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Data Fabric and Data Mesh in Banking: Applications for Risk, Fraud, and Regulatory Intelligence

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ABSTRACT

This paper examines the application of data fabric and data mesh in banking, with a focus on their roles in enhancing risk management, fraud detection, and regulatory compliance. It evaluates how these architectures address key challenges in the banking sector, such as data fragmentation, growing fraud concerns, and regulatory complexity. It utilises real-world use cases to demonstrate how data fabric supports real-time analytics and governance, while data mesh empowers domain-led innovation and agility through decentralisation. The combined approach offers a scalable, intelligent framework for financial institutions navigating digital transformation. The paper also identifies key technical, organisational, and regulatory challenges, offering strategic insights for successful implementation in complex banking ecosystems.

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Introduction

The modern banking landscape is increasingly complex and data-intensive, creating fertile ground for evolving fraud schemes, heightened regulatory pressure, and a rising demand for real-time, enhanced risk intelligence [1]. Financial institutions process massive amounts of data of structured and unstructured data across credit risk systems, payment networks, digital systems, and compliance platforms. Yet, most of the data remains siloed among different platforms and departments, which hinders the ability to support real-time data analytics, agile compliance reporting, and integrated fraud prevention. These challenges have had a nontrivial impact. A 2023 report by Nasdaq indicated that global bank fraud schemes totalled $485.6 billion, with transaction fraud accounting for the majority [2]. At the same time, the global spending on financial crime compliance has surpassed $274.1 billion in 2023, a $63 billion increase from 2020 levels [3]. This spending had been driven by the growing complexity of regulatory regimes such as FATCA (US) and AMLD6 (EU). The growing spending on financial crime prevention, accompanied by rising volumes of financial losses from financial fraud, indicates that the traditional centralised data architecture, which depends on static ETL (Extract, Transform, Load) pipelines and batch processing are ill-equipped to meet the demands of the landscape. These traditional systems lack both the agility to respond to emerging sophisticated threats as well as the scalability to accommodate the scale of financial data and the evolving regulatory requirements.

To address these shortcomings, financial institutions are looking towards modern data architectures, particularly data fabric and data mesh, to improve the agility, intelligence, and scalability of data ecosystems. Data fabric is a unified, integrated, and intelligent data platform architecture that is able to deliver consistent data access and management [4]. The platform enables real-time data integration, governance, and orchestration in multi-cloud environments, using AI and automation to simplify access and unify siloed data. As presented by, the adoption of data fabric reduced the time required for integration design by 30%, deployment time by 30%, and maintenance efforts by 70% [5]. According to, data fabric is already simplifying data access and facilitating self-service data consumption for organisations, despite the uniqueness of their workflow [6]. In contrast, data mesh is a decentralised approach to data management which decentralises data ownership by treating data as a product, enabling domain-specific teams, such as those in fraud and compliance, to develop and manage their data pipeline [7]. This enables alignment of data governance with operational ownership, supporting responsiveness and scalability, necessary to combat challenges in the financial sector [8]. The growing interest in data fabric and data mesh technologies within the financial sector drives this article's objective: exploring their applications for risk management, fraud detection, and regulatory intelligence. Here are the specific objectives

- Evaluate the effectiveness of Data Fabric and Data Mesh in Modern Banking Intelligence
- Explore the role of Data Fabric and Mesh in reshaping risk, fraud and compliance operations.
- Explore the key use cases of data fabric and data mesh in banking
- Investigate the challenges hindering full-scale adoption and implementation of the technologies in banking.

Problem Statement

Despite the $274.1 billion global spending on financial crime compliance, most banks continue to operate on legacy architectures that separate operational, analytical, and compliance data systems, resulting in fragmented insights, increased susceptibility to fraud,

poor data quality, and time-consuming manual interventions. The lack of unified systems and application of traditional fraud detection systems that are reliant on static rules and batch updates is increasingly unable to address emerging threats as real-time payments (RTP) and instant cross-border transactions become the norm. Moreover, compliance teams are unable to efficiently deliver timely and accurate reports due to unconnected systems, lacking real-time data traceability. These limitations increase operational costs and regulatory exposure. To address these challenges, financial sector players are looking towards data fabric and data mesh technologies that promise decentralised, integrated, intelligent and scalable data infrastructures with a multi-cloud environment. This paper critically analyses the effectiveness and implementation of Data Fabric and Data Mesh in banking. It examines their real-world application across risk, fraud, and compliance domains, and outlines the organisational, technical, and regulatory factors that must be addressed to enable successful adoption.

