



*Data-powered*  
**Innovation  
Review**

Wave 9

# Foreword

*Looking at the frozen spheres that grace the pages of this magazine, I'm reminded of the delicate and balancing future of data and AI. There's a fragile beauty in that stillness, yet incredible energy and potential exists beneath the surface. The imagery resonates deeply with where we are today – on the edge of something extraordinary but requiring careful thought and responsibility to navigate.*

This edition of the Data-powered Innovation Review explores the power of generative AI, data platforms, and other emerging technologies – all of which have the potential to transform industries, optimize processes, and drive new avenues of growth. But we also face a profound challenge: How do we harness this power without allowing it to overrun the very systems that make our innovations possible? As much as we're excited by what AI can do, we should not ignore the financial and environmental costs that come with it.



## Niraj Parihar

Chief Executive Officer,  
Insights and Data, Capgemini



Turning towards 2025, it is more important than ever to strike a balance between these seemingly competing forces.

Readers will uncover many balancing acts in this edition. Combining the “hunches” of generative AI with the contextual, “symbolic” power of knowledge graphs, for example, but also a fascinating deep dive into how data and AI can create a thriving “blue economy” around the oceans while preserving and improving maritime life. And then there's the impact of generative AI on life sciences: transforming drug discovery and clinical trials but also prompting us to consider the environmental and ethical implications of how we scale this technology. Finally, there's the balancing act that data professionals have to face: leveraging AI and automation for the entire solutions lifecycle while rediscovering the role of the human expert in this newly defined loop.

As we navigate the future, let us carry forward the lessons of balance and care, just as the frozen spheres rest calmly in a winter landscape. Here's to a new year of thoughtful innovation, ethical advancement, and sustainability. May 2025 bring you success, inspiration, and a sense of purpose in all you do.







## Ron Tolido

Chief Technology Officer,  
Insights and Data, Capgemini



*Every new edition of the Data-powered Innovation Review is special to us. Making it never fails to inspire us to flex our innovation muscles, brainstorm compelling data and AI topics, reach out to the right people – inside and outside the company – and simply spark a bunch of fresh, forward-looking activities while doing so.*

Still, this 9<sup>th</sup> edition, published right before 2025 starts, is even more special. It's the time of the year in which many businesses contemplate the past period and, even more so, put together their vision, perspectives, and plans for the new year. And this time, just what a remarkable year it promises to be. Whether we call it a "pendulum swing" or an ongoing, delicate balance act (or both), 2025 might just turn out to be a different, transitional year - whether in terms of forces and movement in (geo)politics, economics, culture, environment, technology, or even society as a whole. "Unpredictability" just does not seem to cut it to describe the volatility of what is about to unfold.

It may be a matter of the hammer and nail, but we are pretty sure that data, analytics, and AI will be a key part of the equation, whatever scenario pans out. And even if forecasting might seem to have a lesser chance of accuracy than ever before, it hasn't kept seven of our data-powered innovation "movers and shakers" from presenting their predictions for 2025.

It's one of the centerpieces of this edition, which in a way itself is a broad, landscape-orientation photograph of where we currently stand with data and what topics have the top of mindshare when thinking about the near future.

Obviously, there's still a lot of enthusiasm for generative AI - both within a growing community of practitioners working with it daily and in most enterprise boardrooms. But as we already saw halfway through 2024, enterprise-scale realism has kicked in, and much more balancing takes place between potentially conflicting forces such as the actual business value and benefits, the cost of AI computing, sustainability impact, legal and regulatory implications, manageability, and the overall confidence level around AI. You'll find many of these juggling acts tackled in this edition, together – of course - with considerations about what comes after generative AI (hint: it sure seems to look "agentic").

Is it all about generative AI then these days? Gladly not. There is plenty of attention paid to data platforms and their architecture, and this certainly seems a signpost for much more to come in 2025. Then, as always, there is a place for technology and sustainability, exemplified by the introduction of our new Global Data Science Challenge – this time in collaboration with UNESCO - and an interesting article co-authored with Heidi Karlsson from The Open Group about the role of data and AI in the blue economy.

The latter topic is also covered in a new podcast series that we have set up as a companion to this magazine. The Data-powered Innovation Jam has a special way of addressing new, inspirational themes around data, analytics, AI, and all that data jazz. Together with my co-host Robert Engels, I have a certain (albeit obscure) background in music, and we try to weave elements from rock, soul, pop, and jazz into the discussions with our external guests. Combine it with the special AI myth-busting powers of co-host Weiwei Feng, and we might have something interesting for you. Try it out on your preferred podcast channel: <https://www.capgemini.com/insights/research-library/data-powered-innovation-jam-podcast/>.

A huge thank you to all contributors to this edition, with a special mention of our external contributors from **The Open Group**, **AWS** and **UNESCO**.

*Enjoy this 9th edition – a snapshot of today, more than a glimpse of tomorrow, and hopefully even a nudge for your own next big idea in 2025.*



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# AI's green balancing act

## Navigating *innovation and environmental impact*



Generative AI has the potential to transform industries and drive growth, but this innovation comes at an environmental cost. Companies must adopt a “sustainable by design” approach that incorporates responsible and sustainable practices to harness power without compromising our planet. By balancing generative AI’s immense potential with its environmental impact, organizations can shape a purpose-driven, sustainable future.

Generative AI (Gen AI) has emerged as a groundbreaking force capable of reshaping industries, creating new revenue streams, and optimizing processes. According to the Capgemini Research Institute report, [Harnessing the Value of Gen AI](#), 80 percent of organizations worldwide increased their 2024 investment in Gen AI compared to the previous year, and the remaining 20 percent are maintaining investment levels. While Gen AI promises a [\\$7 trillion boost to global GDP](#) over the next decade, there is a darker side to this innovation: the significant energy consumption and environmental costs associated with its use. As Gen AI gains momentum, it is essential to understand the balance between its enormous potential and its environmental footprint.

### Core discussion

Gen AI’s impact on businesses is indisputable. Organizations leveraging it are already experiencing an average 15.8 percent increase in revenue, according to a [2023 Gartner survey](#), making it a vital tool for future growth. However, the environmental implications are becoming a pressing concern. Gen AI models such as GPT-4o require massive amounts of energy to train, customize, and operate, leading to increased carbon emissions. For example, the power required for a single query on ChatGPT is six to 10 times more than that of a traditional Google search. This scale of consumption creates an urgent need for sustainable solutions.

To harness the transformative power of Gen AI while addressing these challenges, companies must adopt a “sustainable by design” approach that emphasizes energy efficiency, resource optimization, and ethical use of AI technologies.

### Tech companies taking action

**Carbon management in tech giants:** Major tech firms like Microsoft and Google have been at the forefront of Gen AI innovation. However, they also face the challenge of carbon emissions. Microsoft’s commitment to reducing its carbon footprint is an example of how organizations can approach AI responsibly. Brad Smith, Microsoft’s President, said his company’s goal is to [neutralize its environmental impact](#). On the other hand, Google’s greenhouse gas emissions [increased 48 percent](#) from 2019 to 2023, emphasizing the need for balanced innovation.

**Capgemini’s initiatives:** Capgemini’s Sustainable by Design framework is a prime example of how organizations can balance the economic benefits of Gen AI with its environmental costs. Through partnerships with hyperscalers, clients, and academic institutions, Capgemini is co-creating solutions that minimize AI’s carbon footprint, reduce energy consumption, and unlock new sustainability-focused innovations like circular product design and resource efficiency.

### Best practices for sustainable Gen AI

**Architect with sustainability in mind:** To mitigate the environmental impact of Gen AI, companies should prioritize energy-efficient designs from the outset. By focusing on model efficiency and minimizing computational waste, they can reduce the energy required for training and inference.

**Leverage AI for sustainability efforts:** Gen AI can also accelerate sustainability initiatives across various sectors. It helps companies track ESG metrics, optimize supply chains, and reduce resource consumption. For example, AI can aid in circular product design, reducing waste and minimizing the environmental impact of manufacturing processes.

**Embrace ethical and responsible AI:** Organizations must also ensure that Gen AI is used ethically. This includes addressing biases in AI models, ensuring transparency in decision-making processes, and maintaining fairness. Responsible AI design will be critical in aligning Gen AI with societal goals, including reducing inequalities and enhancing workforce diversity.



*By adopting responsible sustainable by design frameworks, organizations can strike a balance between AI’s vast economic potential and its impact on the planet.*



## Market trends

As businesses increasingly adopt Gen AI, the need for sustainable practices is becoming more critical. The environmental cost of Gen AI is projected to rise significantly. By 2027, AI is expected to consume **4.2 to 6.6 billion cubic meters of water**, which is four to six times Denmark's total water usage. Data centers are also expected to increase their power consumption dramatically, with the social cost of global incremental emissions **projected to reach \$125 billion to \$140 billion** by 2030.

The competitive landscape is evolving, with companies seeking sustainable solutions to balance the growing demand for AI services with their environmental impact. Leaders in the space, like Capgemini, are partnering with hyperscaler cloud providers and AI leaders to adopt renewable energy, optimize AI models for energy efficiency, and establish guardrails to minimize environmental and ethical risks.

The rapid expansion of Gen AI presents both opportunities and challenges. While technology offers unprecedented potential to drive innovation and revenue, its environmental cost cannot be ignored. Companies must take a holistic approach, incorporating sustainability into the design and operation of AI models. By adopting responsible, sustainable by design frameworks, organizations can strike a balance between AI's vast economic potential and its impact on the planet.

The future of Gen AI lies in responsible innovation. As companies continue to integrate this transformative technology, they must ensure it is done sustainably, ethically, and with long-term societal benefits in mind. By doing so, businesses can help create a purpose-driven, sustainable future that benefits both the planet and its people.





# Start innovating now

*#DataPowered  
#AI4Good #DataMasters  
#SustainableGenAI  
#SustainableByDesign*

## **Prioritize energy-efficient AI models**

Optimize algorithms and use techniques like model pruning to reduce energy consumption in AI design and operation.

## **Leverage AI for sustainability**

Use AI to track ESG metrics, optimize supply chains, and promote resource efficiency through initiatives like circular product design.

## **Implement a sustainable by design framework**

Integrate sustainability into AI operations, using renewable energy, optimizing models for low-carbon output, and ensuring ethical AI practices.





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# Creating relevant data dialogs

## *The art of semantic interoperability*



Building industry-wide data spaces will revolutionize the way companies interact in the future. These intercompany ecosystems facilitate collaborative use cases between partners, suppliers, and even competitors on equal footings, while protecting the data sovereignty of each participant from centralized data collection. However, to avoid being just an empty shell, each use case has to be filled with life through semantics to create a common language, enabling relevant data dialogs between companies.

The dominant form of exchanging files between different companies, especially in B2B conversations, is still email. This makes the famous “Excel > Export” one of the most important functionalities of any data solution. This dependency on human interaction with minimal automation, even for small tasks such as a simple check for fitting a spare part, can lead to endless email chains, delays, and human error.

Especially in Europe, advances like the [German Supply Chain Act](#) or Digital Product Passports as part of the [EU Sustainable Product Strategy](#) are forcing manufacturing companies to effectively integrate with all partners in their value chain and industry to meet the regulations. Even the public sector is forced to digitize and provide interoperable digital services (refer to [IEA](#)). All of these regulations must be followed while still abiding by [GDPR](#) data protection rules.

Out of this necessity to collaborate, an innovative blueprint for industry-spanning data ecosystems has emerged. This approach enables them to look beyond regulatory reporting and opens the possibility for a multitude of high-value use cases that have been impossible before.

Starting from [Gaia-X](#) and the [International Data Space Association](#) concepts, many initiatives like [Catena-X](#) for the automotive industry, [European Data Spaces](#), [POSSIBLE](#), and [many others](#) have been founded.

The number of collaborations shows the immense potential upsides of these data spaces for all kinds of use cases, including:

- Supply chain traceability
- Calculation of ESG metrics
- Digital behavioral twins
- Traffic forecasts
- Energy generation management

There are varieties in the setup of the dataspace, but most of them facilitate connector technology ([EDC](#) or [IDS](#)), handling data offers and exchanges in combination with a certain amount of middleware, like brokers for finding data offerings, identity management for validation of users and connectors, interactive portals, and development kits for integration (e.g., [Tractus-X Collection](#) for participating in Catena-X).

This technology enables the participant to flexibly define an individualized data exchange. However, as long as only files or data packages are exchanged, the situation is still comparable, as with an SFTP service or the previously mentioned email chain. For most use cases, multiple modeling steps are required.

Every bit of shared information for a use case has to be properly consolidated into an ontology or a digital twin model, describing what to expect and how to interpret it to enable interoperability between participating applications.

An ontology is a form of modeling the meaning of entities and defining their relationships with each other. This provides a shared language to facilitate a common interpretation of data for both humans and machines. Ontologies can take many different forms, but many data spaces resort to the Linked Data Standards provided through the [Semantic Web Technology Stack of the W3C](#). This makes it possible to create a highly interoperable model definition without vendor login. In addition to that, some facilitate additional standards, like the [Asset Administration Shell](#) from the Industrial Digital Twin Association (IDTA) utilized in Catena-X to define exchanged datasets as digital twins. An exemplary tool for editing and managing AAS twins is the [Bosch Semantic Stack](#).

Let us imagine the calculation of the carbon footprint required for the [battery passport](#) of a high-voltage battery built in a car, as defined in Catena-X. Original equipment manufacturers (OEMs) must correctly provide the footprint together with material composition and other performance and durability KPIs. Due to a diversified supplier strategy, batteries from different partners can be utilized. The data is requested, and they are provided as Excel or PDF files or in some other format. This leaves the OEM with the challenge of processing and interpreting these data sources. It is possible that the companies implement highly different calculation methods.

For that reason, the required result is defined in a concise [data model](#). For our example, the model utilizes a [Semantic-Aspect-Meta-Model \(SAMM\)](#) to create a generic ontology-based digital twin of the battery.



That digital twin model is shared with all participants to ensure they provide the correct information for the required result. However, it still leaves opportunity for different exchange structures. This is handled through defined semantic sub-models for the use cases, that are verifiable and ensure that the data is sent from the partner in the right format and structure. Therefore, the application of the OEM can automatically extract, match, and calculate the final information for the passport.

Despite the effort, the information provided is still not completely ensured to be correct since the vendor's mapping and compilation of the data could be wrong due to a misinterpretation of its own source data. The vendor is required to properly model its own data landscape into a individualized enterprise ontology and then logically validate the mapping between the meaning and the content requirements of the use case.

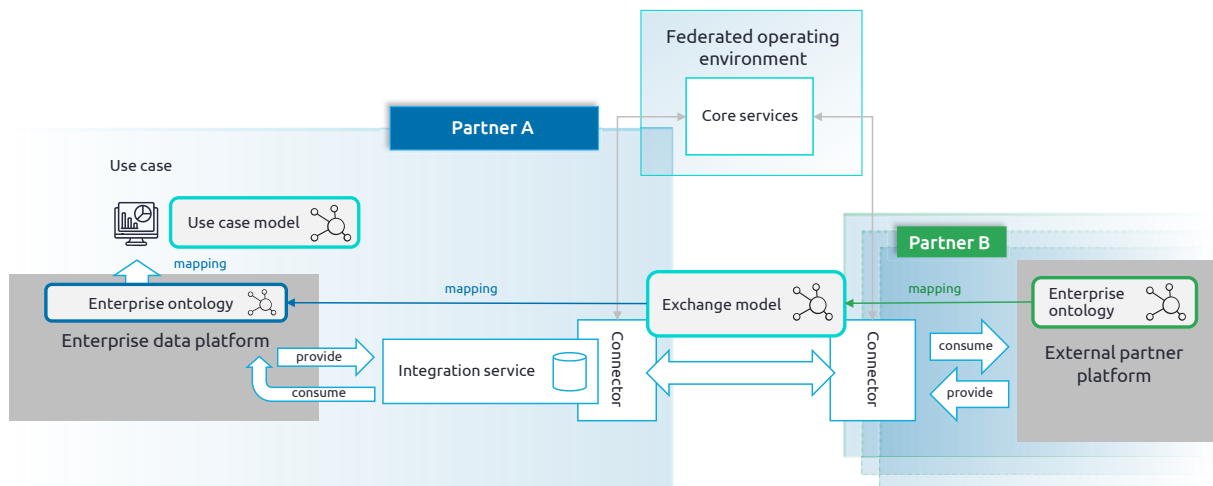


Figure 1: Importance of ontologies in the process



*Companies are required to properly model their own data landscape into a individualized enterprise ontology and then logically validate the mapping between their meaning and the content requirements of the use case.*



Besides the obvious legal challenges created by an industry collaborating in a data space, all the moving parts determine the success of use cases. A data space has potentially thousands of participants and different implementations to steer. Successful data spaces try to ensure:

- Use cases have well-defined business value
- Companies are working collaboratively
- New participants can easily enter

To lower the barriers of entry, Catena-X for example facilitates an OSS-first strategy and provides implementation kits for standardization of solutions. They also collaborate and certify products and SaaS solutions to communicate natively with the environment.

