Digital Economy White Paper" released by the China Academy of Information and Communications Technology in December 2022 shows that the digital economy of 47 countries grew by 15.6% year-on-year, accounting for 45.0% of GDP. This demonstrates that digital technology and the digital economy are the forerunners of the world's scientific and technological revolution and industrial transformation, and are key areas of the next round of international competition. Seizing digital transformation is essential to gaining a strategic advantage in future development.

As the economy transforms, economic supervision must also adapt. The digital development of audit subjects forces internal audit to simultaneously transform its concepts. Under the backdrop of the digital economy, corporate objectives, governance structures, and internal management models will also undergo changes [1].

Internal audit, as an integral part of the governance of enterprises and institutions, carries new positioning and value in the digital era. It fully plays the role of internal audit functions to assist enterprises and institutions in realizing the value of digital transformation. Experts like Fedyk believe that compared to other industries, the audit industry has advantages in researching digital issues [2].

2.1 Enriching the Perspectives of Internal Auditing and Fulfilling the New Mission of Audit Supervision

Emerging information technologies enable internal auditing to transform from compliance and single-type audits to consultative and continuous audits. The timeline of audits now ranges from post-event to mid-event and pre-event. The spatial scope has expanded from accounting to encompass business, operations, and governance. Additionally, the scope of information has broadened from offline, dispersed data to online, integrated data, marking a transition from sampling audits to full data audits. Lastly, the audit philosophy has shifted from a defensive approach to proactive control.

2.2 Enhancing the Quality and Efficiency of Internal Auditing to Better Adapt to the New Digital Transformation

Data processing, data analysis, and data application facilitate the implementation of remote, continuous, and agile auditing. Replacing manual operations with machines rapidly reduces costs and increases efficiency. Multidimensional profiling significantly enhances audit outcomes. Furthermore, AI-powered analysis substantially improves the quality of audit results. These measures can reduce the cost of conducting audits, enhance overall audit benefits, and facilitate the transformation of audit outcomes, providing support for improving the quality and efficiency of internal audits.

2.3 Playing the Functions of Internal Auditing and Practicing Audit Supervision Responsibilities More Effectively

The transition from "process-based" to "data-based" drives the digitalization of the entire lifecycle of internal audits and promotes comprehensive online, end-to-end audit control. Comprehensive data coverage and full audit coverage facilitate complete monitoring of key areas, ensure control over

critical stages, and manage significant risks effectively. The integration of data, business, and technology enhances the value added by audits, improves operations, and supports decision-making. This approach provides the necessary momentum to fully leverage the capabilities of internal audit functions.

3. The Essence and Transformation Path of Digital Auditing

Digital auditing involves the use of digital infrastructure and technologies. It centers on the responsibilities of audit work in new era, employing digital audit platforms and various information systems. This approach enables cross-domain, comprehensive data analysis, detecting anomalies, identifying problems, and improving risk-related supervision, evaluation, and recommendation activities. It emphasizes the use of big data technology to conduct comprehensive and full audits of audit content, breaking away from the traditional limitations of sampling, discovering connections and patterns among massive data, and objectively and comprehensively revealing problems and analyzing the causes and risks involved. Continuous audit monitoring based on digital audit application advances audit checkpoints, achieving automated management of the audit lifecycle.

3.1 Informatization of Audit Methods

Informationized auditing involves overall analysis, anomaly detection, dispersed verification, and systematic research, transitioning from traditional manual auditing to diverse informationized auditing. Internet audit technology enhances the flexibility of audit work. Remote transmission technology improves the real-time acquisition of audit materials. Additionally, satellite positioning data overcomes the traditional time and space limitations of inventory methods. Data platforms also enhance the timeliness and quality of information.

3.2 Full Quantification of Audit Samples

Audit samples transition from traditional sampling to full data auditing. Full data auditing, through massive data mining techniques, breaks the barriers between business sections, conducts comprehensive screening and associated analysis, and extends the depth and breadth of issues identified in digital audits.

Under traditional audit models, the planning, investigation, implementation, and reporting phases of audit work need to be conducted on-site, limiting work efficiency. Under the digital audit model, the needs for regular and real-time audit supervision are met, enhancing the efficiency of audit work while also expanding the depth of audits, increasing data coverage, and further improving audit quality, facilitating the transition from inspection and verification to evaluation and assessment.

3.3 Diversification of Audit Verification

In the audit verification phase, traditional audits mainly rely on on-site methods, including physical observation, inventory monitoring, document and physical item checks, inquiries, analytical reviews, recalculations, and executions. The audit working papers are also compiled on-site [3]. Under the digital audit model, the centralized storage and management of big data break information sharing barriers, promoting the organic unity of comprehensive coverage and quality improvement in internal audits. This achieves a shift from problem detection to risk revelation in audits.

