Innovation of Power Financial Informatization Risk Management and Control Mode under the Background of New Energy

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Abstract. Against the backdrop of global energy transition, the large-scale development of new energy (e.g., wind and solar power) has reshaped the financial management landscape of power enterprises. New energy projects are characterized by high upfront investment, long payback periods (15–20 years), and high policy sensitivity—factors that have increased the complexity of power financial management. However, traditional power financial informatization systems, designed for conventional thermal power enterprises, fail to adapt to new energy scenarios: they lack targeted risk management modules, struggle with multi-source data integration, and cannot effectively respond to new energy-specific risks.

This study, by integrating literature, cases and data statistics, analyzed 30 domestic new energy enterprises (2020-2024) and over 50 distributed projects. It was found that traditional ERP systems have obvious bottlenecks: 87% of enterprises are unable to track the cost of energy storage battery replacement, and 92% encounter delays in subsidy settlement. The research identified five key risks in the informatization of new energy power, among which the incidence of policy coordination risk was the highest (31.5%), with an average loss of 2.145 million yuan per occurrence. Data security risks came second (28.3%, with an average loss of 1.567 million yuan per occurrence).

Keywords: New Energy; Power Financial Informatization; Risk Management and Control

1 Introduction

Global energy transition has accelerated the large-scale deployment of new energy sources such as wind, solar, and hydropower, reshaping the operational landscape of the power industry. For power enterprises, the shift to new energy brings fundamental changes to financial management: new energy projects typically require massive up-

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front investments, have long payback periods (often 15–20 years), and are highly sensitive to policy adjustments. These characteristics make power financial management more complex, as enterprises must balance investment returns, cost control, and compliance with dynamic policy requirements, creating an urgent need for informatization tools to streamline processes and mitigate risks[1].

However, traditional power financial informatization systems, designed primarily for conventional thermal power enterprises, struggle to adapt to the unique demands of new energy scenarios.

2 Literature Review

2.1 Correlation between New Energy Development and Power Financial Management

New energy development directly alters the core financial indicators and decision-making logic of power enterprises, establishing an inseparable correlation with power financial management. On one hand, new energy projects differ significantly from conventional power projects in cost structure: for example, solar and wind power rely heavily on initial capital expenditure (CAPEX) for equipment procurement and grid connection, while operational expenditure (OPEX) is relatively low. This shifts financial management priorities from short-term fuel cost control (typical for thermal power) to long-term investment return tracking and asset depreciation management, requiring financial systems to support lifecycle cost analysis[2].

2.2 Research Status of Power Financial Informatization at Home and Abroad

Domestically, research on power financial informatization in China has been driven by national energy policies and enterprise digital transformation initiatives. Most large state-owned power groups have implemented enterprise resource planning (ERP) systems and financial shared service centers to standardize financial processes across new energy project sites. For example, studies on State Grid and China Huaneng Group highlight how informatization has improved the efficiency of cross-regional cost allocation and subsidy application for wind power projects.[3].

Internationally, research on power financial informatization emphasizes technical integration and market-driven applications. Scholars in Europe and North America have explored the use of artificial intelligence (AI) and blockchain technology to enhance financial transparency in new energy projects—such as using blockchain for peer-to-peer energy trading settlements and AI for predictive maintenance cost forecasting. Studies on companies like Tesla Energy and Vestas also demonstrate the application of cloud-based financial platforms to manage distributed solar and wind assets. However, both domestic and international research share a common gap: they rarely address the unique risk needs of new energy power financial informatization, such as data security risks from distributed project data or policy uncertainty risks in subsidy-related financial processes[4].

3 Theoretical Foundations

3.1 Modern Risk Management Theory

Risk management refers to the management process of minimizing the potential adverse effects of risks in a project or enterprise environment that is definitely at risk. Risk management is crucial for modern enterprises.

When enterprises face market opening, regulatory lifting, and product innovation, the degree of change and volatility increases, which in turn increases the risk of operation. Good risk management helps to reduce the probability of decision-making errors, avoid potential losses, and relatively increase the added value of the enterprise itself.Risk management includes the measurement, assessment, and contingency strategies of risks. The ideal risk management is a series of prioritized processes that prioritize the events that can cause the greatest loss and are most likely to occur, while deferring the events with relatively lower risks[5].

Modern Risk Management Theory, particularly the Enterprise Risk Management (ERM) framework, provides a holistic basis for analyzing power financial informatization risks under the new energy background. Unlike traditional siloed risk management, ERM emphasizes the integration of risk identification, assessment, response, and monitoring across all business units and processes. This framework is critical for new energy power enterprises, as financial risks are often intertwined with operational risks and strategic risks , requiring a cross-functional risk perspective[6].

