Chapter 6
AI-Integrated Data Governance Frameworks for Real-Time, Scalable, and Ethical Data Architectures

Rituraj Jain
https://orcid.org/0000-0002-5532-1245
Marwadi University, India

Adalbert Musengamana
Marwadi University, India

ABSTRACT

In the context of modern big data environments, this chapter explores how data governance reshapes the portrayal and management of data—an essential factor in maintaining data quality, security, and compliance. This underlines the fact that data has not only become a record-keeping asset, but also a strategic driver of insights and decisions. Against the volume, velocity, variety, and veracity challenges that characterize big data, this chapter surveys flexible, integrated, adaptive governance frameworks based on a core reflection of elements of compliance, real-time access, data stewardship, and security. It analyzes practical issues, such as no architecture, no visibility of the data, and no sponsorship, and develops solutions for automation, balancing accessibility with security, and promoting data literacy. Firms, such as Airbnb, Uber, and GE Aviation, provide tangible examples of good governance. Finally, the chapter discusses future trends, such as AI, NLP, and hybrid cloud innovations, that would create sustainable data-driven ecosystems.

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1. INTRODUCTION

1.1 Significance of Data Governance in Big Data Ecosystems

In today's data-driven landscape, organizations increasingly rely on data-derived insights to enhance speed, innovation, and competitiveness. This reliance has grown with the integration of artificial intelligence (AI), which transforms data into a strategic asset for real-time analytics, predictive modeling, and intelligent automation. However, without robust data governance, AI-generated insights may become unreliable or non-compliant. Effective data governance ensures data integrity, consistency, and adherence to legal and ethical standards, safeguarding against risks such as data breaches, regulatory penalties, and poor decision-making (Fattah, 2024; Prakash, 2024; Sadiq et al., 2022).

Governance plays a critical role in fostering trust and accountability across big data ecosystems. It enables organizations to adapt to shifting market or regulatory demands without undermining stakeholder confidence (Chukwurah et al., 2024; Nwobodo et al., 2024; Dam et al., 2023). As organizations manage vast volumes of information from customer interactions, market trends, and operations, governance provides a structured framework ensuring security, reliability, and accessibility. Moreover, AI's success in extracting meaningful insights depends on the quality of underlying data. Governance frameworks help mitigate inaccuracies, biases, and compliance risks by establishing clear policies and standards. Especially in high-stakes sectors like healthcare and finance, data governance can define the boundary between success and failure (Antwi et al., 2024).

Data governance is now one of the most crucial planes in contemporary business and is driven by paper-driven data. As a result of the growth in the number of organizations that rely on huge volumes of information, data governance has become an essential issue to derive meaning or insight from the data and be innovative. The history of research in this area of study has shown how data science has evolved over the years, where data was once an outcome of operations processes to a value adding strategic resource out of which wise decisions can be made.

Notably, the idea of data governance has been developed owing to the increased complexity of data ecosystems. The earlier methods were a type of data integrity and standardization exercise that was largely operation-limited. When big data appears in the form of the '4Vs' or volume, velocity, variety, and veracity, the conventional ways of governance become ineffective, and it has become an oxymoron to mention governance of big data.

Most of this information is due to the enormous amount of information that can be generated from customer interaction, operations, and market trends, and according to researchers, the current methods of storage and processing have become

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