ISSN: 2688-9323

Study on Full-Cycle Auditing of Government Investment Projects under a Research-Oriented Audit Approach

-- Taking the Yibin Municipal Audit Bureau as a Case Study

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Abstract

Government investment projects typically involve substantial capital expenditure, long construction periods, multiple participating entities and risks that may extend across different stages, while traditional ex-post compliance auditing has limited capacity to address these risks in a timely manner. Using the Yibin Municipal Audit Bureau's full-process audit practice as a case, this paper adopts a single-case study method and draws on publicly available policy documents and materials issued by the audit authority to examine how research-based auditing operates through pre-audit research, in-process supervision and post-audit implementation. The findings show that project pipeline management, risk profiling, in-depth analysis, data screening, mid-term consultation, rectification and the application of audit findings have shifted the focus of government investment auditing from experience-based project selection and ex-post correction towards risk identification, process supervision and governance improvement. The case also indicates that leadership by operational departments, coordination among supporting departments, institutionalised procedures and the application of digital and intelligent technologies are necessary conditions for integrating research-based auditing throughout the lifecycle of government investment projects.

Keywords

Research-based Audit; Government Investment Projects; Full-process Audit.

1. Introduction

Government investment projects serve as a key vehicle for the allocation of public financial resources and the provision of public services. They are characterised by large scales of funding, lengthy construction cycles, multiple stakeholders, and a relatively centralised exercise of authority and use of funds. During the project implementation process, risks may arise at various stages-including preliminary decision-making, tender management, engineering changes, fund disbursement and final settlement-which can lead to issues such as decision-making errors, non-compliant tendering, uncontrolled engineering changes, idle or wasted funds, and settlement disputes.As the modernisation of national governance continues to advance, audits of government investment projects must not be confined to ex post compliance reviews and the detection and rectification of errors; instead, greater emphasis should be placed on end-to-end risk identification, analysis of policy implementation, and the enhancement of governance effectiveness. Research-based auditing emphasises the application of a research mindset throughout the entire process-from project initiation and implementation to the rectification of audit findings-and helps to shift the focus of government investment project audits from ex post supervision to end-to-end governance.

ISSN: 2688-9323

Existing research has produced a wealth of findings concerning the essence, functions and implementation pathways of research-based auditing. Wang Yongmei et al. (2021) argue that research-based auditing emphasises the application of a research mindset and methodology in conducting audit projects, whilst using audit practice to inform audit theory[1] . Zheng Shiqiao and Liu Xingrui (2022), examining its essence, types and conditions for application, point out that research-based auditing helps to enhance audit quality and value[2]. Qi Zhendong and Zhang Zixuan (2022) constructed a theoretical analytical framework for research-based auditing, emphasising that its fundamental objective lies in better serving the modernisation of national governance[3]. Yan Weilong and Zhuang Shangwen (2022) further pointed out that national auditing should not only fulfil the function of detecting and rectifying errors and malpractices, but should also reveal the institutional and mechanistic causes underlying problems, thereby driving institutional improvements[4].Qin Rongsheng (2024) and Ma Chaojie et al. (2024), on the other hand, emphasise-from the perspectives of high-quality development in auditing and the restructuring of audit practice-that research-based auditing is a key means of enhancing the quality and efficiency of audit work[5,6].Wang Huijin et al. (2024), approaching the issue from the perspective of auditors' professional competence, explain that the advancement of research-based auditing also requires auditors to simultaneously enhance their professional theory, practical skills and research literacy[7].

Relevant research on the audit of government investment projects and digital and intelligent auditing has also provided important insights for this paper. Xu Ya (2022) points out that public investment audits should focus on major practical issues and respond to the new requirements arising from reforms to the investment and financing system and changes in the public investment audit environment[8].Li Xujie (2026), in examining the full-process tracking audit of government investment projects, emphasises that full-process auditing plays a vital role in standardising project management, mitigating financial risks and enhancing investment efficiency[9]. Li Man and Wei Xiaojuan (2022), starting from the audit of the implementation of major policy measures, propose that research-based auditing should serve the analysis of policy implementation and the enhancement of audit oversight effectiveness[10].Li Kun (2026) focuses on the digital and intelligent transformation of national auditing, pointing out that data sharing, computing power coordination and the prevention and control of compound risks are key issues in the advancement of digital and intelligent auditing[11].Overall, existing research has explored theoretical implications, governance value, public investment auditing and technological empowerment; however, there remains scope for further research into how grassroots audit bodies can specifically embed research-based auditing throughout the entire process of government investment projects, particularly regarding the establishment of operational mechanisms through pre-audit assessment, in-audit analysis and post-audit implementation.

2. Research Design

2.1. Research Methods and Data Source

This paper adopts a single-case study approach, taking the Yibin Municipal Audit Bureau as the subject of study and using the full-process audit of government investment projects as the analytical context, to examine the specific operational mechanisms of research-based auditing within grassroots audit authorities.The selection of the Yibin Municipal Audit Bureau as a case study is primarily based on its representativeness and instructive value. On the one hand, grassroots audit authorities generally face practical challenges such as the complex risks associated with government investment projects, limited audit resources, insufficient professional capacity and significant pressure to undergo technological transformation; the practices of the Yibin Municipal Audit Bureau reflect the common circumstances faced by

ISSN: 2688-9323

similar audit authorities in advancing the transformation of government investment project audits.On the other hand, the Yibin Municipal Audit Bureau has already established a relatively comprehensive set of practical approaches in areas such as project pipeline management, pre-audit research, data auditing, process supervision and rectification management, thereby providing ample empirical evidence to illustrate how research-based auditing is embedded throughout the entire lifecycle of government investment projects.

The data for this study were drawn primarily from publicly accessible policy and institutional documents, materials issued by audit authorities, internship observations and work records, and information concerning representative projects. Policy and institutional documents were used to establish the context of research-based auditing and government investment auditing. Materials released by audit authorities provided evidence of the organisational arrangements and audit practices adopted by the Yibin Municipal Audit Bureau. Internship observations and work records supplemented the procedural details of specific audit activities, while representative project information supported the examination of how research-based auditing was implemented and what outcomes were observed in practice.