Data ecosystems provide a unique approach to working together while still retaining data sovereignty. This balances sharing and making data accessible for seamless integration over company borders while gaining more control and understanding of your own data and what is shared. However, without a semantic backbone as a common data language between companies, use case implementation can end in chaos without realizing the promised impact.



# Start innovating now

*#DataEcosystems*

*#DataSpaces*

*#KnowledgeGraphs*

*#Ontologies*

*#DigitalTwins*

*#Semantics*

## **Become an active participant in a data space**

Become an early adopter of one of the use cases in your industry, paving the way for value creation through inter-company collaboration.

## **Embrace semantic technology standards**

Establish semantic technology as a core capability within your data strategy and explore the common standards for your industry to facilitate maximum interoperability for your applications.

## **Start building your own ontologies**

Start modeling the first high value use cases in your own enterprise ontology to start formalizing your domain knowledge and facilitate a shared understanding.







## Sjoukje Zaal

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## Data fabric

*Unlocking all of data's  
superpowers*

Utilizing data is not a passing trend; it's a core element of business strategy. However, despite its potential, many organizations struggle with turning overwhelming amounts of data into valuable insights. This is where data fabric comes in, offering a solution to unify and streamline disparate data sources. By connecting and integrating data from various environments, data fabric provides a clear path from complexity to actionable insights that drive innovation and improve competitive advantage.

**The data challenge:  
Why data fabric matters**

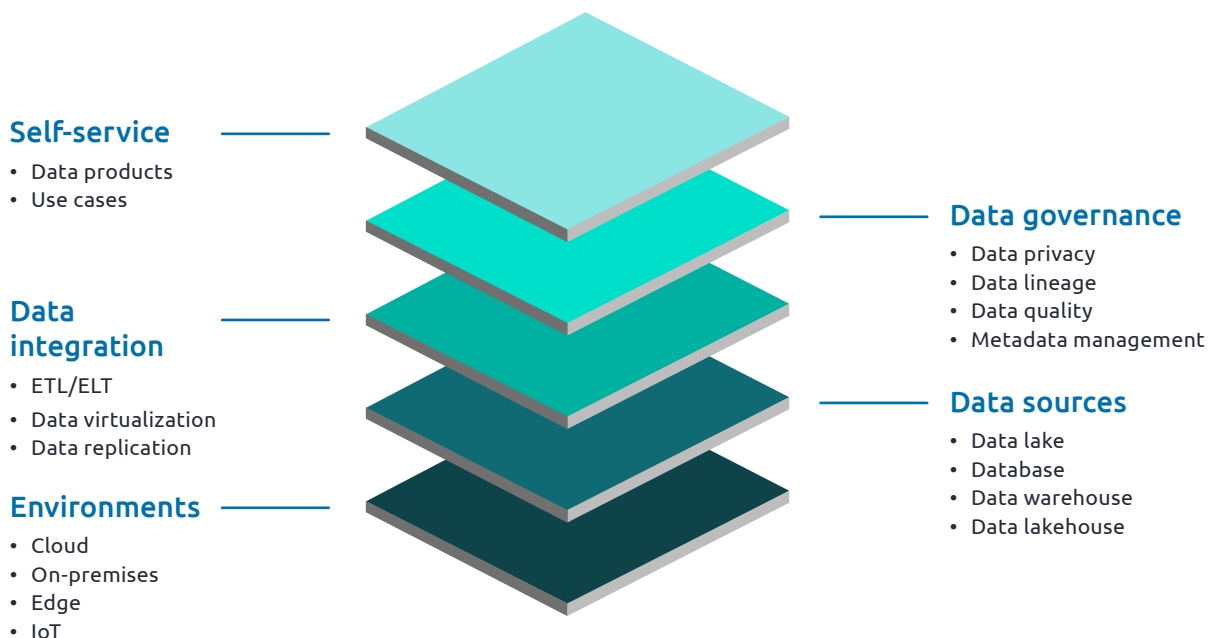
Businesses face the dual challenge of becoming data-driven while navigating an increasingly complex landscape. From data silos to a lack of coordination between business and IT, and growing concerns about privacy and governance, the hurdles are many. But amidst all these challenges, one thing remains clear: data is a key

asset in today's digital world. The real question isn't whether data is valuable; it is instead how organizations can leverage it effectively. In a fast-paced, competitive environment, businesses that can unlock the value of their data will make more informed decisions, optimize operations, and stay ahead of competitors. This is where data fabric proves its worth, making it easier to integrate, analyze, and secure data, driving both innovation and business success.

**The need for data fabric:  
Bringing order to chaos**

A data fabric acts as a unified platform that connects and manages data from various sources – whether on-premises, in the cloud, or in a hybrid setup. It integrates structured, semi-structured, and unstructured data, creating a cohesive environment where all data types work together seamlessly. In other words, data fabric eliminates the silos that stifle innovation and ensures that data is always ready to provide real-time insights.

Today's data environments are anything but simple. The idea of funneling all data into one central repository doesn't hold up in a world of distributed systems and multi-cloud ecosystems. Data fabric allows organizations to keep their data where it is while still making it accessible and manageable, so it's easier to extract the insights that power decision-making and business growth.



**Foundation layer: The role of metadata**

The foundation of data fabric is metadata: the data about your data. In a world where data exists in multiple locations, formats, and systems, metadata helps connect the dots. Rather than moving data around unnecessarily, metadata enables data virtualization, allowing real-time access without physically transferring data. This approach streamlines data discovery, integration, and governance, ensuring that the right data is accessible at the right time.



This metadata layer is also what makes data fabric “smart.” It doesn’t just connect data; it helps organize it in a way that makes sense. By automating processes like data discovery and governance, metadata enables organizations to manage complex data environments more efficiently while maintaining control over quality and security.

### **Composable data products: Innovation at speed**

One of the most powerful features of data fabric is the ability to create composable data products. These are reusable, modular datasets or services that can be combined in various ways to create new capabilities or services. Instead of reinventing the wheel every time a new business need arises, organizations can use existing data products to accelerate innovation.

This modular approach allows businesses to rapidly respond to market demands, creating new offerings or features without starting from scratch. It’s about leveraging what’s already available, making it easier and faster to innovate while maintaining flexibility.

### **Data democratization and self-service: Empowering teams to innovate**

Traditionally, data has been controlled by IT departments, slowing down decision-making and limiting innovation. With data fabric, that changes. Data democratization means giving everyone in the organization the ability to access and work with data, not just the IT team. This shift empowers teams to experiment, collaborate, and iterate faster, without waiting for IT to process every request.

By enabling self-service analytics and empowering teams to create their own data products, organizations can speed up innovation and improve collaboration. Developers, data scientists, business analysts – everyone gets the tools to explore data and generate insights in ways that drive the business forward. In short, data fabric fosters a more agile and responsive organization.



### **AI integration: Powering smarter insights**

AI relies on high-quality, structured data to provide valuable insights. Fortunately, data fabric is designed to work seamlessly with various data structures – whether it’s tables, graphs, or lists – ensuring that AI and machine learning models have access to the rich, reliable datasets they need to make accurate predictions.

With strong governance and data lineage, data fabric provides the foundation for AI and machine learning models to thrive. This enables innovations in areas like predictive analytics, personalized recommendations, and automation, while ensuring the integrity and security of the data being used.

Data fabric also enhances the AI process by automating many of the routine tasks that traditionally take up valuable time. Tasks like data integration, quality management, and anomaly detection can be automated using AI, freeing up organizations to focus on more high-value innovations that drive business growth.

### **The transformative power of data fabric**

Data fabric isn’t just a technological solution – it’s a game-changer for how organizations manage their data. By leveraging metadata and AI-driven solutions, data fabric helps organizations create a flexible, responsive, and innovative data environment. This environment fosters faster insights, quicker development cycles, and the ability to respond to market changes with agility.

Perhaps most importantly, data democratization enables a culture of innovation where employees across departments can contribute to business success. As data volumes grow and complexities increase, data fabric will be the key to not only managing these challenges but turning them into new opportunities for growth.

Data fabric is an essential solution for organizations looking to stay competitive and innovative in a world where data is becoming increasingly complex. By integrating AI, automating routine tasks, and empowering teams to access and use data freely, you’ll position your organization for success in the digital economy.



*By enabling self-service analytics and empowering teams to create their own data products, organizations can speed up innovation and improve collaboration.*



# Start innovating now

*#DataIsTheNewOil*

*#DataPoweredInnovation*

*#DigitalTransformation*

*#CompetitiveAdvantage*

## **Build a unified data fabric**

Begin by implementing a data fabric that integrates and manages data across all environments: cloud, on-premises, and hybrid. Real-time access and seamless connectivity eliminate silos, unlocking new possibilities for faster insights and product development.

## **Create reusable data products**

Transform your data into modular, reusable products. This approach accelerates innovation and enables faster iteration, so you can create new services and capabilities without starting from scratch every time.

## **Empower teams with data**

Democratize your data by making it accessible to everyone. Self-service capabilities allow teams to experiment and innovate quickly, fostering a culture of continuous, business-driven innovation.







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## DataGPT

Harnessing *the power of Gen AI* to  
transform the entire data lifecycle

The ability to navigate data lifecycles with precision and efficiency is more critical than ever. Generative AI can play a transformative role across the entire data lifecycle, from strategy and architecture to engineering, integration, and governance. It supports every stage of data management, making processes more efficient, automated, and scalable. Organizations that treat data as a strategic asset and integrate generative AI across every stage of the data lifecycle will be uniquely positioned to lead the way in innovation and gain a competitive advantage.

Data leaders today face a range of challenges when managing the data lifecycle, from navigating the sheer volume and complexity of data to maintaining its quality, security, and regulatory compliance. With data streaming in from diverse sources in various formats, ensuring consistency and accuracy across every stage – whether it’s data collection, integration, processing, or disposal – can feel overwhelming. The added pressure of adhering to strict data privacy regulations and extracting actionable insights from vast datasets only heightens these complexities, often stretching resources thin. This is where generative AI (Gen AI) emerges as a transformative solution. By automating labor-intensive processes like data extraction, cleansing, and orchestration, Gen AI not only elevates data quality and consistency but also strengthens security and compliance. Its ability to seamlessly integrate data across systems while delivering real-time insights empowers data leaders to make faster, smarter decisions, all while driving down operational costs and boosting efficiency.

### Strategic support and data governance

Gen AI revolutionizes the complexities of data lifecycle management, transforming them into streamlined, intelligent processes. At the strategic level, it significantly enhances data governance by analyzing vast amounts of historical data, identifying patterns, and ensuring compliance with regulatory frameworks. Gen AI assists in developing data governance strategies by automatically generating policies related to data security, privacy, and classification. AI tools evaluate data quality, flagging potential issues and recommending optimal data structures, which in turn allows organizations to create stronger long-term data strategies. Additionally, AI-powered tools simplify compliance management by ensuring adherence to local and global regulations, helping organizations align their data practices with legal requirements seamlessly.

### Architectural design and data modeling

Gen AI plays a crucial role in data architecture by automating the creation of data models and streamlining decisions around data structures and storage solutions. It analyzes existing infrastructure, suggesting architectural frameworks that are customized to business needs and optimizing storage, retrieval, and security measures. With the ability to predict future data demands based on

historical patterns, AI helps enterprises scale their data architecture efficiently. When it comes to data modeling, Gen AI automates schema generation, data mapping, and transformation processes. By leveraging historical data, AI can refine models that predict data relationships, leading to the development of more accurate and effective data architectures.

### Engineering, extraction, and data integration

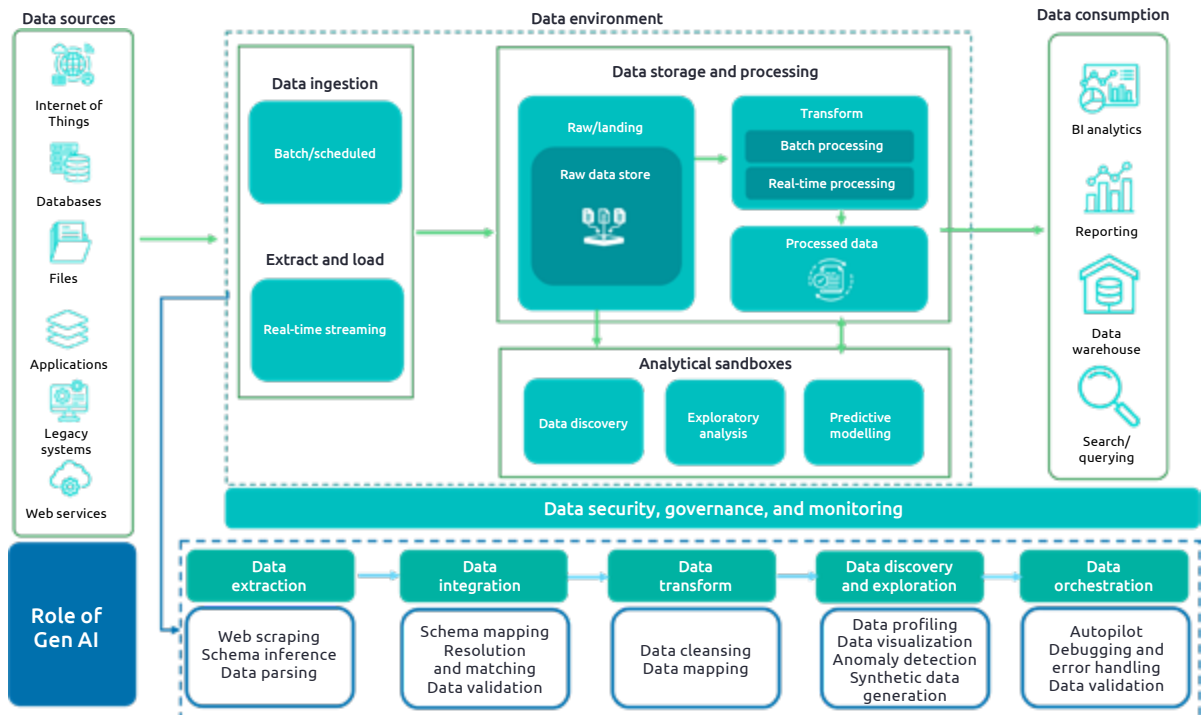
In data engineering, Gen AI automates complex tasks such as data transformation and pipeline creation. Previously manual processes – like writing ETL (extract, transform, load) scripts or managing data flows between platforms – are now handled by AI models. These models can generate code, orchestrate workflows, and even troubleshoot pipeline errors in real time, dramatically improving operational efficiency. Large language models (LLMs) can also be used for web scraping, extracting, and processing information from web pages. Gen AI assists in parsing unstructured or semi-structured data, automatically inferring schemas, and extracting relevant information. For data integration, Gen AI analyzes disparate datasets and generates mappings between different formats. By training on source and target data schemas, AI creates transformation rules that simplify the integration process. For example, Gen AI can be instructed to automate tasks like transferring files from blob storage to Snowflake tables or writing PySpark code to aggregate data from AWS S3 into Redshift or Databricks for further processing.



*Generative AI bridges the gap between data management and actionable insights, empowering leaders to scale like never before. It revolutionizes every step of the data lifecycle, making it faster, smarter, and more strategic.*



## How Gen AI can uplift the entire data lifecycle management



### DataOps, orchestration, and continuous integration

Gen AI continues to play a key role in operational processes through DataOps by automating the continuous integration and monitoring of data pipelines. AI models can analyze pipeline performance, detect anomalies, and provide optimization recommendations. They assist in real-time debugging and error recovery, reducing system downtime and improving operational resilience. AI-driven orchestration extends to scheduling tasks, managing dependencies, and efficiently allocating resources based on real-time needs. In governance, Gen AI automates metadata management and compliance reporting, ensuring that the organization adheres to data usage policies and regulatory standards effortlessly.

