

# Building a Digital Future: Emergent AI Trends

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Initiatives: [Technology Innovation](#)

AI is a foundational catalyst for digital business. Enterprise architecture and technology innovation leaders must harness emerging AI trends to democratize and foster its responsible use, adapt composite techniques, leverage AI for real-time analytics at the edge and exploit its generative powers.

## Additional Perspectives

- [Summary Translation: Building a Digital Future: Emergent AI Trends](#)  
(12 May 2022)

## Overview

### Opportunities

- Breakthrough innovations in artificial intelligence (AI) are lowering the barrier to entry, aiding in its democratization within the enterprise and expanding the potential use cases by providing technology leaders with a plethora of AI techniques (composite AI) from which to choose.
- Edge AI deployments enable enterprises to exploit real-time analytics without compromising privacy. Technology advancements in computation, TinyML and privacy-preserving techniques hold the most promise.
- Broader and deeper adoption of AI will require adoption of responsible AI practices and technologies to deliver societal value, and to mitigate its risks through ethical and transparent use.
- Generative AI is the next frontier, with AI systems possessing capabilities to create new artifacts. This can significantly accelerate R&D time, reduce costs in areas such as material design and drug discovery, or even solve the dearth of data for AI through synthetic generation.

## Recommendations

Enterprise architecture and technology innovation leaders, including CTOs, wanting to exploit emergent AI trends should:

- Democratize AI within the organization by harnessing augmented analytics tools and through focused training and hands-on lab experiences for business analysts and developers.
- Prioritize use cases where data-driven AI techniques such as machine learning (ML) can be complemented by symbolic AI techniques such as knowledge graphs or rule engines to enhance learning efficiency and to solve a broader range of business problems.
- Assess potential use cases for edge AI, prioritizing those that have current constraints around latency and privacy and new use cases that can deliver significant business value through real-time analytics.
- Work with stakeholders within the organization, particularly chief data and analytics and legal officers, to document your core principles and values for responsible AI. Fund and advertise training programs to educate the stakeholders and employees on the importance of responsible AI practices.
- Determine use cases for generative AI, starting with low-risk ones such as augmenting real data with synthetic data to achieve better privacy outcomes and improve model accuracy.

## What You Need to Know

Artificial intelligence (AI) has gone through peaks and troughs over the past decades, but the last 10 years truly represent a breakthrough period in the annals of AI. The recent advances in AI wouldn't have been possible without the convergence of five key factors:

1. The rise of big data and parallel processing systems that can store and process data at massive scale, and cost-effectively.
2. Advancements in compute infrastructure, especially the emergence of powerful graphics processing units (GPUs) for complex computations.
3. The rise of new machine learning (ML) techniques — advancements in deep learning, reinforcement learning and the advent of transformer architectures that power large language models.

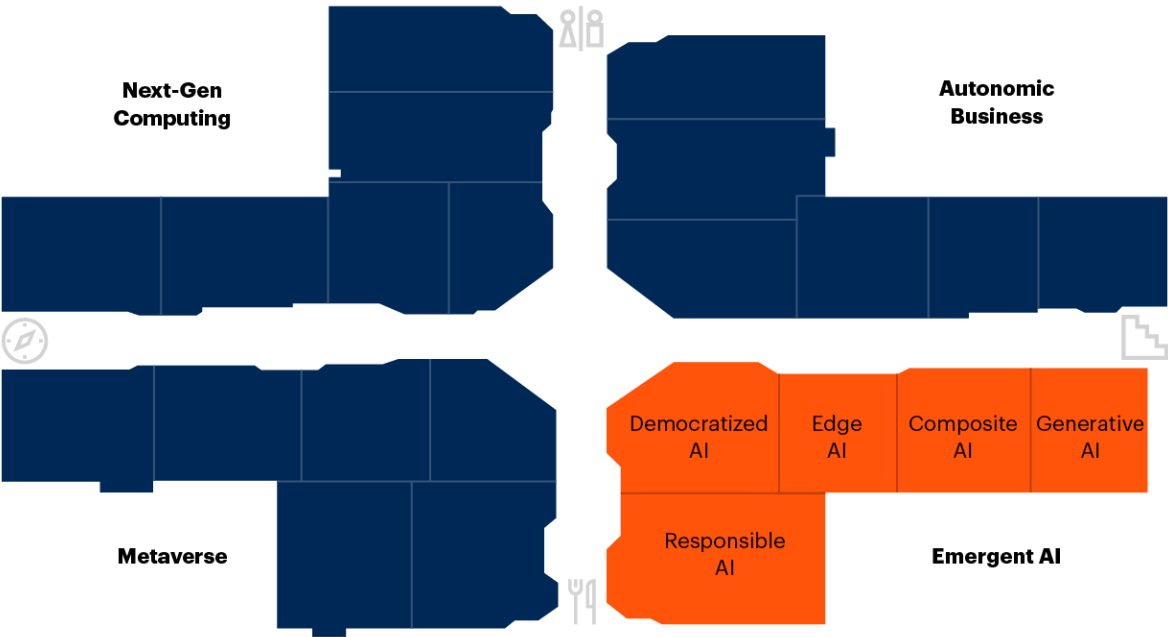
4. The emergence of cloud computing to experiment and operationalize AI faster with lower complexity.
5. The vibrant open-source ecosystem, which enabled mainstreaming of deep learning frameworks and resulted in an explosion of startups.

