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# Strengthening True Performance Accountability: Seamless Integration Between Financial Systems and The Cloud to Gain Real-Time Insights into Budget Costs

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**ABSTRACT**

Strengthening performance accountability has become increasingly important for organizations operating in complex and data-intensive environments, particularly within the energy and utilities sector in the United States. Fragmented financial systems and delayed budget reporting often limit transparency, weaken cost control, and constrain managerial accountability. This study examines how seamless integration between financial systems and cloud-based platforms facilitates genuine performance accountability through real-time budget insights. Adopting a quantitative research design, data were collected from 300 professionals working in finance, accounting, management, and information systems roles within U.S. energy and utilities organizations. The data were analyzed using Structural Equation Modeling–Partial Least Squares (SEM-PLS 3). The findings reveal that financial system integration and cloud capability both have significant positive effects on real-time budget insights and true performance accountability. Moreover, real-time budget insights partially mediate the relationships between financial system integration and performance accountability, as well as between cloud capability and performance accountability. These results demonstrate that digital financial infrastructure strengthens accountability most effectively when it generates continuous, real-time budget visibility that supports timely decision-making and transparent financial oversight. This study contributes to the literature on digital finance and performance management by empirically positioning real-time budget insights as a critical mechanism linking cloud-enabled financial integration to accountability outcomes. Practically, the findings offer guidance for organizations seeking to enhance budget transparency and accountability through integrated and cloud-based financial systems.



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## 1. INTRODUCTION

Performance accountability has become a central concern for organizations operating in increasingly complex and data-intensive environments. In the United States, particularly within the energy and utilities sector, organizations face mounting pressure to ensure transparent budget management, efficient cost control, and timely financial

decision-making. Regulatory demands, large-scale capital investments, volatile energy markets, and public accountability obligations require organizations to move beyond traditional, siloed financial management practices toward more integrated and data-driven performance systems [1]. As a result, strengthening true performance accountability—defined as the ability of organizations to accurately monitor, evaluate, and justify financial performance in real time—has emerged as a strategic priority. In this context, Enterprise Resource Planning (ERP) systems and integrated financial frameworks play a pivotal role by enabling real-time data integration, process automation, and enhanced financial visibility, thereby supporting compliance and strategic responsiveness in highly regulated and capital-intensive environments [2].

ERP-based financial systems, particularly advanced platforms such as SAP-FI/CO, have been widely adopted to address the growing complexity of financial management in the energy and utilities sector. These systems streamline financial reporting by centralizing real-time data, reducing errors, and improving compliance with regulatory standards [3]. SAP-FI/CO provides comprehensive capabilities for financial reporting and cost management, effectively addressing challenges related to data heterogeneity, regulatory requirements, and financial transparency in capital-intensive industries [4], [5]. Furthermore, enabling technologies such as in-memory processing and AI-driven analytics strengthen financial management infrastructures by supporting predictive analytics, real-time monitoring, and strategic alignment [6], [7]. Complementing these systems, advanced data-driven financial planning frameworks integrate near real-time data and predictive insights to optimize revenue, enhance cross-functional collaboration, and align operational decisions with long-term profitability, compliance, and sustainability objectives [6].

Despite advancements in enterprise financial systems, many organizations continue to experience fragmented data architectures in which budgeting, accounting, forecasting, and operational cost systems operate independently [1], [8], [9]. This fragmentation frequently results in delays in financial reporting, limited budget visibility, inconsistencies in cost data, and reduced managerial responsiveness. In sectors such as energy and utilities—characterized by high operational costs and significant financial and social implications of budget deviations—the absence of real-time financial insight weakens accountability mechanisms and constrains effective performance management. As a response to these challenges, organizations are increasingly adopting **hybrid and multi-cloud** financial and analytics solutions to overcome data silos and enhance transparency across heterogeneous systems. Multi-cloud strategies enable enterprises to distribute workloads across major hyperscalers—**AWS, Microsoft Azure, and Google Cloud Platform (GCP)**—and, where relevant, database-centric services on **Oracle Cloud Infrastructure (OCI)**, to improve resilience, reduce vendor lock-in, and meet regulatory and data-residency constraints [10]. Contemporary architecture guidance emphasizes that successful hybrid/multi-cloud environments require standardized integration patterns, secure networking, and consistent governance across cloud boundaries [11], [12].

Cloud-enabled financial systems play a critical role in enhancing accountability and performance management through centralized data, integrated planning, and governed analytics. Increasingly, this capability is operationalized not as "one-cloud ERP," but as **a multi-cloud operating model** in which the system of record (ERP and core finance) is connected to the system of insight (enterprise analytics and AI) through secure, low-latency interoperability [13], [14]. For example, SAP and Google Cloud have highlighted co-engineered replication and federation approaches that allow organizations to blend SAP and non-SAP data in analytics platforms for near real-time visibility, addressing common data silos that

span finance and operations. Likewise, Oracle and Microsoft announced Oracle Database@Azure, reflecting an enterprise trend in which organizations keep database services on OCI while consuming Azure-native services, enabling flexible placement of financial workloads without sacrificing performance or governance [15].

Architecturally, achieving real-time budget insights in multi-cloud settings typically requires an end-to-end reference stack: (1) **source systems** (ERP, budgeting, procurement, operational cost systems); (2) an **integration layer** (API management and iPaaS/ESB to standardize exchanges, plus event-streaming patterns to propagate postings and cost events with minimal latency); (3) a governed **data layer** (cloud data warehouse/lakehouse that consolidates SAP and non-SAP datasets while preserving lineage and access controls); (4) an **analytics and planning layer** (BI dashboards for variance monitoring, forecasting, and scenario analysis); and (5) cross-cutting **security, governance, and observability** (federated identity, encryption, audit trails, and unified monitoring). Hybrid and multi-cloud architecture guidance underscores that these patterns are crucial to maintain consistent controls and performance across multiple providers [16], [17].