### Data usage and decision-making

Finally, Gen AI enhances data usage by delivering actionable insights and visualizations that support decision-making processes. With natural language processing (NLP) interfaces, AI allows non-technical users to explore and interact with data in real time. AI models generate predictive analytics and run simulations, helping stakeholders validate hypotheses, forecast outcomes, and make informed decisions based on real-time data insights.

One key factor driving data leaders to adopt Gen AI for enhancing data lifecycle management is the urgent need for increased operational efficiency

amidst growing data complexity. As organizations grapple with vast amounts of data generated from diverse sources, traditional data management approaches often fall short in terms of speed and scalability. Gen AI offers advanced automation capabilities that streamline the entire process. By leveraging AI, data leaders can significantly reduce manual workloads, minimize errors, and enhance data quality, allowing teams to focus on strategic initiatives rather than routine tasks. Furthermore, the ability of Gen AI to deliver real-time insights and predictive analytics empowers organizations to make more informed decisions, ultimately driving innovation and competitive advantage in a data-driven landscape.

### Increasing the strategic value of data

Gen AI is set to revolutionize how organizations manage the entire data lifecycle, from strategic planning to technical execution. By harnessing AI-driven automation, companies can optimize each stage, enhancing strategy, refining architecture, accelerating modeling, automating engineering tasks, and simplifying data integration. This not only boosts operational efficiency but also elevates the role of data as a strategic asset, enabling businesses to make smarter decisions, scale their data operations, and stay competitive in an increasingly data-centric world. As Gen AI continues to advance, its impact on data lifecycle management will grow, empowering organizations to move from simply managing data to unlocking its full transformative potential.





# Start innovating now

*#LLMDrivenDataLifecycle*  
*#DataGPT*  
*#GenAIDrivenDataLifecycle*  
*# AIGovernance*

## **Automate tedious data prep with Gen AI**

Leverage Gen AI to automate data cleaning, transformation, and integration, streamlining your workflows and freeing up valuable time. Launch a pilot project to see how AI-driven data preparation enhances efficiency and accuracy.

## **Supercharge compliance with AI guardians**

Utilize Gen AI to automate data governance, detect anomalies, and ensure compliance with real-time reporting. Implement AI in one area of data governance to track and report compliance risks effortlessly.

## **Turn data into insights – and actionable scenarios**

Gen AI can create future scenarios and strategic insights, acting as your decision-making partner by forecasting outcomes based on data trends. Work with business leaders to build an AI-driven scenario generator and enhance decision-making with data-backed simulations.





### Dr. Daniel Kühlwein

Head of GenAI, Insights and Data Germany, Capgemini



### Mike Miller

Senior Principal Product Lead, Generative AI, AWS



### Gwang-Chol Chang

Chief, Section of Education Policy, Education Sector, UNESCO



# The Grade-AI Generation

*Revolutionizing education with generative AI*

Our Global Data Science Challenge is shaping the future of learning. In an era when AI is reshaping industries, [Capgemini's 7th Global Data Science Challenge \(GDSC\)](#) tackled education. By harnessing cutting-edge AI and advanced data analysis techniques, participants, from seasoned professionals to aspiring data scientists, are building tools to empower educators and policy makers worldwide to improve teaching and learning.

The rapidly evolving landscape of artificial intelligence presents a crucial question: how can we leverage its power to solve real life challenges? Capgemini's Global Data Science Challenge (GDSC) has been answering this question for years and, in 2024, it took on its most significant mission yet – revolutionizing education through smarter decision making.

The need for innovation in education is undeniable. Understanding which learners are making progress, which are not, and why is critically important for education leaders and policy makers to prioritize the interventions and education policies effectively. According to UNESCO, a staggering 251 million children worldwide remain out of school. Among those who do attend, the average annual improvement in reading proficiency at the end of primary education is alarmingly slow—just 0.4 percentage points per year. This presents a sheer challenge in global foundational learning hampering efforts made to achieve the learning goal as set forth in the Sustainable Development Agenda.

### The Grade-AI Generation: A collaborative effort

The GDSC 2024, aptly named “The Grade-AI Generation,” brought together a powerful consortium. Capgemini offered its data science expertise, UNESCO contributed its deep understanding of global educational challenges, and Amazon Web Services (AWS) provided access to cutting-edge AI technologies. This collaboration unlocks the hidden potential within vast learning assessment datasets, transforming raw data into actionable insights for decision making that could change the future of millions of children worldwide.

At the heart of this year's challenge lies the PIRLS 2021 dataset – a comprehensive global survey encompassing over 30 million data points on 4<sup>th</sup> grade children's reading achievement. This dataset is particularly valuable because it provides a rich and standardized data that allows participants to identify patterns and trends across different regions and education systems. By analyzing factors like student performance, demographics, instructional approaches, curriculum, home environment, etc. the AI-powered education policy expert can offer insights that would take much longer time and resources to gain from traditional methods. Participants were tasked with creating an AI-powered education policy expert capable of analyzing this rich data and providing data-driven advice to policymakers,

education leaders, teachers, but also parents, and students themselves.

### Building the future: Agentic AI systems

The challenge leveraged state-of-the-art AI technologies, particularly focusing on agentic systems built with advanced Large Language Models (LLMs) such as Claude, Llama, and Mistral. These systems represent a significant leap forward in AI capabilities, enabling more nuanced understanding and analysis of complex educational data.

*“Generative AI is the most revolutionary technology of our time,”* says Mike Miller, Senior Principal Product Lead at AWS, *“enabling us to leverage these massive amounts of complicated data to capture for analysis, and present knowledge in more advanced ways. It's a game-changer and it will help make education more effective around the world, and enable our global community to commit to more sustainable development.”*

### The transformative potential of AI in education

The potential impact of this challenge extends far beyond the competition itself.



*Such innovative technology is exactly what this hackathon has accomplished. Not just only do we see the hope for lifting the reading level of young children around the world, we also see a great potential for a breakthrough in education policy and practice.*

**Gwang-Chol Chang**

Chief, Section of Education Policy, UNESCO

The GDSC has a proven track record of producing innovations with real-world impact. In the 2023 edition, ‘The Biodiversity Buzz’ participants developed a new state-of-the-art model for insect classification. Even more impressively, the winning model from the 2020 challenge, ‘Saving Sperm Whale Lives’ is now being used in the world's largest public whale watching site, happywhale.com, demonstrating the tangible outcomes these challenges can produce.

### Aligning with a global goal

This year's challenge aligns perfectly with Capgemini's belief that data and AI can be a force for good. It embodies the company's mission to help clients ‘get the future you want’ by applying cutting-edge technology to solve pressing global issues.





## Beyond the competition: A catalyst for change

The GDSC 2024 is more than just a competition; it's a global collaboration that brings together diverse talents to tackle one of the world's most critical challenges. By bridging the gap between complex, costly collected learning assessment data and actionable insights, participants have the opportunity to make a lasting impact on global education.

## A glimpse into the future

The winning team 'insAightED' which consisting of Michal Milkowski, Serhii Zelenyi, Jakub Malenczuk, Jan Siemieniec, based in Warsaw Poland. They developed an innovative solution aimed at enhancing actionable insights using advanced AI agents. Their model leverages the PIRLS 2021 dataset, which provides structured, sample based data on reading abilities among 4<sup>th</sup> graders globally. However, recognizing the limitations of relying

solely on this dataset, the team expanded their model to incorporate additional data sources such as GDP, life expectancy, population statistics, and even YouTube content. This multi-agent AI system is designed to provide nuanced insights for educators and policymakers, offering short answers, data visualizations, yet elaborated explanations, and even a fun section to engage users.

The architecture of their solution involves a lead data analyst, data engineer, chart preparer, and data scientist, each contributing to different aspects of the model's functionality. The system is capable of querying databases, aggregating data, performing internet searches, and preparing elaborated answers. By integrating various data sources and employing state-of-the-art AI technologies like Langchain and crewAI, the insAightED model delivers impactful, real-world, actionable insights that go beyond the numbers, helping to address complex educational challenges and trends.

Example:

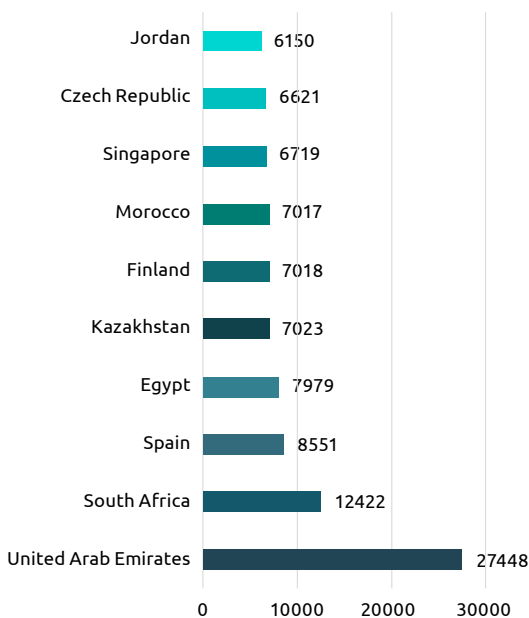
> Visualize the number of students who participated in the PIRLS 2021 study per country

### Short answer

The number of students who participated in the PIRLS 2021 study varied widely across countries, ranging from 27,448 in the United Arab Emirates to 1,657 in the United States.

### Data visualization

Top 10 countries by Number of students in PIRLS 20212 study



### Details

#### Data Analysis

The PIRLS 2021 study saw varying levels of student participation across different countries and regions. Key findings include:

- The United Arab Emirates had the highest participation with 27,448 students
- South Africa followed with 12,422 students
- Several countries had over 8,000 participants, including Spain and Egypt
- The United States had the lowest participation among listed countries with 1,657 students

#### Geographic Distribution

#### City-Level Data

#### Participation Range

#### Notable Observations

#### Fun section

Do you want to see a joke related to the topic?

WARNING! it won't be funny

- Why did the statistician bring a ladder to the PIRLS study?  
– He wanted to reach the highest level of student participation!

Processing Time:

72.24s

Cost:

\$0.1907

Figure 1: Show an example of the winning model. The image has the model answering the following prompt "Visualize the number of students who participated in the PIRLS 2021 study per country"

As we stand on the brink of an AI-powered educational revolution, the Grade-AI Generation challenge serves as a beacon of innovation and hope. It showcases how the combination of data science, AI, and human creativity and passion can pave the way for a future where quality education is accessible to all, regardless of geographical or socioeconomic barriers.

# Start innovating now

*#GDSC2024*

*#AIForEducation*

*#DataScience*

*#GenAI*

*#AI4Good*

## **Dive into AI for good**

Explore how AI can be applied to solve societal challenges in your local community or industry.

## **Embrace agentic AI systems**

Start experimenting with multi-agent AI systems to tackle complex, multi-faceted problems in your field.

## **Collaborate globally**

Seek out international partnerships and datasets to bring diverse perspectives to your AI projects.





### **Bala Natarajan**

Gen AI and Sustainability Head,  
Insights and Data India, Capgemini



### **Bikash Dash**

Gen AI Practice Head, Insights  
and Data India, Capgemini



## **Gen AI for enhanced architectural efficiency**

# *Augmenting the architectural lifecycle*



Integrating generative AI into the enterprise architectural lifecycle can streamline draft creation, enhance decision-making, and prioritize ethics. This empowers architects in the IT Service industry to innovate rapidly, develop scalable solutions, reduce manual validation, and accelerate time-to-market.

Generative AI (Gen AI) is reshaping the landscape of enterprise architecture, empowering organizations to innovate, optimize, and adapt to the rapidly changing digital world. It enables architects to automate repetitive tasks, generating innovative designs and solutions and provide valuable insights. Gen AI thereby enables architects to focus on strategic thinking, complex problem-solving, and driving business value while ensuring cost-effectiveness, scalability, and trust in the architectures they enable. Gen AI tools will be used to analyze legacy business applications and create appropriate replacements, reducing modernization costs significantly.

### What will the enterprise architecture of the future be like?

As businesses become increasingly complex and technology-driven, the role of enterprise architecture is evolving to meet the demands of the digital age. In the future, enterprise architects will serve as the IT control tower, providing a unified view of the business and IT landscape and driving innovation through a scenario-based approach.

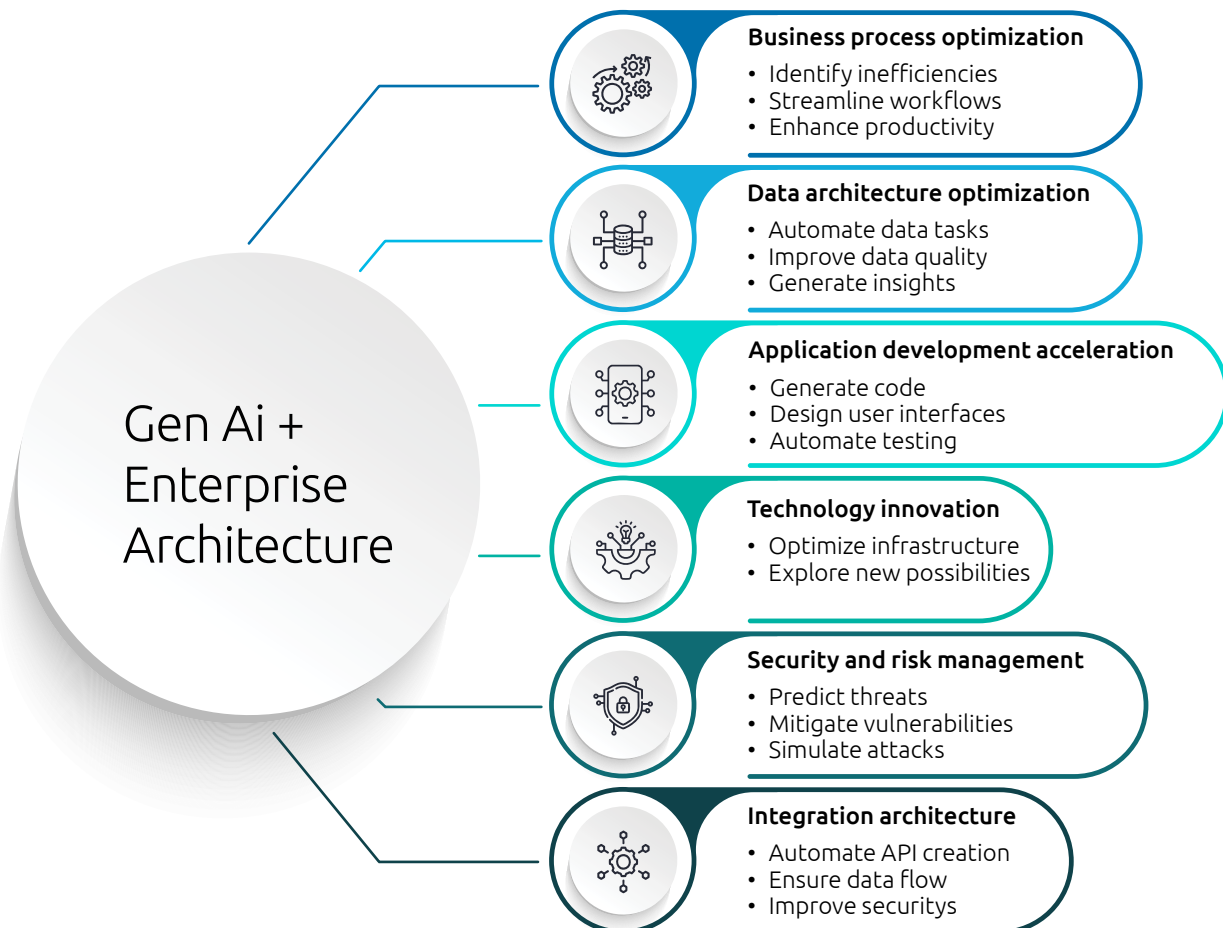
Gen AI will be a critical tool for enterprise architects, automating tasks like data ingestion and acting as a versatile language translator. However, the architect will always maintain control over the AI, ensuring it aligns with the organization's goals.

Beyond governance, enterprise architects will play a pivotal role in application modernization and leveraging AI innovation. They will be instrumental in driving the AI transformation of other business capabilities, making the enterprise architecture function as a pioneer in AI adoption.

