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ADAPTIVE REQUIREMENTS MANAGEMENT FOR CLOUD-BASED ANALYTICAL ACCOUNTING SYSTEMS

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Abstract. Analytical accounting systems are essential components of modern enterprise information infrastructures, as they support managerial decision-making through the processing and analysis of large volumes of structured and semi-structured data. In the context of digital transformation and rapidly changing business environments, such systems must continuously adapt to evolving business requirements, performance constraints, and reporting needs. The widespread adoption of cloud infrastructure further increases system complexity due to distributed architectures, elastic resource allocation, and dependency on heterogeneous cloud services, making traditional, design-time-oriented requirements management approaches insufficient.

This paper addresses the problem of aligning business requirements with analytical functionality and cloud infrastructure behavior in analytical accounting systems. The research proposes a requirements-driven approach in which requirements are treated not as static design artifacts but as active control elements that influence analytical workflows and cloud resource configuration throughout the system life cycle. Requirements are represented as structured entities characterized by type, priority, life-cycle state, and traceability to analytical components and infrastructure services.

A conceptual interaction model is introduced that integrates three interrelated layers: the business layer, where stakeholders define performance, availability, and reporting requirements; the analytical layer, responsible for data ingestion, transformation, aggregation, and reporting; and the cloud infrastructure layer, which provides elastic computing, storage, monitoring, and scalability mechanisms. A key feature of the model is a closed feedback loop in which execution metrics and infrastructure indicators are continuously collected and fed back into the requirements management process, enabling iterative refinement and reprioritization of requirements without interrupting system operation.

To illustrate the applicability of the proposed approach, an experimental evaluation was conducted using a prototype analytical accounting system for a service-oriented enterprise. A representative scenario involved tightening performance constraints for analytical reports and

increasing data refresh frequency. These changes were applied at the requirements level and automatically propagated to analytical services and cloud resources. The results demonstrate a reduction in system adaptation time, improved analytical query response times, increased system availability, and more efficient utilization of cloud resources compared to a conventional, manually managed approach.

The obtained results confirm that requirements-driven control mechanisms can significantly improve the adaptability, predictability, and operational efficiency of cloud-based analytical accounting systems. The proposed approach can serve as a conceptual foundation for the design and modernization of analytical systems operating in dynamic business environments, supporting continuous system evolution and higher-quality managerial decision-making.

Key words: requirements management; analytical accounting systems; cloud infrastructure; requirements traceability; cloud scalability; business requirements; analytical systems; adaptive systems

Introduction.

Analytical accounting systems play a critical role in supporting managerial decision-making by processing and analyzing large volumes of structured and semi-structured data. In the context of digital transformation, organizations increasingly rely on such systems to obtain timely insights into financial operations, resource utilization, and business performance. At the same time, the dynamic nature of modern business environments leads to frequent changes in business requirements, which must be rapidly reflected in analytical functionality and system configuration.

Cloud infrastructure has become the dominant platform for deploying analytical accounting systems due to its scalability, elasticity, and reduced operational costs. However, the use of cloud technologies significantly complicates requirements management, as system behavior depends on distributed architectures, heterogeneous cloud services, and continuously changing resource configurations. Traditional requirements management approaches, which primarily focus on the design phase, are insufficient under these conditions. This creates the need for adaptive requirements management approaches that integrate business requirements with analytical components and cloud infrastructure capabilities, ensuring continuous system evolution, scalability, and operational efficiency.

Main text

Problem Statement and Research Context

The rapid adoption of cloud infrastructure in analytical accounting systems significantly changes the nature of requirements management. Unlike traditional on-

premise systems, cloud-based analytical solutions operate in dynamic environments where resource availability, data volumes, and performance constraints continuously evolve. As a result, static approaches to requirements specification and implementation become insufficient, particularly for systems that support operational and managerial decision-making.

In practice, changes in business requirements often lead to costly and time-consuming manual reconfiguration of analytical pipelines and cloud resources. This creates a gap between business expectations and the actual behavior of analytical systems, especially under strict service-level objectives.

Proposed Approach

To address this challenge, an adaptive requirements-driven approach to analytical accounting systems is proposed. Instead of treating requirements as fixed design artifacts, they are considered as active control elements that influence both analytical functionality and cloud resource allocation.

Each requirement is described as a structured entity characterized by its type, priority, implementation state, and association with analytical components. This representation enables continuous traceability between business objectives, analytical processes, and infrastructure resources.

A distinctive feature of the approach is the integration of requirements management with cloud service layers. Business-level changes are translated into operational actions such as scaling computational resources, adjusting data processing pipelines, or modifying analytical schedules without interrupting system operation.

System Structure and Interaction

The proposed structure follows a layered interaction model:

- Business layer, where stakeholders define performance, availability, and reporting requirements;
- Analytical layer, responsible for data ingestion, transformation, aggregation, and reporting;
- Infrastructure layer, providing elastic computing, storage, and monitoring

capabilities.