In parallel, cloud adoption introduces a variable-spend cost model that can either strengthen or undermine accountability depending on governance maturity. To ensure that cloud-enabled visibility translates into budget discipline, organizations increasingly institutionalize **FinOps** as an operational framework and cultural practice that brings financial accountability to cloud spending through shared cost visibility, allocation, and decision rights across finance, engineering, and business teams. This reinforces the view that "true performance accountability" in digital finance is not only a function of technology adoption, but also of organizational capability to govern, monitor, and justify budget outcomes continuously.

Prior studies have highlighted the potential of digital transformation and cloud technologies in enhancing organizational performance, financial transparency, and decision quality, particularly in the context of budget cost management; however, empirical evidence explicitly linking seamless financial system integration, cloud capability, and performance accountability remains limited [18]–[20]. Much of the existing research has focused on technological adoption, system efficiency, or financial performance outcomes, while the accountability dimension—especially true performance accountability supported by real-time budget insights—has received comparatively less empirical attention, particularly within robust quantitative frameworks applied to the U.S. energy and utilities sector. Digital technologies such as process automation, artificial intelligence, and advanced analytics have been shown to improve forecasting accuracy, optimize resource management, and enhance transparency, thereby contributing to more accountable financial operations and reducing governance risks [21]–[23]. Similarly, cloud computing improves scalability, accessibility, and control over financial information through stronger security and compliance mechanisms, supporting data governance and operational agility [24]. In addition, FinOps-oriented governance provides a practical mechanism to align cloud usage with budget control and accountability expectations in hybrid and multi-cloud environments [16].

Addressing this gap, the present study investigates how seamless integration between financial systems and cloud platforms contributes to strengthening true performance accountability through real-time insights into budget costs within the energy and utilities sector in the United States. Adopting a quantitative research approach, **data were collected in 2024** from professionals working in finance, accounting, and managerial roles using a structured Likert-scale questionnaire, and the relationships among financial system integration, cloud capability, real-time budget insights, and performance accountability were analyzed using Structural Equation

Modeling–Partial Least Squares (SEM-PLS 3). This study makes several important contributions: theoretically, it extends the literature on performance management and digital finance by empirically positioning real-time budget insights as a critical mechanism linking cloud-enabled financial integration to accountability outcomes; methodologically, it demonstrates the application of SEM-PLS to test a comprehensive structural model using primary data from a strategically important and highly regulated sector; and practically, it provides actionable insights for policymakers, financial managers, and organizational leaders seeking to strengthen accountability frameworks through integrated and **multi-cloud** financial architectures that align financial transparency, technological capability, and organizational performance in the digital era.

## 2. LITERATURE REVIEW

### *2.1. Performance Accountability in Financial Management*

Performance accountability refers to an organization's ability to transparently measure, monitor, and justify the outcomes of its financial and operational activities relative to predefined objectives [25], [26]. In public and regulated sectors such as energy and utilities in the United States, performance accountability extends beyond internal efficiency to encompass regulatory compliance, public trust, and long-term financial sustainability. Traditional accountability systems have largely relied on periodic reporting, ex-post evaluation, and hierarchical control mechanisms. Although these approaches support compliance requirements, they often fail to provide timely and actionable information needed for proactive budget management and effective cost control, particularly in complex and capital-intensive operational environments [27], [28].

Recent literature highlights a shift from conventional accountability toward true performance accountability, which emphasizes continuous monitoring, outcome-oriented performance measurement, and the use of timely data for managerial [29], [30]. In this view, accountability is strengthened when managers can detect budget deviations as they occur, analyze underlying cost drivers, and implement corrective actions promptly, thereby reducing inefficiencies associated with delayed oversight. This evolution is especially critical in capital-intensive industries, where small delays in budget control can produce substantial financial consequences. Empirical studies [27], [31] suggest that accountability mechanisms supported by timely, accurate, and integrated financial information enhance managerial responsibility, reduce budgetary slack, and improve organizational performance. However, true performance accountability depends on advanced information systems capable of delivering accurate, integrated, and near real-time financial data; without seamless system integration, accountability frameworks remain reactive and limited in strategic effectiveness [1], [6], [32].

### *2.2. Financial System Integration*

Financial system integration refers to the alignment and interoperability of budgeting, accounting, forecasting, and cost management systems across organizational units. Integrated financial systems establish consistent data standards, reduce manual reconciliation, eliminate information silos, and improve data accuracy across financial processes, thereby enabling reliable end-to-end

financial information flows [1], [33]. In complex organizations, fragmented financial systems often generate inconsistent budget figures, delayed close and reconciliation cycles, and limited cross-functional visibility—conditions that weaken coordination and decision-making across departments [34]–[36].

Prior research indicates that integrated financial systems strengthen internal control mechanisms and improve decision quality by consolidating financial information from multiple sources into a unified, enterprise-wide performance monitoring environment [1], [37]. This integration is particularly critical in the energy and utilities sector, where cost structures span production, transmission, distribution, and maintenance activities and therefore require coherent and coordinated budget oversight. Nevertheless, traditional on-premise integration approaches are frequently constrained by system incompatibility, high maintenance costs, and limited scalability, reducing organizational responsiveness to volatile cost environments and weakening performance accountability [6], [38], [39]. Consequently, financial system integration increasingly leverages cloud-enabled architectures to enable flexible scalability and continuous, standardized data exchange—capabilities essential to dynamic budget management in complex operational settings.

### *2.3. Cloud Computing and Multi-Cloud Capability*

Cloud computing provides on-demand access to shared computing resources, enabling organizations to store, process, and analyze data in a scalable and cost-efficient manner. Cloud capability refers to an organization's ability to effectively deploy, integrate, govern, and utilize cloud technologies to support core business processes [40]–[42]. In financial management contexts, cloud capability enables continuous data synchronization, real-time analytics, and cross-system interoperability, thereby improving the timeliness and accuracy of financial information for budgeting, forecasting, and performance monitoring [43].

In contemporary enterprise settings, cloud capability increasingly manifests as multi-cloud capability—the ability to operate across more than one hyperscaler (e.g., AWS, Microsoft Azure, and Google Cloud Platform) and, where relevant, Oracle Cloud Infrastructure (OCI) for database-centric workloads—while maintaining consistent security, governance, and operational controls. Multi-cloud strategies are frequently adopted to mitigate vendor lock-in, improve resilience, satisfy regulatory and data-residency requirements, and optimize workload placement. Reference architecture guidance emphasizes that hybrid and multi-cloud success depends on clear role separation, secure service delivery, and standardized governance across providers.

