

A low-angle photograph looking up through a dense forest canopy. Sunlight filters through the green leaves, creating a dramatic starburst effect in the center. The light rays are bright yellow and white, contrasting with the deep green of the foliage. The overall mood is bright, hopeful, and natural.

Data-powered Innovation Review

Wave VIII

Foreword



Niraj Parihar

Chief Executive Officer,
Insights and Data, Capgemini



The visuals of the Data-powered Innovation Review editions never fail to inspire me. Just look at this eighth edition. It may need a second view, but then we see it: we are looking up to trees, reaching out towards the sky. In their togetherness, they create stunning, almost geometrical patterns. Unearthly, and at the same time as natural as nature can get.

Isn't that also what we are currently witnessing in the rapid evolution of technology, powered by data? Browsing through the articles in this edition, many examples pop up of innovative change that would have been unthinkable without recent breakthroughs in technology, notably of course in AI. Whether it's in the domain of battling climate change, the medical and life science fields, or autonomously driving

cars, we continuously elevate what we deemed the art of the possible.

Much like a tree grows and extends its branches, so does the realm of data-powered innovation. Each article in this edition is like a branch, growing towards new possibilities and discoveries. The roots of this growth lie in the data, nourished by the collective efforts of researchers, engineers, and visionaries. That's why I am happy to see quite a few articles homing in on the foundations of data management and governance, as they are absolutely key to achieving success with even the fanciest applications of advanced analytics and AI. At the same time – arguably more than ever – we see a stronger emphasis on what it means to be human amid the turbulence of digital, virtual, augmented, and artificial technology.

Just as a canopy of trees provides shelter and sustenance to countless organisms, so too does the expanding landscape of data-powered technology offer opportunities for growth and advancement in every sector of human endeavor.

I hope this edition not only enlighten but also cultivate your curiosity, nurturing your appetite for innovating with data. Let it serve as a reminder that as we gaze up at the towering trees of progress, there is always more to discover, more to innovate, and more to achieve.

Kind regards!

Editor's note



Ron Tolido

Chief Technology Officer,
Insights and Data, Capgemini



Welcome to the eighth edition of the Data-powered Innovation Review. We're thrilled to offer you a forest of inspiring ideas. Think of this magazine as a special place to gather and share stories about innovating with data. To us, it's not really about the magazine itself (as glossy as it may be): it's much more about finding compelling data and AI topics, reaching out to the right people – inside and outside the company – and simply sparking fresh innovation activity.

We are halfway through 2024 and the topic of generative AI is still top of mind to many people – both to a growing community of practitioners working with it daily and to executives in most enterprise boardrooms. Realism has kicked in, however, and we see a sharper focus on actual benefits and value cases, together with a stronger

interest in the proper foundations of data management, governance, cost containment, and sustainability considerations. Next to that, it becomes more obvious by the day that the role of humans – whether “in the loop” or in a collaborative partnership with their AI creations – is pivotal to success. As often happens, in the end it's not about the technology but instead about mindset and culture.

It reminds us of the theme of Capgemini's 2024 TechnoVision trend report: “augment ME!” That makes the case for the phenomenal augmentation power of technology, yet recognizes that it is up to us, humans, to decide when and how to use it.

We decided to have the same duality reflected in this edition of the Data-powered Innovation Review.

In the first section, **Data for augmentation**, we provide various concepts and showcases which demonstrate how data and innovative technology make results possible that were once considered impossible. There's a lot of generative AI there. As a recurring theme, we also provide a snapshot of what our Generative AI Lab is busy with these days. But there's life beyond #GenAI. How about next-generation semiconductors, virtual twins, even an autonomous enterprise on the horizon?

Then, in **Data for humans**, we dive into the other side of the equation. As always, there is a special place for technology and sustainability, exemplified by an interesting article about the role of data in climate tech. In another recurring theme, an update from our Gen Garage lab shows how data enables sustainability, diversity, and inclusiveness.

A huge thank you to all contributors to this edition, notably our external partners Dassault Systèmes, Neo4j, and The Open Group. We hope this edition will help you see the forest for the trees in data-powered innovation.

Enjoy the walk!



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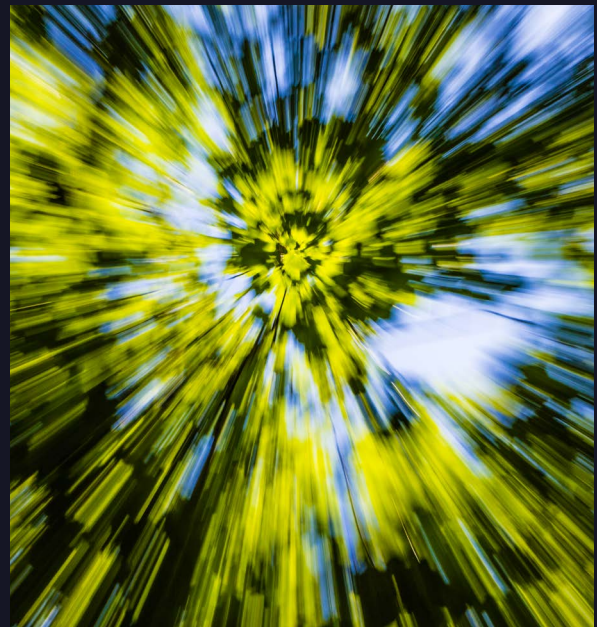
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Data for *humans*





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RAISE helps organizations move from exploration to results

2024 is the year for scaling AI



Weiwei Feng

Global Generative AI Portfolio Tech Lead, Insights and Data, Capgemini



Capgemini's RAISE framework signifies a new era of advancement and evolution for generative AI. It embraces the fast-evolving and highly experimental development of the technology and adapts to the rapid pace of innovation. RAISE delivers accelerators and learnings to harness the power of AI and generative AI while focusing on sustainability, scalability, and trustworthiness.

Generative AI has emerged as a groundbreaking force, democratizing innovation across industries. Open source and commercial models alike have become widely available, leveling the playing field for those eager to harness their potential.

However, as approachable as generative AI may seem, navigating its complexities is no small feat. Within just a year, the field has seen seismic shifts in paradigms and underlying technologies. Organizations are exploring generative AI, recognizing its value as a catalyst for innovation and revenue growth. The Capgemini Research Institute underscores this trend, revealing that [nearly 90% of organizations plan to prioritize AI](#), including generative AI, in the next 12 to 18 months. The question is: are organizations ready to transition from mere exploration to achieving tangible results?

Generative AI generates new content, ideas, or solutions by learning from vast datasets. This extends from creating realistic images and text to generating code and innovative solutions across various fields.

As generative AI solutions are being constructed, decoupled development has led to redundancy and inefficiency.

This disconnected approach gives rise to multiple issues: identical open-source models running on separate GPUs, increasing costs and complexity; commercial APIs used in disparate applications, preventing better vendor deals due to split volumes; and the repeated development of similar applications without performance comparison or monitoring.

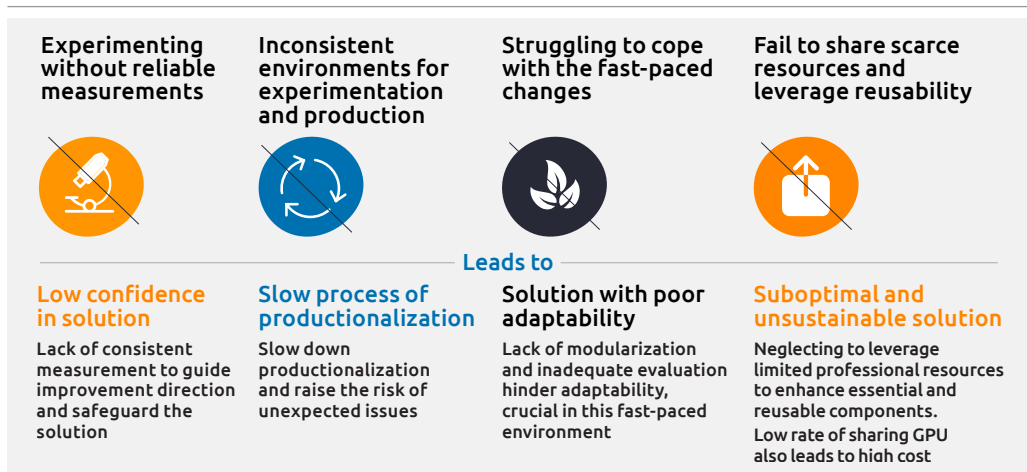
The year 2023 was a time for experimentation; 2024 is the year for scaling.

To address these challenges and herald a new era of development, we crafted the RAISE framework to enforce sustainability, reusability, and trustworthiness throughout the code, establishing a robust AI partnership with our clients. The RAISE framework streamlines the development process, ensuring that generative AI solutions are built on a solid, efficient, and cohesive infrastructure.

Exploring the RAISE framework

RAISE is a gateway to a future of trustworthy, scalable, and sustainable AI. While many companies concentrate on solutions, RAISE shifts the focus to infrastructure – the foundation of both the service and solution layers.

Reasons for the current low return on investment



“The RAISE framework streamlines the development process, ensuring that generative AI solutions are built on a solid, efficient, and cohesive infrastructure.”

RAISE’s is built on modularization. It promotes the development and deployment of reusable components as independent services, covering an array of AI and generative AI models, tools, and data services. This includes both commercial APIs and open-source models.

At the core of the RAISE framework is a uniform pipeline structure, ensuring cohesion and efficiency throughout development and deployment. It emphasizes efficient deployment of open-source models, leveraging shared GPUs for optimal resource utilization, minimizing environmental impact, and maximizing performance. Its unified management system facilitates easy comparison, efficient deployment, and thorough monitoring of both open-source models and commercial APIs, improving scalability and enabling cost savings as new models emerge.

Adaptability and experimentation are critical, as is embracing a diverse mix of technologies and staying open to future changes. As H. James Harrington, CEO, Harrington Management Systems noted, “Measurement is the first step that leads to control and eventually to improvement,” highlighting the importance of enforced evaluation. Such processes not only enable rapid comparison of changes in the experiment stage but also ensure smooth transitions to new ideas and models.

RAISE continually identifies and builds reusable components to enhance trust, efficiency, and performance in AI and generative AI applications. Its current

offerings include model cascading for cost savings, prompt optimization for performance improvement, and RAG services for scaling enterprise text retrieving service. The framework is committed to evolving and refining its services, empowering its users to embrace ultramodern technology.

RAISE provides a path towards:

- Trustworthy AI, through rigorous evaluation, testing, and monitoring
- Scalable AI, by embracing modularization, DataOps, MLOps, DevOps, and governance
- Sustainable AI, focusing on cost optimization, reusability, and efficiency.

Pioneering the future

The RAISE framework is setting the pace towards a future where AI’s potential is fully unleashed. This next phase in RAISE’s evolution is pioneering tomorrow’s innovations.

Innovative deployment and customization.

The future of RAISE is marked by an even greater emphasis on customization and efficiency. Leveraging the latest advancements in large language models (LLMs), RAISE is poised to offer an even more refined infrastructure setup. This includes specialized pipelines for deployment, fine-tuning, and data management, designed to streamline the AI development lifecycle from conception to deployment.

Tailored data and model training.

A standout feature for RAISE is its enhanced capability for organizations to craft their own high-quality datasets for training or evaluation purposes. This ensures the data meets the specific needs of each project and also elevates the quality of model training. Coupled with the RAISE training framework, organizations will have the flexibility to develop custom models, pushing

the boundaries of what's possible with generative AI.

Cost-effective model selection. A novel aspect of the RAISE framework is its intelligent model selection service, designed to optimize resource allocation by matching the most suitable model to each task. This reduces costs and amplifies the effectiveness of AI initiatives.

Leading the way into tomorrow

RAISE is pioneering innovative solutions that address today's challenges and anticipate tomorrow's opportunities.

As large models advance in capability, emerging agents face the challenge of dynamically decomposing tasks and choosing the right tools for completion. RAISE provides these agents with an ever-growing toolbox, incorporating a comprehensive catalog of information and standardized endpoints.

We invite you to reach out. Together, let's shape the future of AI, leading the charge into uncharted territories of possibility and success.



#RAISE
#GenAI
#AIMesh

Innovation takeaways

Modularization for efficiency

Break down AI development into reusable components with RAISE, optimizing resources and streamlining processes for enhanced efficiency.

Trust and scalability

Ensure trustworthiness and scalability in AI solutions with RAISE's evaluation, testing, and monitoring mechanisms.

Future-proof innovation

Stay ahead of the curve with RAISE's commitment to adaptability and customization, empowering organizations to pioneer tomorrow's AI solutions.



Extending how we interact with technology

The Generative AI Lab's triple quest for efficiency, synergy, and precision



Robert Engels

Head of Capgemini Generative AI Lab, Insights and Data, Capgemini



Capgemini's Generative AI Lab's 2024 vision focuses on AI innovation in three key areas. First, small large language models (LLMs) operating at the edge enable AI to function seamlessly on devices, enhancing sustainability and efficiency and bringing intelligence closer to the user. Second, AI-driven multi-agent systems create a cohesive, flexible, and powerful AI ecosystem. Finally, logical LLMs redefine accuracy and creativity, expanding the possibilities of what AI can achieve. Let's dive into the heart of AI innovation and discover the exciting possibilities that await us.

The Generative AI Lab at Capgemini is shaking things up in the world of artificial intelligence as it focuses on three key areas that will change the way we use technology. The lab is working on creating tiny LLMs that can work on their own, AI systems that can communicate and learn from and with each other, and LLMs that can guarantee both new ideas and increased accuracy.

But it's not just about pushing the limits of AI. It's about changing the way we interact with technology. The Generative AI Lab is seeking AI systems that are more sustainable, work together better, and are smarter than ever before. It is all about creating a future where technology augments us, instead of the other way around.

Let's take a closer look at each of the focus areas for 2024 and see why they're changing the game in AI and shaping the future of technology.

Small LLMs at the edge

Imagine having AI that is not just a distant, bulky cloud operation but a sleek, powerful force right next to you, probably not even online. That is precisely what the Generative AI Lab is working towards with the first focus area: small large language models that can operate at the edge.

Traditionally, LLMs have been confined to the cloud, requiring significant computational resources and bandwidth. However, the Generative AI Lab is looking

to change that by creating smaller, more efficient LLMs that can be more precise for specific tasks, are trained in a much more sustainable manner, and run on edge devices, such as smartphones, smart home devices, and autonomous vehicles.

This shift towards edge AI has far-reaching implications. With smaller LLMs, devices can process data in real-time, reducing latency and enabling faster decision-making. It also opens new possibilities for AI to be used in areas where connectivity may be limited or non-existent.

Genuine AI multi-agent systems

The Generative AI Lab's second focal area is genuine AI multi-agent systems, where multiple specialized LLMs work together to achieve a common goal. Unlike traditional AI systems that run in isolation, multi-agent systems allow for collaboration, learning, and adaptation between agents, possibly even capturing intent and perceiving purpose and acting on it.

These systems have the potential to revolutionize industries such as healthcare, finance, and logistics. For instance, in crisis management, multi-agent systems could enable rescue teams, firefighting crews, control rooms, support teams, press, government, and AI systems to work together to analyze complex situations like natural disasters more effectively.

“The Generative AI Lab shows the potential to revolutionize how we can trust and cooperate with autonomous systems.”

Logical LLMs for novelty and correctness

The third focus area is logical LLMs that can guarantee both novelty and correctness in their responses. Traditional LLMs are trained to generate responses based on probabilistic patterns, possibly leading to nonsensical answers. However, the Generative AI Lab is working on LLM responses that are not only novel but also logical and factually correct.

These logical LLMs have far-reaching implications for industries such as education, engineering, and legal applications. For instance, in education, these LLMs could help generate personalized materials for students,

making learning more engaging and effective. In engineering, logical capabilities can enhance counterfactual reasoning (what if) and identify constraint violations with high precision.

Reshaping AI

Our Generative AI Lab pushes the boundaries of what’s possible with AI. By creating small LLMs that can run at the edge, genuine AI multi-agent systems, and logical LLMs that can guarantee both novelty and correctness, we are shaping the future of technology as we know it. Successful implementation of these areas will significantly innovate a diversity of industries and thereby shows the potential to revolutionize how we can trust and cooperate with autonomous systems. As we move forward into a future where AI is increasingly integrated into our daily lives, initiatives like the Generative AI Lab will play a crucial role in showing the way to a future where technology serves humanity, not the other way around.