All internal documents and project-related information were anonymised in accordance with research ethics, and content unsuitable for public disclosure was excluded from the study. During data analysis, the case materials were organised around three stages: pre-audit research, supervision during the audit, and post-audit transformation. The materials were then examined through several themes, including institutional guidance, risk identification, technical support, collaborative governance, and the use of audit outcomes. This process provided a structured basis for moving from the classification of case evidence to its theoretical interpretation.

2.2. Case Introduction

This paper examines the audit practices applied by the Yibin Municipal Audit Bureau to government-invested projects, with particular attention to the organisational arrangements and operational conditions associated with research-based auditing. Under the leadership of the Municipal Party Committee Audit Commission, the Bureau has formed an organisational structure consisting of fourteen internal departments. These include the General Office, the Comprehensive and Planning Management Section, the Policy and Regulations Review Section, the Electronic Data Audit Section, the Fixed Asset Investment Audit Section, and the Audit Rectification Supervision Section. Within this structure, the Fixed Asset Investment Audit Section undertakes the main responsibilities for auditing government-invested projects. The Electronic Data Audit Section supports the collection of project data, the identification of anomalies, and related technical analysis, while the Audit Rectification Supervision Section oversees the correction of problems identified during audits and the implementation of audit findings. The division of responsibilities among these departments provides an organisational basis for applying research-based auditing across the full process of government-invested projects.

Audits of government-invested projects cover multiple stages, including project approval, tender management, contract performance, fund disbursement, engineering changes, completion settlement, and audit rectification. These stages are closely related, and problems arising at one point may affect subsequent activities. Audit work must therefore address complex procedures, dispersed documentation, and risks that may extend across different stages of project implementation.

The Yibin Municipal Audit Bureau has integrated research-based auditing into its routine practices to strengthen the anticipatory and governance functions of audit supervision. Its main measures include establishing project reserves, conducting pre-audit research, organising consultation and analysis, preparing risk alert lists, developing a data audit platform, and applying intelligent audit assistants. These practices indicate that the focus of audit work has

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gradually expanded beyond ex-post verification. Greater attention is now given to assessment before the audit, supervision during project implementation, and the subsequent rectification of identified problems.

The internship materials included in the case study provide evidence for this analytical structure. The organisation of project documents reflects the preparation undertaken before an audit, while cost records provide information for examining specific audit procedures. Data entered into the rectification system show how audit findings are tracked and implemented after the audit. Materials concerning personal experience, routine administrative work, and other individual matters are excluded from the main analysis because they are not directly related to the research focus.

3. Analysis of the Current Status of Research-Oriented Auditing Practices in Yibin City's Audit Bureau

3.1. Organisational and Institutional Support: Fundamental Conditions for Embedding Research-Based Auditing into Full-Process Auditing

The application of research-based auditing throughout government investment project audits depends on a clearly designated operational unit. In the Yibin Municipal Audit Bureau, this role is mainly undertaken by the Fixed Asset Investment Audit Section. Its work covers project approval, tender management, contract performance, fund disbursement, project changes and final accounts upon completion.

The section is responsible not only for carrying out specific audit projects, but also for conducting pre-audit investigations, identifying key audit areas, assessing issues found on site and preparing preliminary audit findings. It therefore provides the main organisational support for putting research-based auditing into practice. With its continued involvement, research-based auditing can be incorporated from the stage of project selection and carried through the audit process, rather than being limited to a summary of experience after the audit report has been completed.

In addition to the operational sections, the Yibin Municipal Audit Bureau has formed a collaborative working arrangement involving several supporting sections. The Comprehensive and Planning Management Section coordinates audit project planning and feasibility studies, which helps determine whether a government investment project should be included in the annual audit plan. The Policy and Legal Review Section focuses on audit quality and the application of relevant regulations, reducing the possibility of incorrectly identifying problems or handling them without sufficient grounds.

Technical support is mainly provided by the Electronic Data Audit Section. Its work includes data collection, organisation, anomaly screening and technical analysis, which helps auditors identify irregularities more effectively. The Audit Rectification Supervision Section follows up on rectification measures, collects feedback and promotes the use of audit findings. This allows the results of an audit to serve not only the rectification of a particular project, but also the prevention of similar problems. Research-based auditing therefore depends on cooperation between operational and supporting sections, rather than being undertaken by a single department. Such coordination enables it to be incorporated into different stages of the audit process.

Institutional arrangements provide the procedural basis for applying research-based auditing in practice. Under the 'Management Measures for the Rolling Reserve of Audit Projects', project selection is supported by continuous investigation and risk assessment. This makes it possible to give priority to high-risk projects and major livelihood projects when preparing the annual audit plan. Regular consultations on major audit projects also allow complex matters to be

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discussed collectively and examined from different professional perspectives, which improves the identification of audit priorities and the assessment of specific issues.

The Full-Process Quality Control Measures place pre-audit preparation, audit implementation, audit reporting and audit rectification within a unified management framework. As a result, key activities such as project selection, on-site auditing and follow-up rectification can be reviewed and traced. The Management Measures for Tiered and Categorised Responsibility for Audit Rectification, together with the Rectification Management Platform, further clarify responsibility for addressing identified problems and strengthen supervision over the rectification process. Audit findings can therefore be followed up over time and incorporated into the management of government investment projects.

At the same time, institutional tools such as the risk alert list for common issues in public works and the comprehensive debt risk service guidelines have further enhanced the operational effectiveness of research-based auditing. These tools summarise recurring issues in government-invested projects-such as construction procedures, fund management, accounting and debt management-providing a reference for auditors to identify risks, assess problems and make recommendations. They not only serve the audit of individual projects but also provide an empirical foundation for pre-audit research and process supervision of subsequent projects of a similar nature.The key finding that emerges from this is that the Yibin Municipal Audit Bureau's promotion of research-based auditing does not rely on the empirical exploration of individual departments, but rather on a model where operational departments take the lead, supported by collaborative efforts from supporting departments, and with institutionalised processes and procedures. This approach embeds research requirements throughout the entire process-from pre-audit research, through in-process supervision, to post-audit implementation-providing a stable organisational foundation for the full-cycle auditing of government-invested projects.

3.2. Pre-audit Research: Shifting from Experience-based Project Selection to Risk Profiling

Research-based auditing is incorporated into project decision-making and audit preparation to reduce reliance on professional experience alone when selecting projects and determining audit priorities. The approach places risk assessment at the centre of the preparatory stage. It extends beyond routine tasks such as collecting documents and assigning personnel. Before fieldwork begins, auditors examine policy requirements, project characteristics, recurring problems and potential risk signals through project reserves, pre-audit investigations and audit plan design. This process provides a basis for directing limited audit resources towards areas requiring closer examination and for improving the focus of government investment project audits.