3.4 Advancement of Audit Checkpoints

Traditional audits operate on a "locking the stable door after the horse has bolted" basis, playing a role in post-event error checking and fraud prevention. In contrast, digital audits operate on a "prevention is better than cure" basis, advancing audit checkpoints to integrate pre-event prevention, mid-event control, and post-event supervision effectively. This realizes a shift from post-event to full lifecycle audits.

Thus, we aim to break professional barriers and data silos to foster sharing, mutual promotion, and mutual benefits. We seek to move away from isolated operations and individual approaches to establish a high-quality, high-efficiency, and cost-effective "middleware + application" system. Additionally, we strive to overcome process rigidity and iterative reluctance, enabling rapid adjustments, optimizations, and improvements in productivity and production relationships. Technological innovation thus enhances efficiency, while data empowerment deepens impacts, and adjustments in production relationships unlock new capabilities. These changes collectively contribute to the reshaping of digital audit business formats and the reconstruction of ecosystems. Ultimately, building an "open, integrated, dynamic, and intelligent" new ecosystem for digital auditing becomes imperative for long-term success.

4. Common Technologies and Methods in Digital Auditing

4.1 Excel Technology

Using formula functions allows us to process various data, analyze information, and manage lists of data and data charts in electronic spreadsheets or web pages. In audit projects, data pivot tables can be created in Excel by categorizing and summarizing related data based on field conditions. Additionally, custom combinations of statistical methods can be tailored according to requirements. This greatly facilitates the conduct of audit work.

4.2 Python Language

Python offers efficient high-level data structures and facilitates simple, effective object-oriented programming, making it a popular choice for scripting and rapid application development on most platforms. Its source code or machine code is used on all major system platforms. In digital audit projects, Python's application areas include web crawling, artificial intelligence, data mining, and image processing, enhancing the intelligence upgrade of digital auditing.

4.3 SQL Statement Analysis Technology

SQL statement analysis technology is a database query and programming language used for accessing data and querying, updating, and managing relational database systems (Figure 1). It can use the same structured query language as an interface for data input and management. In audit projects, by setting the required data fields and filtering data in intermediate tables, SQL statements can be used for real-time analysis and monitoring, helping to quickly identify anomalies and respond accordingly.

```
SELETCT
orgnname,--Unit Name
pucnumber,User ID
sgname,--User Name
DATEDIFF(GET DATE(),canceldate,'mm')months, --Account cancellation
prepaybal--Deposit amount
from dwa_sj_prod.ads_cst_szhsj_qryp_w_c_cons_mf
where ds =max_pt('dwa_sj_prod.ads_cst_szhsj_qryp_w_c_cons_mf')
and sgstatusname--'closed customer'
and subste(buliddate,1,4)>='2018'
and prepaybal>10000--the depositamount is greater than 10000yuan
```

Figure 1: SQL Statement Analysis Table under Specific Conditions for Pre-stored Amounts Greater than 10,000 Yuan

4.4 Visualization Technology

This involves encoding data into visual objects (such as points, lines, colors, spatial relationships, dynamic effects, etc.), assembling these objects into graphics to convey information, and using a collection of graphic elements to create data images, while representing data attributes in a multidimensional form for deeper observation and analysis from different dimensions.

Auditors can use big data visualization software for modeling, analysis, and outputting results. This allows them to explore suspicious clues, delve into their characteristics, and create pictorial and scenographic displays, ultimately obtaining evidence of project violations in audits.

4.5 BI Tools

BI tools, with their functional data analysis and visualization capabilities, help enterprises build data analysis systems and create data portals with analytical insights. Using 'data middleware + audit intermediate table + BI tool' for visualization modeling reduces the modeling threshold. This assists auditors in understanding the overall picture of problems, directly locating significant business risks, and making audit business data 'more vivid'.

4.6 Unstructured Data Conversion Technology

Unstructured data conversion technology transforms data that is irregularly structured or incomplete Figure 2, lacks a predefined data model, and is inconvenient to represent with a two-dimensional logical table database into highly organized and neatly formatted data [4]. It is mainly used for the conversion of documents, texts, pictures, XML, HTML, reports, images, and audio/video information.

