Data 4.0: making your data Al-ready

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Foreword

Artificial Intelligence (AI) and Generative AI (GenAI) are transforming how businesses operate, innovate and compete. However, one crucial factor underpins their success: data quality. Just as advanced algorithms and powerful computers are essential, so too is the quality of the data they rely on. Today, high-quality data forms the backbone of modern business operations.

Effectively leveraging this data, however, presents its own set of challenges. The speed and accuracy of Al outputs depend on accessing current, relevant datasets, while poorquality data can lead to flawed outcomes. This growing recognition of data's importance has driven a significant evolution in data management, moving from simple digital records to sophisticated, cloud-native data stacks. These systems, provide flexibility, scalability and integration capabilities, which are key to unlocking Al's full potential.

Data 4.0 marks a major leap forward by treating data as a central, strategic asset essential for digital transformation. It adopts cloud-native, metadata-driven approaches and harnesses intelligent automation to deliver operational insights at scale.

This report provides timely, practical guidelines grounded in real-world experiences and a forward-looking view of how organizations should assess their data landscape. It traces the evolution of data management and introduces a seven-pillar framework for Al-ready data, addressing both technical and strategic aspects, while aligning data initiatives with business goals.

As we progress towards an 'agentic future' where AI systems grow increasingly autonomous, the data foundations we build today will shape our success. The era of GenAI is not a distant prospect – it is unfolding now. Organizations that prioritize data readiness today will lead tomorrow, harnessing AI's potential to drive innovation, efficiency and growth.



Alexy Thomas Partner, Technology Consulting EY India

Foreword

"Your research is only as good as your data" "Your analytics are only as good as your data" "Your conclusions are only as good as your data"

These and similar expressions have been bantered about for many years. We hear expressions like these used, but are firms actually adopting what they are saying? Well, in this new world of AI/GenAI, they better be!

Data and the processes and disciplines in managing data are more important today than ever before. Truly managing data as a strategic asset is no longer a 'nice to have', but mandatory to the success of any organization. And especially today, as organizations strive to embrace AI and GenAI to enhance their businesses, understand their markets, improve customer service and increase efficiency, recognizing how critical data is to these new technologies is paramount. "Your AI is only as good as your data" is the term we must all now embrace!

In the following paper, Alexy Thomas, Partner at EY, does an outstanding job of laying out the argument for data management adoption. What is so well done in this paper is not that you'll find anything particularly new, but that you'll find how Alexy leverages the various known capabilities of data management and aligns them in a clear and constructive way, making the case for data management as fundamental to your Al program and success.

Alexy presents the three critical areas of data readiness - data integrity; data management and database performance and ties them to the key considerations of Al-ready data - incorporating data governance; enhancing data discoverability and modernizing the application stack. It is this construction of concepts which he refers to as "Data 4.0". He expands on these concepts by emphasizing the importance of leveraging today's cloud technologies; building a strong foundation of metadata management and data cataloging and providing transparency and improved access to data while protecting and ensuring data is being used effectively and ethically.

And why are these so important? Because firms face significant challenges to the success of their AI programs without embracing disciplined data management. The EDM Council, approaching our 20th year anniversary as the global data management association, has been a champion of raising the awareness of foundational data management best practices through the promotion of the DCAM (Data Management Capability Assessment Model). As you read about the 7 pillars of an AI-Ready data framework so well-articulated in this paper and you'll see how data management best practices will be the stepping stone to a successful AI program.

If you believe that 'your AI is only as good as your data', then review and embrace the concepts provided Alexy Thomas in this paper. As a data management practitioner for decades, I can say with confidence that Alexy has successfully made his argument for the importance of data management for AI!



John Bottega President EDM Council

Why do businesses need Al-ready data?

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Why do businesses need AI-ready data?

In the past two years, the world has witnessed an unprecedented surge in AI capabilities, ushering in a new era of technology. The rise of Generative AI (GenAI) has accelerated AI's evolution into a truly general-purpose technology, democratizing access and spurring creative experimentation across all sectors. Enterprises worldwide are swiftly moving beyond point solutions, integrating horizontal AI applications across internal functions to achieve sustained competitive advantage. As AI continues to reshape the global technological landscape, India is emerging as a key player. Poised to become one of the largest markets for AI, the country is transforming into a massive playground for AI applications that drives enterprise growth and productivity.

Investments in consumer-facing technology, next-generation supply chains, and intelligent automation platforms have the potential to lead with an AI-first approach, leapfrogging legacy paradigms. The EY CEO Outlook Pulse Survey 2024 reports that 99% of CEOs are planning to invest in GenAI. GenAI implementation could give a significant boost to India's GDP. According to an EY study, this could be US\$359 billion to US\$438 billion in fiscal year 2029-30 over and above the baseline estimates, representing a growth rate of 5.9% to 7.2% that year.

Al advancement relies on sophisticated algorithms, computing power, and vast amounts of high-quality enterprise data. This data is crucial for decision-making, customer interactions and operations across industries. The Al value chain benefits from enhanced data and analytics capabilities, improving everything from personalized recommendations to automated screening.

Data quality and quantity are critical for AI success, including GenAI, machine learning and analytics. Poor-quality data can lead to inaccurate results, while implementation speed depends on current, relevant datasets. Organizations that build an open and trusted data foundation will best leverage their data assets.

Integrating structured and unstructured data

Structured datasets have historically provided a foundation for traditional AI development, as they are typically concerned with numerical or categorical prediction, pattern recognition or automated decision-making. However, future AI applications, especially GenAI require the diversity and depth of information that comes from semi-structured and unstructured data, including video monitoring and company records as the neural networks are designed to model complex, non-linear relationships using a graph data structure. This data that is typically stored in file systems, DAM systems, CMSs and version control systems can provide highly valuable Al insights grounded in customer information.

In sectors like financial services, banks possess a treasure trove of customer data due to long relationships and frequent interactions across various channels. This presents a golden opportunity to gain deeper insights into their customers and organizations are yet to tap into it fully.

Insufficient access to unstructured data can result in incomplete and inadequate view, potentially impeding AI development and adoption.