#GenerativeAILab
#EdgeComputing
#MultiAgentAI
#LogicalLLMs #SustainableTech
#AllInnovation
#FutureOfTechnology

Innovation takeaways

Small is big

Small LLMs operating at the edge enable AI to function seamlessly on devices, enhancing sustainability, efficiency, and bringing intelligence closer to the user.

Multi is more

AI-driven multi-agent systems create a cohesive, flexible, and powerful AI ecosystem.

Logical makes sense

Logical LLMs redefine accuracy and creativity, expanding the possibilities of what AI can achieve. The future is exciting.



Knowledge graphs improve GenAI

*Validating results builds
trust for organizations*



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Generative AI can make recommendations that will transform decision-making for organizations – but how can people trust the answers GenAI provides? Knowledge graphs can play a vital role in ensuring the accuracy of GenAI’s output, bolstering its reliability and effectiveness.

In Douglas Adams’ *The Hitchhiker’s Guide to the Galaxy*, a supercomputer called Deep Thought is asked for the answer to “Life, the universe, and everything.” After 7.5 million years, Deep Thought responds “42.” Representatives from the civilization that built Deep Thought immediately ask how it arrived at the answer, but the computer cannot tell them. When Adams wrote this scene in the 1970s, he was (arguably) making a joke – but today, many people find themselves in this situation when interacting with generative AI (GenAI).

GenAI works by drawing upon millions of pieces of data – a volume that’s impossible for humans to effectively analyze. Businesses are excited by its potential to deliver valuable insights and make well-informed predictions – but if different GenAI tools are asked the same question and give different answers, how could an organization decide which result is more correct? How would a person fact-check the responses?

Addressing the shortcomings of unstructured, implicit data

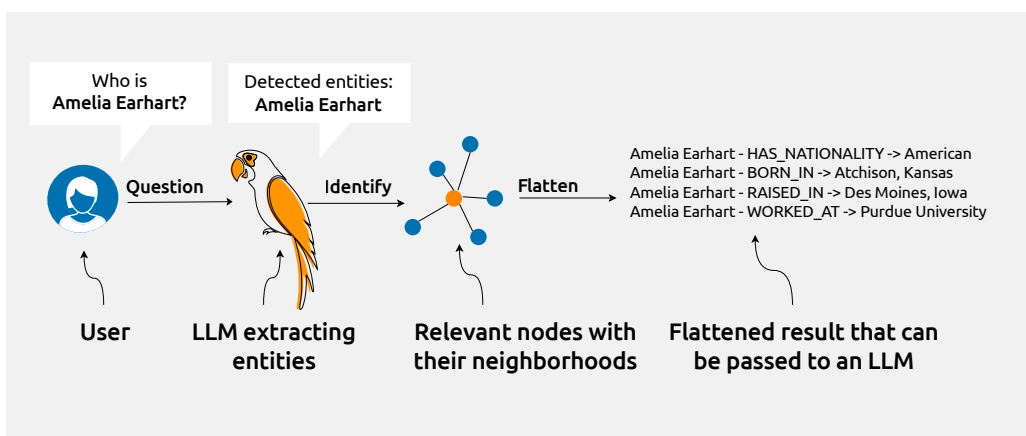
The challenge relates to the large language models GenAI relies upon.

An LLM can contain massive amounts of data, but it’s commonly stored in an unstructured, implicit manner. This makes it difficult to investigate how a GenAI tool arrived at its answer.

Since the release of ChatGPT in late 2022, Neo4j and Capgemini have been working independently / collaborating to overcome this challenge by using knowledge graphs. These store complex, structured data and the relationships between them. Instead of relying solely on LLMs to directly generate database queries, our solution incorporates a high-level interface that allows the LLM to interact seamlessly with a knowledge graph via database query templates. These templates serve as structured frameworks, guiding the LLM to fill in specific parameters based on the user’s request.

This simplifies the task for the LLM by abstracting away complex logic. (See Figure 1). This separation of concerns

Figure 1



ensures the LLM focuses on natural language understanding and generation, while the query templates handle the technical aspects of database interaction – improving the overall accuracy and efficiency of retrieval.

In this example, the query template uses a vector search to locate relevant nodes within the knowledge graph that correspond to the entities present in the user’s question. This identifies the nodes relevant to the query, which are then used to retrieve neighborhoods or shortest paths around the nodes within the graph. This helps contextualize the retrieved information and provides a more comprehensive answer to the user’s query. More information about this specific query template is available in this [blog post](#).

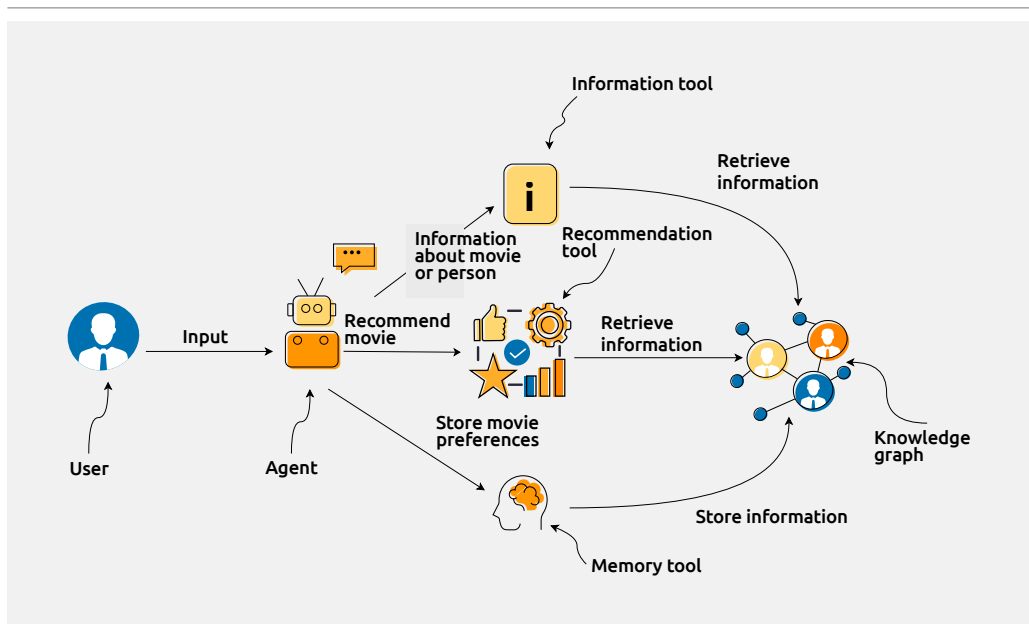
Tailored templates

Query templates can be tailored to discrete domains such as finding dependencies within supply chains or executing aggregation operations for business intelligence purposes, enabling organizations to address specific challenges. This more targeted approach best leverages the LLM’s capabilities to

generate insights by ensuring they are not only relevant but deeply informed by the underlying data structures, helping enterprises to efficiently transform their raw data into actionable intelligence.

That said, the complexity of business requirements often exceeds what a single query template can accommodate when an LLM interfaces with a Knowledge Graph. Therefore, it’s essential to embrace an adaptive approach, providing a rich assortment of query templates that can be selectively deployed to match specific business scenarios. Leveraging the LLM’s capability to invoke functions, GenAI can dynamically select and employ multiple query templates based on the context of the user’s request or the specific task at hand. This results in a more nuanced and flexible interaction with the database, and significantly amplifies the LLM’s ability to solve intricate business intelligence and analytics problems. (See Figure 2).

Figure 2



This LLM-powered movie agent uses several tools, orchestrated through carefully designed query templates, to interact with the Knowledge Graph.

- The information tool retrieves data about movies or individuals, ensuring the agent has access to the latest and most relevant information.
- The recommendation tool provides movie recommendations based on user preferences and input.
- The memory tool stores information about user preferences in the Knowledge Graph, allowing for a personalized experience over multiple interactions.
- More information on this movie agent project can be found on [GitHub](#).

Democratizing data and empowering business users

The Knowledge Graph acts as a bridge, translating user intent into specific, actionable queries the LLM can execute with increased accuracy and reliability. By allowing any user – regardless of technical knowledge – to inspect how the LLM arrived at its answers, people can validate the information sources themselves. Benefits include:

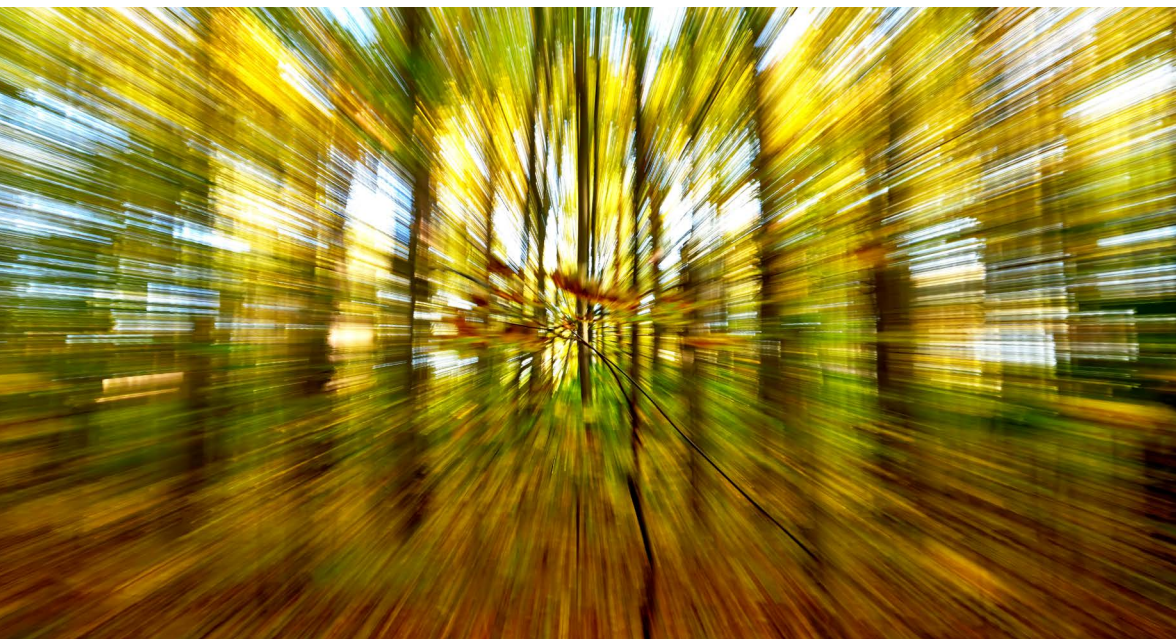
- Results that are explainable, repeatable, and transparent. This can enhance trust in GenAI in everything

“We expect knowledge graphs to help large language models embrace iterative processes to improve their output.”

from research and discovery in life sciences to digital twins in sectors such as manufacturing, aerospace, and telecommunications.

- Better-informed and better trusted business decisions
- Freed up time for experts such as prompt engineers to concentrate on tasks that require their specialized skills.

As we look ahead, we expect Knowledge Graphs to help Large Language Models embrace iterative processes to improve their output. Our enthusiasm is shared by other experts in the field including Andrew Ng at DeepLearningAI, underscoring the widespread recognition of their transformative capabilities. As we help create the future, it’s clear the journey with these intelligent systems is only just beginning – and is moving much faster than Deep Thought ever did – so it’s critical that people are given the means to fact-check generative AI as it evolves.



#KnowledgeGraphs

#LLM

#RAG

Innovation takeaways

Trust is important

Knowledge graphs can boost confidence in the output from GenAI systems – making it easier for people and organizations to embrace them.

Tools for the tool

With knowledge graphs, large language models can dynamically employ multiple query templates to match specific business scenarios, making interactions with GenAI more nuanced.

Democratizing data

By making it easier for everyone in an organization to interact with generative AI, knowledge graphs can free up experts to focus on tasks that require their specific skills.



AI is more than ML

Bringing knowledge into the spotlight



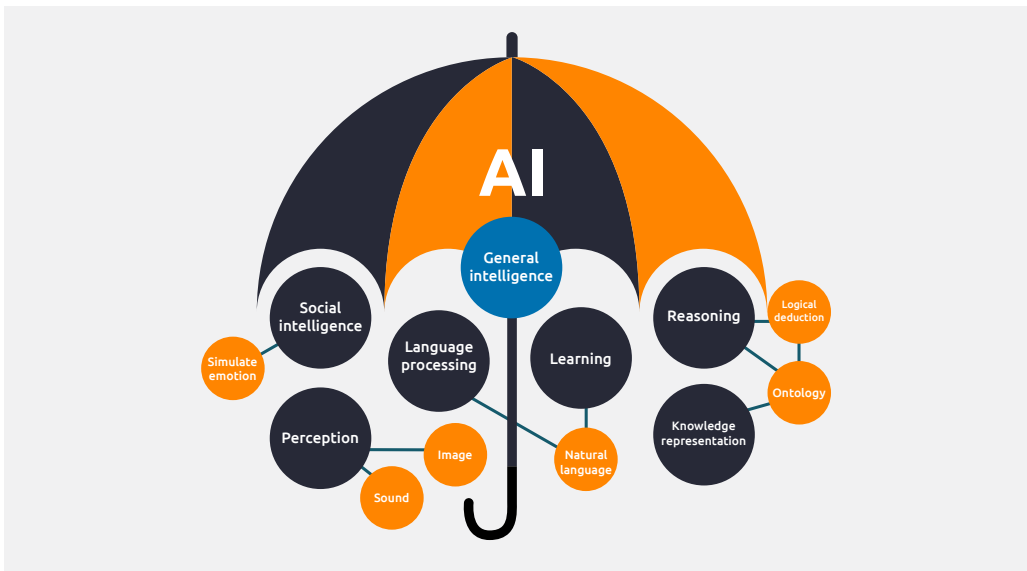
Veronika Heimsbakk

Knowledge Graph Lead,
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To reach the main goals of Artificial Intelligence, one must master all relevant technologies, overcoming limited goals. Representing knowledge should be considered for any system using generative algorithms, to eliminate hallucinations and to achieve explainable answers. Here, we bring the under-communicated field of knowledge representation into the AI spotlight, highlighting the importance of knowledge in a world overflowing with content.

The field of artificial intelligence (AI) is often mistaken for being equivalent to machine learning (ML). However, there are core technologies that might not be the first to come to mind when discussing AI.



One can look at AI as a toolbox, and in any proper toolbox there are a lot of tools. Machine learning is one such tool, along with social intelligence, reasoning, knowledge representation, natural language processing, and many more. According to many, the goal with AI is to achieve general intelligence and, to reach that, one must master all the tools. One foundational tool, knowledge representation, is crucial for AI.

What is knowledge representation?

Representing knowledge, as facts and statements, in a machine-readable manner can be done by building ontologies. An ontology is the explicit

specification of a conceptualization. It holds formal names and definitions of entities for a subject area or domain. It holds properties and relations between these entities, including the meaning of what they are; an ontology holds semantics – the meaning of things – in a domain, and given the logic of the subject or domain it describes.

Ontologies can be built using the Web Ontology Language (OWL), which is a standardized language within W3C's Semantic Web Technologies. They are best known as semantic knowledge graphs. A knowledge graph works as a unifying logical language for data, equally interpretable by both humans and machines, not dependent on

“Given the rapid popularity of generative algorithms, knowledge and facts have never been as important.”

natural language. In a knowledge graph, ontologies are what makes the knowledge layer.

A knowledge graph is built up by Uniform Resource Identifiers (URIs) that work as global and unique identifiers for all things in your graph. The URIs of a graph form triples, which we also call a fact or statement. A triple consists of three resources: the subject, the predicate, and the object. This is what the machine will interpret, and all things can be annotated in any thinkable language, making the graph readable to humans and not dependent on their natural language.

With ontology, one accesses a powerful AI tool: being able to reason over data and derive new insights from existing facts. This is possible due to the accessible semantics in a machine-readable graph representation available in ontologies. Reasoning is those logical conclusions humans make, based on existing knowledge, and it can be done in the data layer by any machine using ontologies, completely detached from natural language.

Where can I find knowledge graphs?