Architecturally, cloud capability becomes strategically meaningful when it is implemented not merely as data hosting, but as a governed end-to-end pipeline: (1) secure connectivity between on-premise and cloud services, (2) standardized integration services (API management/iPaaS), (3) scalable storage/compute for finance and operational datasets (warehouse/lakehouse), and (4) consistent identity, auditability, and

observability across environments. Without these components and integration discipline, cloud platforms risk functioning primarily as data repositories rather than as enablers of real-time insight and true performance accountability.

In addition, cloud adoption introduces a consumption-based cost model that requires explicit accountability mechanisms. FinOps is widely recognized as a governance approach that institutionalizes financial accountability for cloud spending by aligning finance, engineering, and business teams through shared cost visibility, allocation, and decision rights. This operational accountability layer is particularly relevant for regulated industries where cost transparency and budget discipline are core performance requirements.

### 2.4. *Real-Time Budget Insights*

Real-time budget insights refer to the continuous visibility of budget allocations, expenditures, and variances as financial activities occur. Unlike periodic budget reports, real-time insights enable organizations to monitor financial performance dynamically and respond promptly to budget deviations [44], [45]. This capability allows managers to detect emerging issues early, improve cost control, and support more adaptive decision-making in complex and fast-changing operational environments.

Research indicates that near real-time financial insight improves forecasting accuracy, strengthens strategic alignment, and reduces financial risk by providing timely feedback that allows organizations to adjust spending behavior and reallocate resources before deviations escalate [46], [47]. In the energy and utilities sector—where operational costs are subject to volatility and regulatory pricing constraints—real-time budget insights are critical for maintaining financial stability and preventing deviations from becoming systemic. Moreover, real-time insights serve as a direct bridge between financial data and managerial accountability: access to up-to-date budget information enhances the ability of managers to justify financial decisions, demonstrate responsibility, and align operational actions with financial objectives. Accordingly, real-time budget insights are increasingly positioned as a key mechanism through which digital finance capabilities translate into accountability and performance outcomes [6], [48].

### 2.5. *Financial Integration, Multi-Cloud Capability, and Performance Accountability (Revised)*

The interaction between financial system integration and multi-cloud capability provides the technological foundation for generating real-time budget insights. Integrated financial systems ensure data consistency and coherence across budgeting, accounting, forecasting, and cost management functions, while multi-cloud platforms enable continuous processing, elastic scalability, and broad accessibility of financial information across stakeholder groups [49], [50]. Together, these capabilities support seamless financial information flows across organizational levels, enabling timely analysis, rapid variance detection, and informed decision-making. Prior empirical research suggests that digital financial integration improves transparency and reduces information asymmetry, with cloud-enabled environments amplifying these outcomes through continuous

monitoring and advanced analytics [51], [52].

From an architectural perspective, this interaction is realized through a reference design that connects (1) ERP and finance source systems, (2) an integration and interoperability layer (APIs/iPaaS and, where necessary, event-streaming for near real-time postings and cost events), (3) a governed data layer (warehouse/lakehouse with lineage and access controls), and (4) analytics/planning services that operationalize budget monitoring. Across this stack, consistent identity management, audit trails, and observability are essential to support accountability requirements. Reference architecture guidance highlights the importance of clear roles and standardized controls across cloud consumers, providers, and governance functions—particularly relevant for regulated sectors.

Despite these advantages, the direct influence of integrated financial systems and cloud capability on performance accountability remains under-examined in structural modeling research. Information processing theory provides a useful lens for understanding this relationship, positing that organizational effectiveness depends on the alignment between information processing requirements and system capabilities. Seamless financial integration combined with robust (multi-)cloud capability increases information processing capacity by improving data timeliness, accessibility, and reliability—conditions necessary for sustaining true performance accountability through real-time budget insights. Additionally, FinOps-oriented governance strengthens the accountability pathway by providing a structured mechanism for cloud cost discipline and transparency.

### *2.6. Hypothesis Development*

Based on the reviewed literature, this study proposes that seamless financial system integration and multi-cloud capability play critical roles in enhancing real-time budget insights, which subsequently strengthen true performance accountability. Financial system integration is expected to improve real-time budget visibility by ensuring consistent, accurate, and timely data flows across budgeting, accounting, forecasting, and cost management processes. Multi-cloud capability is expected to amplify this effect by enabling scalable processing, continuous data synchronization, and broad accessibility of governed financial information across stakeholders. Together, these capabilities create the conditions necessary for dynamic budget monitoring and transparent performance evaluation, forming the basis for the study's hypotheses:


Figure 1. Conceptual Framework

## 3. RESEARCH METHODS

### *3.1. Research Design*

This study adopts a quantitative, explanatory research design to examine the relationships between financial system integration, cloud capability, real-time budget insights, and true performance accountability. The quantitative approach is appropriate for testing theoretical relationships and validating hypotheses using statistical modeling techniques. The study employs a cross-sectional survey design, where data are collected at a single point in time from respondents working in organizations within the energy and utilities sector in the United States. Structural Equation Modeling using the Partial Least Squares approach (SEM-PLS) is applied as the primary data analysis technique. SEM-PLS is selected due to its suitability for complex research models involving multiple latent variables, mediating relationships, and non-normal data distributions. Furthermore, SEM-PLS is appropriate for predictive-oriented studies and medium sample sizes, making it well suited for the objectives of this research.

### *3.2. Population and Sample*

The population of this study consists of professionals working in energy and utilities organizations in the United States, particularly those involved in finance, accounting, budgeting, performance management, and information systems. These respondents are considered appropriate because they possess direct knowledge of financial system integration, cloud-based platforms, and budget accountability practices within their organizations. A purposive sampling technique is employed to ensure that respondents meet specific criteria relevant to the research objectives. The inclusion criteria are as follows: (1) respondents hold positions related to finance, accounting, management, or information systems; (2) respondents have experience using integrated financial systems or cloud-based financial platforms; and (3) respondents are employed in organizations operating within the energy and utilities sector in the United States. A total of 300 valid responses were collected and analyzed. This sample size exceeds the minimum requirements recommended for SEM-PLS analysis, ensuring adequate statistical power and model stability. The sample size is also consistent with the "10-times rule," which suggests that the minimum sample should be ten times the largest number of structural paths directed at any construct in the model.