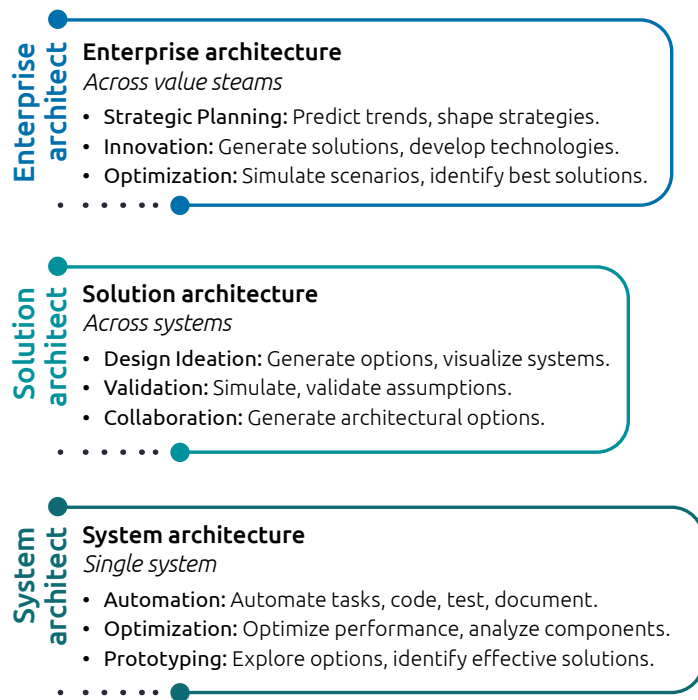
In 2025 and beyond, enterprise architectures adopting Gen AI must look forward to agentic AI, which offers significant potential for enterprise architects to revolutionize their organizations.

### Key components of the enterprise will benefit from Gen AI

Gen AI, with its ability to create validation and search content, can significantly enhance various components of enterprise architecture. Here are some key areas:



SAFe (scaled agile framework) 6.0 provides a comprehensive framework for architects. By identifying key activities within each architect role (enterprise, solution, and system), we can effectively map opportunities for Gen AI augmentation.



Through this strategic integration, architects at all levels can significantly enhance their efficiency, foster innovation, and ensure that their designs are not only robust but also perfectly aligned with overarching business objectives.

While Gen AI offers immense potential for enterprise architects, it's essential to recognize its limitations. Not all challenges or innovation needs can be fully addressed solely through Gen AI. To maximize its benefits, consider integrating it with other powerful technologies like graph, edge, and emerging technologies. A strategic and adaptive approach that leverages a diverse technological toolkit will ensure that organizations can harness the full potential of Gen AI while mitigating its risks.

Gen AI enablement across SAFe 6.0 architect roles

### Three ways to leverage Gen AI in enterprise architecture adoption

- **Embedded integration:** Incorporate AI-powered features within your existing enterprise architecture tools for seamless integration and streamlined workflows.
- **Hybrid approach:** Develop custom AI applications and connect them to your enterprise architecture for tailored solutions and greater flexibility.
- **Standalone development:** Create independent AI applications or host them on Gen AI platforms for complete autonomy and control.

### Success stories: where enterprise architectures are leveraging Gen AI

**MetaCorp:** Struggled with manual code development at enterprise level.

- **Action & Outcome:** Implemented Gen AI for automated code generation; reduced development time 15 to 25 percent across technologies and improved code quality

**WealthTrust:** As a Finance Corp wanted to assess and mitigate IT risks

- **Action:** Followed Gen AI approach for threat simulation to develop more effective risk mitigation strategies

**InnovateSoft:** Needed to design user-friendly applications for better usability.

- **Action & Outcome:** Employed Gen AI for design options to create more intuitive and engaging applications resulting in an increase in CSAT of approximately 10 percent

As the digital landscape evolves, enterprise architects must adapt to the transformative power of Gen AI. This means acquiring new skills, embracing new tools, and adopting new ways of thinking. From mastering AI-specific programming languages to designing AI-driven architecture models, architects must stay ahead of the curve to ensure their organizations remain competitive and innovative.



*Gen AI empowers architects to focus on the creative and strategic aspects of their work, ultimately shaping a future where technology and human ingenuity seamlessly converge.*



# Start innovating now

*#GenAI4Architects*

*#EnterpriseArchitecture*

## **Prioritize Gen AI-driven modernization**

Embrace Gen AI as a strategic tool to transform your enterprise architecture and drive innovation. Foster a culture of continuous learning and collaboration for Gen AI.

## **Transition to zero-trust data architecture**

Implement a robust security framework that treats all data as untrusted, ensuring data privacy and integrity.

## **Explore augmented technologies**

Recognize that Gen AI may not be a silver bullet. Consider integrating it with complementary technologies like graph databases to address complex challenges and achieve optimal results.







**Parvin Moyassari**

Global Lead in Life Sciences,  
Insights and Data, Capgemini



## Gen AI in life sciences

Real-world applications *drive*  
transformation across the value  
chain in life sciences

**Generative AI (Gen AI) is revolutionizing the life sciences industry by enhancing efficiency, innovation, and precision across the value chain. From accelerating drug discovery and transforming clinical trials to enabling personalized medicine, improving patient care, and streamlining regulatory compliance, Gen AI is unlocking new possibilities that are shaping the future of healthcare.**

Life sciences organizations are jumping on the Gen AI bandwagon, and it is becoming clear that this technology's potential to transform the sector is nothing short of exciting. Let's dive into how Gen AI is already making an impact today and what the future holds.

### **Accelerating drug discovery: The next frontier**

One of the most thrilling applications of Gen AI in life sciences is its ability to turbocharge drug discovery, which traditionally takes time and requires large investments.

By processing mountains of biological data, Gen AI uncovers patterns that are invisible to the human eye. It can analyze genomic sequences and protein structures and research literature in record time, speeding up the drug discovery process and improving accuracy. This game-changing technology is set to help companies scale molecule design in ways we have never seen before, making drug development faster and more cost-effective.

On top of that, Gen AI is proving itself as a champion of drug repurposing. By analyzing clinical trial data and scientific literature, it can find new uses for existing drugs – offering faster, cheaper treatment options for patients. As Gen AI models evolve, this ability to identify promising drug candidates and repurpose existing compounds will only get stronger.

### **Making clinical trials smarter, faster, and more inclusive**

Clinical trials have a reputation for being slow and expensive, but Gen AI is shaking things up, making them smarter, quicker, and more efficient. By automating complex tasks like protocol design and authoring, analyzing complex data for quicker decision-making, reporting on regulatory reviews and submissions, Gen AI is making the development process for clinical trials more agile and efficient while cutting down on costs. Gen AI models can sift through historical trial data at lightning speed, spotting trends and predicting risks that might otherwise slip under the radar.

Moreover, Gen AI could enhance clinical trials by creating personalized treatment plans, enabling real-time protocol adjustments, and simulating trial scenarios for better design and allowing remote participation. These capabilities make trials more adaptable, efficient, and patient-centric, accelerating the development of new treatments.

Gen AI also has patient recruitment covered. By analyzing electronic health records and other datasets, it can efficiently match patients to clinical trials, speeding up recruitment and getting trials underway without unnecessary delays. Plus, this approach helps make trials more inclusive, ensuring a broader, more diverse pool of participants – a critical step toward developing treatments that work for all.

### **Elevating marketing excellence**

Gen AI is rapidly transforming the marketing landscape by enabling hyper-personalized content creation, optimizing multi-channel engagements, and enhancing customer-centric strategies. Additionally, Gen AI can provide precise measurement of campaign effectiveness, generate insights from customer data, and support real-time competitive intelligence, ultimately driving more effective and dynamic marketing strategies.

### **Enhancing manufacturing: Dynamic and optimized processes**

Gen AI also offers significant advantages in manufacturing in life sciences. In an industry where precision is everything, Gen AI is bringing new ways to optimize production lines, reduce time to market, and maintain top-notch quality control. By integrating Gen AI-powered systems into manufacturing workflows, companies can automate and optimize key stages of product development and continuously monitor and improve their processes in real time. As personalized medicine becomes more of a focus, flexible manufacturing processes will become even more critical for scaling individualized treatments.

### **Governance and ethics: Ensuring responsible AI use**

As Gen AI becomes more embedded in life sciences, it is crucial to have strong governance and ethical guidelines in place. AI models, especially in healthcare, must be transparent, unbiased, and secure. Solid data governance ensures that AI applications meet regulatory standards while safeguarding sensitive patient data.

A key component of responsible AI use is ensuring that Gen AI applications stay impartial – especially in high-stakes areas like clinical trials or drug development. In the early stages, Gen AI has been used for lower-risk tasks – like automating literature searches or summarizing conference reports – where errors have minimal consequences.





As organizations gain more confidence in the technology, they will expand its use into more critical areas where precision is paramount.

Ethical AI development also means being transparent with patients and stakeholders. AI-driven decisions should be explainable, and the data used to train the models must be carefully curated to avoid bias. By building these safeguards, life sciences companies can ensure that their AI/Gen AI systems are not just effective but also trustworthy and aligned with the highest ethical standards.

### A new reality

The life sciences sector is on the verge of a major technological revolution, thanks to Gen AI's ability to transform the entire value chain. In the coming years, enterprises will witness significant breakthroughs as they integrate Gen AI into their workflows at scale. The combination of different categories of Gen AI models (LLMs, SLMs and MLMs) with Agentic AI and other advanced technologies such as conversational AI and VR/AR, etc. will serve as a powerful catalyst, driving higher levels of automation, improving efficiencies and accelerating return on investment.

As multimodal Gen AI systems become more advanced and we transition toward these models, the life sciences industry will experience significant benefits. By integrating diverse data types such as genetic information, medical imaging, and patient records, these systems will lead to more accurate diagnoses and personalized treatments. They will enhance decision-making through comprehensive insights, improve accessibility with inclusive content, and boost user experience with natural interactions.

While LLMs and MLMs offer unparalleled accuracy and contextual understanding, it is important not to overlook the value of SLMs. These models excel in resource efficiency, cost-effectiveness, and the ability to be fine-tuned for domain-specific applications, making them indispensable for scenarios requiring quick deployment and high privacy standards.

Moreover, as life sciences organizations embrace agentic AI (and multi-agent) systems, they will witness significant advancements across their organization. These AI systems will enable autonomous decision-making and enhance operational efficiency by managing complex tasks such as optimizing clinical trials, monitoring patient health in real-time, and automating laboratory workflows, all with minimal human intervention. By continuously learning and adapting to new data, agentic AI can provide personalized treatment recommendations, improve patient outcomes, and streamline drug development processes.

The future looks bright for life sciences organizations ready to embrace Gen AI and its frontiers. This technology is primed to unlock unparalleled innovation across the entire value chain. As the industry continues to evolve, Gen AI will be at the core of a new era in healthcare, one that is faster, more personalized, and more impactful than ever before.



*The life sciences sector is on the verge of a major technological revolution, thanks to Gen AI's ability to transform the entire value chain. In the coming years, enterprises will witness significant breakthroughs as they integrate Gen AI into their workflows at scale.*





# Start innovating now

*#GenAIForLifeSciences*

*#AIForHealthcare*

*#DrugDiscoveryRevolution*

*#AdaptiveClinicalTrials*

*#SmartManufacturingAI*

## **Optimize the development process of clinical trials**

Utilize Gen AI to create adaptive clinical trial design, refine trial eligibility criteria, and personalize patient engagement. This approach increases trial efficiency, enhances patient outcomes, and enables faster, more flexible processes.

## **Implement personalized medicine**

Leverage Gen AI to integrate and analyze diverse data types, such as genetic information, medical imaging, and patient records, to develop highly personalized treatment plans and predict patient responses to different therapies. This ensures that patients receive the most effective treatments tailored to their unique genetic makeup and medical history, improving outcomes and reducing adverse effects.

## **Develop domain-specific copilots**

Step into the future by augmenting your workforce with AI-powered assistants that are domain specific. These systems can assist in drug design, clinical trials, and manufacturing, providing real-time insights and predictions that dramatically improve decision-making, scalability, and operational efficiency.





### Joakim Nilsson

Knowledge Graph Lead, Insights and Data Sweden, Capgemini



### Johan Müllern-Aspegren

Emerging Tech Lead, Applied Innovation Exchange Nordics, and Core Member of AI Futures Lab, Capgemini



## Mulder and Scully for fraud prevention

*Teaming up AI capabilities*

Fraud detection can be revolutionized with hybrid AI. Combining the “intuitive hunches” from LLMs with a fraud-focused knowledge graph, a multi-agent system can identify weak signals and evolving fraud patterns, moving from detection to prevention in real-time. The challenge? Rule sets need to be cast in iron, whereas the system itself must be like water: resilient and adaptive. Historically, this conflict has been unsolvable. But that is about to change.

## A multi-agent setup

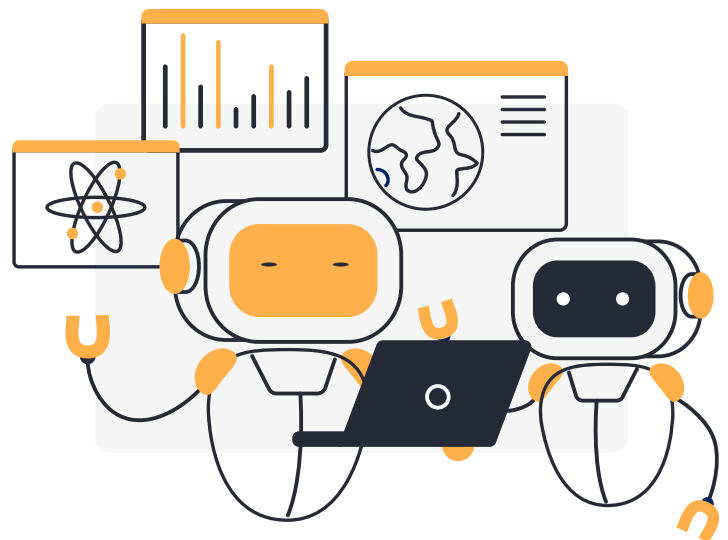
Large language models (LLMs) are often criticized for hallucinating: coming up with results that seem feasible but are plain wrong. In this case though, we embrace the LLM’s gut-feeling-based approach and exploit its capabilities to identify potential signs of fraud. These “hunches” are mapped onto a general ontology and thus made available to symbolic AI components that build on logic and rules. So, rather than constricting the LLM, we are relying on its language capabilities to spot subtle clues in text. Should we act directly on these hunches, we would run into a whole world of problems derived from the inherent unreliability of LLMs. However, this is the task of a highly specialized team of agents, and there are other agents standing by, ready to make sense of the data and establish reliable patterns.

When we talk about agents, we refer to any entity that acts on behalf of another to accomplish high-level objectives using specialized capabilities. They may differ in degree of autonomy and authority to take actions that can impact their environment. Agents do not necessarily use AI: many non-AI systems are agents, too. (A traditional thermostat is a simple non-AI agent.) Similarly, not all AI systems are agents. In this context, the agents we focus on primarily handle data, following predefined instructions and using specific tools to achieve their tasks.

We define a multi-agent system as being made up of multiple independent agents. Every agent runs on its own, processing its own data and making decisions, yet staying in sync with the others through constant communication. In a homogeneous system, all agents are the same and their complex behavior solves the problem (as in a swarm). Heterogeneous systems, though, deploy different agents with different capabilities. Systems that use agents (either single or multiple) are sometimes called “agentic” architectures or frameworks.

For example, specialized agents can dive into a knowledge graph, dig up specific information, spot patterns, and update nodes or relationships based on new findings. The result? A more dynamic, contextually rich knowledge graph that evolves as the agents learn and adapt.

The power is in the teaming. Think of the agents Mulder and Scully from The X-Files television show: Mulder represents intuitive, open-minded thinking, while Scully embodies rational analysis. In software, there always have been many Scullys but, with LLMs, we now have Mulders too. The challenge, as in The X-Files, is in making them work together effectively.



## The role of a universal ontology

We employ a universal ontology to act as a shared language or, perhaps a better analogy, a translation exchange, ensuring that both intuitive and analytical agents communicate in terms that can be universally understood. This ontology primarily consists of “flags” –generic indicators associated with potential fraud risks. These flags are intentionally defined broadly, capturing a wide range of behaviors or activities that could hint at fraudulent actions without constraining the agents to specific cases.