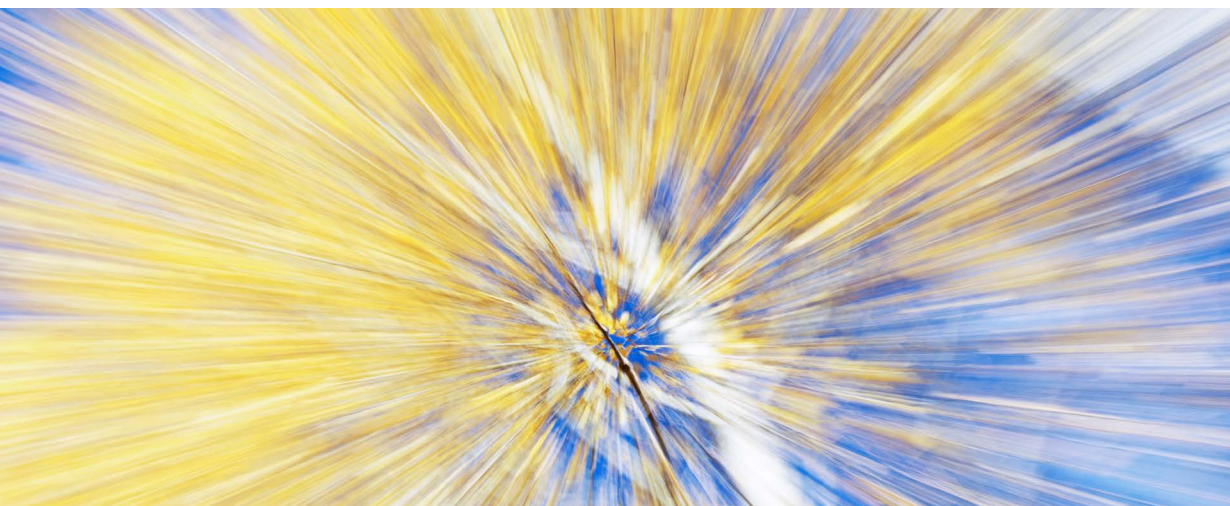
Graphs are all around us. It's about reflecting reality in the data itself. It lets data flourish in its natural way of

patterns and connectivity through triples, instead of forcing information into tables. Knowledge graphs empower the linked nature of social media. They are found within digital twins in the manufacturing and energy sectors. They are found in metadata descriptions across the public sector. They are found in supply chains. They describe complex domains such as life science and finance. They are everywhere.

Why is knowledge representation important in AI technologies?

Given the rapid popularity of generative algorithms, such as ChatGPT, knowledge and facts have never been as important as they are today. Generative AI algorithms are based on predictive calculations and probability. This means your answer is the most likely sequence of letters (or words) based on the input – the question. They have no notion of truth in content; therefore, one says that such algorithms hallucinate. Hence generative, they are made for generating text, images, video, or sound, not to be used as an encyclopedia.

It is therefore important to consider knowledge representation before throwing generative AI loosely on data, especially if explainable answers and facts are important. Many organizations and use cases do not allow for hallucinations in application responses. A predictive algorithm does not reason over facts, but there are technologies that do. In the data layer. Semantic knowledge graphs are such a technology.



#AI #GenAI
#KnowledgeRepresentation
#Reasoning
#KnowledgeGraph
#Semantics
#SemanticWeb
#Ontology

Innovation takeaways

AI is more than ML

AI is a box of many tools, where all must be mastered to achieve the main goal of AI.

A unifying logical language

Being able to capture the meaning of things in a machine-readable manner with accessible semantics is crucial in a world of vast amounts of content and predictive madness.

Knowledge representation implies reasoning

Deriving new facts from existing data brings new insight and discovery of unknown potential and knowledge.



Interpretable AI is the future of autonomous cars

AI must pay attention to make human-like decisions



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A diverse AI skill set will be required if an artificial intelligence system capable of ultimately replacing human drivers is developed. These AI skills include long-term and short-term planning, risk assessment, seamless interaction with humans for predictable in-traffic behavior, and effective human driver hand-over. Additionally, self-training strategies based on unsupervised learning are crucial for continuous improvement at a fleet level, ensuring adaptation to an ever-changing environment due to AI integration. However, these high-level skills fundamentally rely on a precise understanding of the context surrounding the vehicle.

Operating an appropriate world model is essential. This model should incorporate semantic concepts that enable reasoning capabilities. Also, the model must be continuously updated with reliable and comprehensive information about context. This information helps infer the current state of the “system,” which refers to the vehicle and its surroundings. Here we focus on the last step: efficiently collecting information around the vehicle.

The winner of the 2007 DARPA Urban Challenge, a 96km-long autonomous driving challenge, was [Carnegie Mellon’s “Boss” robotic SUV](#). It was equipped with cameras, GPS, and multiple active sensors, including lidars, radars, and sonars; its acute sensing capability created accurate motion planning commands. A radically different approach was followed in 2016 by [NVIDIA’s autonomous lane-following demonstration](#). Using only three camera inputs, the understanding of the environment was accomplished with a full AI approach and a reasonable amount of training data.

AI models have an exceptional ability to provide highly accurate predictions, given large enough training data sets, but also warrant great caution as their performance is counteracted by epic unpredictable failures. The wide adoption of AI models for safe use in autonomous driving systems depends heavily on the development of more interpretable AI models. Our belief is that next-generation AI-powered autonomous vehicles will be

inspired by a human-like decision-making process: we pay attention to the objects on the road, their distance, and speed, and AI must do the same. Therefore, we have been developing innovative interpretable AI-models and working towards deploying these models in physical autonomous vehicles.

Interpretable AI for autonomous driving

Our team of AI and robotics experts at Hybrid Intelligence, a division of Capgemini Engineering, is working in partnership with the Computer Science and Artificial Intelligence Laboratory at MIT on developing innovative trusted AI solutions for autonomous driving. Adopting an end-to-end AI solution strategy like that of NVIDIA, we developed a modular AI solution that is more explainable by design and facilitates the inspection process of the quality of the output of each module. This links perception and control modules directly to steering wheel commands. We exclusively utilize camera data as inputs, emulating the sensory input humans rely on while driving. Additionally, our control module draws inspiration from biological systems, relying on neural circuit networks developed by our MIT partner. Despite comprising only 19 neurons, this innovative neural control module remarkably [predicts accurate driving directions](#). Each neuron mimics a biological one and implements an ordinary differential equation, making it

a lot more expressive and much smaller than the state-of-the-art deep networks. Neurons tend to be task-specialized, providing a clear explanation of the functional behavior and making the model more interpretable.

Our team **increased the interpretability of the overall AI solution** even further, using a novel probabilistic approach based on a variational autoencoder and introducing a new interpretability approach. By perturbing the intermediate representation of input images encoded by a variational autoencoder, we identify features (such as car, road, and vegetation) associated with specific neurons. Additionally, we assess uncertainty in these features. Crucially, we correlate this information with the accuracy of final commands given to

the car. Our interpretability approach combines qualitative and quantitative insights, revealing both potential errors in intermediate representations and the reliability of AI model outputs.

Data in service of accurate decision-making

We push further toward the human-like decision-making process by compressing these rich human-interpretable modalities and passing them to neural controllers to improve autonomous driving performance. This enables a deeper understanding of the root cause of decisions, such as determining whether the command given to the car is off the mark due to an underestimated distance to an obstacle or the underestimated speed at which the car is moving.



RGB



Monodepth



Optical flow



Semantic Segmentation



Instance Segmentation



Panoptic Segmentation

We will test our approach in a real-world environment at the Serge Kampf Les Fontaines campus during Q2 2024. Further optimization of the computer

vision modules has been performed with the support of our partner, NVIDIA, and we are actively working on this ambitious program with other teams.

“Experience without theory is blind, but theory without experience is mere intellectual play.”

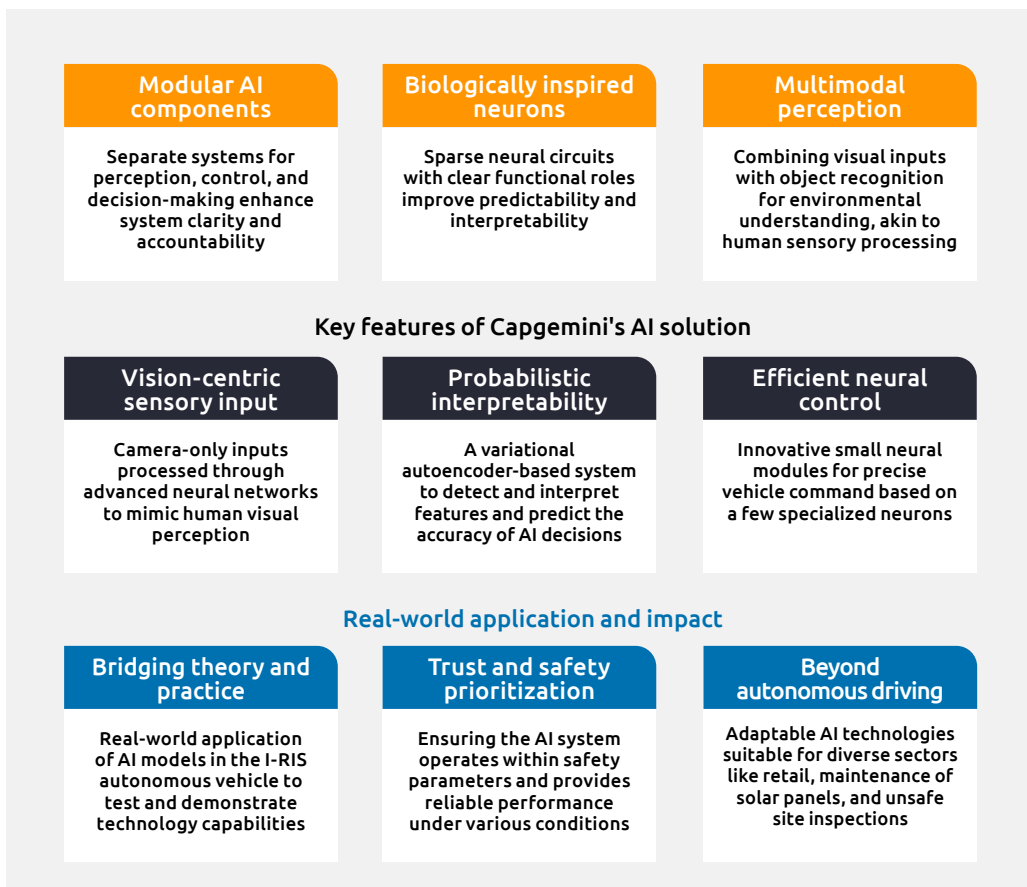
– Immanuel Kant

The potential of trusted AI

The future of AI-enabled autonomous vehicles draws inspiration from both early classical multi-sensor solutions and recent vision-centric AI-based approaches. Our belief lies in a balanced approach, emphasizing trusted AI as a critical component. A modular AI solution

subject to inspection, to identify failure modes, allows targeted improvements to eliminate recurring issues. This actionable insight drives a closed feedback loop, continuously enhancing overall system reliability. Within the Capgemini-MIT partnership, we develop mature AI solutions that explain decisions and ensure safety levels for semi- and fully automated systems. While our primary focus is autonomous mobility, our adaptable computer vision module finds applications in drone-based solar panel maintenance, site inspections, and consumer goods and retail industries. These advances transcend autonomous driving, benefiting diverse sectors.

Essential elements for trusted AI in autonomous vehicles



#InterpretableAI
#AutonomousDriving
#MultimodalModels

Innovation takeaways

Trusted AI for complex systems

The Capgemini-MIT collaboration is forging a unique path forward for the automation of complex systems, such as autonomous vehicles. Our modular vision-centric AI-based solution increases the interpretability of systems that enable autonomous driving capabilities.

Rich perceptual understanding

The ability to understand the visual inputs that an autonomous system receives in a rich human-like way could be the answer to better decision-making.

From autonomous driving theory to practical demonstration

Real-time AI inference inside our physical autonomous vehicle prototype will power its autonomous steering capability.



Building the autonomous enterprise

*When the dream
becomes an objective*



Manuel Sevilla

Chief Technology Innovation Officer,
Capgemini Business Services



Imagine a business where AI does more than assist or augment – it makes the big calls. The concept of an autonomous enterprise is shaking up industries, from high-frequency trading to supply chain management, putting AI in charge of tough decisions and actions. As we dive into this new era, the key is figuring out how to blend human creativity with AI smarts to unlock a future brimming with innovation and possibilities.

Maybe you've heard about the Henn na Hotel Tokyo Ginza? It is certified by Guinness World Records as the first hotel staffed with working robots. In an evolving mix of humans and technology, it aims to have more tasks done by AI-powered, human-like machines, while providing better service to its customers and providing a compelling, flawless hotel stay. Now, to some this may sound more like a Hotel California situation (you can check out anytime you like, but you can never leave), but the signs are there nevertheless: innovative companies are built and rebuilt with AI and autonomous automation at the very core of their design.

From AI to autonomous

Unleashing the full power of different flavors and applications of AI agents, together with intelligent automation, reveals a whole new level of business process automation. This is known as

the autonomous enterprise which we define as "a business where AI handles strategic decision-making and complex operations, blending human creativity with automation for continuous innovation and efficiency". The concept is to fully delegate decisions and initiatives to AI –not only the execution of tasks. Imagine AI not only as a worker, augmenting us in our daily activities, but also as a manager, tasked with analyzing complex situations, predicting changes and trends, and making both operational and strategic decisions. What if AI would not only handle routine procurement tasks, but also decide to work with a new supplier, not renewing the contract of a current one? What if AI would not only take care of bookkeeping but act to invest in company A instead of company B? What if a robot would not only monitor an assembly line, but would also decide to increase the production of a product while decreasing the target of another? What if it would change its price as well?



It's not a pipe dream

Think this is science fiction?
Much of this is already happening.

- **High-frequency Trading (HFT):** AI systems analyze financial market trends, focus on short-term investment horizons, identify arbitrage opportunities, and make decisions, all without human intervention – autonomously executing large numbers of transactions.
- **Procurement strategies:** Especially for tail-end procurement, it is already realistic to fully automate the whole process, from request for quote (RFQ) issuing all the way up to selection and contracting of the vendor. And not surprisingly, with regulations becoming complex (think Scope 3 data for sustainability, trading restrictions etc.) and more data being produced and exchanged with suppliers, the more automation had to be applied – now leading to an increasing number of autonomous decisions and actions throughout the process.
- **Frictionless lending:** As consumers are demanding rapid answers, many financial services companies pioneer solutions that decide – with no human in the loop – to grant or not grant a loan. The combination of financial data and social media data – especially in China where this may be in the same hands – has enabled fully autonomous credit lending.
- **Supply chain planning:** The complexity of a modern supply chain and the varieties of impact that have to be dealt with (such as geopolitical considerations, closure of maritime ways, shortage of key components such as semi-conductors or chemical resources, and inflation) turns out to require a high level of automation – or even autonomy – to respond promptly and “be like water.”
- **Yield management:** As is well known in the airline industry, the price difference between two similar tickets (same plane, same category) can be significant. Depending on

a continuously changing, complex context, these prices are continuously and autonomously updated, driven by AI algorithms and business rules. Yield management has expanded to many other sectors, such as trains, personal transport, hospitality, and energy.



The role of humans

In the end, the question is not about the capabilities of AI to cover the autonomous needs of a process or an entire company. They are there – or are getting there soon. It's much more about the role of humans in this rapidly evolving landscape. What has to be done by a human, what should be done by a human, what could be done by a human are some fundamental questions to answer.

The financial services sector, for example, has many processes that request a four-eyes check, especially for key decisions (e.g., in the context of potential criminal acts such as money-laundering). It currently means that two different persons have to be involved in the process, and it is successful only when both reach the same conclusion. To reduce cost and increase efficiency, an AI system and a human can perform the same process collaboratively. Will current

“The autonomous enterprise is shaking up industries, from high-frequency trading to supply chain management, putting AI in charge of tough decisions and actions.”

regulation approve two different AI systems jointly performing the check?