There are three critical areas for data readiness. They are:

- ► Data integrity
 - > Ensure high-quality, consistent data across all sources
 - Implement rigorous data cleansing and validation processes
 - Regularly audit data for accuracy and completeness
- Data management
 - Develop a comprehensive data governance strategy
 - Key components to consider include
 - a) Data lifecycle management
 - b) Tagging and classification systems
 - c) Company data dictionaries
 - d) Reference and master data management
- ► Database performance
 - Optimize database structures for AI workloads
 - Ensure scalability to handle increased data processing demands
 - Implement efficient data retrieval mechanisms

GenAl relies on a strong foundation of data maturity, which involves an organization excelling in both integrating data-through processes like moving and transforming itand managing its governance. Without data maturity, the prototyping, deployment and effective testing of GenAl-or any type of analytics-become very challenging.

Leveraging unstructured data for Al success

Indian organizations are still in the journey of maturing their data management. To harness the full potential of GenAl applications, businesses must effectively adopt a strategic approach to balancing technology, people and processes. Organizations can tap into their unstructured data effectively by aligning data strategy with Al objectives that include reassessing strategic objectives for data in light of GenAl advancements.

Imagine owners of a small business applying for a loan through a bank's online platform, where they interact with an Al-powered financial advisor for personalized guidance. To be effective, the Al needs access to a variety of data sources: structured data such as the applicants' financial history, tax returns, credit scores, existing loans and account balances; as well as unstructured data including business performance, market trends and economic forecasts; and internal bank data with up-to-date lending regulations and compliance requirements.

The AI system must analyze both structured and unstructured data to offer accurate advice and navigate the loan application process effectively, all while adhering to financial regulations and data protection laws. If the AI system cannot properly access or interpret these data sources, there is the risk of providing incorrect loan eligibility information, unsuitable product recommendations, or overlooking critical financial factors, which could lead to poor decision-making and potential financial or regulatory issues for both the bank and the business owners. The consequences of poor data integration in this scenario could be severe, potentially resulting in financial losses for both the bank and the business owners, damaged customer relationships or even regulatory compliance issues.

By implementing a comprehensive strategy to leverage unstructured data, businesses can significantly enhance their AI capabilities, leading to more accurate, personalized and valuable AI-driven services across various industries and applications. For instance, a global bank is leveraging information from its social media handles to identify potential customers and assess credit risk. By analyzing this unstructured data, the bank has expanded its ability to offer credit to a wider range of customers while simultaneously minimizing default risk.

Data requirement and sources

While businesses and governments think about data access, it is important to keep in view that data requirements and issues pertaining to data access will vary by industry. For instance, in the financial services sector, AI applications focus on customer experience, product design and risk management, requiring diverse datasets like customer interactions, market data and financial records while healthcare relies on patient records, medical images and regulatory data for clinical services, outreach and compliance. Retail and agriculture emphasize product design, procurement and production planning, utilizing data on market research, soil conditions and logistics.



The following table summarizes a few examples of AI use cases and their corresponding data requirements.

Industry	AI Use Cases	Data Requirements
Financial Services	Product and service design and innovation	Includes customer, market and competitor data
	Improving customer experience through Virtual Assistant enabled conversations	Includes summaries of past customer interactions, key concerns and FAQs
	Document creation for underwriting	Includes past documents, SOPs and product characteristics
	Marketing and sales	Includes e-mail data, product documents, onboarding guides with text, audio and video, sales data, customer data, customer profiles and credit history
	Collections, recovery and attrition control	Includes user data, cashflow/bank statements, KYC data, payment schedules, regulatory requirements and risk management data
Healthcare	Clinical services and operations	Includes patient healthcare data and records, disease report databases, medical images, patient test reports and research data
	Community outreach	Includes data pertaining to key health concerns for Al- based content creation and personalized engagement, and virus and disease data tracking for early detection of breakouts
	Audit and compliance	Includes regulatory data, digital forensics and compliance requirements
	Product, design and research	Includes product and packaging data, structures, material and ingredients data and design blueprints
	Procurement, manufacturing and quality assurance	Includes contracts data and documents, logistics and inventory data and quality control information
Retail	Sales and marketing	Includes market research and product category data, product descriptions and insights
		Includes user-level data to create buying recommendations, warranty, refunds and repairs data
	Store operations and staff management	Includes store level customer and inventory insights, product descriptions
Agriculture	Production planning	Includes soil mapping data, food supplies and prices data, subsidies data, provenance of crops, organic certification, and other data points collected at Mandis
	Irrigation management	Includes groundwater availability, data about pipeline infrastructure and efficiency, data about power subsidies, historic rainfall information, soil moisture data, river flow data, flood data and soil moisture
	Crop protection and management	Includes data pertaining to crop insurance schemes, climatic forecasts, weather forecasts/pattern, crop storage infrastructure data, and data pertaining to costs and availability of pesticides and insecticides, historic disaster damage data, drone data and other data relevant for underwriting
Tech Services	Application development and support	Includes data of past coding models, automated response management, data engineering models and UI/UX designs
	Business process management	Includes processes data, customer experience data
	Infrastructure and operations	Includes contract data, past incident and response data
	Marketing	Includes marketing data, content data and customer data

Industry	Al Use Cases	Data Requirements
Government Services	Efficient policy drafting and data-driven decision making	Includes datasets on public consumption, expenditure, data on key governance indicators like education and healthcare etc., government statistics and data reports through M&E systems
	Enhancement citizen engagement	Includes personalized AI content, engagement on draft policies, government policies and schemes and grievance redressal
	Automated report generation	Includes KPI tracking data, public expenditure and impact data
Media	Schedule and distribute content	Includes audio data for subtitles and captioning, rights management and fact checking for fake news, platform use data
	User engagement and monetization	Includes user analytics/demographics, viewership tracking and user preference profiling/behaviors
	Prevent the spread of misinformation	Includes integrated databases to flag inaccurate news, social media streams and news streams

Accessing the benefits of data

Optimizing data for AI unlocks an organization's growth potential. A consolidated, secure and compliant data ecosystem enables gaining insights, hidden trend discovery and accurate predictions. AI models also can deliver faster, reliable and accurate outputs.