As we evaluate the trends that will shape the future of AI in the enterprise, Gartner sees the following trends as the most significant:

1. **Democratized AI** — Making AI accessible to a wide set of users.
2. **Composite AI** — The ability to deploy a variety of AI techniques aligned with the right use cases.
3. **Edge AI** — Enable digital moments by harnessing AI for real-time analytics closer to data sources.
4. **Responsible AI** — Ethical usage of AI.
5. **Generative AI** — Use AI to generate new artifacts and create groundbreaking products.

Figure 1: Emergent AI Trends

Build the Digital Future



Source: Gartner  
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**Table 1: Emergent AI Trends**

(Enlarged table in Appendix)

	AI				
	Democratized AI	Composite AI	Edge AI	Responsible AI	Generative AI
<b>Obstacles</b>	Tooling immaturity for automated AI and lack of knowhow and skills outside of data science team.	Lack of talent and knowhow on symbolic AI.	Heterogeneity, inadequate security and limited processing power on the edge.	AI efforts are ad hoc and technical staff either don't understand or prioritize responsible AI practices.	Tools and techniques are nascent and immature.
<b>Opportunities</b>	Tools and techniques are nascent and immature.	ETo expand the potential use cases and efficiency of AI.	Enable real-time interactive applications such as immersive collaboration, autonomous vehicles and unique digital experiences.	Use AI in an ethical, fair and explainable manner to engender trust.	Start with synthetic data use cases but create a long-term roadmap to exploit other areas.
<b>Outcomes</b>	Scarcity of data scientists should no longer hinder the adoption of AI in the organization.	Leverage composite AI techniques to lower AI TCO and expand AI use cases.	Process high-velocity data on the edge with deep neural networks to enable real-time analytics.	Mandate a professional code of conduct across the organization, incorporating ethical use of data and AI.	Reduce costs of AI projects and accelerate time to value. In the long term, improve new product innovation and R&D economics.
Note: AI = artificial intelligence; TCO = total cost of ownership					

Source: Gartner (April 2022)

Despite all this progress, we are still decades away from “artificial general intelligence (AGI),” which is the ability of machines to understand or learn any intellectual task that a human being can and exhibit a similar level of reasoning and multidomain thinking. The early steps toward that goal are: unsupervised learning systems, which enable a system to learn with raw data (unlabeled) and with limited human intervention; and reinforcement learning, where the model learns through actions, where desired behaviors are rewarded and where undesirable behaviors are punished.

In order for AI to make progress in understanding the world around us, it needs to be able to interpret and reason through multimodal learning (learning from text, images, speech, etc.), which is in its infancy now.

## Democratized AI

**Strategic Planning Assumption (SPA):** By 2025, organizations that create a formal program for citizen development, analytics and automation will be far more agile than those that do not.

**Description:** Democratized AI comprises techniques and tools aimed to improve the construction of AI applications by reducing the burden on humans and the need for expert knowledge. As a result, many organizations and multiple roles within them can replace data science and AI expertise with augmented AI functionality.