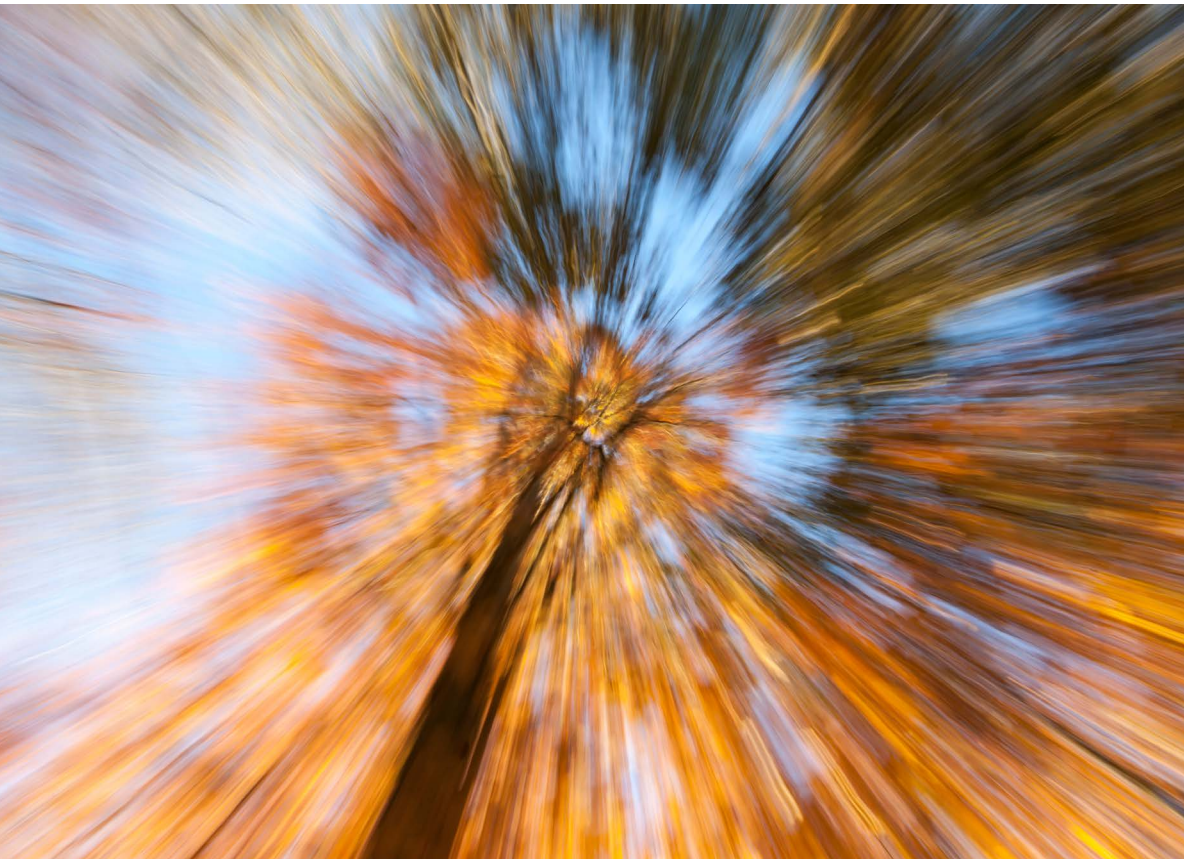
Some actions seem to require a human to act. For instance, every process that requires a signature would mean systematic involvement of a human. But the explosion of electronic signatures has led to the ability to sign without anyone involved, as long as credentials have been given to the system (or AI solution).

In the 1970s, IBM claimed: “a computer can never be held accountable, therefore a computer must never make a management decision.” Fifty years later, there are cases where management decisions have been delegated to systems, but accountability cannot. The use of a governance and control instance is mandatory, and ironically, due to the volumes of transactions to be checked,

the biggest part of this control instance needs to be delegated to...AI systems. Indeed, the question of the accountability is essential. Recently, an airline had to pay back a ticket to a customer because its chatbot gave him the assurance he would be paid back by following an incorrect procedure. The airline argued it could not be held liable for information provided by a chatbot, but justice formally rejected that argument.

Price may be the irony

The autonomous enterprise seems a logical destination of where AI and a flurry of additional innovative technologies will bring us. And there are so many benefits to achieve while on our way. Having said that, it's still a matter of having a solid business case. Ironically, with the price of key AI technology rising (in terms of money, but also in terms of environmental impact) the balance sheet might look differently than expected, especially when the inflation of technology cost is higher than that of human salaries. Replacing AI by humans, could this be a hotel you can leave after all?



#AI
#AutonomousEnterprise
#IntelligentAutomation

Innovation takeaways

AI-powered decisions

The autonomous enterprise allows AI to go beyond assisting with tasks to making strategic decisions, transforming industries like high-frequency trading and supply chain management. This shift enhances efficiency and drives continuous innovation.

Autonomous processes

From frictionless lending to automated procurement, AI is enabling fully autonomous processes. This not only speeds up operations but also ensures better accuracy and compliance with complex regulations.

Human-AI collaboration

The rise of the autonomous enterprise prompts a reevaluation of human roles, emphasizing the balance between human creativity and AI capabilities. Ensuring ethical and accountable AI use is crucial as businesses navigate this new landscape. can free up experts to focus on tasks that require their specific skills.



The dual paths of semiconductor innovation *“More Moore” versus “More than Moore”*



Ravi Gupta

Senior Director and Semiconductor
Trend Leader, Capgemini



In the ever-evolving world of semiconductor technology, two groundbreaking concepts, “More Moore” and “More than Moore,” carve distinct paths through the technological forest. Each approach offers unique advancements and opportunities, shaping the future of the semiconductor value chain in profound ways. And it’s all crucial for the future of data-powered innovation.

Semiconductors stand at the heart of today’s digital revolution, fueling advancements in AI, data analytics, and edge computing. As the building blocks of modern electronics, these tiny yet powerful components are critical in processing and storing the vast amounts of data generated by today’s smart technologies – and do it in a less energy-consuming, more sustainable way. The ongoing development through the distinct strategies of More Moore and More than Moore (MtM) not only enhances computational power and efficiency but also broadens the functional scope of semiconductors, paving the way for innovative applications in AI and the expanding data landscape.

More Moore: Pushing the boundaries of miniaturization

Moore’s Law, a principle named after Intel co-founder Gordon Moore, posits that the number of transistors on a microchip doubles approximately every two years, thereby increasing performance and capabilities while reducing relative cost. The More Moore approach focuses on advancing semiconductor technology by reducing transistor sizes. This miniaturization drives higher performance, increased functionality, and greater integration, faithfully following Moore’s Law.

Some of the current best practices of this approach include the following:

- **Nanometer nodes:** The semiconductor industry has successfully scaled down to incredibly minute process nodes. Chips are now being produced at seven

nanometers (nm), five nm, and even as small as three nm.

- **FinFET technology:** Adoption of fin field-effect transistor architectures enhances power efficiency, transistor density, and overall chip performance.
- **Advanced lithography:** Techniques like extreme ultraviolet (EUV) lithography are crucial for crafting smaller, more complex patterns on silicon wafers.

And here are some of the future trends expected for More Moore:

- Sub-nanometer nodes pushing the envelope beyond three nm to possibly two nm and smaller will require innovative approaches in lithography, materials, and equipment.
- New materials such as graphene and advanced gate dielectrics are pivotal for sustaining Moore’s Law.
- 3D integration and quantum computing: Vertical scaling with 3D integration and the exploration of quantum computing promise to revolutionize performance and tackle problems beyond classical computing’s reach.

More than Moore: diversifying technology

Introduced in the early 2000s, the MtM approach acknowledges that not all technological needs scale with Moore’s Law. This alternative strategy emphasizes diversification and integration of non-CMOS (complementary

“On one side, More Moore is pushing the laws of physics and material science innovations to make ever-smaller intelligent devices; on the other, we see More than Moore’s innovations enabling heterogenous integration of CMOS with bionic technologies.”

metal-oxide-semiconductor) technologies to meet broader functional requirements.

Here are some of the current best practices of this approach:

- **Extended silicon use:** MtM extends traditional silicon technology to include new, non-digital functionalities, often leveraging More Moore’s scaling capabilities.
- **Specialized applications:** Technologies like sensors and micro electronic mechanical systems are vital in sectors such as automotive and healthcare. Integration of these technologies into systems like IoT is becoming increasingly common.

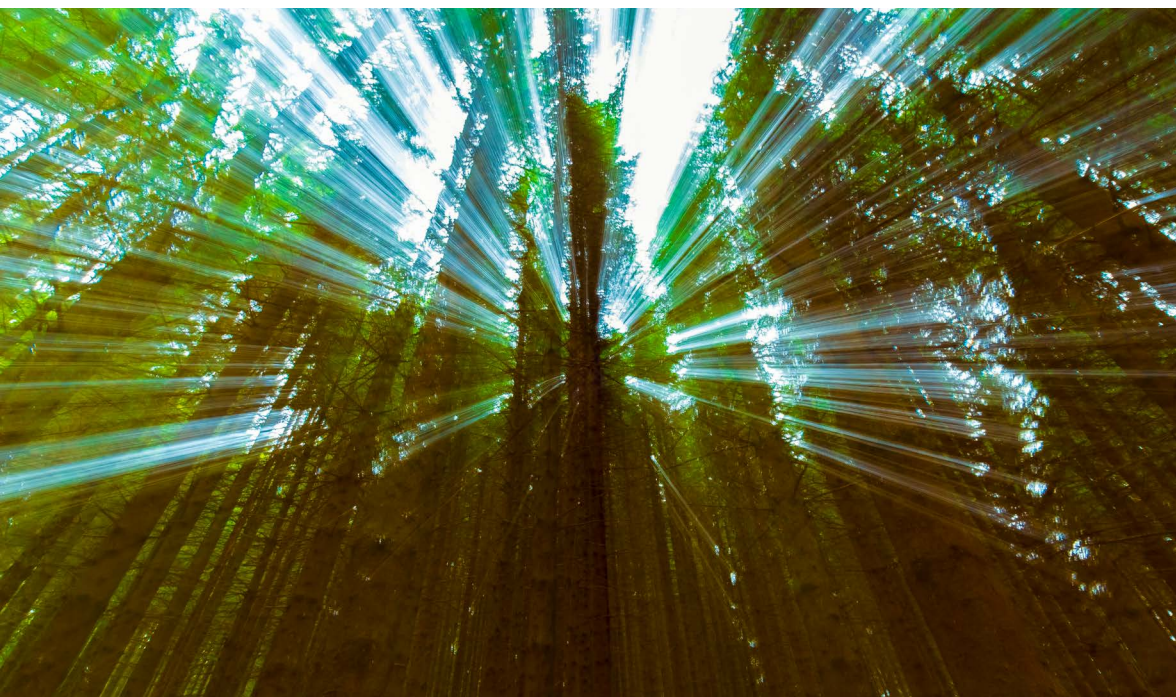
And some of the future trends expected for More than Moore include the following:

- **Heterogeneous integration:** This involves integrating various devices and functionalities into a single package, enhancing system-level performance.
- **Quantum sensing and bioelectronics:** From quantum technologies in sensing and imaging to the integration of biological components in electronic devices, MtM is setting the stage for next-generation applications.

Complementary paths toward innovation

It’s crucial to understand that More Moore and More than Moore are not competitors but complementary technologies. Together, they forge paths toward creating new, high-value systems. While More Moore continues to challenge the physical limits of materials and engineering, More than Moore paves the way for innovative system designs and the integration of diverse technologies.

This dual approach not only enriches the technological landscape but also promises a fertile ground for future breakthroughs in semiconductor technology. As we trek deeper into this forest of innovation, the combined strengths of More Moore and More than Moore are poised to redefine what’s possible, nurturing the seeds of tomorrow’s technological advancements.



#Semiconductors

#Chips

#GPU

Innovation takeaways

Foundation for modern technologies

Semiconductors are integral to the development of AI, data analytics, and edge computing, serving as the foundational components that manage and process the increasing data demands of modern technology. Advancements in semiconductor technology thus play a critical role in enabling the growth and capabilities of these cutting-edge fields.

Dual approaches to semiconductor innovation

More Moore focuses on advancing chip performance through miniaturization of transistor sizes, adhering to Moore's Law, while More than Moore explores integrating diverse technologies to enhance semiconductor functionality beyond simple scaling.

Future technological impact

Both approaches are driving the semiconductor industry forward, with More Moore pushing the limits of physical scaling to achieve higher efficiency and More than Moore facilitating new applications in fields like quantum computing, bioelectronics, and heterogeneous system integration.



Powering the generative economy

Virtual twins drive innovation and democratize knowledge



Morgan Zimmermann

CEO of NETVIBES, Dassault Systèmes



Coupling the experience economy – in which experience counts more than product – with the circular economy – in which reducing, reusing, and recycling are the main principles – results in a greater generative economy – one in which more is generated than consumed. This is a vital shift, if we hope to balance the needs of billions of people around the globe while preserving the planet. But to succeed in this new economic model, enterprises across all sectors must evolve beyond their current digital transformations.

The generative economy model creates continuous value through innovation, while also being a powerful means to address social and environmental challenges. Given that knowledge and innovation are important foundations in this model, it's no surprise that thriving in a generative economy will require enterprises to leverage data to make better decisions.

This requires providing every team member with access to comprehensive data and knowledge to power innovation, within a collaborative environment that enables people to share results and act across the enterprise. This democratization of knowledge-driven decision-making will empower people and accelerate innovation, fostering more agile organizations and freeing up time to focus on the company's largest, mission-critical challenges.

At Dassault Systèmes, we believe the virtual world will extend and improve the real world – and we anticipate experiences powered by virtual twins will be at the heart of this transformation.

Beyond the digital twin

Many companies – across all sectors, but led by those in aviation, automotive, and general manufacturing – are familiar with digital twins.

There's no question digital twins have proven their worth. As the Capgemini Research Institute noted in its 2021 report [Reflecting reality](#), organizations using digital twins enjoyed, on average, a

15% growth in key sales and operational metrics, an improvement in system performance of more than 25%, and a 16% boost to sustainability.

That said, digital twins rely on data generated in the past, even as they're used to predict the future. Virtual twins are extending the possibilities. Virtual models powered by generative AI allow us to contextualize and elevate data into a unified, normalized representation of complex objects, systems, or factories.

In addition to providing a common referential for understanding, learning, and predicting, this approach unleashes the power of simulation to enable "What if" scenario modeling.

Data, decisions, and operations

Virtual twins are a blend of three important components:

- The digital model – an advanced representation of the product, the factory, or the enterprise. This model can be a 3D representation, a system model, or an ontology.
- Real-world data from across the enterprise's ecosystem and beyond, fully contextualized, projected on the virtual twin, and available anytime, anywhere, via any device.
- People and processes, through powerful built-in collaboration methods and tools.

This ability to reduce the gap between data, decisions, and operations is the key that will enable companies to imagine,

build, and deploy innovative new products and services.

Virtual twins are already transforming innovation at companies in many industrial sectors. Here are a couple of examples drawn from clients who are using the NETVIBES solution.

Superior supply management: In the manufacturing sector standards, regulations, and competition are raising expectations for automotive manufacturers. Every design decision is weighed against large sets of critical KPIs, and designers must balance price, weight, CO2 emissions, safety, and other vital criteria. With MOD/SIM/DATA and AI, designers can easily understand the impact of their decisions on all criteria. They can leverage knowledge, supplier value chain content and catalogs, procurement, logistics, best practices, new material specifications and other data to select the most relevant combination to create a better product. AI-enabled virtual twins help navigate this complexity and provide a new level of synthesis to guide decisions. Dassault Systèmes provides a major global automaker with a unique combination of artificial intelligence, machine learning, collaborative business processes, and an enriched single 3D data model of each vehicle. This helps the client better manage the business impacts of market volatility. The automaker can aggregate equipment designs, configurations, historical data, and forecasts to test different design scenarios in a virtual twin. The company can understand, anticipate, quantify, and optimize vehicle price and cost, and improve equipment-purchasing negotiations by sharing these insights with other stakeholders.

Better project oversight: In the infrastructure and cities sector – encompassing nuclear, oil and gas, and renewable energy – we use virtual twin experiences to help clients elevate data, from engineering and construction to operation and maintenance. Virtual twins are a game changer, providing science-based models for interpreting, understanding, and contextualizing

“Virtual models powered by generative AI allow us to contextualize and elevate data into a unified, normalized representation of complex objects, systems, or factories.”

real-world data from sensors. AI is accelerating this by helping customers learn from the past to navigate the future through predictive models, such as anticipating deviation risks in construction phases. An example of this is [our work with India-based L&T Hydrocarbon](#).

Maximizing the virtualization of knowledge

The virtual twin experience is the enabler to transform implicit information and know-how into explicit and actionable knowledge. At Dassault Systèmes, we provide our customers with virtual twin experiences that help them think and operate in a generative way and create new, net positive business models. Our virtual twin solutions build on our AI-augmented Industry Solution Experiences by leveraging the current acceleration of AI to maximize an enterprise’s ability to virtualize knowledge. This provides clients with fresh opportunities to leverage their employee know-how and other corporate assets to drive innovation.

The generative economy will extend the experience economy with sustainability and other imperatives. This will have a major impact on the way organizations work and will require connection between silos of people who don’t share the same backgrounds and expertise. The virtual twin experience will not only trigger this transformation, it will enable it to succeed – and organizations must start implementing such solutions now to ensure they’re prepared for future growth.