### *3.3. Data Collection Procedure*

Data were collected using a structured online questionnaire distributed to potential respondents through professional networks, industry associations, and organizational contacts within the energy and utilities sector. The online survey approach was chosen to facilitate access to geographically dispersed respondents across the United States and to enhance response efficiency. Prior to full-scale data collection, a pilot test was conducted with a small group of respondents to assess clarity, relevance, and reliability of the measurement items. Feedback from the pilot test was used to refine the questionnaire and ensure content validity. Participation in the survey was voluntary, and respondents were assured of anonymity and confidentiality to minimize response bias.

### 3.4. *Measurement of Variables*

All constructs in this study were measured using multi-item scales adapted from prior literature and contextualized to the domains of financial system integration and cloud-based budget management, with responses recorded on a five-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree"). Financial System Integration (FSI) was measured through items capturing the degree of interoperability, data consistency, and alignment among budgeting, accounting, forecasting, and cost management systems; Cloud Capability (CC) was assessed using items reflecting the organization's ability to deploy, integrate, and utilize cloud-based platforms for financial data processing, analytics, and system scalability; Real-Time Budget Insights (RTBI) were measured by items evaluating the availability, timeliness, and accuracy of real-time budget monitoring, cost visibility, and variance analysis; and True Performance Accountability (TPA) was measured through items capturing financial transparency, managerial responsibility, justification of budget outcomes, and the alignment between financial performance and organizational objectives. All measurement items were designed to reflect respondents' perceptions of their organizational practices.

### 3.5. *Data Analysis Technique*

Data analysis was conducted using SEM-PLS 3 software following a two-stage analytical procedure comprising evaluation of the measurement model and evaluation of the structural model. The measurement model assessment aimed to ensure the reliability and validity of the constructs. Internal consistency reliability was evaluated using Cronbach's alpha and composite reliability (CR), with values above 0.70 indicating acceptable reliability. Convergent validity was assessed using the Average Variance Extracted (AVE), where values above 0.50 indicate that a construct explains more than half of the variance of its indicators. Discriminant validity was examined using the Fornell–Larcker criterion and cross-loading analysis to confirm that each construct is empirically distinct from the others in the model.

Following the validation of the measurement model, the structural model was assessed by examining path coefficients, coefficients of determination ($R^2$), effect sizes ($f^2$), and predictive relevance ($Q^2$). A bootstrapping procedure with 5,000 resamples was employed to test the statistical significance of the hypothesized relationships. In addition, the mediating effects of real-time budget insights were analyzed by evaluating the significance of indirect effects, with the strength of mediation interpreted based on the magnitude and statistical significance of both direct and indirect paths.

### 3.6. *Ethical Considerations*

This study adheres to standard ethical research practices. Participation was voluntary, and respondents were informed about the purpose of the study before completing the survey. No personally identifiable information was collected, and all responses were analyzed in aggregate form. Data were stored securely and used solely for academic research purposes.

## 4. RESULTS AND DISCUSSION

### *4.1. Respondent Profile and Descriptive Statistics*

This study analyzed data from 300 valid respondents working in the energy and utilities sector in the United States, who were selected based on their direct involvement in financial management, budgeting, performance monitoring, or information systems to ensure the relevance and reliability of the data. As summarized in Table 1, the respondent profile is dominated by finance-related and managerial roles, indicating that participants possessed adequate knowledge of financial system integration and performance accountability practices, while the majority reported more than five years of professional experience, suggesting substantial familiarity with both traditional and cloud-based financial systems.

Table 1. Respondent Profile

| Characteristic | Category | Frequency | Percentage (%) |
|---|---|---|---|
| Position | Finance/Accounting Manager | 92 | 30.7% |
| | Budget Analyst / Controller | 68 | 22.7% |
| | Senior / Operational Manager | 61 | 20.3% |
| | Information Systems / IT Manager | 54 | 18.0% |
| | Other Related Roles | 25 | 8.3% |
| Total | | 300 | 100.0 |
| Work Experience | 1–5 years | 64 | 21.3% |
| | 6–10 years | 121 | 40.3% |
| | >10 years | 115 | 38.4% |
| Total | | 300 | 100.0 |
| Organization Type | Electricity Utilities | 118 | 39.3% |
| | Gas Utilities | 69 | 23.0% |
| | Water Utilities | 51 | 17.0% |
| | Renewable Energy Firms | 62 | 20.7% |
| **Total** | | **300** | **100.0** |

Source: Authors (2025)

Table 1 shows that the respondent profile is well aligned with the objectives of this study, as the majority of participants occupy roles that are directly involved in financial management and decision-making. Finance and accounting managers (30.7%) and budget analysts/controllers (22.7%) together constitute more than half of the sample, indicating that a substantial proportion of respondents possess in-depth knowledge of budgeting processes, cost control, and financial system integration. The presence of senior or operational managers (20.3%) further strengthens the dataset, as these respondents are typically responsible for translating financial information into strategic and operational decisions. Additionally, the inclusion of information systems or IT managers (18.0%) is particularly relevant given the study's focus on cloud capability and system integration, as these roles bridge financial requirements with technological implementation.

In terms of work experience, most respondents have more than five years of professional experience, with 40.3% reporting 6–10 years and 38.4% reporting more than 10 years. This indicates a mature and experienced respondent base that is likely familiar with both traditional financial systems and newer cloud-based platforms, thereby enhancing

the credibility of their perceptions regarding real-time budget insights and performance accountability. The distribution of organization types also reflects the structural diversity of the U.S. energy and utilities sector, with electricity utilities representing the largest share (39.3%), followed by gas utilities (23.0%), renewable energy firms (20.7%), and water utilities (17.0%). This balanced representation suggests that the findings are not confined to a single sub-sector but instead capture variations in cost structures, regulatory pressures, and technological adoption across the industry, thereby supporting the broader generalizability of the study's results.