The Yibin Municipal Audit Bureau applies a rolling reserve mechanism to the management and screening of government investment projects. The arrangement of 'three years in reserve, two years in the rolling pipeline, and one year for implementation' treats project selection as a continuing process rather than a single annual scheduling exercise. Candidate projects are identified from departmental recommendations, feedback from counties and districts, matters attracting public concern and problems found in earlier audits. The Bureau then uses thematic consultation and risk assessment to determine which projects should receive priority.

Projects involving substantial funding, close links to public welfare, long construction periods or high levels of public attention are generally more likely to enter the reserve pool. The list remains adjustable and may be revised in response to policy implementation, fund utilisation and actual construction progress. Project approval is therefore based less on established annual practice and more on identified risks and current governance needs.

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Pre-audit investigation begins with a systematic review of project materials. These commonly include approval documents, tender and bidding records, contracts, fund disbursement records, design change documents and lists of problems identified in previous years. The audit team uses this information to form an initial risk profile before entering the project site.

For public hospital construction projects, the organisation of pre-audit materials involves more than verifying whether documents have been submitted in full. Auditors also examine whether contracts were concluded in accordance with relevant requirements, whether engineering changes were unusually frequent, whether payments corresponded with construction progress and whether the necessary approval procedures had been completed. Problems identified in comparable projects are used as reference points for reviewing tendering procedures, contract performance, fund effectiveness and engineering changes. The resulting comparison helps the audit team determine which matters require more detailed verification during fieldwork.

The audit implementation plan is prepared in accordance with the risks identified during the preliminary review. When approval procedures are complex, contract numbers are high or engineering changes occur frequently, the plan places greater emphasis on project approval, tendering, contract performance and change orders. Where projects involve large funding amounts and multiple payment stages, auditors conduct more detailed checks of fund disbursement, accounting records and project performance.

Professional responsibilities are also allocated according to the identified risks. Engineering personnel review project quantities, cost estimates, contract execution and on-site conditions. Finance and accounting personnel examine fund flows, accounting treatment and the basis for payments. Data analysts organise project information, compare relevant datasets and screen for unusual items. External audit support staff supplement the team in areas requiring specialist judgement, including construction cost estimation, measurement and verification. This arrangement allows different forms of expertise to be matched with the main risk areas before the on-site audit begins.

Process records generated during fieldwork may also support the preliminary research. Cost service logs, for example, record the progress of the project audit, the principal types of problems identified and the status of evidence collection. Auditors can use this information to refine on-site verification and to classify audit issues at later stages.

A preliminary review of rectification records and project documents further enables the audit team to identify procedural weaknesses, fund management problems and settlement disputes that have recurred in similar projects. These findings serve as reference points when determining which areas of a new project warrant closer examination. Pre-audit research is therefore not confined to checking the completeness of submitted materials. In the practice of the Yibin Municipal Audit Bureau, it directs audit attention towards major risks concerning project approval, contract performance, fund effectiveness and change management.

3.3. In-process Supervision: Shifting from Compliance Checks to In-depth Analysis

The Yibin Municipal Audit Bureau selected the special audit investigation of municipal public hospital construction projects as a representative case for examining policy implementation and project performance. The investigation covered three projects with a total investment of RMB 5.598 billion. Its scope included major policy implementation, performance of participating organisations, approval procedures, tender management, engineering changes, quality control and fund disbursement.

The audit did not examine project documents in isolation. Policy requirements were compared with actual construction progress, contract terms and payment records to determine whether relevant policies had been implemented, participating organisations had fulfilled their responsibilities and management duties had been clearly assigned. The investigation identified

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problems involving RMB 325 million, indicating that the audit extended beyond document compliance to the implementation and management of the projects.

Approval documents were reviewed to assess whether the construction scope, investment scale and project schedule were consistent with policy requirements. Tender documents, contracts and engineering change records were then examined together to determine whether participating organisations had performed their duties in accordance with contractual terms and relevant regulations. Where frequent engineering changes, incomplete supporting materials or inconsistencies between payment milestones and construction progress were identified, the audit team traced the responsibilities of the project owner, contractor, supervising body and competent authorities. This analysis distinguished problems arising from weak implementation, inadequate supervision and internal control deficiencies, allowing the audit findings to reflect broader weaknesses in project governance rather than only procedural omissions or irregular payments.

In examining fund performance, the Bureau follows the principle that funds should move with projects and that audit work should track their use. Financial data, construction progress records, contract performance information and payment vouchers were reviewed together to assess whether funding arrangements corresponded with project progress, payments were supported by contractual provisions and fund use achieved the expected results.

Idle funds, delayed payments and inefficient fund use were not treated solely as financial management irregularities. The audit team also examined their possible causes. Idle funds, for example, may be associated with premature budget allocation, delays in project approval, slower construction progress, weak contract performance management or insufficient coordination by the project owner. Locating funding problems within the full project lifecycle provides a clearer basis for identifying their sources and formulating rectification recommendations.

Data tools were mainly used to organise audit materials, screen suspicious leads and cross-reference legal provisions. Data specialists compiled information on project approvals, contracts, payments, engineering changes and rectification, enabling the team to identify anomalies in amounts, timelines and supporting documents. The intelligent audit assistant supported regulatory searches, policy clause matching and the preliminary organisation of suspicious findings. These tools improved the processing of audit data and the identification of leads, while the assessment of issues, analysis of causes and formulation of recommendations remained dependent on professional audit judgement.

The mid-term consultation mechanism supported coordination during ongoing supervision. In the special audit investigation of projects funded by additional government bonds, audit teams from nine counties and districts submitted periodic progress reports. The Fixed Asset Investment Audit Section then provided on-site clarification and professional guidance based on the issues identified. Recurring problems involving fund management, project progress and data organisation were consolidated through consultation, allowing audit teams to adjust subsequent verification priorities. This arrangement also supported the consistent application of standards in issue identification and evidence verification across different projects.