This data-driven approach empowers seamless team collaboration and strategic focus. Analysts can dive into higher-level analytics, while data scientists freely explore frontiers, catalyzing transformative breakthroughs.



How organizations can leverage Al and its interconnectivity to core data capabilities

Critically, this foundation boosts revenue through enhanced customer engagement, cross-selling, upselling and digital marketing optimization. For instance, if a customer is buying a camera through an ecommerce platform, the platform can analyze photography-related hashtags and discussions to recommend trending accessories or techniques for crossselling. If many camera customers ask about low-light photography, it can prioritize recommendations for low-light optimized lenses or accessories. Similarly, by mining product reviews, analyzing customer support interactions, leveraging user behavior data for personalization, applying image and video analysis for context-aware suggestions, the platform can also present an upsell opportunity.

By harnessing data's full potential, the organization positions itself for sustained growth and market leadership, elevating competitive edge in today's data-driven landscape.

Newer revenue models allow users of data-driven AI to make faster decisions and swiftly adapt to changing market dynamics. By leveraging the right data in AI models, organizations can identify potential revenue streams and extract value from the marketplace more effectively. While AI-driven business models serve as powerful growth drivers, it is crucial to understand both what AI can do and how to leverage it for maximum benefit. The financial advantages of data-driven AI extend beyond direct revenue generation and cost savings. Organizations can create new business models in adjacent industries, access previously untapped markets and achieve significant cost optimizations. These optimizations come through productivity enhancements, infrastructure savings and reductions in operating expenses.

Data monetization represents a powerful opportunity for organizations to create tangible economic value from their data assets and AI capabilities. This can involve developing new data products, enhancing internal business performance, gaining competitive advantages and addressing industry-wide challenges. A company can also potentially sell or license its datasets or AI models (trained on its proprietary data) to other businesses or third parties. By leveraging unique data insights, companies can differentiate themselves in the market and even expand into adjacent industries or new markets. **Servicing customers better** by leveraging AI algorithms to analyze customer behavior and preferences, businesses can tailor their offerings, create personalized communications, and identify high-potential leads, ultimately driving sales and customer loyalty.

Operational efficiency is another key advantage of investing in data and AI. These technologies enable scalable operations, allowing businesses to handle increased volume without proportional cost increases. AI-driven process optimization and resource allocation can significantly reduce inefficiencies, leading to improved productivity and reduced operational costs. For instance, manufacturing plants can optimize production schedules, while retail chains can better manage inventory distribution based on AI-predicted demand.

By strategically implementing data-driven Al initiatives, organizations can realize these multifaceted benefits, leading to improved financial performance, enhanced competitiveness, and long-term sustainability in an increasingly data-centric business environment. The key lies in aligning Al strategies with business objectives and effectively leveraging both structured and unstructured data to drive informed decision-making and innovation across all aspects of the organization.

Key considerations for Al-ready data are:

- 1. Incorporating governance into data architecture
- 2. Enhancing data discoverability
- 3. Modernizing application stacks to support innovative AI applications and enable agile, datadriven processes

The evolution towards Data 4.0

The evolution towards Data 4.0

Data - a brief history

The origin of data-driven problem-solving can be traced back to the 17th century when John Graunt, a London haberdasher, pioneered mortality data collection. This nascent field evolved significantly through the centuries, with people like Florence Nightingale leveraging data visualization to revolutionize medical practices, and Edgar Codd's groundbreaking conceptualization of relational database management systems.

Later, digitization and enterprise data available in digital forms have led to data being used for decision-making, from descriptive to prescriptive to predictive and then to generative. Evolution of data usage and technology can be traced to four revolutionary leaps analogous to the industrial revolution.

Data 1.0: The dawn of digital

The 1980s heralded the era of personal computing, democratizing access to data analysis tools. This period saw data primarily confined to specific business applications, largely in non-digital formats. Organizations started creating data bases and data marts to generate reports.

Data 2.0: Rise of enterprise data

As internal processes became digitalized and organizations built enterprise-wide systems, the need for an enterprisewide view of information arose. Enterprise data warehouses emerged, with analytical applications and reporting tools like Teradata, Vertica, and Greenplum powering advanced reports and visualizations primarily for regulatory and finance reporting.

Data 3.0: The big data revolution

This marked an era of unprecedented growth in data volume, variety and velocity. This surge was driven by the proliferation of smartphones, sensors, connected vehicles and other digital devices, which now auto-generate vast amounts of data. However, the true catalyst for this explosion in data was the increasing utility of data analytics and the automation of decisions based on these insights. The 'big data' phenomenon required the development of novel tools and methodologies to effectively process and analyze these vast data sets. Organizations made significant investments in sophisticated programs to harness and explore these extensive data lakes. This era brought both tremendous opportunities and challenges, from advanced analytics and artificial intelligence to data quality, monetization, privacy and security.

Despite the advancements, much of the data work within organizations remained focused on foundational tasks. These included adding new fields to databases, aligning disparate systems, defining metadata, implementing basic governance, deploying business intelligence systems and preparing data for machine learning algorithms. Companies collected more data than ever before in their quest to transform their operations and make data-driven decisions, yet a considerable portion of the work was still centered on maintaining essential data infrastructure and processes.

Data 4.0: Data-first architectures: powering intelligent applications

Data 4.0 represents a significant evolution in how organizations approach data management and utilization. It is a cloud-native, metadata-driven paradigm that leverages intelligent automation and trusted insights at an operational scale. Unlike previous data strategies, Data 4.0 treats data as a central, strategic asset, essential for driving digital transformation and enabling organizations to remain competitive in a rapidly changing technological landscape.

Moving beyond traditional storage, processing and analysis to offer a more integrated and intelligent approach, Data 4.0 leverages cloud infrastructure for scalable and flexible data solutions, addressing the challenges of increasing data volume and complexity. Modern data stacks are characterized by cloud-native data lakehouses built on open architectures, utilizing open formats, standards and opensource technologies. Data catalogs have become as crucial as the data stores themselves and open formats enable various engines, such as SQL engines, search engines, analytical workloads and AI-powered conversational storytellers - to efficiently access and operate on the data. This approach allows for greater flexibility and specialization in data processing and analysis, as different tools can be used for specific purposes while all accessing a common, wellorganized data resource.