The key to this system lies not in isolating a single flag but in identifying meaningful combinations. A single instance of a flag may not signify fraud; however, when several flags emerge together, they provide a more compelling picture of potential risk.





## Hybrid AI adaptability

The adaptability of the system lies in the bridging between neural and symbolic AI as the LLM distills nuances in texts into hunches. They need to be structured and amplified for our analytical AI to be able to access them. As Igor Stravinsky wrote in his 1970 book *Poetics of Music in the Form of Six Lessons*, “Thus what concerns us here is not imagination itself, but rather creative imagination: the faculty that helps us pass from the level of conception to the level of realization.” For us, that faculty is the combination of a general ontology

and vector-based similarity search. They allow us to connect hunches to flags based on semantic matching, and thus address the data using general rules. Because we work in a graph context, we can also explore direct, indirect, and even implicit relations between the data.

Now let’s explore how our team of agents picks up and amplifies weak signals, and how these signals, once interwoven in the graph, can lead the system to identify patterns spanning time and space, patterns it was not designed to identify.

**A scenario:** Welfare agencies have observed a rise in fraudulent behavior, often uncovered only after individuals are exposed for other reasons like media reports. Identifying these fraud attempts earlier, ideally at the application stage, would be extremely important.

Step 1

### Intuitive agent captures weak signals

The intuitive agent analyzes application language and metadata, searching for potential fraud indicators. In this case, the LLM detects uncommon phrasing and identifies it as a potential flag. It extracts metadata and text and embeds a vector of the text. Using this data, it generates one or more nodes of type “hunch”.

Step 2

### Mapping to the fraud ontology

The ontology provides a framework for mapping these weak signals (hunches). The system performs a vector-based similarity search across known flags. By connecting the hunches to structured flags in our knowledge graph, the system establishes a baseline for detecting organized crime patterns even when signals appear weak or scattered.

Step 3

### Establishing patterns through cross-referencing hunches

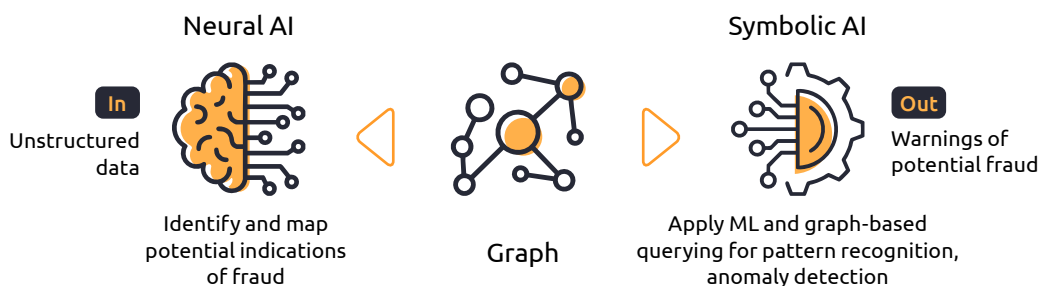
The analytical agent notices that multiple applications have hunches connected to the flag “unusual phrasing.” Using the embedded vectors, the system confirms that some of the sections of text that were noticed by the intuitive agent are very similar. So far, nothing substantial has been found, but there is a disturbing pattern.

Step 4

### Analytical agents cross-reference with transaction data

Alongside hunches, there are also nodes now that include transaction data tied to bank accounts and payment destinations. The analytical agent queries these connections, revealing earlier similar applications linked to an individual previously prosecuted for financial crime. Though not directly involved in recent cases, a trail of hunches connects to them, triggering an alert.

**Outcome:** By combining intuitive and analytical insights, authorities uncover a well-coordinated fraud ring that would be hard to detect through traditional methods. The agents map amplified weak signals as well as explicit and implicit connections. Note also that the system was not trained on detecting this pattern; it emerged thanks to the weak signal amplification.



One of the powers of hybrid AI lies in its ability to amplify weak signals and adapt in real time, uncovering hidden fraud patterns that traditional methods often miss. By blending the intuitive insights of LLMs with the analytical strength of knowledge graphs and multi-agent systems, we’re entering a new era of fraud detection and prevention – one that’s smarter, faster, and more effective. As Mulder might say, the truth is out there, and with the right team, we’re finally close to finding it.



*This innovation shifts the approach from simple fraud detection to proactive prevention, allowing authorities to stay ahead of fraudsters with scalable systems that learn and evolve.*



# Start innovating now

*#MultiAgent  
#KnowledgeGraph  
#FraudDetection  
#LLM #HybridAI*

## **Implement a universal ontology**

Create a shared ontology to bridge neural (intuitive) and symbolic (analytical) AI agents, transforming weak signals for deeper analysis by expert systems and graph-based connections.

## **Form specialized multi-agent teams**

Build teams of neural (real-time detection) and symbolic (rule-based analysis) AI agents, each specialized with tools for their role.

## **Leverage graph technology for cross-referencing**

Use graph databases to link signals over time and across data sources, uncovering patterns like fraud faster, earlier, and at a lower cost than current methods.





### Heidi Karlsson

Director Open Footprint®  
Forum, The Open Group



### Arne Rossmann

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# Inclusive currents Navigating the *blue* economy with AI



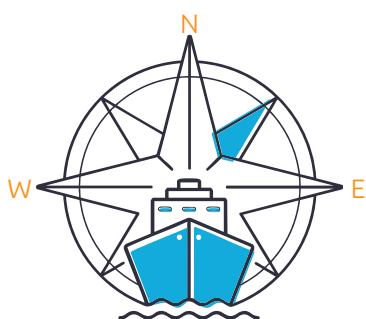
The blue economy offers a framework for sustainably managing ocean resources and balancing economic growth with environmental protection. With the integration of AI and the Open Footprint® Data Model, we can optimize resource use, enhance pollution detection, and support marine conservation efforts. Involving local communities is crucial to ensuring equitable benefits and fostering inclusive decision-making, paving the way for a healthier ocean ecosystem and a more sustainable future.

### The importance of the blue economy

The ocean covers over 70 percent of the Earth's surface and is crucial for sustaining life. It provides food, regulates the climate, and supports billions of livelihoods. However, balancing economic growth with environmental sustainability is a significant challenge. This is where the blue economy comes into play. It is a framework dedicated to the sustainable use of ocean resources, aiming to foster economic development while protecting marine ecosystems.

The blue economy encompasses a variety of sectors, including fisheries, aquaculture, maritime transportation, coastal tourism, and renewable energy sources like offshore wind and tidal power. This concept is not solely about exploiting ocean resources; it emphasizes maintaining long-term sustainability by safeguarding marine biodiversity, reducing pollution, and ensuring the health of ecosystems.

#### Maritime transportation



AI improves shipping routes  
lowering fuel consumption and emissions

The ocean is vital to global health and contributes significantly to the global economy. However, without effective management, these benefits could be lost to overfishing, pollution, and climate change.

Food security is a key pillar supported by a healthy ocean, with over [three billion people relying on seafood](#) as a significant source of protein. Additionally, the ocean helps absorb large amounts of carbon dioxide, mitigating climate change effects. Given the increasing threats to ocean health, sustainable management of these resources is more critical than ever. This is where innovative technologies, particularly AI, can make a transformative impact.

### Harnessing technology for the blue economy

Technology has always played a role in ocean exploration and management, but AI is emerging as a powerful tool for optimizing resource use. With its capability to process vast datasets, identify patterns, and generate insights, AI is revolutionizing the management of marine environments.

In the blue economy, AI applications are already optimizing fishing practices, preventing illegal fishing, and enhancing marine conservation. Additionally, AI is assisting renewable energy sectors in maximizing production from offshore resources.

AI has the potential to significantly change our interactions with the ocean across several key areas.

- **Marine resource management:** AI algorithms can monitor fish populations and ecosystems, ensuring sustainable fishing practices.
- **Sustainable aquaculture:** AI optimizes feeding processes in aquaculture, promoting fish health and minimizing waste.
- **Pollution detection:** By analyzing satellite images and sensor data, AI can quickly identify oil spills and other pollutants.
- **Maritime transportation:** AI-driven systems optimize shipping routes, reducing fuel consumption and lowering emissions.
- **Climate change adaptation:** AI helps model the effects of climate change on ocean systems, aiding in the development of adaptive strategies.

### The Open Footprint Data Model

The [Open Footprint Data Model](#) is a standardized framework designed to collect, store, and share environmental data. It provides a consistent and transparent way to measure the environmental impact of various activities, particularly in industries related to the blue economy.

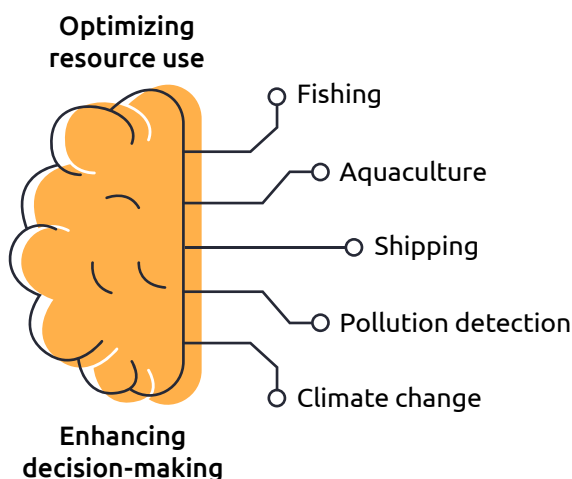
In this context, the model enhances decision-making by supplying accurate, high-quality data. This enables businesses and governments to monitor their environmental footprints, ensuring that their activities are sustainable and aligned with environmental regulations.



The true potential of AI in the blue economy emerges when it is combined with reliable data. The Open Footprint Data Model provides the necessary foundation for effective AI applications.

For example, in marine resource management, AI can analyze data from the Open Footprint framework to monitor fish stocks and predict trends. In pollution control, AI can utilize footprint data to identify pollution sources and develop targeted solutions, thereby reducing harm to marine ecosystems.

### AI's role in the blue economy



### Inclusion in the blue economy

A crucial but often overlooked aspect of the blue economy is inclusion. To fully realize its potential, all stakeholders – especially local communities and marginalized groups – must be involved in decision-making processes.

**Engaging local communities:** Coastal communities are directly impacted by ocean health. AI can support resource management, benefiting local fisheries and ensuring sustainable practices. Involving locals respects their traditional knowledge and needs in blue economy planning.

**Bridging technological gaps:** Advanced technologies like AI risk widening the gap between developed and developing nations. Equitable access to these technologies is crucial, requiring governments and businesses to provide training and resources for local stakeholders.

**Promoting gender and social equity:** Women and other underrepresented groups often contribute significantly to marine industries but are frequently undervalued. AI can support gender equity by ensuring diverse voices are included in sustainable ocean management practices.

Consider the example of marine pollution detection. Oil spills pose a significant threat to marine life and coastal communities. AI can analyze satellite imagery to detect oil spills and monitor their spread, enhancing detection accuracy by providing context

such as spill size and potential environmental impact. This comprehensive approach allows for quicker response strategies, minimizing damage to ecosystems and involving local communities in protective measures.

### Challenges in implementation

Despite the immense potential of AI and the Open Footprint Data Model, several challenges must be addressed.

**Data interoperability:** Different organizations often use various data formats, complicating data sharing and integration.

**Collaboration needs:** Successful implementation requires cooperation between technology experts and marine scientists.

**Ethical concerns:** Bias and inequality are risks in AI applications, necessitating ethical considerations in implementation.

**Inclusive participation:** Without a concerted effort to include local and marginalized communities, these technologies could exacerbate existing divides.

### Solutions for success

To overcome these challenges, businesses and governments ought to invest in data infrastructure and research and development, promote interdisciplinary partnerships, and establish regulatory frameworks that govern the ethical use of AI in marine environments.

Moreover, creating policies that promote inclusion in the blue economy is essential. This includes engaging local communities in decision-making processes, ensuring equitable access to resources, and fostering capacity-building initiatives that empower diverse stakeholders.

By harnessing AI and the Open Footprint Data Model, the blue economy can thrive, ensuring sustainable ocean management and equitable benefits for all. As we look to the future, the journey toward a healthier ocean ecosystem is just beginning. With collaborative efforts and innovative technologies, we can create a sustainable future for our oceans and the communities that depend on them.



*The true potential of AI in the blue economy emerges when it is combined with reliable data. The Open Footprint® Data Model provides the necessary foundation for effective AI applications.*



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*#BlueEconomy  
#SustainableOceans  
#InclusiveInnovation  
#BlueInnovation #Inclusion  
#Innovation #Data #AI #Ocean  
#Economy #R&D #BlueTech  
#Technology #GreenEnergy  
#Environment #Conservation  
#Climate #Sustainability*

## **Sustainable growth**

Embrace the blue economy to champion responsible ocean resource use, driving economic progress while safeguarding our precious marine ecosystems.

## **AI empowerment**

Harness the power of AI to transform ocean management and unlock new possibilities for resource optimization and conservation through innovative insights.

## **Inclusive practices**

Elevate local communities and underrepresented voices in decision-making, creating an equitable blue economy that paves the way for a sustainable and prosperous future for all.







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## Raising confidence in AI

### The importance of a *trust and validation frameworks*

Generative AI is changing how industries work, but trust is what makes it truly valuable. A robust trust and validation framework keeps AI ethical, safe, and reliable. It reduces risks and ensures responsibility at every step – from data to decisions. With this, businesses can confidently use AI, knowing it's secure and accountable.

The rise of advanced generative AI (Gen AI) is revolutionizing industries, offering unmatched efficiency and insights, from drafting content to creating lifelike visuals. However, unlocking its full potential requires more than just innovation: It demands a strong trust and validation framework to ensure outputs are accurate, ethical, and reliable.

Capgemini RAISE, a Gen AI trust and validation framework by Capgemini, provides structured metrics and systematic insights that allow organizations to uphold AI accountability. This framework facilitates rigorous evaluations and actionable mitigation strategies, enhancing transparency and trust in AI systems.

As Gen AI increasingly shapes decision-making and interactions, ensuring its secure, ethical, and reliable integration into broader functionalities is crucial. Trust is no longer optional. Instead, it is a core requirement for successful, real-world AI applications. Businesses that operationalize AI transparency, trust, and security will see a significant improvement in user acceptance, adoption, and business goals in the forthcoming years.

### Gen AI trust: An experience and not an activity

Throughout the development life cycle, the intensity and significance of evaluating each trust component can be dynamically adjusted to meet evolving needs and challenges. This adaptive approach ensures that as AI applications progress from conceptualization to deployment and beyond, the focus on data integrity, model evaluation, policy adherence, monitoring protocols, and human oversight remains calibrated to mitigate risks and optimize performance. Such flexibility not only enhances agility but also reinforces the framework's resilience in navigating the complexities of AI integration effectively.

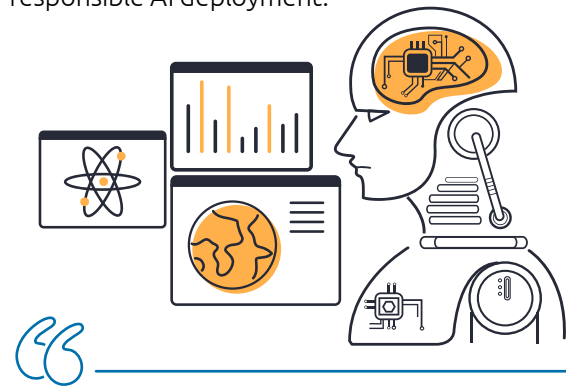
### Generative AI validation: A differentiating perspective

In Gen AI, validation is critical to ensuring that AI-generated outputs are accurate, reliable, and aligned with intended goals. Unlike traditional testing, validation in AI evaluates content quality, coherence, and relevance while checking for biases and maintaining compliance. A robust trust and validation framework is essential for deploying Gen AI responsibly across various domains.

For example, in healthcare, virtual assistants must provide accurate information. Validation ensures that medical data is processed correctly,

recommendations align with clinical guidelines, and robust monitoring prevents misinformation while protecting patient privacy. This is crucial for maintaining patient safety and complying with regulations like the Health Insurance Portability and Accountability Act (HIPAA).

Similarly, in sectors like finance and legal, rigorous testing ensures Gen AI delivers accurate, ethical, and compliant outcomes. Across industries, trust and validation frameworks are key to building user confidence, safeguarding data, and ensuring responsible AI deployment.