#VirtualTwin
#DataScience
#DigitalTwin
#GenAI
#GenerativeEconomy

Innovation takeaways

The innovation imperative

Sustainability is making innovation even more important – and is just one factor disrupting current economic models. Companies must embrace solutions like virtual twins powered by AI to succeed in this rapidly evolving environment.

Turn data into a corporate asset

Companies must provide all employees – not just leaders and experts – with the ability to make informed, knowledge-driven decisions. Virtual twins leverage data and AI to enable a common understanding, shared learning, and coordinated, effective action.

Enterprises don't exist in a bubble

True innovation and competitive advantages will increasingly require companies to understand information in context, then deploy solutions specifically designed to help leverage the insights derived from this contextualized data.



Data for *humans*

Data and AI could help save our planet Driving innovation in battery tech for a sustainable future Sudarshan Sahu, Capgemini	43	Going for gold The next four years will decide who the data winners are in consumer-facing industries Owen McCabe, Capgemini Kees Jacobs, Capgemini	64
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Data and AI could help save our planet

Driving innovation in battery tech for a sustainable future



Sudarshan Sahu

Team Lead, Emerging Technology Team,
Data Futures Domain, Capgemini



Imagine a world where data and AI join forces to combat climate change. By integrating innovative solutions in carbon capture storage and battery technology, the world can address pressing sustainable challenges. AI algorithms are revolutionizing carbon capture processes by optimizing efficiency, monitoring, and storage site selection, thereby enhancing the effectiveness of CO2 capture from industrial emissions. In parallel, data-powered approaches are directing battery technology toward a greener future, enabling the design of more efficient and durable batteries through discovery of novel materials.

Climate change is an urgent global crisis demanding immediate attention and innovative solutions. The effects of climate change, such as escalating temperatures, severe weather occurrences, and ecosystem disruptions, pose significant challenges to the sustainability of our planet. Harnessing the power of data and AI is a promising avenue to combat this. AI technologies hold the potential to help mitigate and adapt to climate change, creating a sustainable future.

Technology is a double-edged sword in the context of climate change. On one hand, technological advancements have led to increased industrialization, urbanization, and transportation, all of which contribute to higher greenhouse gas emissions and environmental degradation. The widespread use of fossil fuels for energy generation, coupled with inefficient industrial processes driven by technological development, exacerbates the problem. On the other hand, carbon capture technology is a promising solution for reducing greenhouse gas emissions. Further, advancements in battery technologies provide unprecedented opportunities to combat climate change and accelerate the transition to a sustainable future. The power of data-powered insights and AI-powered optimizations mean engineers and researchers can unlock new possibilities for reducing greenhouse gas emissions, facilitating renewable

energy integration and powering the clean energy revolution.

The price of training

Big data, machine learning, and artificial intelligence continue to gain prominence in information technology but experts are raising concerns about the environmental costs of computation – primarily data and AI’s carbon footprint and greenhouse gas emissions. The datasets used to train AI are increasingly large and take an enormous amount of energy to run. [As Forbes wrote](#), “The MIT Technology Review reported that training just one AI model can emit more than 626,00 pounds of carbon dioxide equivalent – which is nearly five times the lifetime emissions of an average American car.” According to the Intergovernmental Panel on Climate Change in its [March 2023 report](#), the adverse impacts of climate change are being felt in every region of the world. Every fraction of a degree of additional warming will intensify these impacts, with increasingly severe and irreversible consequences. The report calls for deep and rapid reductions in greenhouse gas (GHG) emissions to limit the rise in global temperature to 1.5°C, using technology, along with financing and international cooperation, as key levers of accelerated climate action.

Data and AI has emerged as a potential solution in the battle against climate change, offering significant potential to mitigate carbon emissions and address

environmental challenges. AI can be used to optimize the design and operation of carbon capture systems, such as chemical absorption or membrane separation processes. By analyzing large amounts of data and identifying patterns, AI can help improve the efficiency of these systems, reduce energy consumption, and lower costs. AI algorithms also assist in carbon tracking through image processing to detect carbon output for factories and power plants. AI uses satellite data to monitor and track these emissions

globally. Further, data and AI can be used to predict future emissions of a company or region. This forecasting feature can help government policymakers plan emissions output targets. According to a study from the University of Surrey, scientists used AI to “adjust a system based on a real coal-fired power station. The model could capture 16.7 percent more carbon dioxide while using 36.3 percent less energy from the National Grid.”

Framework for leveraging data and AI to combat climate change

Topics	Data collection and integration	Data analysis and modeling	Climate risk assessment and management	Renewable energy integration	Climate policy and decision support
Subtopics and solutions	Comprehensive data collection systems to gather information on various aspects of climate change	Utilize advanced data analytics techniques, such as machine learning, statistical modeling, and geospatial analysis	Conduct comprehensive risk assessments to identify vulnerable regions, communities, and infrastructure	Leverage AI algorithms to optimize the integration of renewable energy sources	Provide policymakers with data-driven insights and decision support tools to inform the climate mitigation policies
	Temperature trends, sea level rise, extreme weather events, greenhouse gas emissions, land use changes	Identify patterns, trends, and correlations within climate data	Collect climate change-related hazards, such as floods, droughts, heatwaves, and storm surges	Optimize renewable energy sources, such as solar, wind, and hydroelectric power, into existing energy systems	Implement AI models at the local, national, and global levels to make informed decisions
	Integrate data from satellite imagery, ground-based sensors, climate models, socioeconomic indicators	Develop predictive models to forecast future climate scenarios, assess the impacts of climate change on ecosystems	Use AI-driven risk modeling tools to quantify the potential impacts of climate-related events and prioritize mitigation	Develop smart grid technologies using real-time data analytics to balance supply and demand, manage energy storage	AI-powered simulations and scenario analysis to assess the potential impacts of different policy interventions
Value proposition					
Use cases	NASA is using satellite technology to monitor methane and carbon dioxide, and is helping partners identify gas leaks, manage forestry and better control landfill emissions	Robert Bosch GmbH uses AI to predict future energy consumption, avoiding high peaking loads, and manage deviations in patterns of consumption	McCain Foods uses ClimateAi, a climate risk model to provide short- and long-term insights for food and beverage firms, helping businesses identify the actions needed today to adapt to climate change disruptions	GE Renewable Energy uses AI to optimize the operation of wind turbines. Its digital wind farm uses AI to analyze data from each wind turbine and optimize its operation to increase energy output	In the UK, AI is helping government officials estimate the impact of a carbon tax on emissions and overall business productivity

According to the [Capgemini Research Institute Climate tech report](#), technology will help organizations achieve close to 40 percent of their decarbonization goals. There are a variety of technologies that could play crucial roles in decarbonizing the energy, transport, industry, buildings, agriculture, and waste management sectors.

Insights from battery data

Furthermore, data analytics plays a crucial role in understanding and optimizing battery performance. Every battery generates vast amounts of data, including voltage, current, temperature, charge cycles, and more. By harnessing this data and applying advanced analytics techniques, researchers and engineers can gain valuable insights into battery behavior and health. For instance, machine learning algorithms can analyze battery data to identify patterns and anomalies that may indicate early signs of degradation or performance issues. By detecting these issues early, manufacturers can implement preventive maintenance measures, optimize charging profiles, and extend the lifespan of batteries.

Testing a battery across thousands of channels generates terabytes of data per week, and the [annual cost of testing 300 cells](#) is expected to be millions of dollars, depending on the scope and complexity of test scenarios. However, teams at MIT, Stanford, and Toyota Research Institute discovered a novel data-driven AI model that reduces testing time by 98%, from more than 2 years to only 16 days. In addition, AI helps in the design and development of the batteries of the future. Recently, Microsoft along with Pacific Northwest National Laboratory (PNNL) used [AI to screen more than 32 million potential candidates](#) to discover and synthesize the new materials that could help create better batteries which use less lithium. And [General Motors invested \\$60 million in Mitra Chem](#), a US-based battery-materials startup, to accelerate the commercialization of affordable electric vehicles (EV) batteries

“Data and AI serve as the guiding stars in our journey towards a sustainable future. By harnessing their power for climate tech, we illuminate pathways to a greener, more resilient world.”

in the US using Mitra Chem’s AI-powered platform. The platform synthesizes novel battery-material formulations, reducing costs, extending battery lifespan, and shortening R&D timelines by over 90%.

As the demand for energy storage continues to grow in sectors such as transportation, renewable energy, and consumer electronics, the role of data and AI in battery technology will become increasingly crucial. By driving innovation and efficiency improvements across the entire battery lifecycle, data-driven approaches are shaping the future of energy storage and powering the transition to a more sustainable and electrified world.

Despite the promise of data and AI in battery technology, several challenges remain. Privacy concerns surrounding the collection and sharing of battery data, for example, must be addressed to ensure consumer trust and compliance with industry regulations.

Data analytics and AI are driving transformative advancements in both carbon capture and battery technology, offering unprecedented opportunities to combat climate change and accelerate the transition to a sustainable future. By harnessing the power of data-powered insights and AI-powered optimizations, engineers and researchers can unlock new possibilities for reducing greenhouse gas emissions, facilitating renewable energy integration, and powering the clean energy revolution. As we navigate the challenges of climate change and energy transition, data and AI will continue to play pivotal roles in shaping the technologies of tomorrow.

#DataDrivenClimateTech
#Data4Good
#GreenTech
#DataDrivenBatteryInnovation
#AllInBatteryDesign

Innovation takeaways

From thinking to mitigating

Urban and industrial planners must act on green infrastructure investment to reduce urban carbon emissions.

Harnessing digital technologies

Digital technologies such as AI, digital twins, and 3D printing can significantly enhance innovation processes and reduce the costs of climate tech adoption.

Ecosystem integration

Accelerating climate tech adoption hinges on collective action. Organizations will need to shift from working individually to operating as part of an ecosystem of organizations across their value chain and wider industry.



Gen Garage

AI-powered sustainability and innovation



Aishwarya Kulkrni

Senior Manager, Project Manager
– Gen Garage, Insights and Data, Capgemini



In our data-powered innovation hub, Gen Garage, emerging visionaries guided by experienced mentors create the next technological breakthroughs. It is a platform where the pulse of innovation beats at the intersection of young talent and technology. In every edition of this magazine, we give you a taste of some of the most compelling data and AI projects that have been going on, and this time we are focusing on inclusiveness and sustainability.

Gen Garage enables diverse teams to work on innovative solutions leveraging cutting-edge technologies like generative AI and machine learning, and serves as a catalyst for operational excellence, delivering transformative solutions. As organizations increasingly recognize the value of data-powered insights and automation, the demand for such advanced solutions continues to soar, and we are glad that we focus on technologies that align seamlessly with the market's trajectory towards enhanced efficiency, innovation, and competitive advantage, keeping inclusion and diversity in our minds.

Here are some of the exciting projects Gen Garage has been involved in.

Sign language to text

Sign language translation is becoming a reality as AI advances, enhancing accessibility in educational and workplace settings. The sign language to text solution built in Gen Garage utilizes advanced machine learning and image recognition to translate sign language gestures into text, breaking communication barriers for the hearing-impaired community. Leveraging Google's Teachable Machine, the initiative aims to foster inclusivity in healthcare and education, ensuring seamless communication during medical appointments and improving academic performance for students. Future goals include bidirectional communication, model refinement, and scalability across smartphone applications, reinforcing the commitment to creating an inclusive society.

Picture 1: Sign language to text



Vernacular voice bot

Businesses recognize the importance of linguistic diversity, making vernacular chatbots essential for global customer engagement. Vernacular voice bot employs advanced generative AI and machine learning to enable seamless communication in native languages, transcending barriers and promoting inclusivity. It revolutionizes document processing by providing tailored responses in any language, enhancing

accessibility worldwide. From assisting healthcare providers with medical forms to aiding financial transactions, its applications are diverse. As AI-powered language processing evolves, the Vernacular Voice Bot promises increased adaptability, transforming digital experiences across sectors. It furthers the advance towards a future where language diversity is celebrated, ensuring inclusivity and empowerment.

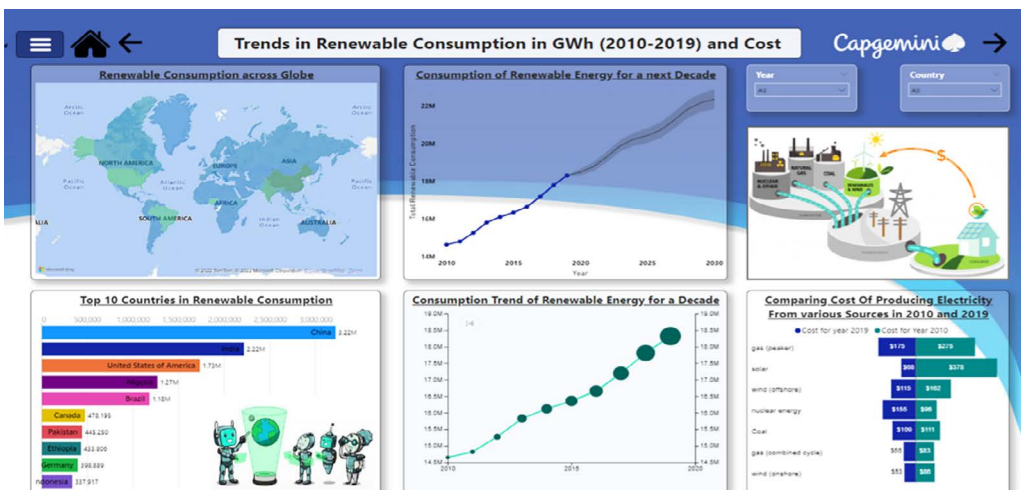
Picture 2: Representative diagram showing voice bot



Sustainability dashboard

The UN's goals for sustainability inspired us to create the sustainability dashboard. Our dashboard delves into the realm of renewable energy and its financial aspect, spotlighting its role in business growth. It does this through analytics-powered insights and a friendly chatbot to help navigate the dashboard with ease. By integrating Microsoft Power BI and AI, it unlocks the potential of data-powered storytelling, revealing revenue trends, forecasting, and helping to achieve sustainability goals for any organization. Armed with data-powered evidence, businesses can strategically pursue diverse deals, positioning themselves for sustained growth and success in the dynamic sustainability landscape – all while using the power of AI.

Picture3: Sustainability dashboard snapshot with interactive AI chatbot



“Gen Garage paves the path towards a future with inclusive AI, where innovation meets talent and transforms possibilities into realities.”

Gen Garage strategically aligns its initiatives with prevailing market trends to address pressing societal and business needs.

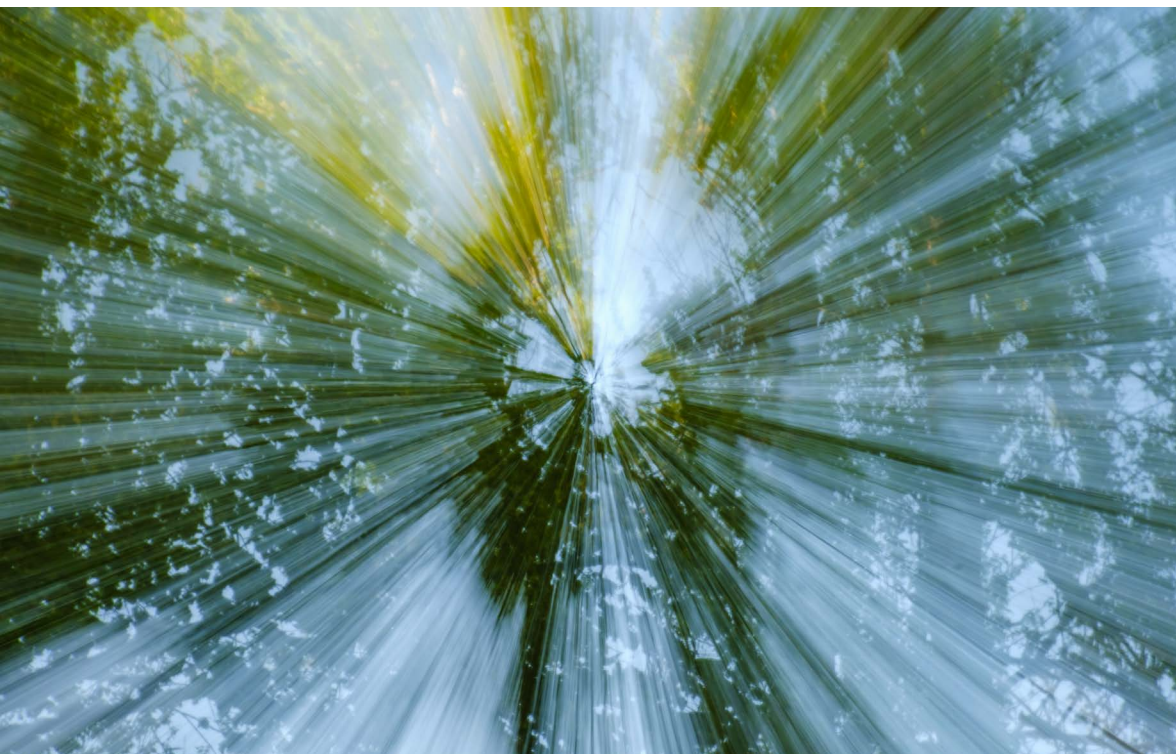
By leveraging advanced machine learning and image recognition, Gen Garage’s sign language to text solution directly addresses the market trend of inclusivity. The initiative aligns with the growing demand for accessible communication tools in healthcare and education, catering specifically to the needs of the hearing-impaired community. As AI continues to advance, the integration of sign language translation represents a significant trend, highlighting Gen Garage’s proactive approach in utilizing market opportunities to foster inclusivity.