This version also introduces concepts such as data as a product, responsible data science and explainable AI, which are essential for building trust and ensuring ethical use of data. Data 4.0 is characterized by the following key pillars:

- 1. Explainable AI: Ensuring transparency in AI operations to build trust and facilitate widespread adoption.
- Responsible data science: Prioritizing ethical considerations in data handling and algorithmic deployment.
- 3. Edge computing: Decentralizing data analytics to optimize speed and efficiency.
- 4. Data democratization: Broadening data accessibility and comprehension to empower decision-makers at all levels.

The impact of Data 4.0

Data 4.0 is transforming how organizations operate on their data. This shift is enabling organizations to power every aspect of their operations, enhance customer and employee experiences and drive innovation through advanced analytics and AI. The following are key ways in which Data 4.0 is changing organizations:

- Data at the center:
 - Data is becoming the backbone of all technological processes, driving efficiency and innovation.
 - Improved data management leads to better customer and employee experiences by enabling more personalized and responsive interactions.

- ▶ Data as a product:
 - Valuable asset: Like software, data is now considered a valuable asset that must be developed, tested and delivered with care.
 - Dedicated teams: Organizations are creating dedicated teams for the development and delivery of data products, which are designed to be easily discoverable and consumable through self-serve platforms.
 - Quality and consistency: Standardized data models and rigorous testing ensure that data products are reliable and interoperable across various systems.
- Self-serve data architecture:
 - Data catalogs: Centralized repositories provide metadata about data assets, making it easier for teams to discover, understand and utilize the data they need.
 - Open and headless architecture: Organizations are adopting open and headless architectures that support a wide range of applications, including analytics, internal tools and APIs.
- ▶ Interacting with partners through data sharing:
 - Real-time insights: Organizations are leveraging realtime data to gain insights into leading indicators and key performance indicators (KPIs).
 - Collaborative data sharing: Data sharing with strategic partners is becoming more prevalent, enabling more informed and agile decision-making. Architectures for sharing data like data clean rooms enable collaborative data sharing by providing controlled access, secure data sharing, supporting data governance, preserving privacy by techniques like differential privacy, k-anonymity and data perturbation.



Data technology evolution

Data 1.0: The Foundation

Era: Early database systems

Key Features:

Creation of data marts

Technologies:

- Oracle databases
- SQL databases

Data 2.0: Enterprise Scale

Era: Enterprise data warehouses

Key Features:

 Analytical Appliances and MPP Databases

Technologies:

- Teradata
- Vertica
- ► Greenplum
- Netezza

Data 3.0: Big Data Revolution

Era: Hadoop ecosystem

Key Feature:

Data lakes

Technologies:

- Hadoop Distributed File System (HDFS)
- ► MapReduce
- ► Hive, Pig, etc.

Data 4.0: Modern Data Stack

Era: Cloud-native, intelligent systems

Key Features:

- Data catalogs
- Open format storage
- Open and headless architectures
- Data Products
- ► Automated Governance
- ► AI Powered

Technologies:

- ► Cloud Data Platforms
- ► Snowflake, Databricks
- ▶ Starburst, Trino
- ▶ Iceberg, Delta, Hudi
- ▶ Spark, Airflow, DBT



What goes into making Al-ready data

Broadly speaking, Al-ready data can be defined as something that is readily available and accessible on a unified platform in user-based formats. However, the technology itself is evolving and so are the standards that define Al readiness, which will have a direct impact on value-cost equations for enterprises. Notwithstanding the changes and interpretations, any Already data has certain core features:

Comprehensive metadata provides the correct context so that users get the necessary information that is of high quality at the right time. Active metadata ensures that all sections of the data ecosystem are always available, accurate, intelligent and oriented towards execution. Comprehensiveness and recency of metadata allow AI systems to deliver business value.

Lineage information and provenance, which shows the data flow path - from origin to all levels of transformation - gives visibility into how the metadata was built and allows tracking of all changes to ensure data quality. As organizations have data on various systems and in different formats, data lineage is necessary to be able to define data strategies, improve quality and ensure effective use of information. Comprehensive, accurate and traceable data is essential to derive value from AI solutions. Data provenance will provide a documented trail that accounts for the origin of a piece of data and where it has moved from to where it is now.

The **fit-for-purpose** element of Al-ready data makes highquality data relevant. Organizations house large quantities of information. Structuring it in a way that sharpens applicability by qualifying the use makes access for users easier, faster and more pertinent. There are clear distinctions between data requirements of different teams and data readiness must reflect that for the Al solutions to produce meaningful output.

Organizations are responsible for **securing** their data to prevent misuse. Secure data makes AI applications trustworthy, allowing organizations to use as well as offer secure access to authorized stakeholders. Data exchanges are complex and can involve internal and external providers, which further underlines the importance of security protocols to prevent lapses that can lead to significant risks.

A robust data **governance** framework and relevant data management policies can enhance an organization's data maturity. A high level of data governance improves transparency and auditability. More importantly, it is a way to ensure ethical, legal and responsible use of data in addition to articulating the organization's approach to risk and response in policy and practice.

Along with this, organizations must approach data readiness initiatives by adhering to privacy regulations like the Digital Personal Data Protection Act (DPDP Act), 2023.

Compliance should be woven into the fabric of data management, ensuring data is collected lawfully and transparently, processed with clear purpose, stored securely and accessed only by authorized parties. By prioritizing data minimization, accuracy and storage limitation, companies can build trust with customers while maximizing the value of their data assets in a responsible and compliant manner.

Al-ready data means:

- ► Data is a product
- Data seamless integration
- Shared asset across the organization and subsidiaries
- Users require adequate access to data
- Security is essential
- Data should be curated
- Data is compliant
- Data flow should be optimized for agility

Current challenges and gaps

In making their data Al-ready - which is available, accessible and trustworthy - organizations usually face many challenges. According to one metric¹ about 87% of data science projects do not reach production because of siloed and ungoverned data as well as underdeveloped data infrastructure. There are both technological and organizational elements to it.