*Four in five executives see at least one trust-related issue as a roadblock to generative AI adoption.*

- Enterprise generative AI, IBM

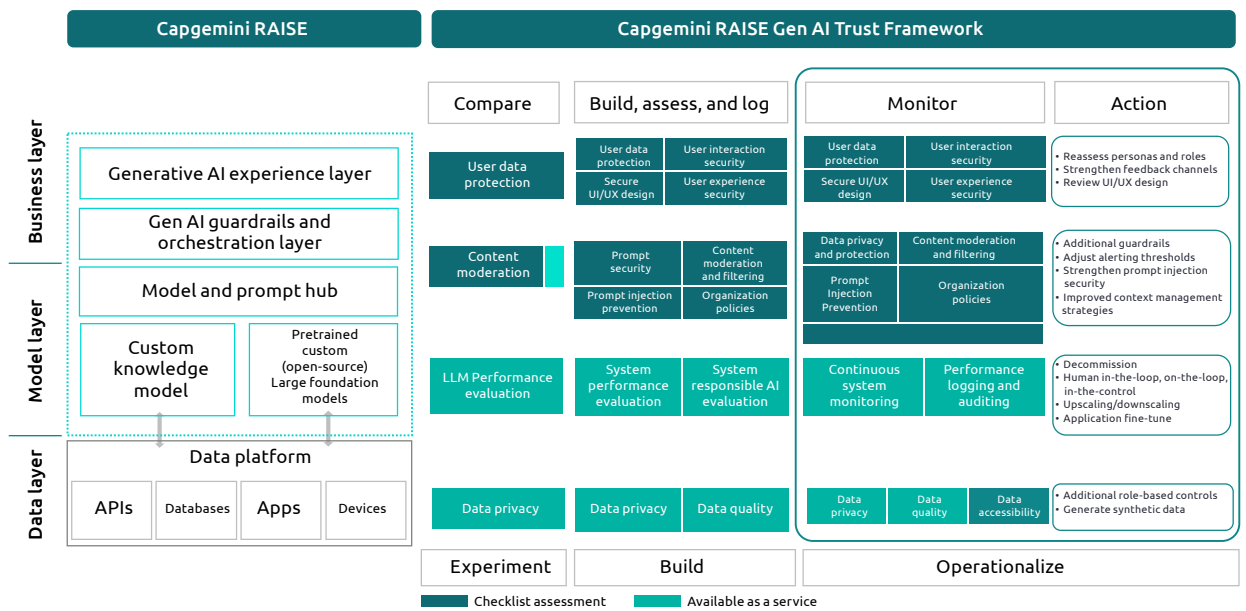


The Gen AI trust framework ensures responsible and secure deployment of Gen AI applications across four layers.

- **Data layer:** Ensures data quality and privacy compliance, safeguarding enterprise data and permissible personally identifiable information (PII) for ethical AI use.
- **Model layer:** Focuses on accuracy, performance, and responsible AI practices to ensure reliable and ethical outputs.
- **Prompt and orchestration layer:** Provides a checklist for security, content moderation, and compliance, ensuring robust and secure AI interactions.
- **Business layer:** Ensures user data protection, secure interactions, and compliant UI/UX design for safe and trustworthy user experiences.





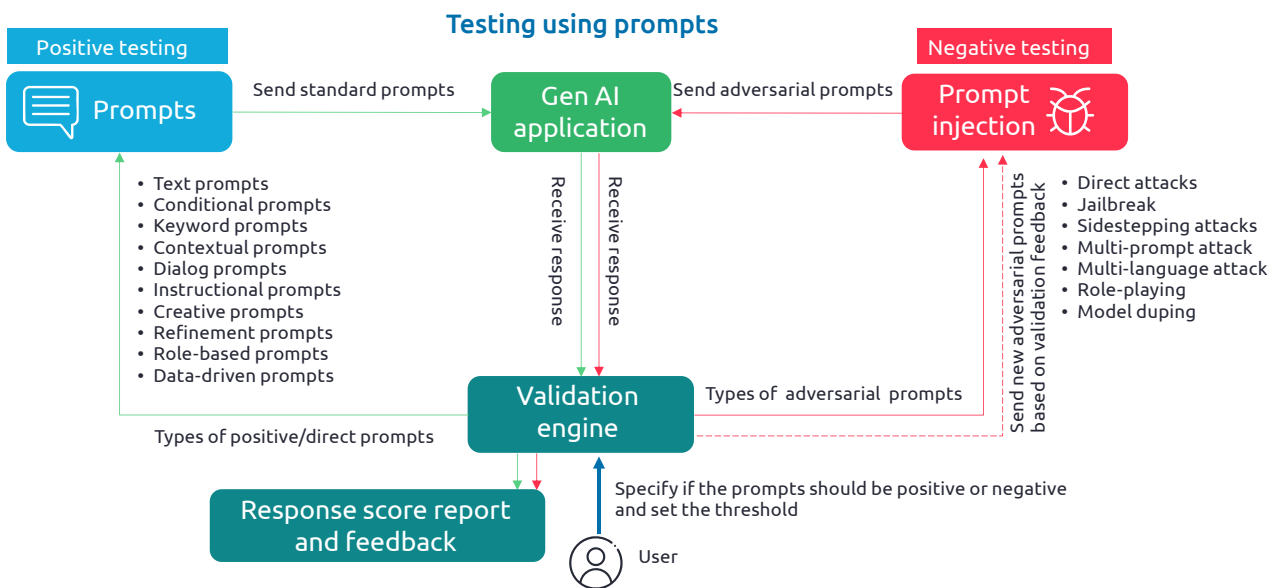


These components provide continuous monitoring, ensuring AI solutions are effective, safe, and ethical across all layers.

Prior to deploying a Gen AI application, it's essential to conduct rigorous testing to ensure its reliability and security. The key components of testing Gen AI applications include the use of benchmarks, red teaming, and a comprehensive validation framework.

### Key components of testing

- **Prompts:** Using a diverse range of prompts to assess the AI's performance and identify errors.
- **Guardrails:** Implementing safety measures to prevent unintended consequences and ensure ethical use.
- **Red teaming:** Simulating attacks to identify vulnerabilities and strengthen security.
- **Positive and negative testing:** Evaluating the AI's accuracy and robustness under various conditions.



Here are key examples of when Gen AI programs lacking enough trust and validation adoption have faced financial and reputational impacts.

- A finance worker was tricked into **paying out \$25 million** after a video call with a deepfake chief financial officer.
- Air Canada was ordered to pay a customer who was **misled by the airline's chatbot**.
- A New York City chatbot called MyCity was found to be asking business owners to **perform illegal activities**.

- AI systems are **causing issues for some US immigration processes**.

A robust trust and validation framework is indispensable for the responsible deployment of Gen AI applications. By meticulously validating inputs, scrutinizing outputs, and safeguarding sensitive data, organizations can effectively mitigate risks, bolster the accuracy of AI-generated content, and cultivate trust among users. This structured approach not only ensures adherence to legal and ethical guidelines but also fosters a secure and positive user experience.



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*#GenAITrust*

*#GenAI4Good*

*#RedTeam*

*#AITrust*

## **Build trust, avoid risk**

Implement a comprehensive Gen AI trust assessment and adoption framework to ensure reliability, security, and ethical deployment while minimizing risks.

## **Future-proof your AI**

Ensure compliance across industries by evaluating your AI systems with continuous monitoring, security protocols, and adherence to regulatory standards, throughout the data to decision journey.

## **Test, monitor, evolve**

Continuously challenge your AI with red teaming to identify vulnerabilities, maintain human oversight, and adapt testing methods to keep your AI secure and resilient.





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## Teaming up data mesh and generative AI

Leverage a *powerful combination* for data mastery

Augmenting data mesh with generative AI delivers unprecedented potential for managing data. This winning combination revolutionizes data governance by automating metadata creation, enhancing data quality, and enabling intelligent classification, making data more consistent and accessible. With advanced analytics capabilities like predictive insights and anomaly detection, issues can be proactively addressed, and data product development can be accelerated. The natural synergy between data mesh and generative AI is ready to be unlocked.

In a data-powered world, organizations are increasingly adopting the data mesh architecture to manage their complex information landscapes effectively. The data mesh, characterized by decentralized data ownership, federated governance, and self-service access, offers numerous benefits in terms of agility, scalability, and data democratization.

However, to fully harness this potential, organizations must explore innovative approaches to enhance their management, analytics, and governance. This is where generative AI (Gen AI) can play a pivotal role. By automating and augmenting various aspects of data operations, Gen AI can amplify the benefits of the data mesh, enabling organizations to extract maximum value.

By automating and augmenting various aspects of data management, analytics, and usage, Gen AI enhances data accessibility, quality, and insights. This synergy enables teams to extract actionable intelligence more efficiently, promoting a culture of innovation and collaboration. Ultimately, the combination of data mesh principles with Gen AI creates a robust ecosystem that empowers organizations to maximize the value of their data assets.

## Widespread benefits

Here are the key areas that benefit from this synergy:

### Data governance and quality

- **Automated metadata:** Streamline metadata creation and management for improved data consistency and discoverability.
- **Intelligent classification:** Accurately classify and categorize data for efficient search and retrieval.
- **Enhanced data quality:** Automatically identify and address data quality issues to ensure reliability.

### Enhanced data access and discovery

- **Natural language interfaces:** Gen AI can enable non-technical users to interact with data using natural language, making data more accessible and understandable.

- **Intelligent search:** AI-powered search capabilities can provide relevant results based on user queries, even when the data is unstructured or poorly organized.

- **Data visualization:** Gen AI can create visually appealing and informative data visualizations, helping users to uncover hidden insights and trends.

### Advanced analytics and insights

- **Predictive analytics:** Gen AI can develop predictive models to forecast future trends and outcomes based on historical data.

- **Prescriptive analytics:** Optimal actions or decisions can be suggested based on data-driven insights.

- **Anomaly detection:** Gen AI can identify unusual patterns or deviations from normal behavior in data, helping to detect anomalies and potential issues.

### Automated data product development

- **Data product generation:** Gen AI can assist in creating new data products by automating tasks such as data cleaning, transformation, and visualization.

- **Data product optimization:** AI can continuously improve the performance and relevance of data products based on user feedback and evolving data patterns.

### Scalability and efficiency

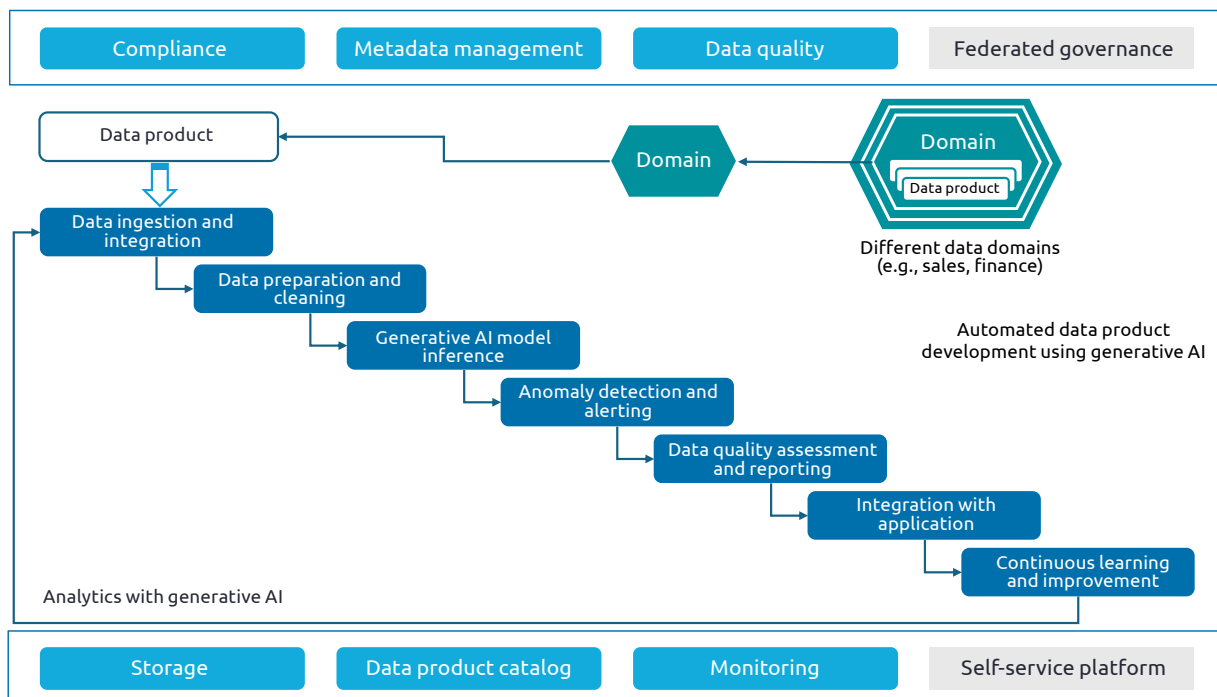
- **Automated data management:** Gen AI can automate routine data management tasks, such as data ingestion, cleansing, and integration, freeing up data teams to focus on higher-value activities.

- **Improved efficiency:** By automating tasks and providing insights, Gen AI can significantly improve the efficiency of data-driven operations.

The diagram on the next page demonstrates a high level architecture flow for augmenting data mesh with Gen AI implementation.







## AI and healthcare

One sector gaining a lot of benefit from Gen AI is healthcare. A large healthcare provider utilizes Gen AI to improve data quality and patient safety within its decentralized data mesh. By leveraging AI-powered anomaly detection, data profiling, and natural language querying, the organization addresses critical challenges such as incorrect medication dosages, duplicated entries, and missing data in electronic health records (EHRs). This leads to improved patient care, reduced errors, and enhanced data-driven decision-making.

The key benefits of this use case are:

- **Improved patient safety.** Reduced risk of medical errors due to accurate and complete patient data.
- **Enhanced data quality.** Identification and correction of inconsistencies, anomalies, and missing values.
- **Empowered medical staff.** Natural language querying enables easy access to data insights, supporting evidence-based decision-making.
- **Efficient data management.** Automated data profiling and discovery streamline data quality assurance processes.

Integrating Gen AI into data governance and management frameworks brings significant advantages. It automates metadata creation, enhances data quality, and facilitates intelligent classification, improving data consistency and accessibility. Gen AI also elevates analytics by providing predictive and prescriptive insights while enabling anomaly detection to proactively address issues. The automation of data product

development streamlines processes, ensuring ongoing optimization and relevance.

Overall, these advancements lead to greater scalability and efficiency, allowing data teams to focus on higher-value activities. By harnessing the full potential of their data, organizations can drive better decision-making, foster innovation, and gain a competitive edge in today's data-driven landscape.

As Gen AI continues to evolve, its integration with the data mesh will unlock even greater possibilities for innovation and value creation. By embracing this powerful synergy, organizations can position themselves at the forefront of data-driven transformation.

*Generative AI can accelerate and augment a data mesh by enhancing data governance, automating data product creation, and improving data consistency and accessibility, making data more reliable and accessible."*



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*#DataMesh #GenerativeAI  
#AI #DataScience  
#DataAnalytics #DataDriven  
#DataMeshArchitecture,  
#DataGovernance  
#DataQuality  
#DataAutomation  
#AIForBusiness*

## Enhance data governance

Integrating Gen AI automates metadata creation, enhances intelligent classification, and improves data quality, resulting in greater consistency and accessibility.

## Automate data product development

Gen AI can streamline the creation of new data products by automating tasks and continuously enhancing the performance and relevance of these products based on user feedback.

## Improve data access

Gen AI empowers non-technical users to interact with data through natural language interfaces, provides intelligent search capabilities, and creates informative visualizations, making data more accessible and insightful.





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## The autogen framework *Augmenting call centers with* generative, multi-agentic AI



## The intersection of generative AI and multi-agent systems presents a promising avenue for enhancing the capabilities of call center agent-assist frameworks. Generative AI models, with their ability to personalize learning experiences, generate interactive content, and enable adaptive assessments, can empower both call center agents and their customers.

The integration of generative AI and multi-agent systems represents a groundbreaking shift in the capabilities of call center agent-assist frameworks. Generative AI (Gen AI) models, with their ability to create personalized, interactive experiences and adaptive learning environments, empower both call center agents and customers alike. Multi-agent systems, consisting of intelligent agents with specialized skills, foster a collaborative environment to deliver a seamless and efficient customer experience. Together, these technologies have the potential to revolutionize call center operations by automating routine tasks, providing real-time decision support, and enabling continuous learning and improvement.