The vernacular voice bot initiative perfectly aligns with the market trend of linguistic diversity, inclusivity, and

empowerment. By employing advanced generative AI and machine learning, Gen Garage addresses the growing need for seamless communication in native languages. As businesses recognize the importance of linguistic diversity in engaging with a global audience, the vernacular voice bot promises to revolutionize digital experiences across sectors.

The sustainability dashboard initiative taps into the market trend of sustainability and its importance for organizations that thrive for a better future. By integrating Microsoft Power BI and AI, Gen Garage maximizes the market opportunity and delivers innovative solutions that drive sustainable business practices and growth.

Gen Garage represents a paradigm shift in how organizations approach innovation. By embracing collaboration, harnessing cutting-edge technologies, and staying attuned to market trends, Gen Garage continues to drive positive change and shape the future of technology. As we look ahead, the possibilities are limitless, and Gen Garage stands ready to lead the way towards a more innovative and interconnected world.



#DataPowered #AI4Good
#DigitalInclusion #GenAI
#InnovateForAll #CuttingEdgeAI
#NextGenNLP #SmartMLSolutions
#VoiceBots #GenGarage
#SustainabilityForGrowth
#TechForInclusion

Innovation takeaways

Beyond communication

Gen Garage not only addresses communication challenges but also opens doors to improved education, employment, and healthcare opportunities for the hearing-impaired community, showcasing the broader impact of technological innovation.

Communication revolution

Leveraging artificial intelligence, vernacular voice bot positions Gen Garage at the forefront of driving inclusivity in communication through innovative technology solutions for differently abled community.

Unlocking sustainable growth

The sustainability dashboard empowers businesses with AI and data-driven insights that help forecast organizational needs to achieve a green future for all.



Human in the loop

One proposal for reducing hallucinations in GenAI



Jyoti Bharambe

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Yashwardhan Sowale

Chief Technology Innovation Officer India,
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Generative AI technology is an incredibly valuable tool but its use includes at least one risk: hallucinations. These are misleading or inaccurate results caused by erroneous assumptions and insufficient or biased training data. One solution is human in the loop, the involvement of humans in the decision-making process. This is especially important in instances where GenAI may present bias toward a group of people or within sectors in which precise and reliable information is crucial, as in medical diagnoses or legal findings.

In the field of generative artificial intelligence (GenAI), where algorithms create complex patterns and digital wonders, there's a hidden challenge – hallucinations. These hallucinations can have profound consequences, especially in domains where precise and reliable information is crucial, such as in autonomous vehicles, and national security. But human in the loop (HITL) is a transformative idea reshaping GenAI's reliability.

One way to reduce hallucinations is to use HITL methods, where a human is involved in overriding or verifying the results of the AI system. Leveraging HITL enhances the reliability and accuracy of AI systems, ensuring they align with human ethics, expectations, and values. We can significantly reduce the occurrence of hallucinations and enhance the trustworthiness of AI systems by:

- Labeling data
- Training the GenAI system
- Evaluating the GenAI system's performance
- Providing feedback on the system

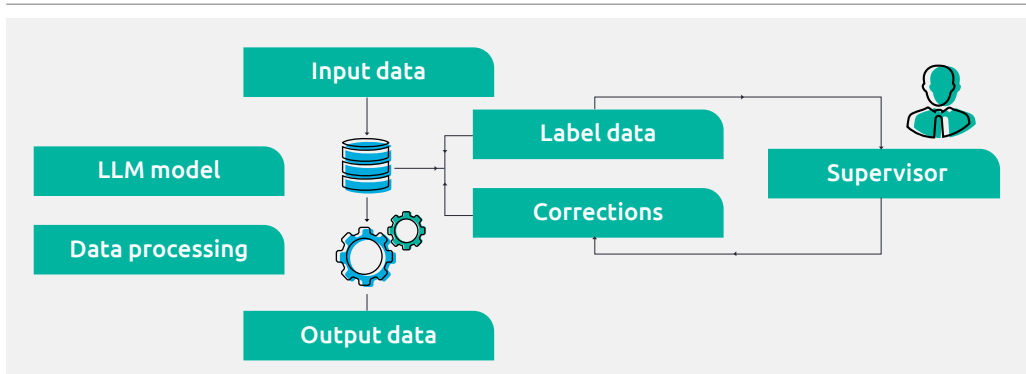
There are several benefits to HITL, including the following:

- **Improved accuracy and reliability:** Human involvement boosts GenAI accuracy and reliability, preventing hallucinations and ensuring authentic decisions.
- **Reduced bias:** Human involvement mitigates GenAI bias, which is critical for addressing issues against specific groups, like women or minorities.
- **Increased trust:** Involving humans builds trust in GenAI systems, which is essential for encouraging their use.

There are, however, several challenges associated with HITL for GenAI:

- **Cost:** HITL for GenAI can be expensive, as it requires the involvement of human workers at the right time in multiple phases.
- **Scalability:** It can be difficult to scale, due to labeling data and training GenAI needs.
- **Expertise:** The process needs human workers who have the expertise in the field to understand the data and the GenAI system.

The below architecture diagram illustrates the workings of a HITL GenAI automated system:



This platform facilitates GenAI-human interaction, offering various features for support:

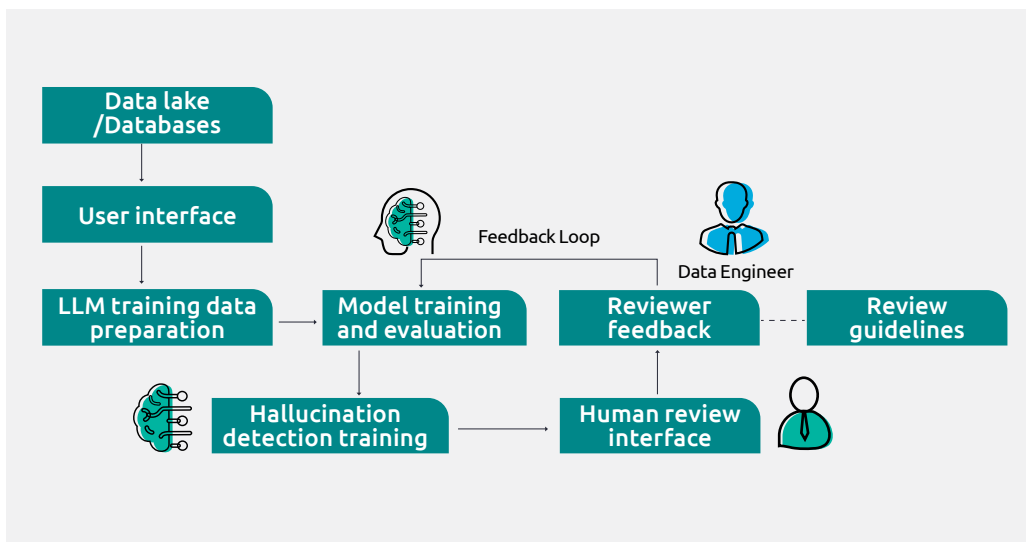
- A user interface for the human worker to interact with the GenAI system
- Tools for the human worker to label data and train the system
- Tools for the human worker to evaluate accuracy.

Adopting best practices ensures effective human oversight in GenAI processes, promoting the reduction of hallucinations while fostering continuous improvement and innovation, including:

- Feedback loop integration
- Explainability and transparency
- Model interpretability
- User feedback integration
- Ethical considerations
- Bias mitigation.

The challenge in data engineering often revolves around generating text, like code generation, documentation, or reports. Large language models (LLMs) can automate these tasks but they are prone to generating false or nonsensical text (hallucinations), hence the solution is human reviewers into the LLM process to identify and correct hallucinations.

Process flow to reduce hallucination



As per the above process flow of HITL, the key components are:

- **LLM:** Generates text based on prompts and data
- **Hallucination detection:** Identifies potential hallucinations in the generated text (can be a separate model)
- **Human reviewers:** Analyze and correct identified hallucinations
- **Feedback loop:** Corrected text and reviewer feedback are used to improve the LLM and hallucination detection model.

Use case: Medical diagnosis

In the domain of medical diagnosis, the HITL approach involves expert radiologists or healthcare professionals who collaborate with the GenAI system to review and validate its findings, reducing the risk of hallucinations and enhancing diagnostic precision.

The HITL implementation approach is as follows.

1. **Data collection and preprocessing:** Gather diverse and representative medical imaging datasets.
2. **Model training:** Train the GenAI model to find patterns and anomalies in medical images.

3. **Initial evaluation:** Allow the GenAI to analyze medical images and provide initial diagnostic suggestions.
4. **Diagnostic confidence thresholds:** Set up confidence thresholds for GenAI diagnoses; human intervention is triggered when confidence levels drop below a certain point, to ensure accuracy.
5. **Review and validation:** Human reviewers validate GenAI diagnoses by thoroughly examining medical images, cross-referencing results, and intervening if hallucinations or misinterpretations occur.
6. **Feedback loop:** Continuously enhance GenAI model with human feedback, ensuring learning from real cases to minimize hallucination risks.

Client case study: Automating contract validation

A client is looking to implement generative AI in its legal tender review system to assess compliance in RFP/tender documents and assign a risk level of each compliance rule. Using AI for contract negotiations involves a dual strategy: first, finding key concepts in the contract, and second, aligning these concepts with the organization's rules. By swiftly analyzing a document to pinpoint crucial concepts in line with organization regulations, AI significantly reduces contract review time. Nevertheless, it remains crucial to have human oversight for accuracy. Machines may overlook language nuances, leading to false alerts or not detecting discrepancies. To keep accuracy, humans must consistently monitor and adjust GenAI based on the data it receives. This ongoing process allows GenAI to enhance its learning. As it improves, it yields greater cost and resource savings.

"AI is only as good as the data it's trained on. Human oversight ensures that the insights derived are ethical, unbiased, and aligned with human values."

– Ginni Rometty
(ex-CEO of IBM)

- **Brief:** Manual contract content validation poses time-consuming and error-prone challenges, heightening compliance risks. Automating with AI streamlines accuracy and efficiency, reducing potential legal and financial complications.
- **Approach:** We developed a contract validation solution employing generative AI. By querying a database of prior legal contracts and considering human-provided impacts, it verifies the reviewed contract's integrity and compliance. The final approval of risk class is done by humans and critical outcomes, such as maximum liability cap percentage, is also determined by humans.
- **Technology:** The solution leverages an embedding model to create a vector database with contracts and uses a publicly available Large Language Model to query the information and perform the validation.
- **Benefits:** Automating contract validation via generative AI enhances accuracy, accelerates review processes, ensures compliance, and reduces human error, leading to heightened efficiency and minimized legal risks.

#AllInnovation
#HumanInTheLoop
#HITL
#DigitalTransformation
#FutureTech
#TechCollaboration
#InnovationInAI
#AIEthics

Innovation takeaways

Synergy unleashed

Leverage the synergy of human intuition alongside GenAI precision to transform digital landscapes and minimize errors.

Precision redefined

Experience the redefined precision of GenAI with eliminated hallucinations, showing how human insights boost accuracy and reliability.

Future harmony

Imagine a future of harmony, where human-AI collaboration drives industries, builds trust, and propels us toward unparalleled technological progress.



Invisible autonomous intelligence

Empowering the future of healthcare



Atul Kurani

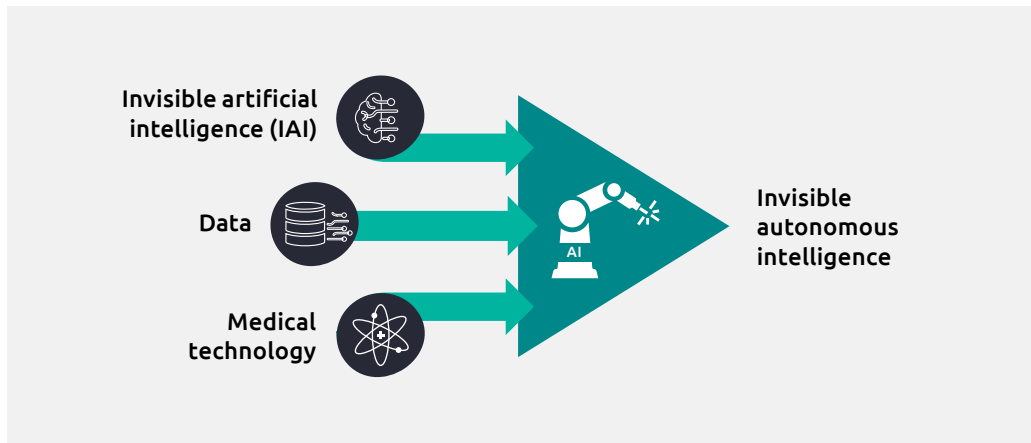
Vice President, Head of Life Sciences, Capgemini Engineering



Technology continually reshapes our lives, and one of the most groundbreaking transformations is occurring in the field of MedTech. Invisible autonomous intelligence, fueled by data-powered innovation, is transforming healthcare. This fusion of advanced technology and medical expertise has the potential to redefine patient care, diagnostics, treatment, and research. Important trends are shaping this exciting realm.

Invisible autonomous intelligence in healthcare, can be considered an amalgamation of primarily three developments.

Understanding invisible autonomous intelligence



Invisible artificial intelligence (IAI): integrates AI and machine learning (ML) into medical technology to operate autonomously, minimizing the need for direct human intervention. These systems, driven by generative AI, continuously evolve by creating new content based on existing data patterns. This evolution enhances diagnostic capabilities, personalizes treatment, and advances research, all while ensuring safety and regulatory compliance in delivering diagnostic and treatment outcomes.

Power of data: At the heart of the transformation lies the exponential growth of data. From medical devices to electronic health records, a myriad of sources generates immense amounts of information. When harnessed efficiently, this data offers unprecedented insights for medical professionals, researchers,

and policymakers. Invisible autonomous intelligence serves as the key player, rapidly dissecting and interpreting data at an unprecedented scale and pace.

Advancements in medical technology: This encompasses robotics, sensors, software algorithms, and various devices. These components are utilized to create medical devices such as Software-as-a-Medical-Device (SaMD), wearables, imaging technologies, and more, facilitating the extraction of valuable data and enhancing healthcare delivery.

Invisible autonomous intelligence powered by data-driven innovation in MedTech is the integration of AI and ML technologies operating autonomously within medical uses. Together with generative AI, these advancements have the potential to revolutionize healthcare and enhance patient outcomes through autonomous operation.

Few examples of Invisible Autonomous Intelligence in Healthcare delivery



AI assisted virtual nursing



AI aiding specialist in patients body scan



Hospital using AI bots for patients care and rehabilitation



Treatment planning

One notable step has been the application of AI and computer vision in surgical technology, enhancing skills like suturing and knot tying. [The Smart Tissue Autonomous Robot \(STAR\)](#) by Johns Hopkins University has shown superiority over human surgeons in tasks such as bowel anastomosis in animal studies. While fully autonomous robotic surgeons are a distant prospect, STAR's

successful performance of laparoscopic surgery on animal soft tissue without human intervention is a significant step forward. Its precision and repetition capabilities surpass those of a human surgeon and are expected to improve with more surgical data, aided by GenAI. STAR can dynamically adjust surgical plans based on real-time conditions during surgery.