Technological challenge:

Data silos: Many organizations struggle with data silos, which makes their enterprise data inaccessible and incompatible with AI solutions. The Nasscom-EY AI Adoption Index 2.0 report highlights this issue in Indian enterprises, revealing that 32% of organizations do not have data back-end ready for AI. Of the other 68%, majority focuses on data accessibility, reflective of the still existing BU-enterprise data silos. Data silos often result from decentralized teams, acquisitions, rapid business growth and separate IT deployments.

1. https://venturebeat.com/ai/why-do-87-of-data-science-projects-never-make-it-into-production/

These silos create several issues, such as:

- Limited cross-organizational data access
- Dataset incompatibility
- Insufficient Al-ready data
- Inefficiency from data duplication
- Heightened security and compliance risks

To effectively implement AI, it is crucial to break down these silos, integrate data architecture, and facilitate information sharing across the enterprise. This integration is key to creating comprehensive datasets that drive successful AI solutions.

Bad data quality: Poor data quality, characterized by a lack of accuracy and integrity, significantly affects AI outputs and business operations. It can cause transaction processing errors and faulty analytics results. High-guality data, possessing validity, consistency, timeliness, completeness and accuracy, is crucial for effective decision-making and Al implementation. Maintaining data quality reduces costs associated with fixing data issues, prevents operational errors, and avoids business process breakdowns that could increase expenses and decrease revenues.

49%

of decision-makers don't trust the quality of their companies' Al data.²

data as the greatest digital

barrier to AI adoption.⁴

42%

37% of decision-makers cite a cite a lack of data lack of quality, unbiased interoperability as a

data.

39%

of decision-makers cite

privacy and the use of

barrier to AI adoption.⁵

consumer concerns about

Sources: 1 - EY CEO Outlook Pulse - October 2023, 2,3,4,5 - EY MIT Technology Review Insights

Legacy data architecture: Many organizations have traditional data architectures that follow centralized control. While that has its advantages, it can also lead to bottlenecks, slowing accessibility for users. Delays could make it difficult to scale data usage and innovate in data products and services as well as inhibit reliability.

Organizations possess a myriad of data types, ranging from customer interactions and transactional records to operational metrics and employee information. Building Al-ready data - defined broadly in terms of comprehensive metadata, lineage information, fit-for-purpose, security and governance - presents challenges. Addressing these is crucial for leveraging AI's full potential.

What happens if your organization's data is not Al-ready

Ineffective AI implementation	Al initiatives often fail to deliver expected ROI owing to model inaccuracies and an inability to scale solutions across the organization, resulting in significant resource waste
Data quality and governance pitfalls	Poor data integrity, inefficient governance and inadequate security measures impair AI performance and expose organizations to regulatory penalties and operational cost increases
Data quality and governance pitfalls	Inadequate or outdated infrastructure obstructs AI deployment and scalability, leading to performance bottlenecks, heightened risks and elevated costs stemming from non- compliance and security vulnerabilities
Change management and skill gaps	Organizational resistance and skill deficits hinder AI adoption and integration, resulting in extended deployment periods, suboptimal utilization, and a failure to achieve strategic transformation

Organizational challenges

Lack of strategy: Lack of strategy affects every stage of the data value chain, from collection and management to distribution and usage. Many organizations struggle with data literacy, hindering their ability to become data driven. It is crucial to integrate structured and unstructured data for better decision-making. Without a comprehensive data strategy, preparing data for AI becomes a significant challenge.

Talent shortage: According to Nasscom, India's data annotation and labeling services market is expected to be worth US\$7 billion by 2030 and engage a potential workforce of one million. Over the past years, there has been a significant increase in the requirement for professionals with expertise in data science resulting in a significant demandsupply gap for jobs like ML engineers, data scientists, DevOps engineers, and data architects ranging from approximately 60% to 73%.

Insufficient budget: Getting data Al-ready is expensive and time-consuming process.

That said, the success of AI adoption lies in embracing the evolving data trends while mitigating challenges.



Achieving Al-ready data

Achieving Al-ready data

Establishing a robust data foundation can lead to AI models with reliable results. Data preparation, storage, management and accessibility across hybrid cloud environments are crucial for driving innovation, creating new revenue models and enhancing productivity. A domain-driven approach helps in effectively managing data and AI initiatives across the organization. This involves categorizing data and AI capabilities into logical domains that align with business functions.

The most important thing is not just collecting the data, but cleaning and categorizing it to ensure that it is in a usable format. Otherwise, the organization is just paying to store meaningless data.

Begin your data journey by asking the right questions

01	Is your data infrastructure truly ready for AI?
02	How robust is your data platform?
03	How easy is it to access your data to enable GenAl use cases?
04	Does the company's governance framework sufficiently address key concerns and sustain trust?
05	What are the potential data risks associated with AI,

Al-ready data solutions build a robust pathway between an organization's data potential and its Al aspirations, setting a clear foundation for Al-enabled business transformation. A clear framework for data sharing incentives is necessary to facilitate the flow of data from private repositories.



As a first step, implementing a frictionless data framework is essential for long-term value. Al-ready data must be accessible, self-defining, and convey its constraints. Enhancing metadata cataloging, data product handling, and automating data access monitoring and provisioning are vital.

An effective AI-ready data strategy aligns with business goals, integrating adaptable knowledge management platforms with LLMs. It prioritizes accessible, self-defining data with enhanced metadata and automated controls. Establishing reliable master data sources, prioritizing critical data elements and maintaining flexible architecture are crucial. This approach ensures efficient AI adoption, balancing data value, risk management and architectural adaptability across the organization. Organizations must ensure compliance with regulations and data privacy laws while improving trust and securing data. This involves creating a robust framework that aligns with business goals and bridges data capabilities with AI objectives.

The seven-pillar AI-ready data framework



Knowledge

management

An adaptive and effective AI data strategy harnesses data value aligns with business goals, and bridges data capabilities with AI objectives. Regular technology updates help in ensuring maximization of potential.

Efficient knowledge management platforms are adaptable and capable of integration with LLMs. This might necessitate data restructuring to help ensure compatibility and effective usage within the LLM knowledge base.