To address these challenges, we propose a novel framework, autogen that will seamlessly integrate Gen AI and multi-agent systems. The autogen framework is designed to harness the power of multiple intelligent agents, each specializing in a specific domain or task, to provide a comprehensive and adaptive support system for call center agents. At the core of autogen is a generative AI model, trained on a vast repository of successful customer interactions, that can provide real-time guidance and recommendations to call center agents. This AI model is complemented by a network of specialized agents, each responsible for tasks such as natural language processing, knowledge retrieval, predictive analytics, and user profiling. These agents work collaboratively to gather relevant information, analyze customer inquiries, and propose tailored solutions, ultimately empowering call center agents to deliver a superior customer experience.

The key strength of this combined approach lies in the complementary capabilities of Gen AI and multi-agent systems. Gen AI models can encode best practices from top-performing agents using vast amounts of customer-service training data. These models support agents by providing real-time guidance, suggestions, and personalized coaching, helping them resolve customer issues more efficiently.

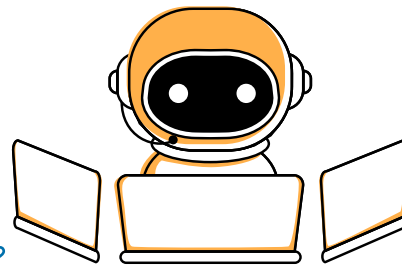
The autogen framework also incorporates mechanisms for continuous learning and improvement, allowing the system to adapt to evolving customer needs and agent feedback. By fostering a synergistic relationship between call center agents and the autogen framework,

organizations can drive measurable improvements in agent productivity, customer satisfaction, and overall business performance.

The autogen framework comprises a multi-agent architecture, where each agent specializes in a specific task or functionality to collectively address the diverse requirements of call center operations.

In tandem, multi-agent systems utilize specialized agents responsible for various tasks, such as natural language processing (NLP), knowledge retrieval, and predictive analytics. Each agent brings unique expertise to address diverse customer inquiries, ensuring comprehensive and timely responses to complex service requests.

These agents work collaboratively, sharing information and insights, to support call center agents in providing efficient, personalized, and inclusive customer service. The autogen framework's modular design allows for easy scalability and adaptation to evolving customer-service requirements.



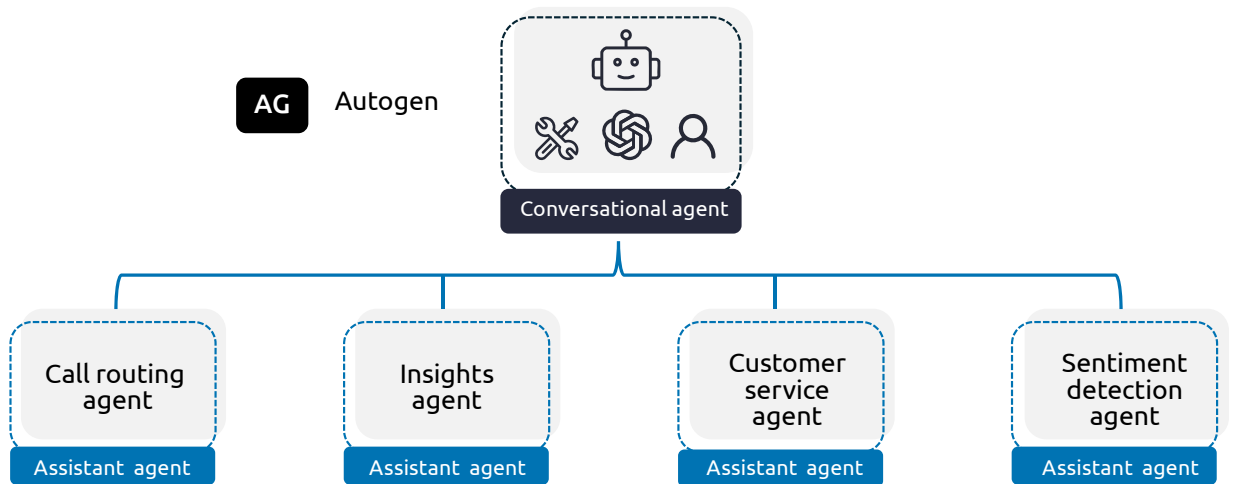
*The integration of generative AI and multi-agent systems represents a groundbreaking shift in the capabilities of call center agent-assist frameworks.*



This integrated framework enhances the overall functionality of call centers, streamlining workflows, increasing agent productivity, and enabling personalized interactions.



## Autogen - The first framework for multi-agent systems



### Examples of autogen in action

- **Real-time guidance.** A call center agent, while dealing with a complex customer issue, can receive real-time suggestions from the Gen AI model based on previously successful resolutions. For instance, if a customer is having trouble with a product refund, the AI can guide the agent through the most effective resolution steps used by top agents, including policy references and response tone recommendations.
- **Collaborative problem-solving.** Multi-agent systems can assist by deploying specialized agents simultaneously. While the NLP agent extracts the core issue from the customer's complaint, a knowledge retrieval agent fetches relevant policy documents. At the same time, a predictive analytics agent provides insights on the likelihood of customer churn based on the conversation.

### Autogen best practices

- **Data-driven personalization.** By leveraging historical customer interactions and performance data, Gen AI models can provide customized support for agents, ensuring consistency and quality in customer service delivery.
- **Collaborative multi-agent framework.** Ensuring that specialized agents work in tandem is essential. Each agent should focus on its task while contributing to the overall goal of delivering a seamless customer experience.
- **Continuous learning systems.** Integrate feedback loops that allow AI systems to learn and improve continuously. This ensures that the technology adapts to evolving customer needs and enhances agents' decision-making processes over time.

The market for AI-driven call center solutions is rapidly growing as businesses recognize the importance of delivering superior customer service in competitive markets. Recent advancements in conversational AI, such as OpenAI's ChatGPT, demonstrate the potential of generative models in transforming customer interactions.

There is an increasing demand for intelligent automation in call centers, with companies looking to improve agent productivity while maintaining personalized customer experiences. Moreover, the focus is shifting towards creating more inclusive and accessible AI systems that cater to diverse customer groups, emphasizing the importance of equity and inclusion in AI development.

Generative AI and multi-agent systems offer an unprecedented opportunity to revolutionize call center operations. By empowering agents with real-time guidance, automating routine tasks, and ensuring personalized customer interactions, these technologies can enhance productivity and customer satisfaction. The proposed autogen framework exemplifies this synergy, providing an adaptive, collaborative, and continuous learning system that drives significant improvements in call center performance.

As the adoption of AI-driven solutions grows, it's essential for organizations to prioritize inclusivity and equity in their deployments. Ensuring that AI systems are designed to serve diverse populations will enable businesses to offer fairer and more accessible customer service experiences.



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*#GenerativeAI  
#MultiAgentSystems  
#CallCenterAutomation  
#CustomerService  
#ConversationalAI #AgentAssist  
#CustomerExperience  
#FutureOfWork #AllInnovation  
#RealTimeSupport*

## **Implement a multi-agent system for specialized expertise**

Deploy multiple intelligent agents that specialize in different areas like NLP, knowledge retrieval, and predictive analytics. This will enable call centers to handle complex customer inquiries more efficiently and deliver high-quality, personalized solutions.

## **Utilize generative AI for real-time agent support**

Leverage Gen AI models trained on historical customer interaction data to provide agents with real-time suggestions and solutions, improving decision-making and shortening resolution times for customer issues.

## **Prioritize inclusivity in call center AI systems**

Ensure that call center AI frameworks are trained on diverse datasets and equipped to support communication in multiple modalities (e.g., sign language, visual aids) to offer an equitable customer experience for all users.







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Innovation Lead, Insights  
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## Unlocking innovation with platform engineering

*The golden path to data mesh  
and AI excellence*

Platform engineering is revolutionizing how organizations develop data products and AI applications by leveraging data mesh architecture and internal developer platforms. This empowers teams to efficiently build AI models and data-driven tools while ensuring automated governance and compliance and maximizing the value of data and AI assets.

Data, AI, and innovation are essential to staying competitive. Organizations need to accelerate development while maintaining quality to remain ahead. Platform engineering, traditionally tied to cloud-native environments and microservices, is now crucial for enabling data mesh architectures, transforming how data products and AI applications are built.

Data mesh allows teams to efficiently develop AI models, AI agents, and analytical tools, such as dashboards. Platform engineering provides the infrastructure and standardized processes – known as the golden path – that streamline development, reduce time to market, and improve product quality.

### Internal developer platforms and data mesh

Internal developer platforms (IDPs), such as [Backstage](#), [Port](#), and [Humanitec](#), are vital enablers of platform engineering and offer self-service capabilities for managing infrastructure, services, and data pipelines. They abstract infrastructure complexity, allowing teams to focus on developing high-quality data and AI products.

In a data mesh environment, IDPs provide essential tools and templates that help teams build and manage data products efficiently. They accelerate the creation of data-driven applications by providing standardized workflows and automation tools, enabling teams to follow the golden path for faster and more reliable development.

### Automated data and AI governance

One of the most significant advantages of platform engineering is automated data and AI governance. Data products are automatically published into data catalogs, while AI models are added to model catalogs with relevant metadata. This ensures consistent governance across the organization and simplifies compliance.

When semantic integration is established between data sources, data products, AI/ML models, and analytical use cases, the benefits are even greater. By linking these elements, companies can better track the value of their data and AI assets, improving transparency and decision-making.

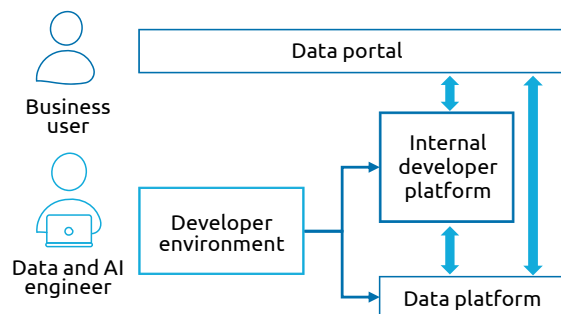
### Bridging the gap: From data to actionable insights

However, the benefits of platform engineering extend beyond the realm of data management. As organizations strive to derive meaningful

insights from their data, the need for robust, scalable, and user-friendly analytical tools has never been greater.

Platform engineering provides a framework for the development and deployment of custom data and AI-powered applications, enabling organizations to transform raw data into actionable insights. By streamlining the process of building and deploying these analytical tools, platform engineering accelerates the time-to-market and ensures a consistent, high-quality user experience.

### IDP Setup



### Developing a predictive maintenance data product

Consider a manufacturing company aiming to implement predictive maintenance to reduce factory downtime. The goal is to develop a data product that analyzes machine performance data, detects anomalies, and predicts when maintenance is needed.

- **Data ownership and product development:** The manufacturing team owns the machine performance data and uses the data mesh model to turn this into a product for preventing equipment failures.
- **Internal developer platform:** With an IDP, the team follows a standardized pipeline for data ingestion, cleaning, and processing. The platform handles infrastructure, allowing the team to focus on developing the data product.
- **Model development:** The team builds a machine-learning model to predict equipment failures. The IDP supports training and deployment, allowing data scientists to refine the model's accuracy.
- **Deployment and governance:** The model is deployed using the Golden Path, and the data product is automatically cataloged with metadata for transparency. The AI model is similarly added to the model catalog, ensuring proper governance and future discoverability.



In this example, platform engineering streamlines the entire process while ensuring that data and AI governance are automated and integrated, improving both development speed and quality.

### The golden path: Empowering developers

The golden path in platform engineering is used to **build and deploy applications efficiently**. By removing infrastructure complexity, the golden path allows developers to focus on innovation and product development.

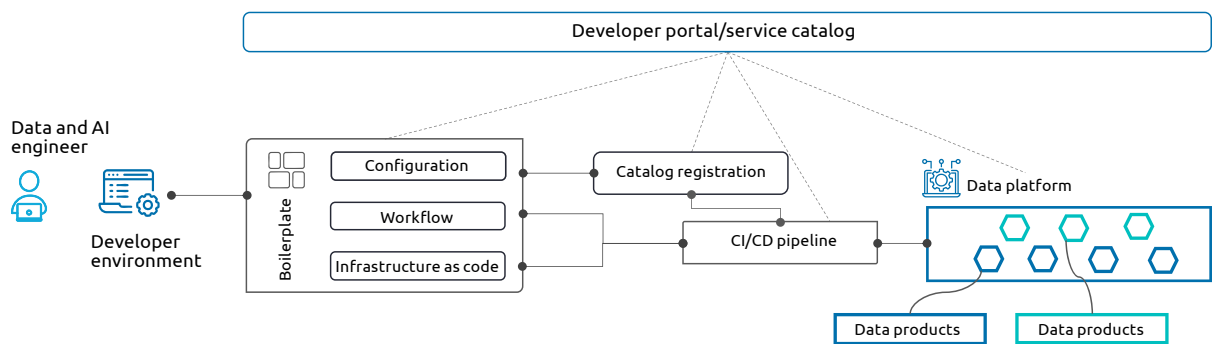
### AI and data products as beneficiaries

AI applications and data products benefit immensely from platform engineering and the golden path. AI models, such as those for predictive maintenance, require large amounts of data, computation, and standardized processes. Platform engineering provides the necessary infrastructure and automation to manage these resources, freeing data scientists to focus on model development.

Automated data and AI governance further strengthens this approach by ensuring that data products and AI models are properly cataloged, discoverable, and compliant. This improves the overall value of data and AI assets within the organization, making them easier to reuse and scale.

In the predictive maintenance example, the golden path enabled the team to quickly build and deploy its data product. The IDP handled data ingestion, model training, and deployment, allowing the team to concentrate on refining the AI model's accuracy.

By ensuring consistency across teams, the golden path helps organizations build AI models, dashboards, and data products faster and with higher quality. It minimizes errors, speeds development, and ensures that best practices are followed throughout the product lifecycle.



### Faster time to market and increased quality

The combination of platform engineering, data mesh, and IDPs leads to faster time to market for new data products and AI applications. Standardized processes and self-service environments allow teams to move quickly from concept to deployment. Automated governance ensures that data and AI products meet organizational standards for quality and compliance.

Moreover, platform engineering improves product quality by enforcing best practices through the golden path. This leads to more robust, scalable data products and AI models that align with business objectives and deliver better outcomes.

Automated governance enhances the value of these assets, ensuring transparency and compliance.

Embrace platform engineering today to accelerate innovation, deliver better products, and gain a competitive advantage in the data-driven world.



### Platform engineering as a catalyst for innovation

Platform engineering, combined with data mesh and IDPs, is a powerful innovation driver. By providing standardized, self-service environments, platform engineering accelerates the development of high-quality data products and AI applications.



*One of the most significant advantages of platform engineering here is automated data and AI governance. When semantic integration is established between data sources, data products, AI/ML models, and analytical use cases, companies can better track the value of their data and AI assets, improving transparency and decision-making.*





# Start innovating now

*#InternalDeveloperPortal*  
*#DataMesh*  
*#PlatformEngineering*  
*#AccelerateInnovation*  
*#AutomatedGovernance*  
*#EmpowerTeams*

## **Empower teams**

Use IDPs like Backstage or Port to give teams autonomy over infrastructure and data products, enabling faster innovation.

## **Automate governance**

Automate the publication of data products into catalogs with full metadata, ensuring consistent governance and enhancing the value of data across the organization.

## **Speed up development**

Adopt platform engineering and the golden path to reduce time to market and improve the quality of AI models, dashboards, and data products.





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## Unlocking the magic of neurosymbolic AI

Neural networks and symbolic reasoning *come together*

Neurosymbolic AI combines the strengths of symbolic reasoning and neural networks to create systems capable of both learning from data and reasoning with structured, human-like knowledge. This hybrid approach addresses the limitations of purely data-driven AI models, which often struggle with generalization and interpretability, by integrating them with symbolic logic that excels in reasoning with explicit rules and representations. Neurosymbolic AI holds promise for applications requiring complex problem-solving, such as natural language understanding, decision-making, and robotics, where both perception and logical reasoning are crucial for achieving human-level intelligence

The pursuit of human-level artificial intelligence has led to the exploration of innovative approaches. One such paradigm, neurosymbolic AI, presents a compelling fusion of data-powered and knowledge-based methods. This hybrid approach aims to address the shortcomings of traditional AI techniques, offering a more robust and versatile solution.