Effectiveness of Data Fabric and Data Mesh in Modern Banking Intelligence

• Unified Data Architecture and Predictive Risk Analytics

Management of financial risks, such as credit, market, and liquidity risk in real-time, is a critical factor for banks within the current markets characterised by volatility, regulatory scrutiny, and ever-raising customer expectations [9]. By creating an intelligent data infrastructure layer that harmonises different risk data sources across departments and systems, Data Fabric plays a critical role in the management of financial risks [10]. Data fabric infrastructure supports automated data integration, metadata management, and AI-enabled discovery. It consolidates structured and unstructured data from core banking systems as well as third-party feeds [11]. This unified access facilitates the development of more efficient predictive models that can seamlessly evaluate creditworthiness, forecast market exposure, and simulate liquidity stress scenarios.

Data Mesh complements the capabilities of data fabric infrastructures by decentralising data stewardship and allowing risk domain teams to maintain ownership of their data products [12]. This decentralised yet integrated model promotes agility, enabling teams to build domain-specific risk models customised to their unique operational context as well as objectives while maintaining interoperability with the broader enterprise. Therefore, data fabric facilitates real-time action and consistency while data mesh facilitates context-based modelling at the departmental level of organisation. Thus, combined applications of the technologies enable banks to move from reactive risk control to proactive risk intelligence.

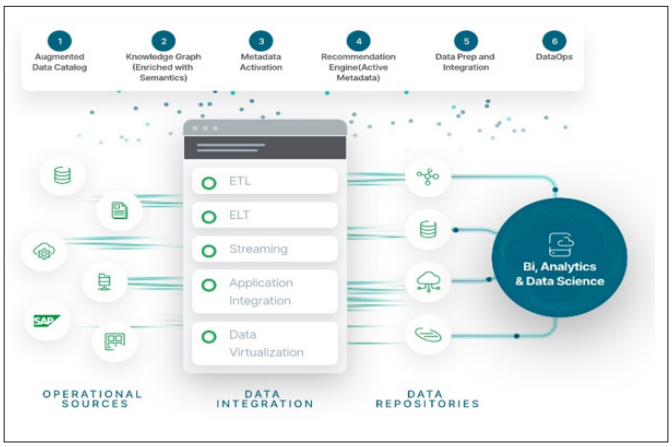

Figure 1: Data Fabric Infrastructure [13]

Streamlined Fraud Detection and Adaptive Response

As the volume of digital payments grows, fraudsters are increasingly seeking to exploit gaps across fragmented banking systems [14]. According to, the challenge of fraud is addressed by data fabric, as it facilitates the integration of cross-channel behavioural data, including login patterns, device fingerprints, transaction velocity, biometric inputs, and geolocation signals [15]. The unification of these data streams boosts visibility, which enables fraud detection engines to perform anomaly detection in real-time. According to, machine learning models deployed within the Fabric framework can detect patterns indicative of synthetic identity fraud, account takeovers, or abnormal transactional behaviour [16].

Data Mesh adds to the responsiveness offered by data fabric by empowering fraud teams at the product, departmental, or regional level to tailor their detection strategies to their needs [17]. The decentralisation enabled by data mesh leads to more accurate detection, faster incident response, and improved user experience. A notable application of this hybrid model (using data fabric and mech) is in behavioural biometrics, where AI models analyse keystroke dynamics, mouse movement, or touchscreen pressure to detect fraud in real-time. Data Fabric integrates this behavioural telemetry across channels, while Data Mesh enables localised adaptation of the detection logic, such as raising fraud scores based on culturally or regionally relevant user behaviour. This combined approach significantly improves the accuracy and speed of fraud response time.