The case shows that the Yibin Municipal Audit Bureau has incorporated policy implementation checks, performance oversight, fund performance analysis, data screening and mid-term consultation into the on-site audit process. Audit attention has therefore expanded from isolated compliance issues to the full course of project implementation. The findings cover specific irregularities while also identifying management weaknesses and gaps in responsibility. Corresponding recommendations focus on dynamic fund supervision, contract performance, engineering change control and the fulfilment of duties by participating organisations.

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3.4. Post-audit Implementation: Shifting from Rectifying Issues to Improving Governance

The post-audit phase is the stage in which research-based auditing converts audit findings into practical governance outcomes. In government-invested projects, final accounts confirm construction costs and the overall investment scale. They also provide a basis for reviewing project approval, contract performance, engineering changes, fund utilisation and quality management. Research-based auditing at this stage should therefore extend beyond cost reduction and issue rectification. By consolidating and analysing audit findings, lessons from individual projects can be applied to the management of similar projects.

In final accounts audits, the Yibin Municipal Audit Bureau and relevant district and county audit authorities have expanded their examination from cost verification to contract compliance, change management, settlement evidence, quality defects and investment performance. The Nanhxi Yangtze River Highway Bridge PPP project illustrates the complexity of auditing major public works because of its large investment scale, long construction period, numerous participating entities and technically demanding construction.

For the project's final accounts audit, the Nanxi District Audit Bureau adopted an approach led by state audits and supported by social audits. GPS positioning, drone aerial photography and road surface radar detection were used to verify irregularly shaped areas, road surface structural layers and on-site quantities of works. These methods provided more objective and verifiable field evidence and improved the audit team's ability to determine the actual physical condition of the project.

The audit findings revealed issues such as non-compliant contract signing, delays in completion acceptance, and the irregular over-claiming of project payments. Whilst these problems manifested superficially as discrepancies in settlement documentation and project measurement, further analysis revealed insufficient coordination between contract management, process acceptance and settlement review.It is thus evident that research-based auditing at the final accounts stage does not merely involve a simple reduction in project payments, but rather involves a retrospective evaluation of the effectiveness of the project's full-process management through cross-verification of settlement documentation, on-site inspections and contract performance.At the city-wide level, audits were conducted on eleven major public works projects with a total estimated investment of 6.426 billion yuan. These audits identified 157 issues, including inadequate preliminary feasibility studies and non-compliant construction procedures, resulting in a reduction of 463 million yuan in investment, whilst also mandating rework on ten projects with quality defects. These results demonstrate that final accounts audits can retrospectively reveal weaknesses in early-stage decision-making, construction management and quality control.

The Yibin Municipal Audit Bureau has extended the use of audit findings from the rectification of individual issues to broader governance improvement. Rectification responsibilities are assigned to specific units, while a dedicated platform records responsible parties, completion deadlines and progress. The four-colour early warning system provides continuous monitoring, and issues are managed by category through inter-departmental coordination. The 'Graded and Categorised Responsibility Management Measures for Audit Rectification' place different types of issues within corresponding accountability arrangements. General issues are addressed within specified periods, key issues remain under continued supervision, and recurring issues are incorporated into institutional reform. Through these mechanisms, the Bureau facilitated the resolution of 266 issues, achieved a rectification rate of 73.3 per cent, recovered and reallocated 2.745 billion yuan, and improved 71 sets of regulations and rules. These results reflect the combined role of responsibility allocation, dynamic monitoring and institutional constraints.

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Audit findings have also been converted into standardised working tools. The Risk Alert List for Common Issues in Public Works, the Risk Service Guidelines for Comprehensive Debt and Special Bond Funds, and the Guidelines for Rectifying Audit Findings consolidate recurring problems involving construction procedures, fund management, debt management and accounting practices. These documents provide reference points for subsequent audits and project management.

This approach differs from rectification confined to a single project. Separate audit findings are summarised as reusable criteria for risk identification, allowing similar problems to be recognised earlier during pre-audit preparation, project implementation and follow-up rectification. It therefore reflects the governance role of research-based auditing more clearly.

The translation of audit findings into practical outcomes follows six stages. Audit teams identify issues through final accounts and project audits, then formulate recommendations according to the nature and causes of the issues and the parties responsible. Rectification items are entered into the management platform with clear responsibilities and deadlines. They are subsequently classified and monitored according to their type and severity, supported by dynamic warnings and follow-up inspections. Recurring and high-frequency issues are further summarised into risk alert lists, rectification guidelines and institutional recommendations. These outcomes are then applied to feasibility studies for new projects, process supervision and management improvement. The post-audit value of research-based auditing therefore extends beyond identifying irregularities and reducing investment expenditure. It also lies in converting rectification experience into institutional arrangements for the continuing governance of government investment projects.

4. Analysis of the Reasons Behind the Practice of Research-oriented Auditing at the Yibin Audit Bureau

4.1. Top-level Design Guides the Institutional Transformation of Research-based Auditing

The promotion of research-based auditing in grassroots audit authorities did not arise solely from spontaneous local experience, but was formed through the gradual transmission of higher-level policy requirements and their adaptation into local institutional frameworks. The establishment of the Central Audit Commission has strengthened the Party's centralised and unified leadership over audit work, whilst also enabling national auditing to place greater emphasis on serving macro-governance, preventing major risks and promoting institutional improvement.Against this backdrop, the '14th Five-Year Plan for the Development of National Audit Work', issued by the Office of the Central Audit Commission and the National Audit Office, explicitly called for the active pursuit of research-based auditing, requiring audit authorities to strengthen systematic research into the background of major policies, reform objectives and implementation outcomes. This requirement provided a policy basis for grassroots audit authorities to shift away from a working approach focused solely on identifying errors after the fact.

In line with central requirements, the Sichuan Provincial Audit Bureau has further linked research-based auditing with audit quality improvement, the use of audit findings, and more scientific and standardised management. A research-oriented approach is expected to run through project initiation, audit implementation, problem analysis and the formulation of rectification recommendations.

Under these requirements, grassroots audit authorities are expected to do more than identify individual problems. They must also examine the causes behind them, propose practical recommendations and promote the use of audit findings to improve management. Research-

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based auditing has therefore moved beyond a general concept and has become part of the working standards applied to project management, quality control and the use of audit results.

