



Digital Transformation of Risk Management Through Cloud Computing and Large Language Models

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Abstract

Risk management in many organizations still depends on spreadsheets, email approvals, periodic reviews, and manual reporting. These practices cannot keep pace with the volume and speed of modern operational, financial, compliance, and cyber risks. Cloud computing and large language models (LLMs) together offer a path to transformation. Cloud platforms provide scalable, event-driven infrastructure for capturing and processing risk signals in real time, while LLMs can read, summarize, and reason over the large body of unstructured text on which risk decisions depend. Both technologies also introduce new risks: concentration on cloud providers, exposure of sensitive data, and LLM outputs that are fluent but wrong. This article proposes a framework for digitally transforming risk management using cloud computing and LLMs. Using a design-oriented approach grounded in ten studies published between 2016 and 2024, it combines configurable risk workflows, event-driven processing, privacy-preserving access control, retrieval-augmented LLM assistance, validated user interfaces, and AI governance. It maps the framework to each stage of the ISO 31000 risk management process and illustrates it with an insurance case involving a surge in claims after a regional flood. It argues that transformation succeeds when LLMs work within governed workflows and permission-aware data access, rather than as standalone tools.

Keywords: risk management, digital transformation, cloud computing, large language models, retrieval-augmented generation, event-driven architecture, enterprise workflow, access control, privacy, AI governance

1. Introduction

Risk management helps organizations anticipate and respond to uncertainty that could affect their objectives. ISO 31000 (ISO, 2018) describes it as an iterative process of identifying,

analyzing, evaluating, treating, monitoring, and communicating risk. In practice, however, many organizations run this process with fragmented tools. Risk registers are kept in spreadsheets, assessments are circulated by email, approvals depend on individuals remembering to act, and reports are assembled by hand before committee meetings. Such practices are slow, error-prone, and hard to audit. They also operate on a periodic cycle while risks now develop in hours.

Digital transformation seeks to replace these practices with integrated, data-driven processes. Basireddy (2022) shows how risk management can be digitized through configurable enterprise workflow architecture, in which risk processes become defined, trackable, and adaptable workflows. Cloud computing provides the infrastructure to run such workflows at scale and to connect them to real-time data. Sannidhanam (2021) illustrates this with event-driven architectures for real-time claims processing, where business events are processed as they occur rather than in batches.

LLMs add a capability that earlier digitization lacked: working with unstructured text. Much risk information takes the form of policies, contracts, incident reports, audit findings, regulatory updates, and emails. Brown et al. (2020) showed that large language models can perform a wide range of language tasks from a few examples. Retrieval-augmented generation (RAG) grounds their outputs in specific documents (Lewis et al., 2020). LLMs can also produce plausible but incorrect content (Ji et al., 2023), which is a serious concern in risk management. This article asks: How can cloud computing and LLMs be combined to transform risk management while controlling the new risks they introduce? It contributes a synthesis of relevant research, a layered transformation framework mapped to the ISO 31000 process, and an illustrative application.

2. Background and Related Work

2.1 Risk management process

ISO 31000 (ISO, 2018) sets out principles, a framework, and a process for managing risk. It emphasizes that risk management should be integrated into organizational activities, structured, customized, inclusive, dynamic, and based on the best available information. These principles are hard to meet with manual tools. Information is scattered, processes are inconsistent, and updates lag behind events. Digital transformation aims to put these principles into practice.'

2.2 Configurable risk workflows



Basireddy (2022) proposes digitizing risk management through configurable workflow architecture. Risk identification, assessment, approval, escalation, and remediation are defined as configurable process definitions rather than hard-coded logic. This makes risk processes consistent and traceable, and it lets organizations change them as regulations, risk appetite, or structures change without rebuilding systems. In the framework proposed here, the workflow layer is the backbone that coordinates people, data, and AI.

2.3 Cloud and event-driven processing

Cloud platforms provide elastic computing, managed data services, and global availability. Sannidhanam (2021) shows how event-driven architectures support real-time claims processing. Each claim and status change is published as an event that independent services process in parallel, which improves responsiveness and scalability. The same pattern applies to risk management more broadly. Risk-relevant events, such as a large transaction, a control failure, a security alert, or a surge in claims, can be captured and routed for assessment the moment they occur. Cloud adoption also brings its own risks. The Financial Stability Board (FSB, 2019) notes that relying on a small number of cloud providers can create concentration risk and systemic vulnerabilities, which must themselves be managed.

2.4 Large language models and retrieval

Brown et al. (2020) showed that sufficiently large language models can carry out tasks such as summarization, question answering, and classification with little task-specific training. Lewis et al. (2020) introduced RAG, which retrieves relevant documents and conditions generation on them. The model's knowledge can then be updated without retraining, and its answers can be linked to their sources. Ji et al. (2023) survey hallucination in natural language generation, meaning outputs that are unfaithful to the source or to fact, and show that it is a persistent problem across tasks. For risk management, where decisions rest on accurate facts, grounding and verification are essential.