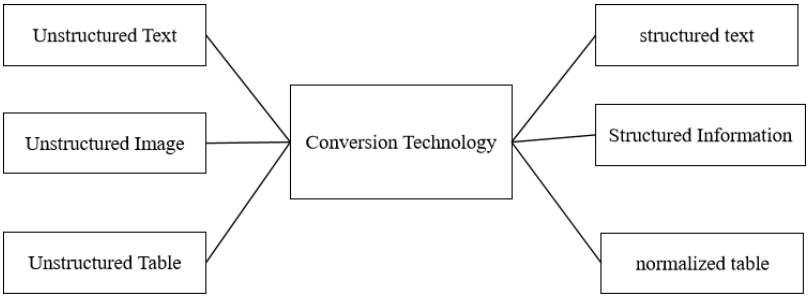

Figure 2: Schematic of Unstructured Data Conversion Technology

By employing unstructured data conversion technology, the analysis and processing of unstructured data are realized. This extends the range of audit data and effectively replaces the manual review of original materials. As a result, audit efficiency is significantly enhanced. Broadening the scope of digital auditing extends the auditors' insight and detection capabilities.

4.7 Robotic Process Automation

By programming computers or using assistive software to simulate human operations Figure 3, robotic process automation helps solve a large number of periodic, repetitive, and mechanical tasks. This relieves human labor and increases efficiency. It features anthropomorphic capabilities, reusability, easy portability, zero integration with business systems, and short manual construction cycles.

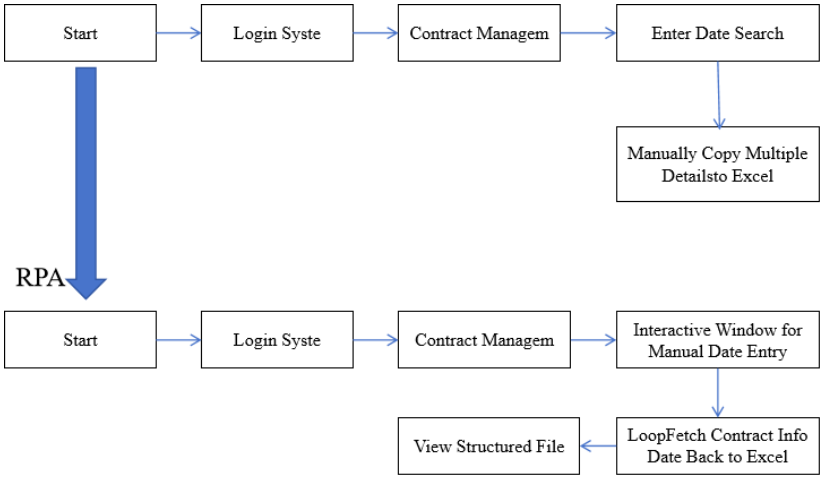

Figure 3: Schematic of Robotic Process Automation

By automating key processes in audit operations, robotic process automation significantly enhances audit work efficiency. These processes include automatic downloading of audit materials, batch information auto-query, and automatic sorting and uploading of audit working papers and confirmation slips. This automation effectively expands the "hands" of audit personnel.

4.8 Machine Learning Technology

Machine learning is a multidisciplinary cross-discipline that studies how computers can simulate or implement human learning behaviors to acquire new knowledge or skills, reorganize existing knowledge structures, and continually improve their own performance. It is the core of artificial intelligence.

Automatically constructing and continuously optimizing data audit models enhances the accuracy

of remote audits. Machines automatically refine characteristics of non-compliant behaviors, build intelligent models, and adjust models based on the latest business data, expanding the "brains" of audit personnel.

4.9 Web Crawling Technology

Web crawling technology is a program or script that automatically captures web information according to certain rules, widely used in the internet domain. For example, auditors can use crawler functions to retrieve information about suppliers, legal representatives, and shareholders from apps like 'Qichacha' and 'Tianyancha'. This enables the automatic acquisition of external network data, expanding the sources of audit data. It replaces manual, mechanical information collection processes, rapidly enlarges the data scale, and enhances the "operational potential" of audit personnel.

4.10 Knowledge Graph Technology

Knowledge graph technology is a type of knowledge base called a semantic network, the basic unit of which is the "entity-relationship-entity" triplet. It represents symbolic artificial intelligence, with the core focusing on the efficient processing and visualization display of multimodal, multi-source heterogeneous data, and multidimensional complex relationships.

By constructing a structured, networked knowledge system, the central brain of digital auditing is established. This system links audit regulations, audit issues, and audit recommendations across a vast amount of knowledge. It provides comprehensive data support for risk areas, multidimensional profiling, and institutional foundations, thereby expanding the "thinking domain" of audit personnel.

5. Conclusion

The future of digital auditing will gradually become standardized, mature, and normalized on the foundation of continuous innovation[5]. The application of various new technologies based on big data, combined with problem-posing and problem-solving approaches, and intuitive visual displays, will continuously facilitate non-site monitoring and closed-loop management. This approach benefits by providing a comprehensive understanding of the overall situation, highlighting key points, increasing precision, and focusing on problems. It continuously advances China's audit capabilities in risk identification and value creation, safeguarding the healthy and orderly development of the national economy.

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