At the local level, the Yibin Municipal Audit Bureau has turned higher-level requirements into more specific institutional arrangements. In audits of government investment projects, the Bureau applies the 'Management Measures for the Rolling Reserve of Audit Projects' to support project selection through continuous investigation, risk assessment and dynamic adjustment. On this basis, it has formed a project management arrangement that includes a three-year reserve, a two-year rolling cycle and one-year implementation.

The 'Management Measures for Regular Consultations on Key Audit Projects' require major projects and complex issues to be discussed collectively, which helps improve the accuracy of problem analysis and audit recommendations. At the same time, the 'Full-Process Audit Quality Control Measures' place pre-audit preparation, on-site implementation, report review and rectification follow-up within the same management framework. This allows the main stages of the audit process to be recorded and traced.

The Yibin Municipal Audit Bureau utilises data platforms and rectification management mechanisms to promote research-based auditing. When applying data, it relies on platforms such as 'Zhi Shen Yun Xi' and intelligent audit tools to organise and analyse project documentation, financial data, contract information and suspicious leads, thereby enhancing the efficiency with which auditors identify issues and match them to the relevant legal provisions.In terms of rectification management, through the use of a rectification management platform, categorised supervision and dynamic tracking, issues identified during audits are transformed into clear rectification tasks, whilst common issues are further summarised into risk alert lists and rectification guidelines.

Top-level design influences research-based auditing through more than general policy guidance. Organisational leadership, institutional arrangements and performance assessment requirements continue to pass specific expectations and working priorities down to grassroots audit authorities.

The experience of the Yibin Municipal Audit Bureau shows that research-based auditing can be incorporated into the full process of government investment project audits only when central requirements and provincial arrangements are translated into workable local systems. These include project management, collective consultation, quality control, data support and rectification management. Through such arrangements, research-based auditing becomes part of routine audit practice rather than remaining at the level of policy advocacy.

4.2. Audit Innovation for Full-Process Governance Driven by Risks and Challenges

Government-funded projects usually involve substantial investment, long construction periods, multiple participating organisations and complicated management procedures. Risks may therefore arise at different points throughout the project lifecycle. At the preliminary decision-making stage, common problems include inadequate feasibility studies, irregular approval procedures and repeated changes to the scope of construction. During tendering, risks may take the form of avoiding required tender procedures, collusion among bidders or unreasonable contract terms.

Once construction begins, arbitrary project changes, poorly managed site orders, weak supervision and inadequate quality control may occur. Fund management presents another area of concern. Payments may not correspond with actual construction progress, allocated funds may remain idle, or special-purpose funds may be used in ways that do not comply with relevant rules. At the final settlement and operational stages, problems may include insufficient evidence for settlement, overstated project costs, construction defects and project outcomes that fail to meet expected performance targets.

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These risks are interrelated rather than isolated. Weaknesses in early project decisions may increase the difficulty of controlling later investment, while inadequate construction management may reduce the efficiency of fund use and create potential quality risks.

Evidence from other regions shows that special bond projects have involved problems such as non-compliant fund use, construction delays and overstated revenue forecasts. These cases reflect recurring risks in the public investment sector, but they do not constitute direct evidence of similar problems in Yibin City.

In the Yibin case, an audit in Nanxi District identified unauthorised project changes and unapproved expansion of construction scope involving 428 million yuan. This finding indicates that local government investment projects face risks related to change management, scope control and investment restraint. Weak management of construction agency services in related projects also suggests that such risks extend beyond financial matters to unclear responsibilities and insufficient supervision among project owners, construction agencies, contractors and supervising bodies.

Traditional audits of government investment projects have generally focused on compliance verification after project implementation, with particular attention to contracts, bills of quantities, payment vouchers and settlement documents. This approach can identify visible irregularities, but it is less capable of tracing how risks arise and develop throughout the project lifecycle. Where preliminary decisions are weak, construction is delayed, funding arrangements are inappropriate or design changes occur repeatedly, audit intervention may take place only after losses or inefficiencies have emerged.

Compliance-based auditing may also identify the immediate form of a problem without fully explaining its underlying causes. Institutional weaknesses, management deficiencies and unclear accountability may therefore remain unresolved. The complexity of government investment projects requires audit work to extend from correcting final-stage errors to examining risks across the full project process.

Research-based auditing responds to these requirements through intervention before, during and after audit implementation. Before an audit begins, the Yibin Municipal Audit Bureau applies open auditing practices, rolling project reserves and project approval consultations to examine policy requirements, funding scale, project progress, public concern and problems found in previous audits. Projects assessed as carrying relatively high risks are then given priority in audit planning.

During implementation, the audit team reviews project approval, tendering and bidding, contract performance, engineering changes, fund disbursement and quality management. The analysis is not limited to confirming individual irregularities. It also examines whether identified problems are associated with management deficiencies, ineffective internal controls or inadequate fulfilment of primary responsibilities.

After the audit, rectification is tracked through the rectification management platform, the four-colour early warning system and categorised supervision. Recurring issues are further consolidated into risk alert lists, debt risk guidance and rectification guidelines, providing reference points for subsequent audits and project management.

The main challenge therefore lies not simply in the increasing number of audit subjects and matters, but in the need to adjust audit methods. Full-process risk management requires audit authorities to examine project selection, implementation, fund performance and rectification rather than relying solely on completion documents and final accounts. The practice of the Yibin Municipal Audit Bureau shows that pre-audit risk assessment, in-depth analysis during implementation and post-audit rectification can extend audit supervision from identifying individual problems to examining their causes and supporting governance improvement.

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4.3. Multi-disciplinary Collaboration to Reshape the Organisational and Talent Capability Structure of Audit Bodies

Full-process auditing of government-invested projects requires a broad and integrated capability structure. Preliminary decision-making depends on policy understanding and risk assessment. Construction and implementation involve engineering management, cost verification and contract review, while fund management requires financial accounting and performance analysis. Post-audit rectification further calls for institutional analysis and the practical application of audit findings. A capability structure centred mainly on financial auditing cannot fully address the demands arising from project approval through to completion. Multi-disciplinary collaboration therefore serves as the professional basis for incorporating research-based auditing into the entire project process.