Descriptive statistics were computed to examine respondents' perceptions of the study constructs. All variables were measured using a five-point Likert scale (1 = strongly disagree; 5 = strongly agree). Table 2 summarizes the mean values and standard deviations for each construct.

Table 2. Descriptive Statistics of Research Variables

| Variable | Number of Items | Mean | Standard Deviation |
|---|---|---|---|
| Financial System Integration (FSI) | 5 | 3.89 | 0.63 |
| Cloud Capability (CC) | 5 | 4.02 | 0.58 |
| Real-Time Budget Insights (RTBI) | 4 | 3.76 | 0.66 |
| True Performance Accountability (TPA) | 5 | 4.08 | 0.55 |

Source: Authors (2025)

The descriptive statistics indicate that financial system integration is perceived at a moderately high level (M = 3.89), suggesting that most respondents agree that budgeting, accounting, forecasting, and cost management systems within their organizations are reasonably well integrated, although the observed variability implies differences in integration maturity across organizations. Cloud capability shows a relatively high mean score (M = 4.02), reflecting the widespread adoption and effective utilization of cloud-based financial platforms and indicating that cloud technology is increasingly embedded in financial operations across the sector. In comparison, real-time budget insights exhibit a slightly lower but still positive mean value (M = 3.76), suggesting that while many organizations have access to real-time budget information, its effectiveness and consistency vary, likely due to differences in system integration quality and analytical sophistication. The highest mean score is observed for true performance accountability (M = 4.08), indicating that respondents generally perceive strong accountability mechanisms supported by financial transparency, managerial responsibility, and data-driven oversight.

### *4.2. Measurement Model Results*

Before testing the structural relationships, the measurement model was evaluated to ensure the reliability and validity of the constructs by following standard PLS-SEM procedures, including assessments of internal consistency reliability, convergent validity, and discriminant validity.

**a. Internal Reliability**

Internal consistency reliability was examined using Cronbach's alpha ($\alpha$) and Composite Reliability (CR), with values above the recommended threshold of 0.70 indicating

satisfactory reliability of the measurement scales.

Table 3. Internal Consistency Reliability

| Construct | Cronbach's Alpha | Composite Reliability (CR) |
|---|---|---|
| Financial System Integration (FSI) | 0.872 | 0.905 |
| Cloud Capability (CC) | 0.861 | 0.898 |
| Real-Time Budget Insights (RTBI) | 0.843 | 0.895 |
| True Performance Accountability (TPA) | 0.887 | 0.918 |

Source: Authors (2025)

Table 3 demonstrates that all constructs in the study exhibit strong internal consistency reliability, as indicated by Cronbach's alpha and Composite Reliability (CR) values that exceed the recommended threshold of 0.70. Financial System Integration (FSI) shows high reliability with a Cronbach's alpha of 0.872 and a CR of 0.905, suggesting that the indicators consistently capture the underlying concept of system interoperability and alignment across financial processes. Similarly, Cloud Capability (CC) records robust reliability values ($\alpha$ = 0.861; CR = 0.898), indicating that the measurement items reliably reflect the organization's ability to deploy and utilize cloud-based financial technologies.

Real-Time Budget Insights (RTBI) and True Performance Accountability (TPA) also demonstrate strong internal consistency, with Cronbach's alpha values of 0.843 and 0.887 and CR values of 0.895 and 0.918, respectively. These results suggest that the indicators used to measure real-time budget visibility and accountability mechanisms are both coherent and stable. Overall, the high reliability values across all constructs confirm that the measurement scales are internally consistent and suitable for subsequent analyses of convergent validity and structural relationships within the SEM-PLS model.

**b. Convergent Validity**

Convergent validity was evaluated using indicator loadings and Average Variance Extracted (AVE). Indicator loadings above 0.70 and AVE values above 0.50 demonstrate adequate convergent validity.

Table 4. Indicator Loadings and AVE

| Construct | Indicator | Loading |
|---|---|---|
| FSI | FSI1 | 0.812 |
| | FSI2 | 0.846 |
| | FSI3 | 0.834 |
| | FSI4 | 0.801 |
| | FSI5 | 0.857 |
| | AVE (FSI) | 0.655 |
| CC | CC1 | 0.821 |
| | CC2 | 0.847 |
| | CC3 | 0.806 |
| | CC4 | 0.833 |

| Construct | Indicator | Loading |
|---|---|---|
| | CC5 | 0.861 |
| | AVE (CC) | 0.637 |
| RTBI | RTBI1 | 0.842 |
| | RTBI2 | 0.874 |
| | RTBI3 | 0.829 |
| | RTBI4 | 0.791 |
| | AVE (RTBI) | 0.681 |
| TPA | TPA1 | 0.855 |
| | TPA2 | 0.879 |
| | TPA3 | 0.863 |
| | TPA4 | 0.831 |
| | TPA5 | 0.848 |
| | AVE (TPA) | 0.692 |

Source: Authors (2025)

Table 4 presents the indicator loadings and Average Variance Extracted (AVE) values for all constructs, providing evidence of satisfactory convergent validity. All indicator loadings exceed the recommended threshold of 0.70, indicating that each item has a strong relationship with its respective latent construct. For Financial System Integration (FSI), indicator loadings range from 0.801 to 0.857, suggesting that the items consistently capture the degree of interoperability, data consistency, and alignment among financial systems. The AVE value of 0.655 further confirms that FSI explains more than half of the variance in its indicators.

Similarly, Cloud Capability (CC) exhibits strong indicator loadings between 0.806 and 0.861, with an AVE of 0.637, indicating that the construct adequately represents the organization's ability to deploy and utilize cloud-based financial platforms. Real-Time Budget Insights (RTBI) also demonstrates robust convergent validity, as all loadings range from 0.791 to 0.874 and the AVE reaches 0.681, reflecting a high level of shared variance between the construct and its indicators. Finally, True Performance Accountability (TPA) shows consistently high loadings (0.831–0.879) and the highest AVE value (0.692), indicating that the indicators strongly represent accountability-related dimensions such as transparency, managerial responsibility, and alignment with organizational objectives.