2.5 Privacy-preserving access control

Risk data is often highly sensitive. It may include personal information, confidential investigations, and details of control weaknesses. The study on Privacy-Preserving Access Control for Electronic Health Record Systems (2016) addresses how to give authorized users



appropriate access to sensitive records while protecting privacy. It covers mechanisms that restrict access by role and purpose and protect confidentiality. Healthcare records and enterprise risk data face similar requirements. This matters especially when LLMs are introduced, because a retrieval system that ignores permissions could expose confidential information to users who should not see it.

2.6 AI governance

The NIST AI Risk Management Framework (NIST, 2023) provides a structure for managing risks from AI systems through four functions: Govern, Map, Measure, and Manage. It emphasizes validity, reliability, safety, security, accountability, transparency, explainability, privacy, and fairness. An organization that uses LLMs in risk management must therefore apply risk management to the LLMs themselves.

2.7 Interface quality

Risk information reaches decision-makers through dashboards, portals, and forms. Errors in these interfaces, such as broken layouts, missing fields, or components that fail on some devices, can hide important information or cause data to be entered incorrectly. Cherukuri (2024) presents Webchecker, a plugin based on the Epsilon Validation Language (EVL) for validating HTML pages built with Bootstrap frameworks. It automatically checks pages against framework rules. Applied to risk portals and dashboards, such validation helps ensure that risk information is presented and captured reliably.

2.8 Research gap

These studies address workflows, event processing, access control, LLM capabilities, AI governance, and interface quality separately. What is missing is an integrated view of how they combine to transform risk management while keeping the new risks of cloud and LLM adoption under control.

3. Research Methodology

The study follows a design-oriented research approach. The problem, that manual risk management is too slow, fragmented, and hard to audit, was identified from the risk management literature. Design requirements were derived from the reviewed studies: real-time



capture of risk events, consistent and configurable processes, effective use of unstructured information, protection of sensitive data, reliable interfaces, and governance of AI. A layered framework was designed to meet these requirements and mapped to the ISO 31000 process. The framework was then demonstrated through an illustrative insurance case. The demonstration is illustrative, and empirical evaluation is left to future work.

4. Proposed Framework

The framework has six layers (Table 1).

Table 1. Framework for cloud- and LLM-enabled risk management

Layer	Purpose	Key mechanisms	Supporting studies
1. Event capture	Detect risk-relevant events in real time	Event streams from operational, financial, and security systems	Sannidhanam (2021)
2. Secure cloud data	Store risk data and control who can see it	Cloud storage, role- and purpose-based access control, encryption	<i>Privacy-Preserving Access Control</i> (2016); FSB (2019)
3. Risk workflow	Coordinate assessment, approval, escalation, and treatment	Configurable workflows, audit trails	Basireddy (2022); ISO (2018)
4. LLM intelligence	Work with unstructured risk information	Permission-aware retrieval, grounded generation, source citation	Brown et al. (2020); Lewis et al. (2020); Ji et al. (2023)
5. Validated interfaces	Present and capture risk information reliably	Responsive dashboards and forms, automated validation	Cherukuri (2024)
6. AI and cloud governance	Manage the risks of the technologies themselves	AI risk framework, provider concentration management, monitoring	NIST (2023); FSB (2019)

Event capture. Operational systems publish risk-relevant events to a cloud event stream (Sannidhanam, 2021). Examples include transactions above thresholds, failed controls, security alerts, claims, and complaints. Rules and models assess events as they arrive, so risk identification happens continuously rather than periodically.

Secure cloud data. Risk registers, assessments, evidence, and documents are held in cloud storage protected by role- and purpose-based access control, following the principles of privacy-preserving access in sensitive record systems (*Privacy-Preserving Access Control*, 2016). Contingency plans and multi-region or multi-provider designs address cloud concentration risk (FSB, 2019).

Risk workflow. Assessed events and identified risks enter configurable workflows that route them to the right owners, apply approval rules, trigger escalation, track treatment actions, and



record every step (Basireddy, 2022). Workflows follow the ISO 31000 process and can be adapted without changing code.

LLM intelligence. LLMs assist at each workflow step. They retrieve relevant policies, past incidents, and regulations, summarize them, draft assessments and reports, and answer questions (Brown et al., 2020; Lewis et al., 2020). Two safeguards are essential. First, retrieval respects the same access controls as the data layer, so users only receive content drawn from documents they are permitted to see. Second, outputs cite their sources, and consequential outputs require human confirmation, which addresses the risk of hallucination (Ji et al., 2023). **Validated interfaces.** Risk dashboards, registers, and forms are built as responsive web interfaces. They are automatically validated on every release (Cherukuri, 2024), so information displays correctly on all devices and data is captured completely.

Governance. The organization applies the NIST AI RMF (NIST, 2023) to its LLM components. It maps where LLMs are used, measures their accuracy and error rates, and manages identified risks through controls and monitoring. It also manages cloud provider dependence as a risk in its own right (FSB, 2019).