STAR performs soft tissue surgery with minimal human help



Other significant developments include:

- In medical imaging, GenAI enhances image quality, denoise scans, and generates images from various angles to aid in diagnosis, treatment planning, surgery, and education.
- AI-powered chatbots or virtual assistants can provide patients with personalized health information and treatment plans. Using GenAI, patient data can be analyzed and IAI systems made to adapt over time based on new data points.
- AI algorithms now swiftly analyze vast genomic, proteomic, and chemical data in drug discovery, predicting potential candidates with precision. They assess molecular interactions to propose novel, effective treatments for diseases.
- In personalized medicine, generalized treatments are giving way to precision medicine, driven by invisible autonomous intelligence. This allows medical professionals to customize therapies based on an individual's genetics, physiology, and lifestyle, reducing side effects and enhancing treatment effectiveness. AI algorithms now aid in creating custom prosthetics and implants tailored to each person's anatomy.
- GenAI simulates virtual patients with diverse conditions, enabling healthcare professionals to practice and hone their skills safely. This is especially beneficial in medical training and education.

Challenges and considerations

Invisible autonomous intelligence offers significant potential but presents challenges such as data needs, bias, ethics, and ensuring accuracy and safety. Collaboration among AI researchers, medical professionals, and regulators is crucial for balancing benefits, patient safety, and compliance.

"A seamless blend of invisible autonomous intelligence powered by data and connected devices is reshaping healthcare delivery, enhancing efficiency and transforming patient outcomes."

Autonomous components must be transparent and verifiable, as they can make independent decisions without human approval. Transparency allows us to review decisions, while verification confirms system behavior accuracy using various techniques, including any unexpected behavior in its environment.

With rapid technological progress, a fully autonomous surgical robot may soon become a reality. However, with decision-making shifted away from the human surgeon and towards the robotic system, how do you address liability if harm comes to the patient? These issues need to be addressed as these systems mature and go through future animal and clinical trial phases.

The evolving regulatory landscape

Invisible autonomous intelligent systems serve roles in both healthcare diagnosis and treatment. Presently, there are no established regulatory frameworks specifically tailored to these systems. However, a regulatory body such as the U.S. Food and Drug Administration (FDA) and the Medical Device Reporting program recognize the necessity for guidelines concerning continuously learning autonomous AI systems and are actively working on their development.

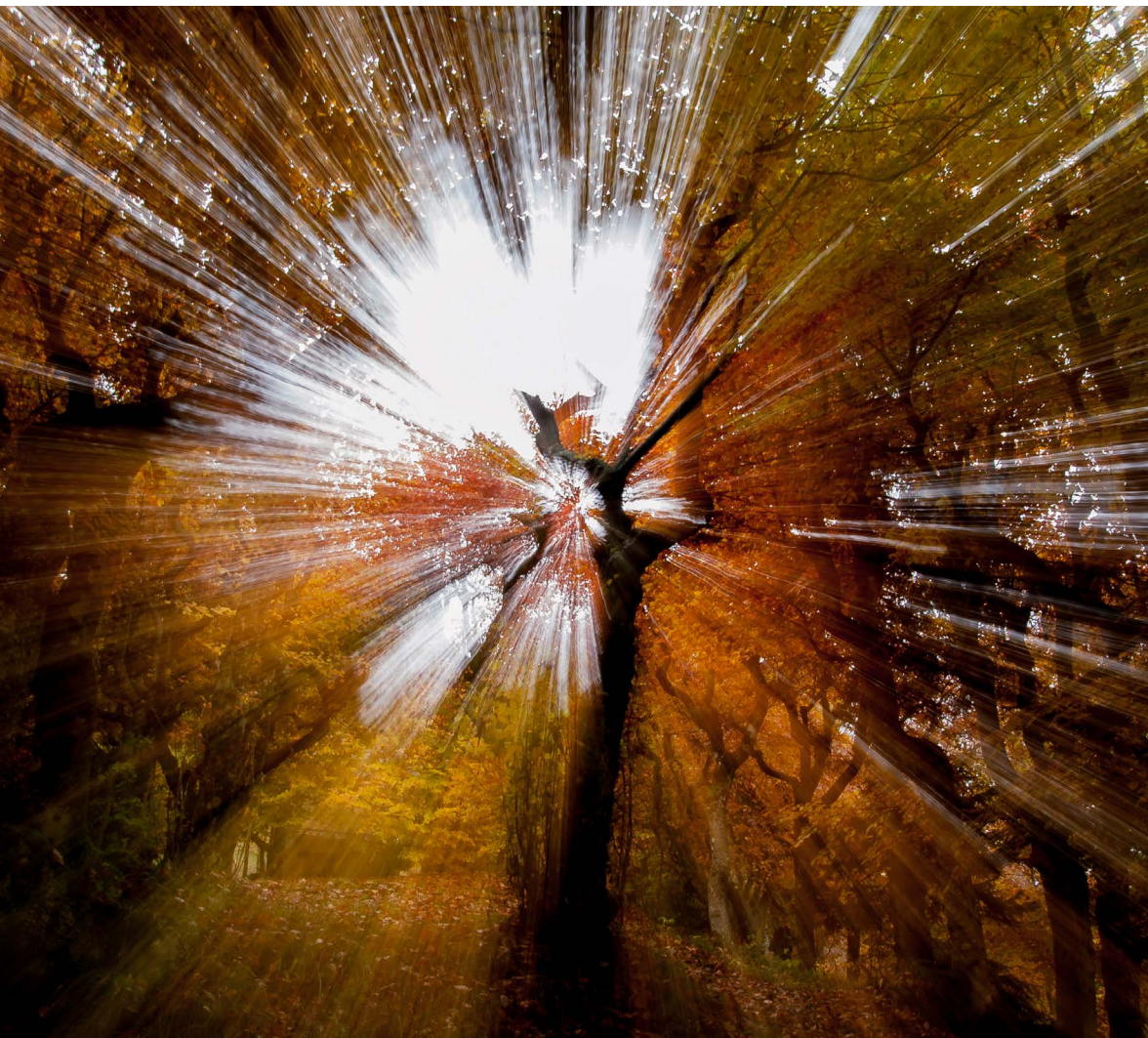
IAI road to full autonomy: The promise for a revolution reshaping MedTech

Various autonomy levels are defined, ranging from mere assistance in specific tasks to effectively replacing clinicians or surgeons. As autonomy levels increase, so do regulatory challenges. In the US, robotic-assisted devices undergo FDA review via the 510(k) premarket notification process.

Future highly autonomous medical robots may fall into the high-risk Class 3 category, necessitating the strictest pre-market approval regulatory pathway. At the highest autonomy levels (Level 5, and possibly Level 4 with full autonomy), robots function both as medical devices and practitioners. The FDA regulates medical devices but not the practice of medicine, which is left to the medical societies. Handling such a situation would

therefore be challenging and may require the creation of a medical establishment to certify the safety of a surgical robot system in such cases.

Invisible autonomous intelligence holds promise in revolutionizing patient care, diagnostics, treatment, process optimization, cost reduction, and medical research. Challenges in verification and validation will be addressed over time, encompassing management of vast datasets, sensors, and intelligent algorithms. This includes aspects like privacy, security, safety, reliability, and quality requirements on a real-time basis as the systems evolve, collect evidence, and correct themselves with these data points. This is where harnessing GenAI ethically ensures responsible technology development, prioritizing safety, security, humane practices, and an environmentally friendly approach to AI.



#InvisibleIntelligenceHealthcare
#AllInMedtech

Innovation takeaways

Enable efficiency and precision

Invisible autonomous intelligence has the potential to enhance overall patient experience and outcomes by improving the efficiency, precision, and accessibility of healthcare services.

Seamless integration of AI in healthcare

AI integration enables healthcare providers to focus more on patient care while leveraging AI for data analysis, diagnostics, and treatment planning.

Empowerment through data-powered insights

Data empowers healthcare providers with actionable options to make more informed decisions and deliver targeted care to patients.



Going for gold

The next four years will decide who the data winners are in consumer-facing industries



Owen McCabe

Digital Commerce Leader, Consumer Products Retail and Distribution, Capgemini



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Global Consumer Products Retail and Distribution Leader, Insights and Data, Capgemini



Before the next Olympic Games take place in LA in 2028, three “next-gen” vectors of change – Gen Z, Gen 4 retail, and GenAI – are set to coincide. We examine the implications of these changes and offer a warm-up exercise, framed by the Olympic ideals, to help you start building the data-powered commercial capabilities needed to win in the new games ahead.

What is changing?: The next-gen opportunity

Three longstanding vectors of change will reach significant tipping points between 2024 and 2028. Their combined impact has the potential to turn the consumer goods industry on its head because collectively they mean that the who, where, when, and how of shopping are

all set to fundamentally change. They will change in ways that will push data and technology to the forefront of the biggest shift in the consumer goods and retail industry for over 30 years.

Conveniently, each of these three vectors of change can be described by a word beginning with “gen” – Generation Z, Generation 4 retail, and generative AI – to give us a next-gen mnemonic.

Figure 1: The three next-gen vectors of change set to transform the consumer goods industry



Who	Where/when	How
<p>Gen Z <i>New audiences and new expectations</i></p> <p>New audiences</p> <ul style="list-style-type: none"> Gen Z (born 1997-2012) enter their 30s Gen Z parents account for >50% births Gen Z join Gen Y to become 58% of the workforce <p>New expectations</p> <ul style="list-style-type: none"> Digital First: 6-8 hrs/day on devices Immediacy, sustainability, purpose Solutions > products Services > ownership 	<p>Gen 4 <i>New routes to market and new touchpoints</i></p> <p>New routes to market (Gen 4 for Retail)</p> <ul style="list-style-type: none"> Third-party marketplaces >50% global e-commerce sales Social commerce up to 40% discovery DTC (direct to consumer) 5-50% sales depending on category Last mile and intermediaries >5% global grocery sales <p>New touchpoints</p> <ul style="list-style-type: none"> Brand hubs and direct-to-consumer sites Connected products/packs, smart labels Superapps, social media and communities Influencers / key opinion leaders 	<p>GenAI <i>New ways to optimize customer experience</i></p> <p>New behaviours</p> <ul style="list-style-type: none"> Awareness of GenAI and conversational commerce as a shopping tool already at 72% 20% actively use GenAI tools to support their shopping decision-making today → 50%+ by 2028 <p>New modalities</p> <ul style="list-style-type: none"> Clienteling, personalised shopping Conversational commerce, chatbots In-flow / immersive shopping Concierge bots, buying agents, selling agents

Source: [What matters to today's consumer in 2024](#)

How to be a “medal winner” in 2028

These three next-gen vectors of change have profound implications for how the data and technology capabilities of consumer goods companies and retailers will need to evolve over the next four years. They will expose which players are data-fit, which have data-drift, and who are the true masters of data-powered sales and marketing. If we time-travel to 2028, we see three classes of capability that will decide the medal contenders.

- 1. Bronze medal contenders are those who excel in executing a data-powered total funnel strategy.**
The minimum required to get on the medals podium will be to have anticipated and mastered the implications of Gen Z becoming mainstream. Gen Z has been leading a fundamental shift in the media and sales channels that consumers are using for gathering information, comparing, deciding, and fulfilling their needs and desires (e.g., Rufus at Amazon, [40% of Gen Z](#) starting their exploratory shopping missions on TikTok or Instagram, and the surge in retail media networks).
- 2. Silver medal winners are those who best leverage first-party data to drive customer lifetime value (CLV).**
The next level of performers will be those who have mastered effective selling through the Gen 4 retail platforms. They will have figured out how to offset the considerable additional costs for customer acquisition and fulfillment by monetizing their one-to-one relationships with end-consumers through sticky revenue models (e.g., brand-led membership, subscription-based models, and connected products and services) that drive core customer lifetime value (CLV) metrics.
- 3. Gold medalists are separated by fine margins from their main rivals – and the difference for the coming years may be how well they leverage AI and GenAI to convert data into action in real time.**

As the “link” economy gets replaced with more prompted and conversational contexts, social commerce is becoming the primary discovery platform for a whole new generation of shoppers. We are working with more and more consumer goods clients who realize how advances in AI can widen the marketing funnel, removing purchase barriers and leading to higher conversion.

How to HIIT gold by 2028

The three next-gen vectors of change mean that the world of consumer goods is about to get even faster, the bar for achievement is to be raised even higher, and the competition is set to become even stronger and more diverse than ever before. So, it is very fitting that we consider the “*Citius, Altius, Fortius – Communitor*” meaning “*Faster, Higher, Stronger – Together*” motto of the Olympic Games as inspiration for the pathway to success.

From our work with leading consumer packaged goods (CPG) companies and retailers, we know this pathway is not a straight line. Instead, what seems to work best is a series of short sharp interventions – not unlike the principles of high-intensity interval training (HIIT). In HIIT, a cycle of a warm-up period is followed by repetitions of high-intensity exercises separated by medium-intensity exercises for recovery, then a cool-down period. This has been proven to achieve dramatic and often rapid improvements in fitness.

Here, we suggest a warm-up checklist based on the Olympic Ideals (faster, higher, stronger, together) and HIIT principles that we feel provides a good starting point for those serious about going for gold. We have left the scoring column blank, but if we were pushed, we would suggest the industry average score would be a two out of five today, i.e., consciously competent but not yet fully competitive in the new who, where, when, and how of shopping.

Of course, the real test will be in four years’ time when we will find out who has made it to the finals, who has made it to the podium, and who has won the gold.

Figure 2: Going for gold: A warm-up checklist for data-powered success

Scored on a scale of 1-5 where 1 = Would not qualify; 2 = Competent; 3 = Competitive; 4 = Confident of a medal; and 5 = Contender to win Gold

Imperatives	NextGen HIIT warm-up Checklist	Readiness Rate 1-5
Faster	<ul style="list-style-type: none"> What level of synchronous data do you have to be real-time connected across physical and digital channels? Are you leveraging behavioral data from Gen 4 retail platforms to qualify and accelerate new product introductions? Are you leveraging GenAI to speed up your time-to-market with fresh content for consumer engagement? Do you enable rapid or same/next day fulfilment options at key physical touchpoints across the shopper journey? 	
Higher	<ul style="list-style-type: none"> Do you have a future-fit customer interaction/engagement strategy? Does it maximize social platforms and experiences for discovery (e.g., embedding commerce into social experiences to enable in-flow shopping, etc.)? Is your brand engagement equally strong for exploratory and repeat purchase missions – leveraging data-driven retail media for targeted reach and offering a seamless experience across all modalities (in-store, online, across devices, etc.)? Are you able to use data and GenAI to continuously generate personalized content and socially convincing propositions? Are you actively leveraging data to improve ease of shopping and minimize frustraters that lead to cart abandonment? 	
Stronger	<ul style="list-style-type: none"> Are you set up to boost your brand development by integrating digital retail media networks into your brand marketing plans – to drive traffic and presence on data-driven platforms across the consumer journey? Do you have a clear plan for your brands to evaluate and appropriately leverage conversational commerce – to build your customer intimacy – maximizing conversion and harvesting rich insights? Do you currently have end-to-end visibility of the data needed to drive joined-up execution of all consumer experiences (including personalized content, dynamic inventory, order-tracking, fulfilment, etc.)? Is your tech stack future-fit to support data democratization and frontline decision-making (front-to-back composable architectures, headless implementation, etc.)? 	
Together	<ul style="list-style-type: none"> Are you working with your partners at the next level of supplier–retailer collaboration (e.g., using data clean rooms and other secure data-sharing platforms) to better target and activate your customer plans for mutual benefits? Have you identified third-party players that you can work with as part of your partner ecosystem to offer genuine utility/benefits to your end consumer beyond what you could do individually? Have you connected your connected product/packaging initiatives into a commercial partner network system to drive repeat purchase and customer lifetime value? Are you participating in industry data standardization and collaboration initiatives (e.g., GS1, 2D barcodes, machine-to-machine data exchange protocols, etc.)? 	

"The world of consumer goods is about to get even faster, the bar for achievement is to be raised even higher, and the competition is set to become even stronger and more diverse than ever before."

#GenZ
#ConnectedCommerce
#DataPoweredConsumerGoods
#DataMasters #GenAI

Innovation takeaways

Next-gen changes need next-gen capabilities

The consumer goods Industry is about to experience three dramatic "next-gen" paradigm shifts with the maturation of Gen Z, Gen 4 retail models, and GenAI over the next four years.

It takes an ecosystem to raise a winner

The winners will be those who make short sharp interventions in their data-powered go-to-market capabilities to raise their game to go faster, higher, stronger – and together.