The Yibin Municipal Audit Bureau has responded to these capability requirements through cooperation among its internal departments. The Fixed Asset Investment Audit Section takes primary responsibility for government investment project audits, with emphasis on project implementation, construction management and issue assessment. The Comprehensive and Planning Management Section supports preliminary project research and planning coordination, allowing audit project selection to correspond more closely with policy priorities and identified risks. The Policy and Regulatory Review Section reviews the application of regulations and audit quality, supporting the accurate characterisation of identified issues. The Electronic Data Audit Section undertakes data collation, anomaly screening and technical analysis, while the Audit Rectification Supervision Section tracks rectification measures and promotes the application of audit findings. This division of responsibilities has gradually replaced the single-section approach with an organisational model led by operational sections and supported by relevant specialist departments.

Table 1. Capacity Requirements and Support Mechanisms for Full-Cycle Audits of Government Investment Projects

Audit Stage	Required Capabilities	Yibin Municipal Audit Bureau's Support Methods
Pre-audit Research	Policy comprehension Risk identification skills Ability to screen projects	The Comprehensive and Planning Management Section participates in project pipeline development and project initiation research The Fixed Asset Investment Audit Section provides specialist project assessment
Supervision during the audit	Project management capability Cost review capabilities Contract review capabilities Financial analysis capabilities	The Fixed Asset Investment Audit Section leads on-site audits Division of labour and collaboration between engineering and finance/accounting staff External audit resources supplement cost estimation and surveying capabilities
Data analysis	Data organisation skills Ability to screen for anomalies Ability to ensure compliance with regulations	The Electronic Data Audit Section provides data support Intelligent audit tools assist with data comparison and regulatory searches
Quality control	Ability to apply regulations Evidence review capability Ability to characterise issues	The Policy and Regulations Review Section participates in the review process and ensures quality control End-to-end quality control systems standardise the audit process
Post-audit implementation	Capacity for monitoring rectification Ability to analyse systems Ability to distil key findings	The Audit Rectification Supervision Section is responsible for monitoring rectification Utilising the rectification platform and risk alert list to facilitate the implementation of audit findings

Source: Compiled from publicly available information

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The Yibin Municipal Audit Bureau develops the multidisciplinary capabilities of its staff through performance incentives, tiered training and audit practice. The '532' appraisal mechanism incorporates data audit applications and the implementation of audit findings into departmental target management, linking professional development with specific audit responsibilities. The 'Mentorship Relay' and '1358' development pathways provide young officials with a staged progression from basic operational training to lead auditor experience and key professional roles. Major project audits also serve as practical training, allowing staff to strengthen on-site judgement, evidence analysis and written communication.

External auditors and university-local government partnerships supplement the Bureau's internal expertise. External professionals provide support in specialised areas such as construction cost estimation, on-site surveying and technical validation. University partnerships introduce expertise in data analysis, policy research and technological applications through practical guidance, research projects and postgraduate placements. The recruitment and selection of 11 postgraduate students and the fact that officials under the age of 40 account for 65 per cent of the workforce may be used to describe changes in the workforce structure. In formal writing, however, these figures should be clearly attributed to publicly available materials issued by the Yibin Municipal Audit Bureau or to compiled case materials.

These arrangements have broadened the Bureau's capacity to conduct full-process audits of government investment projects. Internal collaboration supports specialised work across different audit stages, while training programmes strengthen the multidisciplinary skills of audit staff. External professionals and university partnerships provide additional expertise in engineering technology, data analysis and research. Together, these measures support the application of research-based auditing from pre-audit research and in-process supervision to post-audit implementation, rather than limiting it to conceptual discussion or isolated project practice.

5. Recommendations for Further Consolidating the Achievements

5.1. Deepening the Long-Term Mechanism for Integrating the Concept and Systems of Research-Based Auditing

For research-based auditing to operate consistently throughout government investment project audits, research requirements should be incorporated into routine procedures rather than applied only through special campaigns or temporary arrangements. The Yibin Municipal Audit Bureau has already established mechanisms for project reserves, regular consultation, quality control and rectification management. Further refinement is needed to define the research tasks, responsible personnel and required outputs at each stage, so that audit staff can investigate issues, record professional judgements and convert findings into practical measures under consistent standards.

Research-based auditing should be integrated into the full management process of each audit project. Before implementation, the audit team should prepare a research outline covering the policy background, project characteristics, funding scale, construction progress, historical problems and potential risks. This outline should provide an important basis for the audit implementation plan. During the audit, analytical records should be prepared for major anomalies, complex issues and disputed matters, specifying the source of each risk lead, the verification method, supporting evidence and preliminary judgement. After the audit, the team should supplement the audit report with an analysis of underlying causes and institutional recommendations, focusing on management deficiencies, responsible parties and possible directions for improvement. These arrangements would embed research activities across the pre-audit, in-audit and post-audit stages, rather than concentrating them at the report-drafting stage.

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Secondly, a mechanism for evaluating research outcomes should be established. Project quality assessment must not be limited to the number of issues identified, the amount of funds reduced or the compliance of the report with standards; it must also focus on the quality of the research and the effectiveness of governance. It is recommended that the following elements be incorporated into project quality assessments: the adequacy of pre-audit research; the soundness of in-audit assessments; the depth of analysis into the root causes of problems; the practicality of audit recommendations; the rate of adoption of recommendations; and the effectiveness of rectification measures.For major government investment projects, a mechanism for reviewing research outcomes could be established, whereby the operational departments, the Legal Review Section, the Data Audit Section and the Rectification Supervision Section jointly evaluate the audit team's research process and the quality of its findings. Compared with practices in other regions-such as conducting audit micro-lectures, mentor-apprentice schemes and outcome reviews-the Yibin Municipal Audit Bureau should, in light of the specific characteristics of its own government investment project audits, integrate the evaluation of research capabilities with project quality control to prevent research-based auditing from becoming a mere formality.

Thirdly, audit authorities should establish case and issue repositories for government investment projects. The case repository should retain practical methods drawn from representative audits, including pre-audit research, audit plan design, data analysis, evidence collection and the application of audit findings. These materials can provide direct reference for subsequent projects. The issue repository should consolidate recurring problems involving project approval, tender management, contract performance, engineering changes, fund disbursement, final accounts and quality management. Each entry should specify the nature of the issue, supporting evidence, applicable regulations, underlying causes and rectification measures. Continuous updates would convert experience from individual projects into reusable knowledge, supporting more efficient and accurate audits of similar projects.