Neurosymbolic AI leverages the power of neural networks to learn from data and the ability of symbolic reasoning to represent and manipulate structured knowledge.

- Neural networks excel at recognizing patterns and relationships within large datasets, making them ideal for tasks like image and speech recognition.
- Symbolic reasoning equips systems with the ability to understand logical rules, supporting both deductive and inductive reasoning.

### Example of neurosymbolic AI in action

#### The foundation of semantic understanding

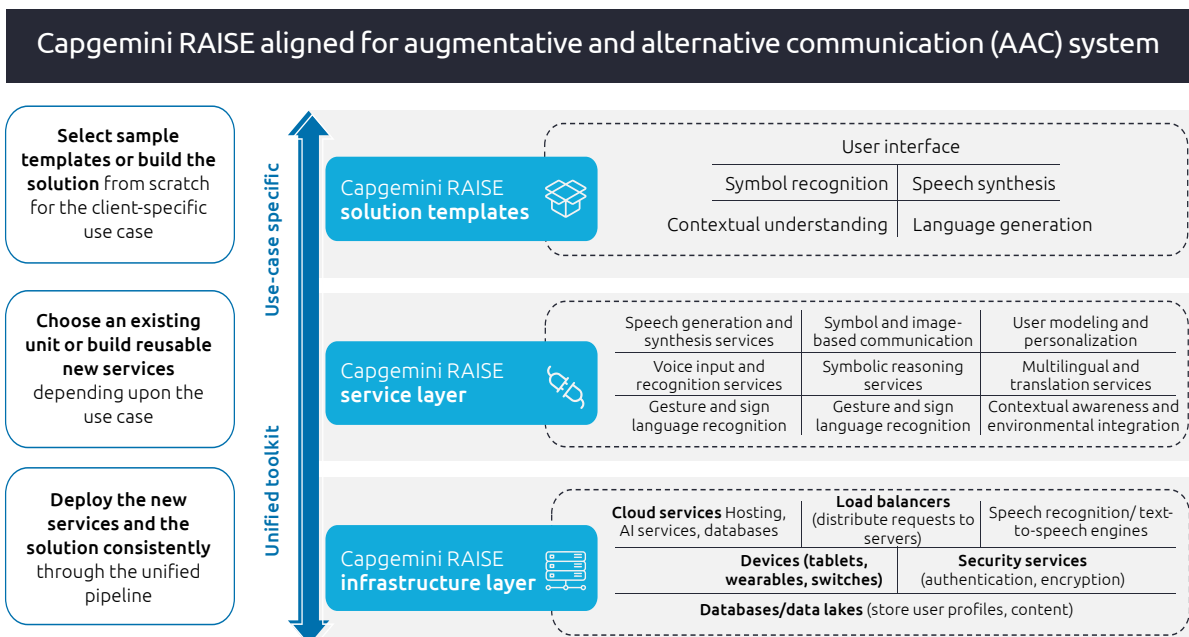
If we ask an AI assistant to “summarize the key points about climate change,” a traditional neural network would likely identify important phrases based on patterns it has learned from similar texts.

However, it might struggle to grasp the deeper meaning of climate change. With neurosymbolic AI, the system combines neural networks to process the language and extract key phrases, while symbolic reasoning applies rules to understand relationships between words and concepts. This ensures that the AI not only identifies important content but also structures it meaningfully.

#### Question answering: Unraveling complexity

Now, imagine if we ask a more complex question, such as: “Why is carbon dioxide harmful to the environment?” The symbolic reasoning layer applies domain-specific knowledge. In this case, the rules of environmental science. It is known that carbon dioxide traps heat in the atmosphere (the greenhouse effect), leading to rising temperatures and environmental damage. By combining these two layers, the system delivers an answer that is both factually accurate and logically sound by connecting cause to effect using well-established scientific principles. The reasoning is clear, transparent, and rooted in knowledge, making the answer both understandable and trustworthy.

Core architecture to support neurosymbolic systems can be devised based on Capgemini’s RAISE platform:





## Use cases

**Healthcare:** Neurosymbolic systems can assist in drug discovery by analyzing vast chemical and biological data, leveraging both neural networks for pattern recognition and symbolic reasoning for knowledge representation.

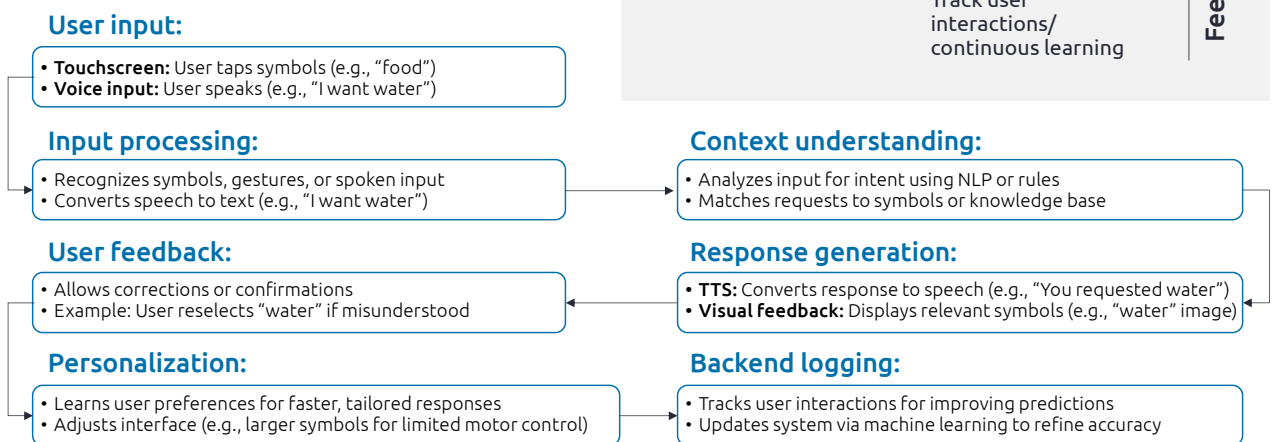
**Autonomous vehicles:** By integrating neural networks for perception and symbolic reasoning for decision-making, neurosymbolic AI can enable autonomous vehicles to navigate complex environments safely and efficiently.

**Fraud detection and compliance in finance:** Combines anomaly detection with regulatory compliance checks. It identifies unusual transaction patterns using deep learning and applies rules to ensure compliance with financial regulations.

**AAC System:** Augmentative and alternative communication (AAC) system for users with speech and motor impairments using touchscreen input, text-to-speech (TTS), symbol-based communication, and speech recognition.

– **Scenario:** User communicates via a tablet-based AAC system by tapping symbols, using voice input, or gestures.

– **Flow steps:**



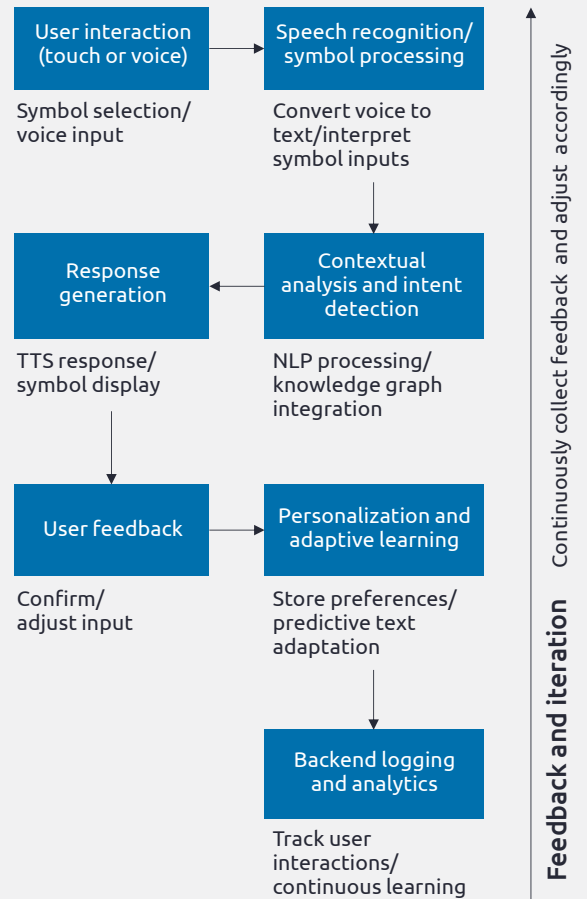
## Best practices

- Clearly define the problem to determine where to apply neural learning and symbolic reasoning. For example, use neural networks for radiological image analysis and symbolic AI for interpreting diagnostic guidelines.
- Develop comprehensive and accurate knowledge bases for symbolic reasoning.
- Prioritize explainability and use optimized streamlined algorithms.

## Challenges and trends

While neurosymbolic AI holds great promise, it also comes with challenges. Furthermore, scaling these systems to handle massive datasets and complex tasks requires significant computational power.

– **Workflow:** Flow diagram for the augmentative and alternative communication (AAC) process



- While symbolic reasoning brings transparency, ensuring that the neural network side of the system is also understandable remains a challenge.
- The potential of neurosymbolic AI is enormous. Neurosymbolic AI offers a path to building smarter, more trustworthy AI.
- There is a tradeoff between performance and interpretability which requires careful architectural considerations.
- Neurosymbolic AI will need ontology and business rules based processing and neural networks.

Neurosymbolic AI represents a significant step forward in the field of AI. By combining the strengths of neural networks and symbolic reasoning, these systems offer the potential to revolutionize a wide range of applications.





*Neurosymbolic AI is a testament to human ingenuity. By combining these two powerful approaches, we are creating a new generation of AI that can reason, learn, and adapt in ways that were previously unimaginable.*



# Start innovating now

*#NeurosymbolicAI  
#ArtificialIntelligence  
#MachineLearning  
#DataScience  
#Innovation*

## Build the neural component (perception)

Collect and prepare your dataset. Choose a suitable neural network architecture. Train the model to process raw data and extract meaningful representations.

## Integrate symbolic reasoning

Define your symbolic knowledge (rules, ontologies, etc.). Connect the symbolic reasoning framework (e.g., knowledge graphs) with the neural network output. Create a system that seamlessly combines perception and reasoning.

## Create an interface

Design an architecture that allows the neural network and symbolic model to interact. Validate and test the system's performance on real-world tasks.





## **Seven predictions for 2025** *What's hot in data, analytics, and AI?*

Seven Leading Innovation Movers and Shakers, Capgemini



Peering into the future is a tricky business – especially in the ever-changing realm of data, analytics, and AI. But if there’s one thing we’ve learned, it’s that uncertainty never stopped us from trying. After all, we’re in a part of the technology profession where predicting the unpredictable is often part of the job description.

We called upon seven of our data-powered innovation movers and shakers to dust off their (frozen) crystal balls and share their visions of what 2025 has in store. Their insights reveal a world where AI balances on the edge of legality, cloud platforms morph into something entirely new, and synthetic data booms with promise – and no, it’s not artificial hype. From “vertical AI” that digs deep into industry needs to conversational AI that knows what you want before you do, these trends give a glimpse of the fascinating, yet challenging, future of data and AI.

Will their predictions come true? Only time will tell, but one thing’s for sure: 2025 is shaping up to be a year we’ll be talking about for a long time to come. And data and AI are right in the middle of it.

Let’s dive in.

### AI is not a crime

AI is not a crime, though sometimes it feels like one, given its swift advance beyond legal bounds. While identity theft, deepfakes, and media manipulation emerge from Pandora’s box, many AI ethicists focus on fairness and transparency, skirting around AI’s darker uses. As AI matures and criminal applications surge, discussions will inevitably shift from theoretical ideals to practical realities, especially when organizations face public lawsuits under new AI regulations. This shift will force experts to tackle how AI can harm society directly. So, while AI is not a crime, it certainly invites a compelling conversation about AI and crime. Let’s face it: When it comes to AI, the real crime would be ignoring the conversation altogether.



**Marijn Markus**

AI Lead, Managing  
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### Augment my governance

Prepare to be captivated. AI agents are about to revolutionize data management in the upcoming year. They will shoulder burdensome data tasks, enabling companies to reach new pinnacles of productivity and efficiency. With AI seamlessly managing data collection, analysis, and access for us, we can finally focus on something much more crucial: getting value out of data for the business. It’s high time to achieve that, isn’t it? The future of data management is upon us, and missing the opportunity of augmenting is not an option. Because in this data game, those who augment govern – and those who don’t get governed.



**Liz Henderson**

Executive Advisor,  
Insights and Data,  
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### Cloud encounters of the third kind

As we look towards 2025, cloud data platforms apply for a new round of transmitted change. We all recognize the need for high-quality enterprise data as a foundation for relevant, trustworthy AI. Add to that the need to adhere to regulations, data sovereignty, privacy sustainability and cost. It soon becomes apparent that a smart mix of different and diverse cloud approaches for data will play a crucial role in the upcoming year. I expect to see a pendulum swing towards larger investments in cloud data platforms, yet it will be clouds of a different kind. Or, to put it differently, the forecast calls for cloud cover – but with a whole new kind of silver lining.



**Prithvi Krishnappa**

Global Head of Data  
and AI, Sogeti



## Let's talk better

Conversational AI will continue to be a hot topic in 2025. Contact center transformation, leveraging "classic" AI and generative AI, will help save labor costs by billions and improve customer service significantly. These technologies can handle routine inquiries and provide instant responses, freeing human agents to deal with more complex issues. Imagine a world where you no longer have to press 1 for assistance – AI will anticipate your every need before you even know you have one. While human agents may become less central, customer satisfaction might reach an all-time high as AI enhances efficiency and personalization in ways we never thought possible. It'll be the talk of the town in 2025.



**Monish Suri**

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## When AI goes vertical

We will see a major rise in domain-specific vertical AI solutions that are finely tuned through rigorous test-driven prompt engineering. These purpose-built AI models will deliver more reliable and precise insights tailored to the unique needs of their industries. For instance, in healthcare, imagine AI predicting patient outcomes like a crystal ball, analyzing vast datasets of medical histories and treatment plans to conjure better patient care and optimized resources. In financial services, AI will become the ultimate fraud-buster, identifying unusual patterns in real time and safeguarding assets with previously unseen precision and confidence. Vertical AI solutions will not only streamline operations but also spark innovation by providing industry-specific intelligence and efficiency. The only way is vertical!.



**Dan O'Riordan**

VP, AI and Data  
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## The semantics of confidence

We've seen many companies adopting the principles of data mesh and semantics as part of their modern data analytics platform strategy. If nothing else, it's needed in 2025 and beyond to comply. For example, the EU AI Act requires close tracking of the purpose of AI models and the underlying data used to train it. This can only be done by enhancing data platforms with semantics, connecting original data sources, forged data products, AI models, all business dashboards, and AI infused applications. It creates high levels of confidence in both data and AI, next to many new, innovative opportunities to leverage data. The endgame? Nothing less than a full digital twin of the enterprise, a hallmark of data mastery.



**Arne Rossmann**

Innovation Lead,  
Insights and Data,  
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## Synthetic data boom

I predict a boom in synthetic data. But first of all, what is synthetic data? It's artificially generated but realistic data that mirrors real patterns without using sensitive information. Why is synthetic data crucial? It tackles privacy, security, data scarcity, and control issues. Traditional data sources are hitting their limits. Privacy laws are tightening, and real-world data often lacks the diversity we need. Synthetic data lets companies create datasets that mimic real shopping behavior in retail or complex production processes in manufacturing without exposing sensitive info or being held back by data gaps. I foresee that 2025 will be the year synthetic data moves center stage. Companies ready to leverage it will build powerful, adaptable models faster than ever. The synthetic data boom will be anything but artificial!



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## About Capgemini

Capgemini is a global business and technology transformation partner, helping organizations to accelerate their dual transition to a digital and sustainable world, while creating tangible impact for enterprises and society. It is a responsible and diverse group of 340,000 team members in more than 50 countries. With its strong over 55-year heritage, Capgemini is trusted by its clients to unlock the value of technology to address the entire breadth of their business needs. It delivers end-to-end services and solutions leveraging strengths from strategy and design to engineering, all fueled by its market leading capabilities in AI, cloud and data, combined with its deep industry expertise and partner ecosystem. The Group reported 2023 global revenues of €22.5 billion.

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