Al-ready data must be accessible, selfdefining and convey its constraints. Enhancing metadata cataloguing, data product handling and automating data access monitoring and provisioning are vital.



Al-ready environments offer a superior context for transaction data. With master data serving as the GenAl context, it is vital to establish a single, reliable source for entities tied to all transaction data.

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Data risk and compliance Data products with automated risk and compliance controls are vital. For a quick Al adoption, robust, automated data controls are needed for data sovereignty, data privacy and compliance to regulatory requirements.

6 Data quality

Not all data in an organization is equally significant. Critical data elements demand resource allocation and observability in appropriate data products to ensure accuracy and user trust in Al-ready data.

Al-ready data architecture For organization-wide AI adoption, a flexible, quickly adaptable data architecture is essential. Utilizing sandboxes for PoC testing, tools like vector databases, and their ongoing management are vital. 1. Al-ready unified data strategy: Organizations need a unified data and Al strategy to effectively prototype, deploy and test Al solutions. A unified data strategy offers a clear roadmap for managing and governing data across all necessary capability components. It aligns with business value objectives and is supported by a defined funding model, ensuring its implementation and ongoing sustainability.

This strategy must align with business goals to enhance:

- Data quality
- Data governance
- Analytics capabilities

When data is trapped in silos or scattered across different systems and departments, AI's ability to deliver valuable insights is severely restricted.

A unified data approach

- Enables AI to deliver more accurate insights
- Improves decision-making processes
- Facilitates connecting the dots between disparate data sources
- Allows more effective AI deployments: a unified approach leads to more successful AI implementations
- Provides deeper insights: customers can harness data to gain more profound insights into their operations and market
- Allows faster growth: streamlined data processes contribute to accelerated business growth
- Increases efficiency: unified data strategies optimize resource utilization and operational efficiency
- Knowledge management: A robust data infrastructure should center around a cloud-based repository-be it a data warehouse, lake or lakehouse-serving as a single source of truth.

Traditional documentation often buries critical insights, making it difficult for businesses to leverage their full knowledge potential. To improve self-service and overall efficiency, organizations must prioritize maintaining a consistent and coherent knowledge management. It offers:

- Data storage
- Streamlined communication
- Information retrieval
- Knowledge sharing

Efficient knowledge management platforms are now evolving to integrate with LLMs. So, organizations should assess their current knowledge management practices to identify areas where LLM integration can provide the most value, invest in training and tools to maximize the benefits of LLM-enhanced knowledge management, develop strategies for continuous improvement and adaptation of their knowledge management systems.

This integration may require:

- Data restructuring to ensure compatibility
- Optimizing data formats for effective usage within the LLM knowledge base
- Developing new protocols for data management and retrieval

By embracing these advancements, businesses can position themselves at the forefront of knowledge management innovation, driving efficiency and competitive advantage in their respective industries.

3. Data governance

To establish a robust data governance model, organizations need to implement several key capabilities:

- Data protection: ability to block and hash sensitive data before it reaches our central repository
- Access control: automated user provisioning to manage data access rights efficiently
- Domain ownership: applying domain-driven design principles in architecture and empowerment of crossfunctional teams to own and manage their respective data domains
- Policy implementation: tools that facilitate the implementation of data management policies and standards by domain teams



Effective data governance yields numerous benefits:

- Enhanced data security
- Ensured compliance with regulations and data privacy laws
- Improved data quality
- Prevention of inconsistent data silos
- Increased trust in data
- ► Better decision-making processes
- Improved operational efficiency

A comprehensive data catalog is essential, acting as a centralized repository for metadata about organizational data assets across different domains. This catalog enables domain teams to easily discover, comprehend and utilize the data relevant to their business functions. To facilitate seamless data exchange between various domain teams, a service mesh should be implemented, ensuring efficient communication and data flow throughout the organization.

Implementing metadata management with proper metadata strategy, adopting metadata strategy and the right metadata management tool and other such measures form part of the strategy.

4. Master data management: Master data management (MDM) plays a critical role in providing a single, reliable source for entities tied to all transaction data. This is vital for creating Al-ready environments that offer superior context for transaction data. While implementing MDM, an organization should analyze the current data environment, the source of data, whether they are in silos, etc. It should also define your business goals, which could include:

- Up-sell and cross-sell opportunities
- Complete view of customers
- Improved data quality and business decisions
- Reduce costs of data maintenance and support
- Improved customer experience

This system should incorporate a tool capable of reliably and automatically ingesting data from various sources at scale, featuring rapid, timely updates and the ability to swiftly recover from failures. Additionally, it should support collaborative, version-controlled modeling and data transformation.

5. Data risk and compliance:

According to Gartner, 30% of GenAl projects are expected to be abandoned by 2025 due to poor data quality, inadequate risk controls, escalating costs or unclear business value. Creating a trusted data foundation is essential for enabling high-quality, reliable, secure, and governed data and metadata management to meet the needs of analytics and Al applications while ensuring data privacy and regulatory compliance. Failing to embed controls into data could leave organizations vulnerable to risk and attacks that could be expensive – or in the worst cases, even existential.

Using data without risk and compliance controls can lead to:

- Regulatory noncompliance
- ► Financial and reputational damage
- Erosion of customer trust

6. Data quality

Effective data quality management is crucial to mitigating risks. A well-designed data architecture strategy, such as a data fabric, provides a robust framework for data leaders to profile data, design and apply data quality rules, discover data quality violations, cleanse and augment data. Robust data quality means ensuring data integrity, consistency and reliability, leading to better decision-making processes. This can be achieved through:

Data observability: Continuous monitoring of data quality levels through data observability capabilities allows organizations to identify data issues before they escalate into larger problems. Data transparency: Transparency into data flows enables data and AI leaders to identify potential issues, ensuring that the right data is used for decisionmaking.

By prioritizing data quality and governance, organizations can build trust in their AI systems, minimize risks and maximize the value of their data. It is crucial to recognize that data quality is not just a technical issue, but a critical business imperative that requires attention and investment.