The integration of research-based auditing into institutional arrangements should therefore focus on process embedding, outcome evaluation and knowledge consolidation. The objective is not to introduce additional slogans or temporary tasks, but to make research outlines, records of major issue assessments, root cause analyses, institutional recommendations, outcome evaluations and case archiving standard components of government investment project audits. Through these arrangements, research-based auditing can become part of routine practice and provide sustained support for audit quality throughout the project lifecycle.

5.2. Deepening the Long-Term Mechanism for Integrating the Concept and Systems of Research-Based Auditing

Digital and intelligent technologies can improve the efficiency of government investment project audits, but their application depends on reliable data, appropriate professional capacity, adequate financial support and effective security controls. The Yibin Municipal Audit Bureau has begun using data platforms and intelligent audit tools for data organisation, anomaly screening and regulatory checks, providing an initial basis for further application.

Technological development should follow a staged approach rather than introducing complex tools across all audit activities simultaneously. A practical sequence is to improve data aggregation, develop model-based screening and then introduce intelligent assistance. This allows technical tools to remain aligned with the procedures and actual needs of government investment project audits.

The initial stage should focus on data standards and collection mechanisms. Government investment project audits involve information on project approval, tendering, contract signing, engineering changes, fund disbursement, construction progress, final accounts and rectification

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feedback. Incomplete sources and inconsistent definitions would limit the effectiveness of subsequent analysis. On the basis of existing platforms, the Bureau should establish a data catalogue that specifies the required information, responsible departments, collection methods and update frequency at each stage. Key fields, including contract numbers, project names, funding sources, payment milestones, change orders and acceptance results, should be standardised to connect project documents, financial records and operational data. Resolving data fragmentation and inconsistent definitions is a prerequisite for reliable risk identification.

The next stage should develop early-warning and anomaly detection models for recurring risks. Initial applications may focus on cost overruns, repeated engineering changes, irregular fund disbursement, delayed contract performance and incomplete final settlement documents. Data comparison can be used to identify unusual amounts, inconsistent timelines, mismatches between project progress and payments, and missing supporting evidence. These leads must then be verified on site. For matters requiring stronger professional judgement, such as the reasonableness of engineering changes, the quality of concealed works and investment performance, technical tools should remain limited to preliminary screening. Audit conclusions must still be supported by contracts, field evidence, expert opinions and applicable regulations.

Specialised intelligent audit tools may be introduced cautiously at a later stage. Tools such as 'Yixiao Shen' are more suitable for supporting regulatory matching, audit plan preparation, issue classification, working-paper organisation and the initial drafting of reports. Historical cases, databases of common issues, rectification guidelines and collections of relevant regulations may further improve their ability to interpret audit matters. Even under these conditions, project cost assessment, responsibility determination, issue classification and audit conclusions require manual review and collective judgement. Technical outputs cannot replace professional audit decisions.

The application of these technologies also requires clear security and accountability arrangements. Government investment project materials often contain contract information, financial data, management records and internal rectification documents. Tiered access, log recording, data de-identification and confidentiality review should therefore be established to reduce disclosure risks. Anomalies, regulatory suggestions and draft text generated by intelligent tools should be treated only as supporting references. Auditors and audit teams remain responsible for verification, judgement and reporting. Review and correction procedures are also needed to address model errors, incomplete data and possible algorithmic bias, ensuring that audit conclusions have traceable sources, adequate evidence and clearly assigned responsibility.

Organisational coordination should distinguish between business lead auditors and data lead auditors while strengthening cooperation between them. Business lead auditors determine audit objectives, identify priorities and classify issues. Data lead auditors organise data, screen anomalies and conduct technical analysis. Both groups should participate in risk identification and evidence verification. Data literacy training is also necessary so that auditors understand data sources, screening rules and model limitations. Universities and external specialists may provide technical support, but their findings should be reviewed by the audit authority before use. The purpose of digital and intelligent application is therefore to improve the identification and analysis of audit issues through reliable data, clear rules, effective security controls and defined responsibilities.

5.3. Establishing a Closed-Loop System for the Efficient Transformation of Audit Findings into Governance Effectiveness

The value of research-based auditing extends beyond identifying specific problems in government investment projects. Its broader function lies in converting audit findings into practical governance improvements. The Yibin Municipal Audit Bureau has established an

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initial foundation through rectification platforms, risk alert lists, rectification guidelines and inter-departmental coordination. However, the use of audit findings still presents several limitations. Some recommendations remain focused on correcting individual cases, with insufficient analysis of institutional causes and preventive measures. The regular sharing of audit findings among finance, development and reform, housing and urban-rural development, state-owned assets, discipline inspection and supervision, and organisation departments also requires further improvement. Follow-up assessment of whether similar problems recur and whether rectification measures remain effective is not yet systematic. Future improvement should therefore extend beyond requiring audited entities to correct identified problems and give greater attention to clarifying responsibilities, consolidating practical tools and incorporating audit findings into subsequent governance activities.

Responsibility for rectification and the standards for closing identified issues need to be defined more precisely. Although the rectification rate shows progress at a particular stage, it does not fully reflect the quality or lasting effect of rectification. Where problems remain unresolved or progress is slow, the reasons should be examined and classified. These may include objective constraints, unclear responsibility, vague rectification measures, weak coordination between departments or long-standing historical issues. Different forms of supervision can then be applied according to the nature of the problem.

For issues that can be corrected promptly, the responsible unit, scope of rectification, completion deadline and required supporting documents should be clearly specified. Long-term problems require phased objectives and continuous follow-up. Where an issue arises from institutional weaknesses or involves several departments, the relevant competent authority should lead the preparation of a rectification plan. Closing an issue should not depend only on whether a rectification report has been submitted. It should also consider whether rules have been revised, funds have been recovered, projects have been corrected, accountability measures have been carried out and follow-up checks have confirmed the results.

Audit findings should also be converted into practical tools that can be used in later projects. Recurring problems found in government investment audits may be extracted from individual cases and organised into risk labels, case repositories, problem databases, rectification guidelines and policy recommendations. Risk labels can highlight frequent concerns such as cost overruns, repeated engineering changes, idle funds, weak contract performance and insufficient evidence for final settlement. Case repositories can record the audit methods used in typical projects, the evidence collected, the causes of identified problems and the corresponding rectification approaches.