Enhanced Regulatory Compliance and Data Traceability

There is a growing demand for an enhanced regulatory framework for compliance within the financial sector to protect individual data and to curb tax avoidance. Frameworks like Basel IV, MiFID II, GDPR, and FATCA demand enhanced accountability, operational compliance, as well as full transparency and traceability of data flows [18]. Data Fabric offers a comprehensive solution to this demand as it's able to offer end-to-end data links across all enterprise systems [19]. According to, data fabric intelligent metadata catalogues and automates governance workflows, enabling compliance teams to track the origin, transformation, and usage of data throughout its lifecycle [20]. The enhanced traceability is crucial for generating audit-ready reports, responding to regulatory inquiries, and validating model assumptions. Thus, the technology supports real-time compliance monitoring by integrating AI with policy-based automation. Data Mesh enhances this framework by decentralising regulatory data ownership. This ensures that different teams own and manage their regulatory data pipelines, including the models and reporting outputs. The decentralisation ensures increased accuracy and responsiveness, given that regulations vary significantly from country to country.

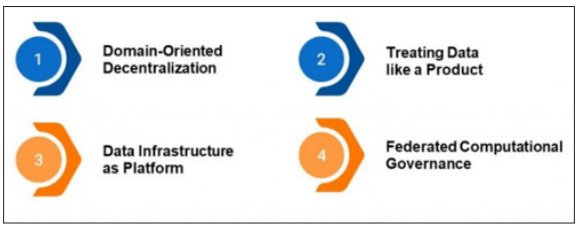

Figure 2: Architectural Pillars of Data Mesh [21]

Role of Data Fabric and Mesh in Reshaping Risk, Fraud & Compliance Operations

• Data Fabric: Backbone for Intelligent Integration

Data Fabric is rapidly emerging as the architectural backbone of intelligent financial data operations. By enabling a unified, AI-

driven data environment that supports dynamic access, policy enforcement, and real-time insight delivery, data fabric is useful in almost all operations within the banking environment. Data fabric leverages intelligent metadata, machine learning, and natural language processing to automate data cataloguing, enable quality checks, and access provisioning across systems. This massively reduces manual integration overhead while improving data discoverability and trust. For example, the IBM Cloud Pak for Data, which data fabric platform widely adopted by banks, offers integrated data virtualisation, governance, and model deployment capabilities, allowing financial institutions to build composable services that support real-time decisions and regulatory obligations [22]. With automated lineage tracking and AI model monitoring, the platform exemplifies how Fabric can underpin intelligent, compliant, and resilient financial ecosystems.

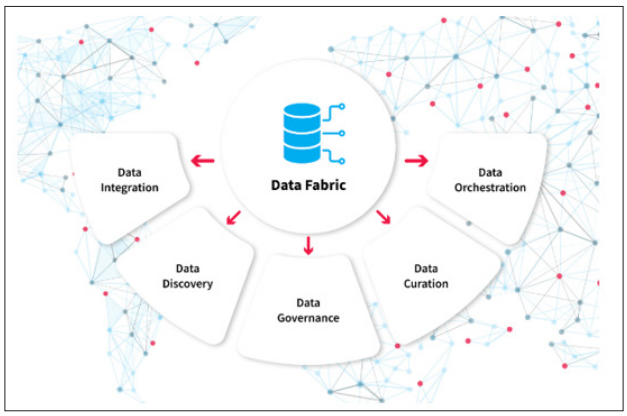

Figure 3: Data Fabric Infrastructure [23]

• Data Mesh: Empowering Domain-Led Innovation

While data fabric offers enhanced integration and intelligence, data mesh introduces an operational model that empowers individual domains to innovate with autonomy and accountability. The core concept of data mesh is decentralisation and the "data as a product" concept, which requires domain teams to consume and produce high-quality, reusable data outputs [24]. In fraud management, data mesh allows each line of business, from retail cards, corporate payments, to mobile banking, to develop and refine fraud detection algorithms unique based on their needs, level and type of threats they face. On the other hand, while dealing with compliance with the regulatory framework, Data Mesh supports rapid iteration and deployment of country-specific models for risk scoring given its decentralisation. Real-time updates to compliance models, facilitated by version-controlled data contracts and federated governance, allow institutions to remain agile amid constantly evolving regulatory landscapes.