7. Al-ready data architecture that is open and headless

An open and headless data architecture will make data access easy and pluggable to where you need it. With this architecture, a company can manage its data from a single logical location, including permissions, schema evolution, and table optimizations. And, to top it off, it makes regulatory compliance a lot simpler.

Adopting open table formats enhances interoperability and flexibility in data storage and processing. A decoupled architecture allows for greater flexibility and extensibility in managing data and AI components.

Polyglot storage: A polyglot storage approach allows for efficient handling of diverse data types, including structured, semi-structured, and unstructured data. Polyglot also supports multiple languages and readily adapts to the use of SQL, NoSQL or hybrid database systems. The most important factor to understand is the data flow within the organization.

Storage options

Object storage: Ideal for large volumes of unstructured data, as it is highly scalable and cost-effective.

SQL databases: For structured data with well-defined schemas.

NoSQL databases: For flexible schemas and semi-structured data.

Graph databases: Store and query relationships between entities.

Vector embeddings: Enable storage and retrieval of "embeddings" (high-dimensional representations of various media). Make data interpretable by foundation models.

In the coming decades, what goes around with databases will continue to come around². Thus, the current databases will be insufficient but there will be new query languages and data models to overcome these problems. To accelerate the next generation of database management systems organizations should stay ready.



Organizing data into consumable products

Data is only valuable when understood in context. Context allows us to see how different data sets relate to each other, leading to deeper insights. Therefore, integrating data context is essential in any data management strategy. Across the industry, various strategies, such as data mesh and data fabrics, are emerging to improve data access. These strategies require advanced metadata management frameworks that facilitate the seamless movement of data across silos. By enhancing metadata management, data context can be elevated to a business level through data enrichment.

Al powering data; data powering Al

Al and data have a symbiotic relationship: Al techniques enhance data quality and preparation, while high-quality data fuels more effective Al models. Leveraging AI, including GenAI, across the entire data value chain can be highly beneficial. Utilizing AI to analyze vast datasets, enabling organizations to make data-driven decisions that optimize operational efficiency and reduce costs.

GenAl can be applied throughout the data value chain, including:

- Sourcing data
- Modeling data into products
- Creating data pipelines for consumption

A more powerful use of GenAI is to leverage an organization's unique data and context from its operations. Organizations typically generate vast amounts of text through contracts, blogs, call transcripts, chat applications, project management tools, emails and internal documentation. A large language model trained on this data can answer domain-specific questions, summarize text, translate languages, adjust tone, and extract issues, themes and sentiments. Essentially, a large language model with access to an organization's accumulated data can become the most knowledgeable "member" of the organization.

GenAl uses natural language processing to provide contextual search results. For example, an appropriate GenAl tool can make ESG data more accessible and assist employees in understanding sector-specific nuances, compliance insights and operational efficiency.



Other key elements to consider

- Central role of data platform in tech architecture: Positioning the data platform at the center of the organization's technology architecture is key to driving data-powered innovation across all aspects of the business.
- Robust and scalable data pipelines: Developing scalable and flexible data pipelines ensures reliable data flow and optimizes data sourcing for best performance.
- Seamless data integration: Efficient integration of data from various sources is crucial for creating a comprehensive and accurate data foundation for AI.
- Real-time data enablement: Enabling real-time data processing and analysis is essential for powering AI applications that require up-to-date information.

Data readiness and governance for Indian enterprises

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Data readiness and governance for Indian enterprises

As companies accelerate their data strategies to harness the power of GenAl, India is on the verge of becoming a datadriven economy. The EY-Nasscom Al Adoption Index 2.0 report highlights how data standardization among Indian firms has improved significantly since 2022. Over 60% of organizations in sectors such as BFSI, manufacturing, CPG, transport, logistics, technology, media and entertainment now have enterprise or business unit-level standardized data. However, gaps remain, as 32% of enterprises still lack an Already data backend.

The report indicates that while technology modernization was once a bottleneck, most Indian enterprises today use modern cloud applications and standardized data systems for AI applications. As the country moves toward a more AIdriven future, Indian organizations are working to overcome persistent challenges related to data accessibility, quality, and security.

What Indian companies are doing

Indian organizations are increasingly adopting sophisticated data strategies to address evolving business needs. Many firms are transitioning from traditional data management systems to more advanced cloud-based solutions.

Indian enterprises are also embracing hybrid approaches to data lakehouse architectures. Companies can use hybrid models as an alternate to hyperscalers. Data lakes are replacing or sometimes absorbing within them older style data warehouses. Data lakes can reside on premises, in the cloud, in hybrid (cloud plus premises) or even across multiple hyperscalers (AWS, Google Cloud, Azure) simultaneously.

Indian startups and cost-effective data solutions

India's startup ecosystem is playing a role in the data landscape. Many Indian startups are focused on providing lowcost solutions. Raga AI (testing and safety), Neysa AI (AI cloud and PaaS), Floworks (developed an AI sales representative using agentic AI) are some examples. Others include KissanAI (an agriculture copilot), Sarvam AI (GenAI building blocks), Xylem AI (LLMOps platform) and others. Open source solutions are also becoming attractive with Indian organizations including government-run bodies taking this route. Industry body Nasscom, Meta and Ministry of Electronics and IT (MeitY) are working to create an open source GenAI platform to promote solutions with socioeconomic impact. The BharatGPT platform is available across channels in 14-plus Indian languages, in video, voice and text. Nandan Nilekani backed EkStep Foundation is constructing datasets for Indian languages and will be open source.

Partner ecosystem

Indian companies are increasingly turning to data aggregators and fintech firms to scale their data infrastructure for AI applications based on their success in using AI to provide solutions. The RBI has given in-principle approval to some account aggregators including CAMS Finserv, CookieJar Technologies and National E Governance Services Asset Data to build a data-sharing solution that will improve access to financial data.

Data governance

One of the key regulatory frameworks introduced is the Data Empowerment and Protection Architecture (DEPA), which provides a consent-based model for data sharing and protection. Introduced in 2020, this framework laid the foundation for the Digital Personal Data Protection Act (DPDPA) 2023, which formalized India's approach to safeguarding digital personal data.