A problem database can organise common issues according to project stages, including project approval, tender management, contract management, engineering changes, fund disbursement and final settlement. Rectification guidelines can then specify the responsible parties, required actions and supporting materials for each type of problem. Policy recommendations should focus on recurring problems across the sector and weaknesses in existing systems. In this way, audit findings can contribute not only to correcting individual projects but also to improving the relevant institutional arrangements.

A more stable mechanism for sharing information and providing feedback across departments is also necessary. Problems identified in government investment projects often fall within the responsibilities of several authorities. Rectification based only on communication between the audit authority and the audited entity may therefore have limited long-term effects. Audit findings can instead be transferred to the relevant departments according to their nature.

Issues involving public fund management may be shared with the finance department and used as a reference for budget allocation and payment supervision. Problems relating to project approval and investment control may be provided to the development and reform department

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to support project approval and budget estimate management. Findings concerning construction management and project quality may be transferred to housing and urban-rural development authorities for sectoral supervision and improvements in project management. Issues involving investment projects undertaken by state-owned enterprises may be submitted to the State-owned Assets Supervision and Administration Commission as reference material for shareholder supervision. Where suspected disciplinary or legal violations, negligence or failures in duty are involved, the matters should be referred to discipline inspection, supervision and organisation departments in accordance with established procedures. Regular joint analysis and feedback can help integrate audit findings more effectively into the management of government investment projects.

The implementation of audit findings should also be assessed through a set of quantitative indicators. Relevant measures may include the rectification completion rate, the recurrence rate of similar problems, the number of institutional revisions, the amount of funds reallocated, the adoption rate of audit recommendations, the number of cross-departmental referrals and the follow-up completion rate for major issues.

These indicators reflect different aspects of audit effectiveness. The rectification completion rate shows the progress made in addressing identified problems, while the recurrence rate indicates whether their underlying causes have been dealt with. The number of institutional revisions reflects improvements in management systems. The amount of funds reallocated shows the economic effect of rectification, and the adoption rate of recommendations indicates whether audit proposals are practical and useful. The results of this assessment should inform the preparation of the following year's audit plan and the selection of key audit areas. Audit findings can then support not only current rectification work but also risk prevention in later projects.

Improving the use of audit findings therefore requires clearer responsibilities, more specific standards, the systematic organisation of findings, stable inter-departmental sharing and quantitative assessment. In practice, the process begins with identifying problems and proposing recommendations, followed by entering the findings into the rectification platform and supervising rectification according to the type of issue. The experience gained is then converted into institutional tools and applied to the management of new projects. Through this process, research-based auditing can move beyond identifying isolated problems and contribute to improvements in management systems and governance capacity for government investment projects.

6. Conclusion

Taking the Yibin Municipal Audit Bureau's practice of full-process auditing of government-invested projects as a case study, this paper analyses how research-based auditing can be embedded throughout the entire audit process of such projects. Research indicates that government-invested projects are characterised by large funding scales, long construction cycles, multiple stakeholders and strong risk transmission. Traditional audit approaches, which primarily focus on ex-post compliance checks, are no longer sufficient to adequately address decision-making risks, tendering risks, construction management risks, funding performance risks and issues relating to the implementation of corrective measures throughout the project lifecycle.By integrating a research-oriented mindset throughout the pre-audit, during-audit and post-audit stages, research-based auditing drives the transformation of government investment project audits from a mere focus on identifying and rectifying errors to one centred on risk identification, process oversight and governance improvement.

Case evidence shows that the Yibin Municipal Audit Bureau has developed a practical framework for research-based auditing that covers pre-audit preparation, audit

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implementation and the use of audit findings. Before an audit begins, rolling project reserves, project approval consultations, pre-audit investigations and risk profiling are used to support project selection and identify key audit areas. This reduces reliance on experience and places risk assessment at the centre of audit planning.

During audit implementation, the audit team examines policy implementation, the performance of duties and the effectiveness of fund use. Data screening and mid-term consultations are also used to support on-site work. Auditors therefore move beyond checking isolated compliance issues and examine the reasons behind identified problems, including unclear responsibilities and weaknesses in project management systems.

After the audit, findings are entered into rectification platforms and followed up according to their type. Common problems are further organised into risk alert lists and rectification guidelines. This allows audit findings to be traced, reused and fed back into later work, extending their role beyond the rectification of individual cases.

The main contribution of this paper lies in supplementing the micro-level operational mechanisms of research-based auditing in the full-process auditing of government-invested projects, drawing on the specific practices of grassroots audit authorities. Whilst existing research has largely discussed research-based auditing at the levels of policy value and theoretical significance, this paper, through the case study of the Yibin Municipal Audit Bureau, further illustrates that research-based auditing is not an abstract concept, but can be integrated into audit practice through approaches such as leadership by operational departments, coordination with supporting departments, institutionalised processes, and the use of data and technology.This paper also demonstrates that the effective operation of research-based auditing depends not only on the research mindset of audit staff, but also on the combined functioning of project management systems, quality control mechanisms, data support capabilities, rectification and implementation mechanisms, and multi-disciplinary collaboration.

From a practical perspective, the experience of the Yibin Municipal Audit Bureau provides a reference for grassroots audit authorities seeking to adjust their approach to government investment project audits. Existing audit procedures can incorporate pre-audit research outlines, assessment records for major issues, analyses of underlying causes, follow-up evaluations of rectification and case archiving as standard requirements. This would support a working process covering pre-audit assessment, in-audit analysis and post-audit implementation. The use of digital and intelligent technologies should remain gradual. Audit authorities should first improve data standards and collection, then introduce anomaly screening and intelligent auxiliary analysis, while retaining manual verification and clearly defined responsibilities.

This study has several limitations. Its conclusions are based mainly on a single case involving the Yibin Municipal Audit Bureau, and their applicability to audit authorities in other regions requires further examination. Data availability also restricted the analysis. Some materials concerning audit procedures and rectification outcomes could not be fully presented, while differences among types of government investment projects were not examined in sufficient detail.

Future research may compare cases across regions, administrative levels and project categories. Further analysis is also needed on the evaluation indicators for research-based auditing, the appropriate scope of digital and intelligent technologies, and the practical effects of converting audit findings into management improvements. Research-based auditing offers a feasible direction for full-process audits of government investment projects by supporting earlier risk identification, closer examination of project implementation and continued use of audit

ISSN: 2688-9323

findings. These functions may strengthen the role of auditing in national governance and public resource allocation.

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