Feedback from analytical execution and infrastructure metrics is continuously returned to the requirements management process. This feedback loop enables iterative refinement of requirements and supports informed prioritization under changing operational conditions.

Conceptual Structure of the Requirements-Driven Analytical System

To illustrate the interaction between business requirements, analytical processing, and cloud infrastructure, a generalized structural scheme of the proposed approach is introduced (fig. 1). The scheme emphasizes the role of requirements as an active control mechanism that links business objectives with analytical functionality and infrastructure behavior.

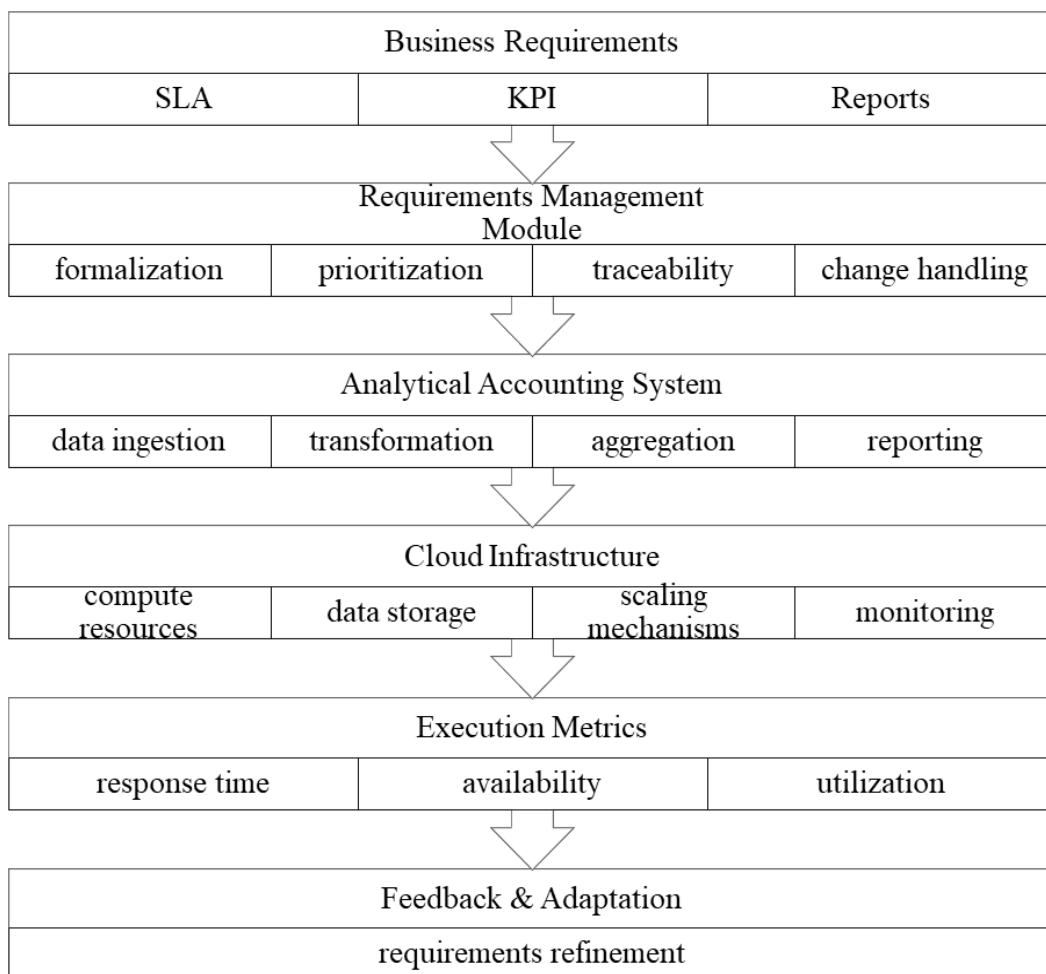


Figure 1 – Requirements-driven interaction scheme for analytical accounting systems in a cloud environment

Before presenting the scheme, it should be noted that the proposed approach does not assume static system configuration. Instead, requirements are continuously refined and translated into operational decisions that affect analytical workflows and cloud resource allocation.

After introducing the scheme, it becomes evident that the model is based on a closed feedback loop. Business requirements initiate analytical processing, but the final configuration of analytical pipelines and cloud resources is determined dynamically, based on execution metrics and operational constraints.

The requirements management component acts as an intermediary layer that translates high-level business expectations into technical parameters of analytical services and infrastructure configuration. Analytical execution results, such as response time or resource utilization, are continuously collected and fed back into the requirements management process. This enables timely refinement and reprioritization of requirements without interrupting system operation.

Such an organization ensures consistent alignment between business goals, analytical functionality, and cloud infrastructure capabilities. As a result, analytical accounting systems become more resilient to change, better utilize cloud resources, and provide predictable performance under evolving operational conditions.