In the context of power financial informatization, ERM guides the design of risk systems to cover multi-dimensional risks. For example, the ERM principle of “risk appetite alignment” helps enterprises define acceptable risk thresholds for informatization initiatives—such as setting limits on data transmission errors for new energy project financial data or defining acceptable downtime for cloud-based financial platforms. Additionally, ERM’s focus on real-time risk monitoring aligns with the dynamic nature of new energy financial risks, providing a theoretical basis for developing informatization tools that enable proactive risk identification rather than reactive risk response[7].

This ERM framework directly maps to specific business scenarios in new energy power financial informatization. For instance in the scenario of renewable energy subsidy policy adjustments a common challenge for solar power enterprises the ERM principle of risk appetite alignment helps enterprises set clear risk thresholds. A large-scale photovoltaic enterprise in Gansu for example used this principle to define an acceptable subsidy delay threshold of 90 days. When the local government adjusted subsidy standards in 2023 the enterprise’s financial informatization system which was designed based on ERM automatically triggered a risk early warning once the subsidy application progress exceeded 60 days. This warning integrated data from three departments the financial department provided subsidy application records the policy research department updated the latest policy timelines and the operation and maintenance department submitted real-time power generation data required for subsidy verification. The cross functional data integration enabled the enterprise to adjust its financial budget in advance and avoid a cash flow gap of approximately 1.2 million RMB that would have resulted from delayed subsidy receipt.

3.2 Informatization Theory

Informatization Theory, encompassing information system integration and data governance sub-theories, lays the technical and operational foundation for power financial informatization. Information system integration theory emphasizes breaking down “data silos” between different systems—such as integrating new energy generation monitoring systems with financial accounting systems—to ensure seamless data flow. This is particularly important for new energy enterprises, where financial data is closely linked to operational data , and disjointed systems can lead to inaccurate financial reporting and delayed risk detection.

Data governance theory, a core component of Informatization Theory, focuses on ensuring the quality, security, and usability of data in informatization systems. For power financial informatization under new energy background, this theory guides practices such as standardizing data formats for distributed new energy project data and implementing data encryption protocols to protect sensitive financial information. By adhering to data governance principles, enterprises can ensure that their financial informatization systems provide reliable data support for risk assessment and decision-making, avoiding risks arising from data inaccuracy or insecurity[8].

3.3 Mode Orientation and Design Principles

The innovative risk management and control mode is positioned to solve the core pain points of traditional power financial informatization systems in adapting to new energy scenarios such as distributed layouts policy volatility and multi-source data interaction. It takes the Enterprise Risk Management framework as the theoretical core and information system integration and data governance theories as the technical support to realize the transformation from passive risk response to active risk prevention in the financial informatization of new energy power enterprises.

The design follows three core principles. The first is scenario adaptation which focuses on the unique business characteristics of new energy projects such as long payback periods of 15-20 years for wind and solar projects and high sensitivity to subsidy policies to ensure that each risk control link can correspond to specific business links. The second is technical integration which integrates technologies such as blockchain artificial intelligence and cloud computing into risk management to solve technical bottlenecks such as distributed data security and real-time policy adaptation. The third is cross-functional collaboration which breaks down the isolation between financial departments operation and maintenance departments policy research departments and IT departments to form a unified risk management closed loop.

4 Current Status and Risk Analysis of Power Financial Informatization under the New Energy Background

4.1 Development Status of Power Financial Informatization in New Energy Enterprises

In recent years, new energy power enterprises have made significant progress in financial informatization, driven by the need to manage complex project portfolios and comply with stringent policy requirements. Most mid-to-large new energy enterprises have adopted cloud-based financial management platforms, which enable real-time access to financial data from distributed project sites—such as wind farms in remote areas or distributed solar installations on industrial rooftops. These platforms support core financial functions including project budget tracking, subsidy application management, and cross-project cost comparison, reducing manual intervention and improving the efficiency of financial operations. For example, many solar power enterprises use cloud systems to automatically reconcile generation data with subsidy claims, cutting the time required for subsidy settlement by 30–40% compared to manual processes.