The DPDPA 2023 recognizes the right to individual privacy and mandates clear guidelines for data fiduciaries–entities responsible for processing data. The Act outlines obligations for both data processors and data principals (data generators), ensuring that personal data is handled with care. In addition, the Act introduces financial penalties for non-compliance and establishes the Data Protection Board of India to oversee data governance.

Snapshot of various government initiatives related to access to datasets in India



Major policies

The Ministry of Electronics and Information Technology (MeitY) launched the Draft National Data Governance Framework Policy in 2022, which aims to provide a unified approach to data governance across sectors. This policy outlines the creation of an India Data Management Office (IDMO), responsible for managing non-personal data governance and improving access to datasets.

Several government initiatives are helping businesses and startups access critical data for AI applications. The IndiaAI Mission, launched in 2024, aims to foster AI development and deployment across the country. With a budget of INR10,300 crore, the mission seeks to establish an India Dataset Platform, which will serve as a centralized hub for nonpersonal datasets available to Indian startups and researchers.

In addition, sector-specific initiatives such as the Account Aggregator Framework and the Bhashini Project are improving data access and sharing within industries. The Account Aggregator Framework allows for the secure sharing of financial data between organizations, while Bhashini focuses on making language data accessible for AI development in Indian languages.

Challenges and the road ahead

While India's data governance frameworks are evolving, concerns remain around data privacy and sovereignty. Many small and medium-sized businesses (SMBs) in India grapple with understanding and implementing data governance practices. Ensuring that businesses of all sizes can comply with regulations like the DPDPA 2023 will be essential for the long-term success of India's AI ecosystem.

Data governance initiatives, including the establishment of IDMO and the rollout of the India Dataset Platform, are expected to address these challenges by providing clear guidance and resources for businesses. These efforts will enable Indian companies to securely manage their data, improve AI readiness and capitalize on the potential of datadriven technologies.

For Indian organizations to become AI-ready, there is a need to prioritize modernizing their data infrastructure, enhancing data accessibility and ensuring robust governance frameworks. Further, to cater to the needs of Indian enterprises, data platform providers can innovate and provide cost effective solutions.

With government support and a growing partner ecosystem, the country is well-positioned to become a leader in Al-driven innovation. Challenges related to data security, privacy and standardization require concerted efforts from both businesses and policymakers. Addressing these gaps can help Indian companies leverage the power of Al and usher in a new era of data-driven growth.

Preparing data for an agentic future

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Preparing data for an agentic future

As we stand at the brink of an agentic revolution, where Al continues to evolve, the very fabric of organizational structures and operations is being redefined. The next level of Al innovation will automate tasks that, until recently, required human involvement. GenAl would extend this transformation by replacing human involvement with autonomous agents and bots, capable of decision-making, data analysis and complex task execution. In fact, we are moving towards a future where traditional roles like Chief Data Officer (CDO) could be filled by a silicon counterpart–a fully autonomous Al that manages data, drives insights and executes on strategic goals with little or no human intervention.

To handle this change, organizations must prepare their data ecosystems and architectures for a reality where AI takes centre stage. In this context, it becomes crucial to rethink how data is stored, processed and leveraged for intelligent decision-making.

A data-ready future

To prepare organizations for an agentic future, where Al agents can access and utilize data as seamlessly as humans, several key measures need to be undertaken. These include:

- ► Implementing a modern data stack
- Organizing data into well-defined domains
- Creating a unified consumption layer with a catalog of trusted data
- Establishing an automated control plane for data governance
- Leveraging AI itself for effective data management

Modern data stack

Data must not only be available but also scalable, secure and Al-ready. This preparation is multifaceted, beginning with the right infrastructure choices. Many organizations have embraced hybrid cloud strategies, combining the flexibility of on-premises systems with the scalability of cloud platforms. Early adopters have gravitated towards hyperscalers like Google Cloud Platform (GCP), Amazon Web Services (AWS) and Microsoft Fabric. However, organizations are increasingly adopting other cloud options like JioCloud and Ola Krutrim. A multi-platform approach has emerged as the new norm. There is no 'one-size-fits-all' solution can meet the varied and growing needs of modern enterprises. Companies are opting for a combinatorial strategy–leveraging Databricks for process-intensive workloads that require spark, while using platforms like Snowflake to host SQL data warehouses. This approach ensures flexibility, scalability and efficiency across diverse data needs.

Domain-driven approach to data

To ensure that data is not only Al-ready but also aligned with business objectives, organizations should adopt a domaindriven approach. This strategy involves creating domainspecific data products, which are enriched with business semantics and ontologies that make the data both valuable and contextually relevant.

Data mesh further accelerates innovation. This decentralized approach empowers teams to manage data as a product, avoiding redundancies and allowing for quicker time-toinsight. Marketing tech tools, such as Relational AI and Celonis, enable the creation of functional and process views of data, bringing operational efficiency to various business functions.

Unified consumption layer and trusted data catalog

At the heart of this transformation is a unified consumption layer, a crucial architectural element that drives the unified view of data across hybrid architectures. The data fabric, supported by a comprehensive trusted data catalog, allows organizations to harness the power of both structured and unstructured data, regardless of the platform on which it resides. This unified view is further augmented by Al-driven tools, which streamline the process of accessing, processing and analyzing data through various engines-be it SQL, APIs or GenAl models.

Enterprise data governance

The widening regulatory landscape, with stringent requirements on data lineage, privacy and risk observability, means that organizations must adopt a robust data governance framework. This includes implementing consistent data policies, centrally defined and executed at the federal level, ensuring both global and regional compliance.

Automated data cataloguing, driven by AI, will play a pivotal role in managing and maintaining the quality of data across the enterprise. AI-powered tools will not only ensure that data is of high quality but will also streamline the entire data lifecycle, reducing the time to insights and enabling faster decision-making.

Al at the core of the data-driven enterprise

Al's role will go beyond being a tool for analyzing data; it is expected to fast become a critical enabler for the entire data ecosystem. Thus, organizations must ensure their data is defined, accessible, certified and secured for seamless Al integration. Organizations that successfully embrace this change will not only lead in the digital economy but will also pioneer the next generation of Al-driven business transformation.





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