**c. Discriminant Validity**

Discriminant validity was first assessed using the Fornell–Larcker criterion, where the square root of AVE for each construct should be greater than its correlations with other constructs.

Table 5. Fornell–Larcker Criterion

| Construct | FSI | CC | RTBI | TPA |
|---|---|---|---|---|
| FSI | 0.809 | | | |
| CC | 0.623 | 0.798 | | |
| RTBI | 0.587 | 0.641 | 0.826 | |
| TPA | 0.601 | 0.659 | 0.702 | 0.832 |

Source: Authors (2025)

Table 5 presents the results of the Fornell–Larcker criterion, which is used to assess discriminant validity among the study constructs. The diagonal values in the table represent the square roots of the Average Variance Extracted (AVE) for each construct, while the off-diagonal values indicate the correlations between constructs. As shown in the table, the square root of AVE for Financial System Integration (FSI) is 0.809, which is higher than its correlations with Cloud Capability (0.623), Real-Time Budget Insights (0.587), and True Performance Accountability (0.601). This indicates that FSI shares more variance with its own indicators than with other constructs in the model.

Similarly, Cloud Capability (CC) exhibits a square root of AVE of 0.798, which exceeds its correlations with FSI (0.623), RTBI (0.641), and TPA (0.659). Real-Time Budget Insights (RTBI) and True Performance Accountability (TPA) also satisfy the Fornell–Larcker criterion, with square root AVE values of 0.826 and 0.832, respectively, both of which are greater than their correlations with other constructs. These results confirm that each construct is empirically distinct and captures a unique aspect of the conceptual model, thereby providing strong evidence of discriminant validity and supporting the robustness of the measurement model.

To further confirm discriminant validity, the Heterotrait–Monotrait ratio (HTMT) was assessed. Values below 0.85 indicate adequate discriminant validity.

Table 6. HTMT Ratios

| Construct Pair | HTMT Value |
|---|---|
| FSI – CC | 0.712 |
| FSI – RTBI | 0.684 |
| FSI – TPA | 0.701 |
| CC – RTBI | 0.736 |
| CC – TPA | 0.742 |
| RTBI – TPA | 0.781 |

Source: Authors (2025)

Table 6 reports the Heterotrait–Monotrait (HTMT) ratios for all construct pairs to further assess discriminant validity. All HTMT values are below the conservative threshold of 0.85, indicating that the constructs are empirically distinct from one another. The HTMT ratios between Financial System Integration and Cloud Capability (0.712), Real-Time Budget Insights (0.684), and True Performance

Accountability (0.701) suggest adequate separation between system integration and the other constructs. Similarly, the HTMT values for Cloud Capability with Real-Time Budget Insights (0.736) and True Performance Accountability (0.742), as well as for Real-Time Budget Insights with True Performance Accountability (0.781), remain well within acceptable limits.

### *4.3. Structural Model Results*

After confirming the reliability and validity of the measurement model, the structural model was evaluated to test the hypothesized relationships among financial system integration, cloud capability, real-time budget insights, and true performance accountability. The assessment followed standard PLS-SEM procedures, including analysis of path coefficients, t-values, p-values, coefficient of determination ($R^2$), effect size ($f^2$), and predictive relevance ($Q^2$).

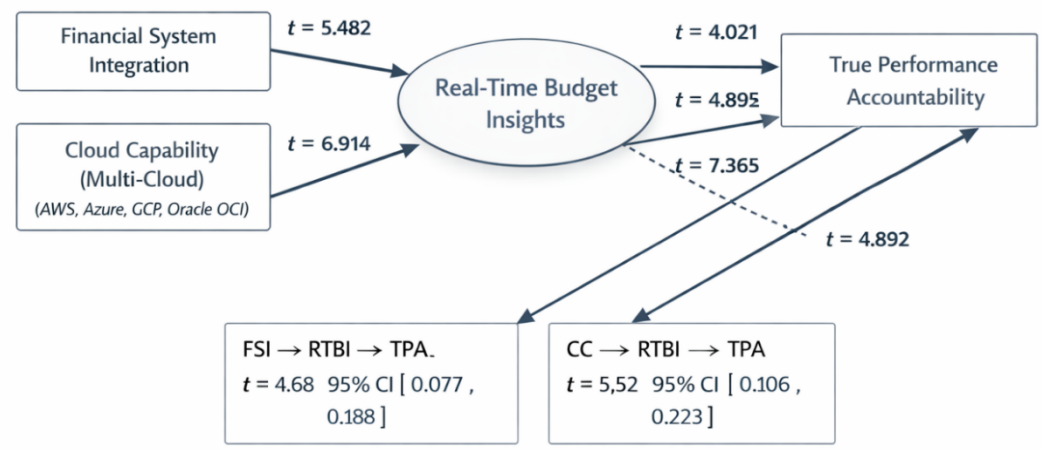


Figure 2. Structural Model

**a. Path Coefficients and Hypothesis Testing**

The significance of the hypothesized relationships was examined using a bootstrapping procedure with 5,000 resamples. Table 7 summarizes the structural path coefficients, t-statistics, p-values, and hypothesis decisions.

Table 7. Structural Path Coefficients and Hypothesis Testing

| | Structural Path | Path Coefficient (β) | t-value | p-value | Result |
|---|---|---|---|---|---|
| H1 | Financial System Integration → Real-Time Budget Insights | 0.312 | 5.482 | <0.001 | Supported |
| H2 | Cloud Capability → Real-Time Budget Insights | 0.387 | 6.914 | <0.001 | Supported |
| H3 | Real-Time Budget Insights → True Performance Accountability | 0.421 | 7.365 | <0.001 | Supported |
| H4 | Financial System Integration → True Performance Accountability | 0.218 | 4.021 | <0.001 | Supported |
| H5 | Cloud Capability → True Performance Accountability | 0.263 | 4.892 | <0.001 | Supported |

Source: Authors (2025)

Table 7 presents the results of the structural path analysis and hypothesis testing, demonstrating that all proposed hypotheses are supported with statistically significant path coefficients ($p < 0.001$). Financial System Integration has a significant positive effect on Real-Time Budget Insights ($\beta = 0.312$; $t = 5.482$), indicating that well-integrated budgeting, accounting, forecasting, and cost management systems enhance the availability and timeliness of budget information. Cloud Capability also shows a strong positive influence on Real-Time Budget Insights ($\beta = 0.387$; $t = 6.914$), suggesting that cloud-based platforms play a crucial role in enabling real-time data processing, accessibility, and analytical capabilities for effective budget monitoring.