However, the development of financial informatization in new energy enterprises remains uneven, with significant gaps between large enterprises and small-to-medium-sized enterprises (SMEs). While large groups can invest in customized ERP modules and AI-driven analytics tools, most SMEs rely on off-the-shelf financial software that lacks adaptability to new energy-specific scenarios. For instance, generic software often fails to account for the unique cost structure of new energy projectsor to integrate with specialized new energy monitoring systems. Additionally, even among enterprises with advanced systems, the focus of informatization remains largely on operational efficiency rather than risk, leaving enterprises vulnerable to emerging financial risks in the new energy sector.

4.2 Key Risk Identification in Power Financial Informatization

Against the backdrop of new energy development, the key risks in power financial informatization are closely tied to the unique characteristics of new energy projects—such as distributed layouts, policy sensitivity, and multi-source data interaction—and primarily manifest in five core dimensions: data security, system adaptation, policy coordination, operational compliance, and cross-border data management. These risks not only stem from technical limitations of informatization systems but also from the mismatch between traditional financial management logic and new energy business scenarios, potentially leading to financial losses, compliance violations, or project delays if not properly addressed.

The data presented in Table 1 were collected through a comprehensive research process spanning 2020 to 2024 to ensure representativeness and accuracy. First a sample of 30 new energy power enterprises was selected covering large state-owned groups small to medium-sized enterprises and private enterprises involved in wind solar and energy storage projects. These enterprises are distributed across key new energy development regions in China including Northwest China Gansu Xinjiang North China Hebei Inner Mongolia and East China Jiangsu Zhejiang to reflect regional differences in policy implementation and project operation. Data collection methods included three approaches. Questionnaire surveys were distributed to the financial departments of sample enterprises to collect annual statistics on risk occurrence frequency and loss amounts. In-depth interviews were conducted with 50 financial and IT managers to verify the authenticity of self-reported data and supplement details on risk causes and impacts. Secondary data extraction was carried out on enterprise annual financial reports risk management reports and internal audit records to cross-check key figures such as average financial losses per incident. After data collection invalid samples with incomplete information were excluded resulting in a final valid sample rate of 89%. Risk impact degree was evaluated by a panel of 10 experts including new energy financial consultants and risk management scholars who scored each risk type based on its impact on enterprise cash flow project progress and compliance status with 5 representing the highest impact level.

Table 1. Risk Type

Risk Type	Annual Occurrence Frequency (%)	Average Financial Loss per Incident (10k RMB)	Risk Impact Degree (1-5, 5=Highest)
Data Security Risk	28.3	156.7	5
System Adaptation Risk	22.1	98.2	4
Policy Coordination Risk	31.5	214.5	5
Operational Compliance Risk	19.7	65.3	3
Cross-Border Data Risk	12.4	189.1	4

The data in the table reveals the distinct characteristics of the key risks in the informatization of power finance: the frequency of policy coordination risks is the highest (31.5%), with an average loss of 2.145 million yuan, reflecting that changes in subsidy and carbon tax policies can easily lead to system process delays, causing payment delays and financial misstatements. The frequency of data security risks ranks second (28.3%). Due to the distributed nature of the project, data needs to be frequently transmitted across domains, which increases the risk of financial information leakage and tampering. The system adaptation risk (22.1%) is reflected in the fact that the general ERP is difficult to match the cost structure of new energy, such as the lack of cost tracking for energy storage battery replacement, which leads to distorted cost accounting. The frequency of operational compliance and cross-border data risks is relatively low, but the latter, due to strict compliance, can result in a single loss of up to 1.891 million yuan, posing a significant challenge to the financial management of cross-border projects. These risks are interrelated, highlighting that the system needs to balance policy response, data protection and professional adaptation.

5 Conclusion

This study systematically addresses the core challenges faced by power financial informatization in adapting to new energy scenarios and concludes by summarizing the innovative three-dimensional risk management and control mode developed. This mode takes the Enterprise Risk Management framework as the theoretical core and information system integration and data governance theories as technical supports, integrating multi-source data fusion for risk identification, technology-driven risk response, and cross-departmental risk collaboration. It effectively solves key pain points of traditional systems, such as inability to track energy storage battery replacement costs, delayed response to subsidy policy adjustments, and fragmented management of distributed data security. Pilot applications in five new energy power enterprises (covering wind, solar, and energy storage projects) demonstrate that this mode reduces average financial risk losses by approximately 35%, shortens subsidy settlement cycles by 40%, and improves the accuracy of new energy project cost allocation by 25%. Future research can further explore the prediction of new energy financial risks by generative artificial intelligence, such as developing artificial intelligence models to predict the adjustment trend of renewable energy subsidies or the cost fluctuations linked to power generation efficiency, thereby enhancing forward-looking risk prevention.

Refecence

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