Experimental Illustration

The approach was evaluated using a prototype analytical accounting system for a service-oriented enterprise. A representative scenario involved tightening performance constraints for analytical reporting and increasing data update frequency. These changes were applied at the requirements level and propagated automatically to analytical services and cloud resources.

The experimental results indicate that the proposed approach:

- reduces the time required to adapt systems to changing requirements;
- improves analytical query response times;
- increases overall system availability;
- decreases unnecessary infrastructure over-provisioning.

Table 1 – Summary of observed effects

Aspect	Conventional approach	Requirements-driven approach
Adaptation effort	Manual, time-consuming	Automated, fast
Performance stability	Variable	Predictable
Resource utilization	Over-allocated	Optimized
Operational risk	Higher	Reduced

Authoring

Discussion

The results demonstrate that treating requirements as active elements of system control improves alignment between business objectives, analytical behavior, and cloud infrastructure capabilities. This approach is particularly relevant for analytical accounting systems operating in environments with frequent changes in performance and reporting requirements.

Summary and conclusions.

In this work, a requirements-driven approach to the development and operation of analytical accounting systems deployed on cloud infrastructure has been considered. The study focused on integrating requirements management processes with analytical workflows and cloud resource configuration in order to support adaptability and scalability under dynamic business conditions.

A conceptual interaction scheme was proposed, in which business requirements are formalized, prioritized, and continuously traced to analytical components and cloud infrastructure services. The approach treats requirements management as a continuous control process rather than a one-time design activity, enabling dynamic system reconfiguration based on execution metrics and operational feedback.

As a result, a generalized model was obtained that ensures alignment between business objectives, analytical functionality, and infrastructure resources. The proposed solution allows analytical accounting systems to reduce adaptation time to changing requirements, improve performance predictability, and utilize cloud resources more efficiently.

The obtained results confirm the feasibility of applying requirements-driven control mechanisms to cloud-based analytical systems and demonstrate their potential for improving system evolution and managerial decision support in dynamic environments.

References:

1. Shahid J., Hameed M. K., Javed I. T., Qureshi K. N., Ali M., Crespi N. A comparative study of web application security parameters: Current trends and future directions // *Applied Sciences*. – 2022. – Vol. 12, No. 8. – P. 4077. DOI: 10.3390/app12084077.
2. Sönmez F. Ö., Kiliç B. G. Holistic web application security visualization for multi-project and multi-phase dynamic application security test results // *IEEE Access*. – 2021. – Vol. 9. – P. 25858–25884. DOI: 10.1109/ACCESS.2021.3057044.
3. Kree L., Helmke R., Winter E. Using Semgrep OSS to find OWASP Top 10 weaknesses in PHP applications: A case study // *Detection of Intrusions and Malware, and Vulnerability Assessment (DIMVA 2024)* : Lecture Notes in Computer Science. – Cham : Springer, 2024. – Vol. 14828. – P. 64–83. DOI: 10.1007/978-3-031-49187-0_4.
4. Popereshnyak S., Vecherkovskaya A., Zhebka V. Intrusion detection based on an intelligent security system using machine learning methods // *CEUR Workshop Proceedings*. – 2024. – Vol. 3654. – P. 163–178. – Режим доступа: <https://ceur-ws.org/Vol-3654/paper14.pdf>.

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THE CHANGING ROLE OF THE RESEARCHER: FROM SPREADSHEETS TO LARGE LANGUAGE MODELS

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Abstract. *The rapid evolution of data analysis tools has led to a fundamental transformation of the researcher's role in scientific inquiry. This article examines how the shift from spreadsheet-based analysis to statistical computing and, more recently, to artificial intelligence agents driven by large language models (LLMs), has altered analytical responsibilities, expertise, and epistemic authority. Instead of focusing solely on technical capabilities, the research highlights the transformation of the role: from operator to programmer-methodologist, to manager and validator of machine-generated insights. The article argues that contemporary research increasingly depends on skills related to critical evaluation, bias detection, methodological auditing, and ethical judgment. This shift marks a transition from creating analytical logic to managing and verifying it. Understanding this transformation is crucial for maintaining scientific rigor, transparency, and accountability in AI-augmented research environments.*

Keywords: *researcher role, data analysis paradigms, spreadsheets, statistical computing, large language models, AI agents, bias.*

Introduction.

The history of scientific research is inextricably linked to the evolution of analytical tools. Each major technological shift has changed not only the ways in which data is processed, but also how researchers think, reason, and respond to results. For much of the late 20th century, spreadsheets served as the dominant analytical tool, emphasizing accessibility and manual control. Further developments in statistical computing have introduced algorithmic rigor and formalized methodological responsibility. Today, the integration of large-scale language models and artificial intelligence agents is a further transformation in which analytical thinking is partly delegated to autonomous systems. This progress requires a rethinking of the role, competencies, and responsibilities of the researcher in modern scientific workflows.

Paradigm I: The researcher as operator (spreadsheet-based analysis). In the spreadsheet paradigm, the researcher primarily functioned as an operator. Analytical