Furthermore, Real-Time Budget Insights exhibit the strongest direct effect on True Performance Accountability ($\beta = 0.421$; $t = 7.365$), highlighting the central role of timely and accurate budget information in strengthening accountability mechanisms. The direct effects of Financial System Integration ($\beta = 0.218$; $t = 4.021$) and Cloud Capability ($\beta = 0.263$; $t = 4.892$) on True Performance Accountability are also positive and significant, indicating that digital financial infrastructure contributes to accountability both directly and indirectly. Collectively, these findings confirm that seamless financial integration and robust cloud capability are critical enablers of real-time budget visibility, which in turn strengthens performance accountability in organizational settings.

**b. Coefficient of Determination ($R^2$)**

The explanatory power of the model was evaluated using the coefficient of determination ($R^2$), where values of 0.25, 0.50, and 0.75 are commonly interpreted as weak, moderate, and substantial explanatory power, respectively. The results indicate that Financial System Integration and Cloud Capability jointly explain 46.2% of the variance in Real-Time Budget Insights ($R^2 = 0.462$), reflecting a moderate level of explanatory power, while Financial System Integration, Cloud Capability, and Real-Time Budget Insights together account for 58.7% of the variance in True Performance Accountability ($R^2 = 0.587$), indicating moderate to substantial explanatory power. These findings demonstrate that the proposed model provides a strong and meaningful explanation of how digital financial integration and cloud capability contribute to real-time budget visibility and performance accountability.

**c. Effect Size ($f^2$)**

Effect size ($f^2$) was calculated to assess the relative impact of each exogenous construct on the endogenous variables. According to established guidelines, $f^2$ values of 0.02, 0.15, and 0.35 represent small, medium, and large effects, respectively.

Table 8. Effect Size ($f^2$)

| Structural Path | $f^2$ | Effect Size |
|---|---|---|
| Financial System Integration → Real-Time Budget Insights | 0.134 | Small–Medium |
| Cloud Capability → Real-Time Budget Insights | 0.198 | Medium |
| Real-Time Budget Insights → True Performance Accountability | 0.276 | Medium–Large |
| Financial System Integration → True Performance Accountability | 0.087 | Small |
| Cloud Capability → True Performance Accountability | 0.112 | Small–Medium |

Source: Authors (2025)

Table 8 reports the effect size ($f^2$) values, which indicate the relative contribution of each exogenous construct to the explained variance of the endogenous variables. The results show that Real-Time Budget Insights have the strongest effect on True Performance Accountability ($f^2$ = 0.276), representing a medium to large effect size and underscoring the critical role of timely and accurate budget information in strengthening accountability mechanisms. Cloud Capability exhibits a medium effect on Real-Time Budget Insights ($f^2$ = 0.198) and a small to medium direct effect on True Performance Accountability ($f^2$ = 0.112), suggesting that cloud-based platforms significantly enhance real-time financial visibility and indirectly support accountability. In contrast, Financial System Integration shows a small to medium effect on Real-Time Budget Insights ($f^2$ = 0.134) and a small direct effect on True Performance Accountability ($f^2$ = 0.087), indicating that while integration is essential for enabling consistent data flows, its impact on accountability becomes more substantial when mediated through real-time budget insights.

**d. Predictive Relevance ($Q^2$)**

Predictive relevance of the model was assessed using the blindfolding procedure, where $Q^2$ values greater than zero indicate that the model has predictive relevance for the endogenous constructs. The results show that Real-Time Budget Insights has a $Q^2$ value of 0.301, while True Performance Accountability records a $Q^2$ value of 0.357, both of which are well above zero. These findings confirm that the structural model demonstrates strong predictive relevance and is capable of accurately predicting key outcomes related to real-time budget visibility and performance accountability.

### *4.4. Mediation Analysis (Indirect Effects & Bootstrapping)*

This study examined whether Real-Time Budget Insights (RTBI) mediate the relationships between Financial System Integration (FSI) and True Performance Accountability (TPA), as well as between Cloud Capability (CC) and TPA, using SEM-PLS 3 with a bootstrapping procedure of 5,000 resamples. Mediation was assessed by evaluating the significance of indirect effects, calculated as the product of the relevant path coefficients (e.g., FSI → RTBI × RTBI → TPA), and by comparing these indirect effects with the corresponding direct effects, with the bootstrapping results—

including t-values, p-values, and confidence intervals—summarized in Table 9.

Table 9. Indirect Effects (Bootstrapping, 5,000 Resamples)

| | Indirect Path | Indirect Effect (β) | t-value | p-value | 95% CI (LL) | 95% CI (UL) | Result |
|---|---|---|---|---|---|---|---|
| H6 | FSI → RTBI → TPA | 0.131 | 4.68 | <0.001 | 0.077 | 0.188 | Supported |
| H7 | CC → RTBI → TPA | 0.163 | 5.52 | <0.001 | 0.106 | 0.223 | Supported |

Source: Authors (2025)

Table 9 presents the results of the mediation analysis based on bootstrapping with 5,000 resamples, showing that Real-Time Budget Insights (RTBI) significantly mediate the relationships between Financial System Integration (FSI) and True Performance Accountability (TPA), as well as between Cloud Capability (CC) and TPA. The indirect effect of FSI on TPA through RTBI is positive and statistically significant ($\beta = 0.131$; $t = 4.68$; $p < 0.001$), with a 95% confidence interval ranging from 0.077 to 0.188, which does not include zero, indicating a meaningful mediation effect. Similarly, the indirect effect of CC on TPA via RTBI is also positive and significant ($\beta = 0.163$; $t = 5.52$; $p < 0.001$), with a confidence interval of 0.106 to 0.223. These findings confirm that real-time budget insights serve as a critical mechanism through which both financial system integration and cloud capability translate into stronger performance accountability, highlighting the importance of timely and accurate budget visibility in leveraging digital financial infrastructures for accountability outcomes.