5. Mapping to the Risk Management Process

Table 2 shows how cloud and LLM capabilities support each stage of the ISO 31000 process, and which controls apply.

Table 2. Cloud and LLM support across the ISO 31000 risk management process

Process stage	Cloud contribution	LLM contribution	Key control
Identification	Real-time event capture across systems	Extract emerging risks from reports, news, and incidents	Human validation of newly identified risks
Analysis	Scalable processing of risk data	Summarize causes and consequences from documents	Source citation for every summary
Evaluation	Consolidated view against risk appetite	Compare risks with policy thresholds and precedents	Final rating by accountable risk owner
Treatment	Workflow execution and tracking	Draft treatment plans and control descriptions	Approval workflow before implementation
Monitoring and review	Continuous monitoring and alerts	Detect changes in risk indicators and narratives	Periodic review of LLM accuracy
Communication and reporting	Shared, accessible dashboards	Draft committee and regulatory reports	Human sign-off, permission-aware retrieval



The mapping shows that LLMs strengthen every stage of the process but make no final decisions. At each stage, a defined control keeps accountability with people and makes AI contributions traceable. This is consistent with the NIST AI RMF emphasis on accountability and transparency (NIST, 2023).

6. Illustrative Case: Claims Surge After a Regional Flood

Consider a property insurer operating the framework. A severe flood affects a region where the insurer has many policyholders.

Event capture. Within hours, the claims system publishes a sharp rise in new claims from the affected postal codes as events (Sannidhanam, 2021). An event rule detects that the claim rate far exceeds normal levels and creates a risk event covering operational capacity, financial exposure, and potential fraud.

Workflow. The risk workflow opens a catastrophe response case (Basireddy, 2022). It notifies the claims operations lead, the chief risk officer's team, and the reinsurance manager, assigns tasks, and sets escalation deadlines.

LLM assistance. The risk analyst asks the LLM assistant for a situation summary. The assistant retrieves the insurer's catastrophe response policy, its reinsurance treaty terms, notes from a similar flood event three years earlier, and the latest claims statistics (Lewis et al., 2020). It drafts a summary covering likely claim volumes, the point at which reinsurance recovery begins, and lessons from the earlier event, citing each source. The analyst checks the figures against the claims data and corrects one assumption before accepting the draft.

Privacy. Individual claim files contain personal information. When a fraud analyst asks the assistant about suspicious claim patterns, retrieval respects access controls (Privacy-Preserving Access Control, 2016). The fraud analyst receives claim-level detail. A board member later asking a similar question receives only aggregated information.

Interfaces. Claims handlers across the region update claim status on tablets in the field. The claims and risk dashboards were validated automatically before release (Cherukuri, 2024), so they display correctly on these devices and capture required fields.

Governance. After the event, the risk team reviews the assistant's contributions under the organization's AI governance process (NIST, 2023). It records that one assumption needed correction and adjusts the assistant's instructions to prompt analysts to confirm reinsurance thresholds.



Reporting. The assistant drafts the board report on the event from the workflow records, which the chief risk officer reviews and approves.

The case shows the framework's central principle. The LLM made the risk team faster and better informed, but it worked within event-driven processes, configurable workflows, permission-aware data access, and human checkpoints.

7. Discussion

7.1 Implications

For research, the framework shows that digital transformation of risk management depends on several technologies working together. Workflows provide structure, event processing provides speed, access control provides protection, LLMs provide understanding of unstructured information, interfaces provide usability, and governance provides trust. None achieves transformation alone. The framework also shows that transformation technologies are themselves sources of risk, which the risk function must manage.

For practitioners, the framework suggests a sequence. Digitize risk processes as configurable workflows first, because they are the backbone for everything else. Connect operational systems through event streams so risks are identified in real time. Enforce access control before introducing LLMs, so AI does not become a route for data leakage. Introduce LLMs as grounded, citing assistants within workflows, with humans confirming consequential outputs. Throughout, validate interfaces and govern both AI and cloud dependencies.

7.2 Limitations and future work

The framework was demonstrated through an illustrative case and is based on a focused set of ten studies. Future research should evaluate it in real organizations, measuring time to identify and treat risks, reporting effort, audit findings, and LLM accuracy. Further research is also needed on permission-aware retrieval methods, on measuring hallucination rates in risk-specific tasks, on managing concentration risk as risk functions move to the cloud, and on how risk professionals calibrate their trust in LLM assistance.

8. Conclusion

Cloud computing and LLMs can move risk management from periodic, manual practice to continuous, integrated, and insight-driven practice. This article proposed a six-layer framework



that captures risk events in real time, protects sensitive data through access control, coordinates the risk process through configurable workflows, uses grounded LLMs to work with unstructured information, validates the interfaces through which people see and record risk, and governs the risks of AI and cloud adoption themselves. Mapped to the ISO 31000 process and illustrated through a flood claims case, the framework shows that transformation is most effective when new technology strengthens human judgment within governed processes. The central conclusion is that digitally transformed risk management must also manage the risks of its own technology.

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