Key Use Cases of Data Fabric and Data Mesh in Banking

Fraud Detection and Prevention

Fraud detection in modern banking has evolved into a real-time, data-intensive operation that requires sophisticated tools capable of analysing massive and multidimensional data to cope with the growing complexity of fraud threats. Data fabric offers an efficient and sustainable fraud detection and prevention approach by enabling the seamless integration of behavioural, transactional, and third-party data across systems [25]. Within the unified analytical layer offered by data fabric, machine learning models and natural language processing are able to operate efficiently to uncover anomalies that would otherwise be missed by traditional rule-based systems [26]. Data Mesh complements these capabilities by allowing regional fraud detection teams to develop and deploy customised fraud alert rules based on local behaviour patterns. The combined use of Data Fabric and Data Mesh offers a comprehensive and agile fraud management ecosystem capable of responding to the constantly shifting tactics of fraud actors across geographies and products.

Risk Management

Risk management is critical for portfolio optimisation, asset management, and credit management in the banking sector. To support this critical role, there is a growing demand for real-time insights and adaptive modelling. Banks need to account for various factors, from borrower behaviour and market dynamics to ESG factors. Data fabric offers effective solutions by integrating key factors, such as ESG disclosures, credit risk scores, macroeconomic indicators, and even sentiment data into a unified analytical environment [27]. This integration allows analysts to assess both traditional and emerging risk vectors simultaneously, improving the precision of portfolio exposure analysis, adopting effective risk assessment, and liquidity forecasting. At the same time, Data Mesh introduces the ability to run domain-specific testing and scenario modelling across business units, which enhances risk management.

Regulatory Intelligence and Reporting

Financial institutions are under pressure to comply with regulatory requirements established by authorities such as Basel IV, MiFID II, GDPR, and FATCA. This is a challenge as regulations are dynamic and are consistently changing. AI tools embedded in Fabric architectures are able the use Natural Language processing for converting complex datasets into regulator-friendly narratives, attaining the compliance goals of regulatory frameworks that require clarity, auditability, and speed [28]. Data Mesh supports this functionality by allowing each regulatory team to maintain its compliance data pipelines.

Challenges in Adoption and Implementation

Technical Challenges

Effective transition from traditional system to data fabric and mesh infrastructure is technologically demanding, particularly in banks that operate on legacy infrastructure. According to, many financial institutions are still reliant on monolithic core banking systems, mainframe environments, and outdated ETL processes that were not designed for real-time, federated architectures. Integrating such systems with modern AI and machine learning platforms and dynamic data fabrics requires a massive overhaul of their systems, re-engineering, and significant investment. This is a barrier for banks that have no resources to invest [29].

Organisational and Cultural Resistance

Organisational resistance is also a significant barrier hindering successful adoption. Many banking institutions already have centralised IT and data governance teams that are not accustomed to the decentralised ethos of data mesh. Shifting decision-making power and data stewardship responsibilities to product or regional teams will meet resistance from departments that have long guarded control over data flows, which will slow the rate of adoption. Moreover, most banks lack sufficient numbers of qualified data product managers, a role essential in mesh architectures for ensuring quality, documentation, and lifecycle management of data assets. Without this role, data products risk being under-defined, inconsistently maintained, or unfit for reuse across teams, making it impossible for firms to realise the full benefits of the technologies.

Conclusion

Data fabric and data mesh represent transformative data strategies and promising solutions to key challenges facing the banking

sector. The strategies address the critical demands for real-time insight, compliance agility, and fraud resilience within the current banking world, where speed, security, and privacy are required, while navigating a sophisticated fraud environment. Data fabric ensures unified access, intelligent integration, and automation, while data mesh empowers domain teams with the autonomy to innovate responsibly and in a decentralised format. The combined use of these strategies enables banks to move beyond siloed legacy systems toward dynamic, scalable architectures that meet evolving regulatory and operational pressures. However, to enjoy the full benefits, there is a need to navigate significant technical and governance challenges. With strong leadership, federated governance, and strategic investment, these architectures can unlock measurable improvements in risk control, compliance, and customer trust.

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