Intensify focus on now and next

A warm-up checklist for your data and technology capabilities is advised before you start; to map your readiness and track your progress in building capacity to go for gold in the next-gen games.



The Open Footprint® Data Model

*A foundation for
sustainability data*



John Lewsey

Principal Solution Architect,
Insights and Data, Capgemini



Building trustworthy data to support our journey to a sustainable future is a hugely challenging task. The recently published Open Footprint Data Model Standard can accelerate this task for organizations of all types and complexities. Having standardized, well-structured data about sustainability will help organizations make better evidence-based decisions that reduce corporate impact on the planet, as well as meet tough new sustainability reporting rules.

Dealing with the climate crisis is a complex global challenge involving governments, organizations, and citizens. To address it, we need bold innovation, as well as new skills in learning how to live more efficiently.

Many governments and organizations across the globe are setting out net-zero plans that declare ambitious targets for carbon reduction in the next couple of decades. Alongside this, many governments are introducing tough sustainability reporting rules, such as the European Union’s Corporate Sustainability Reporting Directive (CSRD) and California’s Climate Corporate Data Accountability Act, all to ensure that organizations declare their environmental impact.

With all these plans being published and regulatory reporting rules being

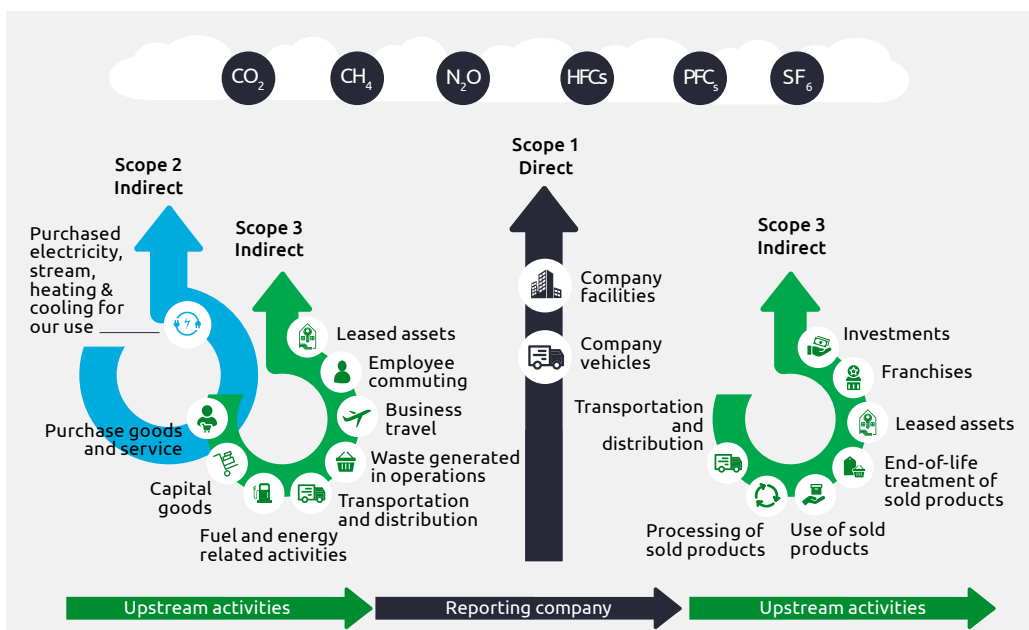
introduced, it seems like everyone is starting to get with the beat and make progress towards reducing our impact on the planet.

Right?

Unfortunately, it’s a bit more complicated than that. Organizations need reliable, trustworthy sustainability data to drive decision-making and produce regulatory reporting, and this data is far from trivial to collect and analyze.

GHG reporting is complex

Let’s consider the greenhouse gas emissions (GHG) domain, which is only a part of the wider sustainability domain alongside water use, land use, biodiversity, and other topics. GHG reporting is divided into three scopes as shown in the illustration.



Scope 1 covers direct emissions generated by an organization’s activities. Scope 2 covers indirect emissions generated by purchased energy. Scope 3 covers the remaining indirect emissions generated by upstream and downstream activities such as the supply chain and product distribution, use, and disposal.

For many organizations, Scope 3 emissions far outweigh those from Scope 1 and Scope 2, especially if they have

complex supply chain and distribution ecosystems. However, Scope 3 emissions are often the hardest to quantify as they involve gathering detailed sustainability data from potentially hundreds of parties across complex, global ecosystems.

In research published by the Capgemini Research Institute in its [Data for net zero report](#), only 22% of surveyed organizations say they are measuring Scope 3 emissions.



The Open Footprint® Data Model Standard

The recently published [Open Footprint Data Model Standard](#) enables organizations to capture and share sustainability data in a consistent, transparent, and traceable way, regardless of industry sector or ecosystem complexity. By using this standard as part of their data discipline, organizations can set up a solid data foundation that supports better decision-making and opens the way for more innovation in tackling the climate crisis.

The standard has been produced by the [Open Footprint Forum](#), part of the Open Group. The Forum includes sustainability and data experts from a wide range of member organizations, including Capgemini. Version 1.0 of the standard covers all air emissions. Later versions will cover other aspects of sustainability.

The model covers all the key information that is critical to recording and sharing sustainability data, including:

- How an organization is structured

- How it works with other organizations
- What facilities and assets it has
- What activities it conducts that contribute to emissions
- What emissions are generated or captured
- How those emissions are calculated
- How emissions relate to a product over its lifecycle
- What emissions are included in which sustainability report against which reporting standard.

A key principle of the model is the ability to support full traceability of data from source to report. This is critical for building trust in sustainability data with stakeholders such as regulators, shareholders, and the public.

How the model helps organizations

Standardizing data within the organization. Often the first battle is to get a coherent view of sustainability data within the organization. This involves collecting data from a diverse

set of business units and organizing it to support analysis and reporting. Basing this common view on a robust, fit-for-purpose data model is an essential step that must be taken early. [The Open Footprint® Data Model](#) is ideally suited to this task.

Sharing sustainability data between organizations.

Organizations need to share sustainability data with partners, customers, and other stakeholders. Using the Open Footprint Data Model to standardize how this data is provided reduces friction, increases the utility of the data, and offers a way of showing provenance to increase trust. This is especially true for GHG Scope 3, which involves integrating data from many parties.

A foundation for sustainability insights from analytics and AI.

Deciding which activities an organization needs to stop, change, or accelerate is key to meeting net-zero commitments and making concrete reductions to environmental impact. Looking past simple mitigations to find the bigger wins requires aid from more advanced analytics and AI. This kind of analysis relies on sustainability data that is consistent, comprehensive, and of good quality, fused with other business data. Basing the sustainability data on a robust model is an essential foundation to this task.

Support for regulatory reporting.

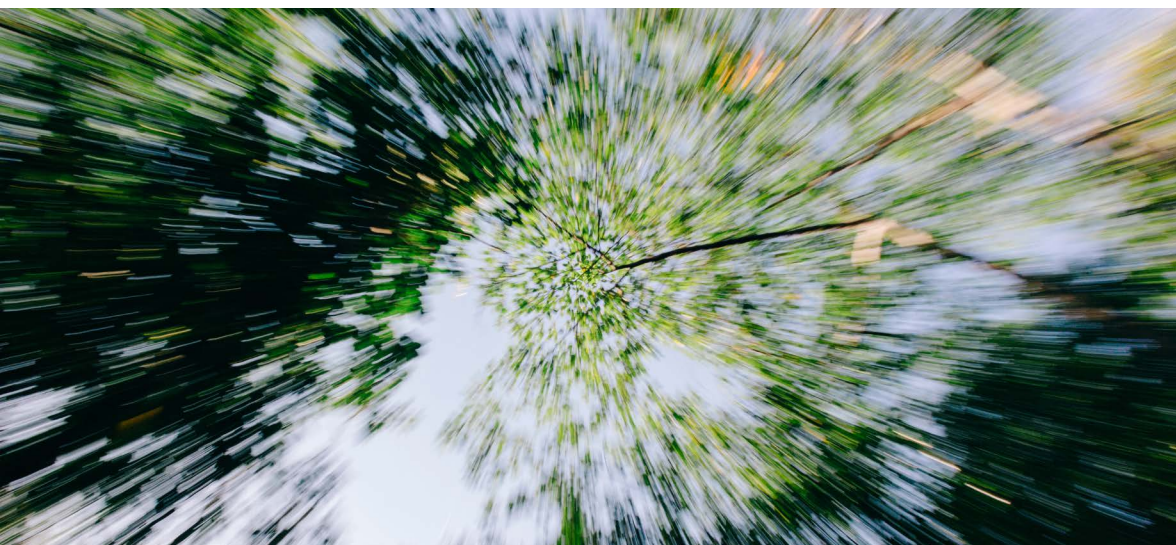
Tough rules on sustainability reporting to regulators are already in place for some

“Organizations can set up a solid data foundation that supports better decision-making and opens the way for more innovation in tackling the climate crisis.”

types of organization in many areas. Over time, these rules are expected to get tougher and widen in scope. Some reporting standards require an organization to not only state the measure of an environmental impact it has made, such as a GHG emission, but how that measure was calculated. Having a data model that supports traceability from source to report, including a record of the calculation steps, is essential for this task. This was one of the main use cases that the Open Footprint Data Model was built around.

Acting on sustainability data

To crack the climate problem, or at least help to minimize an organization’s impact on the planet, we need trustworthy sustainability data. Adopting a common data standard is a clear enabler to building a solid data foundation on which we can rely for evidence-based sustainability decisions. This foundation is also a critical enabler for the innovation we need to apply to the climate problem, so we can look after the one and only planet we live on.



#DataPowered #AI4Good
#Sustainability #DataTrust
#DataForNetZero #DataModelling
#TheOpenGroup

Innovation takeaways

Sustainability decision- making needs trusted data

Any decision-making needs to rely on trusted data, but this is especially true for the sustainability domain. It is a new topic for many organizations and the stakes are high when it comes to placing bets on what interventions are going to make a material difference to reducing environmental impact.

Base sustainability data on a robust model

The sustainability domain is a complex issue. Therefore, a simple data model trying to capture those complexities isn't going to cut it. It is better to start off with a robust model that can properly cope with the intricacies of the domain rather than having to migrate data repeatedly as simpler models fall short.

Align sustainability data across ecosystems

Having standardized data within an organization is a great start, but business ecosystems often includes many organisations and geographies. Sustainability data needs to be aligned using well-founded standards, so that sharing data is low friction and high value.



Give AI a seat in data-governance committees

A view from the near future



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Unlock the power of AI in data governance with “Nexus” – a soon-to-be AI collaborator that will revolutionize decision-making. From real-time monitoring to compliance validation, Nexus augments human expertise, ensuring agile, transparent, and future-proof data governance. Join us in this exciting tale.

Opening the meeting as chair, I say, “I welcome Data Nexus, our new member joining us this month. Nexus will be a fantastic addition to our data-governance committee, providing a data-powered perspective and validation of our direction. And all of that – as AI of course tends to do – based upon the outcomes from our past decisions and the available data we provide to it.

“Nexus is a large language model-based conversational bot with the ability to listen, understand, and contribute to our discussions based upon the information about our organizational direction we provide to it, as well as other earlier discussions, minutes, and recorded actions. All of that is coupled with the data quality information it has access to from the organization’s master data Management and data governance platforms. Now let’s get down to business...”

The case for governance

The landscape of data management is constantly evolving, with organizations needing to grapple with increasing challenges related to data integrity, privacy, and compliance, while ensuring there is a persistently ethical approach to the use of all data. In a recent [Forrester survey](#), 80% of respondents claimed that governing data at scale was currently particularly challenging and 82% found the policies confusing.

Organizations have had to double-down on this, recognizing there are two key requirements to benefitting competitively and safely from the explosion of AI capabilities: their data and their people. Data governance committees have become pivotal in

shaping and executing the strategies and policies to ensure these focus areas are addressed effectively. These committees are typically comprised of individuals from various departments, each bringing unique perspectives and expertise. The decisions and oversight they provide have far-reaching implications across the organization, including optimizing data quality for operational efficiency, keeping data secure, assuring regulatory compliance with regulations like (GDPR, and EU AI Act, etc.), and addressing ethical requirements.

One thing that will soon set some organizations apart in this respect is the integration of AI bots – or “agents” – as active committee members, contributing to and validating the decisions made by the human team.

Challenges with traditional decision-making processes

While human committee members bring invaluable insights and context, the sheer volume and complexity of data and processes within modern organizations create significant challenges, particularly in keeping the agility required to make decisions at the speed of the business. These challenges lead to potential oversights, errors, or delays. Compounding this, human bias can influence decision-making, and the increasing adoption of machine learning-based systems can hamper the clarity and explainability of rationales, further increasing risk. The “black box” logic of the neural network structures often applied in machine learning means that particular focus must be placed on the quality (including ethical dimensions) of

the data fed into them, both for training and operational use.

The possible implications of getting all this wrong include increased cost, lost revenue, and damaged market reputation, raising the pressure and workload of the governance committee.

The AI bot as a collaborative contributor

Integrating an AI bot (our previously introduced Nexus) into the data governance committee transforms the decision-making landscape. AI bots, powered by large language models (LLMs), can analyze vast datasets (far beyond human capability) at unprecedented speeds, finding patterns and providing clear, easily interpretable data-driven insights. This contributes a level of analytical rigor that complements the qualitative input of human committee members.



Key capabilities include the following:

Data analysis: The AI bot excels at analyzing large datasets quickly, finding trends, anomalies, and potential risks. This analytical capability enhances the committee's ability to make informed decisions based on comprehensive data insights.

Real-time monitoring: Unlike other members, who may have human limitations in monitoring real-time data fluctuations, Nexus works continuously, providing up-to-the-minute information and alerts on key governance metrics. This ensures that the committee can respond promptly to emerging challenges or opportunities.

Risk mitigation: The AI bot can assess data risks objectively, minimizing the impact of human biases on risk assessments. Considering a broad spectrum of factors aids it in developing robust risk mitigation strategies that align with organizational goals.

Validating decisions with AI

Beyond insight contribution, Nexus would play a crucial role in validating decisions made by the committee, assessing them against predefined criteria, and ensuring that they always align with organizational policies and industry regulations.

Compliance assurance: As regulations governing data continue to evolve, ensuring compliance remains a top priority. Nexus, equipped with the latest compliance frameworks, validates decisions to guarantee alignment with legal requirements.

Consistency checks: The AI bot helps maintain consistency in decision-making by cross-referencing current and past decisions. This consistency is vital for creating a stable and reliable data governance framework over time.

Auditing and transparency: Through its ability to log and audit decision-making processes, Nexus enhances transparency within the committee. This not only eases internal accountability but also provides an audit trail for external stakeholders and regulatory bodies.

Addressing concerns and building trust

While the integration of AI in decision-making processes brings undeniable benefits, it is essential

“Integrating AI into the data-governance committee transforms the decision-making landscape.”

to address concerns related to trust and accountability. Transparency in the functioning of the AI bot, clear communication about its role, and regular training updates for committee members will foster trust and collaboration.

Additionally, human oversight remains paramount in decision-making. Nexus is a tool that augments human capabilities, rather than a replacement. In line with the good ethical practice of always keeping overall human accountability for decision-making, human team members

retain ultimate control over the decision-making process, with the bot acting as a supportive and enhancing element.

The introduction of an AI bot as a full member of a data governance committee is a paradigm shift in decision-making processes. By contributing analytical insights, ensuring real-time monitoring, and validating decisions against predefined criteria, it enhances the overall effectiveness of data governance. To maximize these benefits, organizations must prioritize transparency, human oversight, and continuous training. As the volumes and complexity of data continue to grow, the collaboration between human expertise and AI capabilities becomes not just advantageous but imperative for robust and future-proof data governance.



#AIGovernance
#DataManagement
#FutureOfWork
#AIIntegration #Innovation
#ComplianceTech #EthicalAI
#DataGovernance #GenAI

Innovation takeaways

AI-powered decision augmentation

Using AI bots like Nexus transforms decision-making by providing real-time data insights and validation, enhancing human expertise in data governance committees.

Dynamic compliance assurance

Through continuous monitoring and adherence to evolving regulations, AI integration ensures proactive compliance measures, mitigating risks and fostering trust within organizations.

Human-AI collaboration

Embracing AI as a collaborative tool, rather than a replacement, underscores the importance of human oversight while maximizing the potential of advanced analytics in shaping resilient data-governance strategies.

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DATA-POWERED INNOVATION
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