Table 10. Direct, Indirect, and Total Effects

| Relationship | Direct Effect (β) | Indirect Effect via RTBI (β) | Total Effect (β) | Mediation Type |
|---|---|---|---|---|
| FSI → TPA | 0.218*** | 0.131*** | 0.349*** | Partial mediation |
| CC → TPA | 0.263*** | 0.163*** | 0.426*** | Partial mediation |

Source: Authors (2025)

Table 10 summarizes the direct, indirect, and total effects of Financial System Integration (FSI) and Cloud Capability (CC) on True Performance Accountability (TPA), providing clear evidence of partial mediation through Real-Time Budget Insights (RTBI). The direct effect of FSI on TPA remains positive and significant ($\beta = 0.218$; $p < 0.001$), while the indirect effect via RTBI is also significant ($\beta = 0.131$; $p < 0.001$), resulting in a substantial total effect of 0.349. This indicates that financial system integration strengthens accountability both directly—through improved transparency and control—and indirectly by enabling real-time budget visibility. Similarly, Cloud Capability shows a significant direct effect on TPA ($\beta = 0.263$; $p < 0.001$) alongside a meaningful indirect effect through RTBI ($\beta = 0.163$; $p < 0.001$), yielding the strongest total effect ($\beta = 0.426$). The presence of significant direct and indirect paths in both relationships confirms partial mediation, suggesting that while digital infrastructure directly enhances accountability mechanisms, its impact is considerably amplified

when it produces actionable, real-time budget insights that support continuous monitoring, justification of financial decisions, and responsible performance management.

### *4.5. Discussion*

The objective of this study was to examine how seamless financial system integration and cloud capability contribute to strengthening true performance accountability through real-time budget insights in the U.S. energy and utilities sector. The empirical findings provide strong support for the proposed research model and demonstrate how digital financial infrastructure reshapes accountability frameworks in complex, regulated, and capital-intensive environments. Overall, the results confirm that digitally enabled integration and cloud-based capabilities are critical enablers of timely budget visibility and accountable performance management, consistent with the argument that organizations require robust information-processing capacity to manage operational complexity and regulatory demands (Egiyi et al., 2023; Ghasemi et al., 2019).

First, the findings show that financial system integration significantly enhances real-time budget insights, reinforcing the importance of aligned and interoperable budgeting, accounting, forecasting, and cost management systems in producing consistent, timely, and decision-ready financial information. In line with information processing theory, organizations in the energy and utilities sector must process large volumes of heterogeneous financial and operational data under strict compliance requirements; integrated financial systems reduce reconciliation delays, limit inconsistent budget figures, and strengthen cross-functional visibility (Dawson, 2021; Titova & Sloka, 2022; Wynne, 2009). Conversely, fragmented system architectures obscure cost drivers, slow budget monitoring, and weaken managerial responsiveness, ultimately reducing the credibility and effectiveness of accountability mechanisms.

Second, the study confirms that cloud capability plays a significant role in improving real-time budget insights by enhancing accessibility, scalability, and analytical speed. Importantly, this effect should be understood within a multi-cloud context, where workloads and data services are distributed across platforms such as AWS, Azure, GCP, and Oracle/OCI to improve resilience, reduce vendor lock-in, and address regulatory constraints. While multi-cloud capability expands organizational flexibility, it also increases architectural complexity, making deliberate design essential. From an architectural perspective, real-time budget insights emerge when source systems are connected to cloud services through standardized integration layers, governed data platforms (warehouse or lakehouse), and analytics and planning services, all reinforced by identity management, audit trails, security controls, and observability to ensure trust and compliance in regulated environments.

Third, the results demonstrate that real-time budget insights have the strongest direct effect on true performance accountability, highlighting the central role of timely, transparent, and actionable financial information in shifting accountability from

retrospective reporting toward a dynamic managerial practice. Continuous visibility into budget allocations, actual expenditures, and variances enables managers to justify financial decisions, align spending with strategic objectives, and respond promptly to deviations before they escalate. In addition, the significant direct effects of financial system integration and cloud capability on performance accountability suggest that digital financial infrastructure strengthens accountability not only through real-time insights but also through improved auditability, standardized controls, and broader transparency across stakeholders. The mediation analysis further reveals that real-time budget insights partially mediate the relationships between financial system integration, cloud capability, and performance accountability, indicating that technology investments alone are insufficient unless they generate decision-ready insight embedded in managerial routines. From both theoretical and practical perspectives, the findings underscore that true performance accountability in the digital era is driven not merely by adopting cloud technologies, but by deploying integrated, governed, and multi-cloud-ready architectures, supported by institutionalized governance practices such as FinOps, to produce timely and defensible financial accountability outcomes.

## 5. CONCLUSION

This study provides empirical evidence on the role of digital financial integration in strengthening true performance accountability within the U.S. energy and utilities sector. The results confirm that seamless financial system integration and robust cloud capability significantly enhance real-time budget insights, which in turn play a central role in improving accountability. Real-time budget visibility enables managers to continuously monitor expenditures, justify financial decisions, and align budget execution with organizational objectives, thereby shifting accountability from a retrospective reporting function toward a more dynamic and proactive managerial practice. The mediation analysis further demonstrates that real-time budget insights partially explain how financial system integration and cloud capability translate into stronger accountability outcomes, underscoring that technology investments alone are insufficient unless they generate timely, accurate, and actionable financial information.

From a practical perspective, these findings suggest that organizations should prioritize not only the adoption of cloud technologies but also the seamless integration of financial systems to fully realize accountability benefits. Integrated systems and cloud platforms strengthen accountability both directly—through enhanced transparency, governance, and control—and indirectly by enabling continuous budget monitoring and data-driven decision-making. Embedding real-time budget analytics into managerial routines and organizational processes is therefore essential for achieving true performance accountability. Overall, this study highlights the strategic importance of cloud-enabled financial integration as a foundation for transparent, responsive, and accountable budget management in complex and highly regulated organizational environments.

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