### Why Trending:

AI democratization is taking several forms as AI techniques start to be integrated within applications, solutions and even other traditional techniques. Four main sub-trends can be identified in this domain:

- **Everyday AI.** The seamless integration of AI techniques within everyday productivity devices and software, including calendar optimization, email sorting and routing, automating meetings scheduling, proactive information distribution, automated preference management, and contextual applications functions.
- **Augmented AI.** Also referred to as “intelligent X,” this trend points to systems where AI techniques provide additional and untapped functionality. For example: intelligent applications; enterprise business applications with embedded or integrated AI technologies, such as intelligent automation; data-driven insights and guided recommendations, which can deliver a more personalized interface, improve productivity and support decision making.
- **Citizen AI (easier-to-use AI).** In addition to existing solutions or applications, AI techniques are also leveraged to make other AI techniques better and more approachable (or just more efficient). Capabilities such as AutoML can enable new users — business analytics professionals, software engineers and data engineers — to quickly tune highly accurate models with limited coding knowledge.
- **Human-centered AI (HCAI).** HCAI is a common AI design principle calling for AI to benefit people and society. It assumes a partnership model of people and AI working together to enhance cognitive performance, including learning, decision making and new experiences. HCAI is sometimes referred to as “augmented intelligence,” “centaur intelligence” or “human in the loop,” but in a wider sense, even a fully automated system must have human benefits as a goal.

## Implications:

From assisting professionals to uncovering unexpected opportunities by automatically identifying trends and patterns hidden in large datasets, to augmenting and assisting workers in complementing their knowledge, democratized AI will touch, by definition, every aspect of our lives, at work and at home. Adding intelligence into applications, instead of more procedural features, allows applications to support decision-making processes alongside transactional processes. However, while AI models spread within organizations, increased scrutiny will be required, where AI experts need to ensure the ethical, bias-free and responsible implementations and evolution of those models.

## Actions:

- Secure your AI today. This will keep AI models performing well, ensure that data is protected, and support “responsible AI” that weeds out model biases and bad decision making.
- Challenge your solutions providers to outline in their product roadmaps how they are incorporating AI in order to add business value in the form of a range of AI technologies.
- Maximize the effects of AI-augmented roles via ongoing education, experience labs, AI-enabled just-in-time training and other methods, so the company, ecosystem and the entire society can take on more exceptional and forward-looking work.
- Prioritize investments in highly specialized and domain-specific intelligent applications delivered as individual point solutions, which help solve problem areas such as customer engagement and service, talent acquisition, collaboration, engagement and more.

## Further Reading:

[Future of Work Trends: AI Joins the Team](#)

[Video: Work Everyday AI Into Offerings to Stay Competitive](#)

[Use Gartner’s MOST Framework for AI Trust and Risk Management](#)

[Human Controls for AI Dangers \(SignatureValue Bank\)](#)

## Composite AI

**SPA:** By 2025, 75% of organizations relying solely on ML for AI initiatives will spend more money per model than those leveraging composite AI techniques.

**Description:** Composite AI refers to the combined application of different AI techniques to improve the efficiency of learning in order to broaden the level of knowledge representations and, ultimately, to solve a wider range of business problems in a more efficient manner.

### Why Trending:

Composite AI is trending up because it brings the power of AI to a broader set of use cases and users who do not have access to large amounts of historical or labeled data but possess significant human expertise. Composite AI also helps to expand the scope and quality of AI applications (that is, more types of reasoning challenges can be embedded). Other benefits, depending on the techniques applied, include better interpretability and resilience and the support of augmented intelligence. In addition to these main benefits, composite AI is gaining in popularity because it improves AI's:

- **Versatility** — It expands the knowledge, know-how and logic that AI solutions can incorporate. This is mainly achieved by combining data-driven models (e.g., ML) with symbolic models (e.g., rules or knowledge graphs).
- **Efficiency** — Composite AI can leverage existing (scientific or heuristic) knowledge as a head start, providing context to constrain search spaces and reduce the required amount of training data or the time, compute resources and energy needed for ML.
- **Adaptability** — Combining more versatility and efficiency enables AI systems that can be changed more quickly, either through retraining (in less time and with less data) of ML models or by making changes to the symbolic representations. This can be done by AI developers or domain experts, or more automatically by, for example, rule induction or graph link prediction through ML.

### Implications:



If the methods, best practices and platforms are starting to adequately address the MLOps domain (that is, the operationalization of ML models), the ModelOps domain (that is, the operationalization of multiple AI models such as optimization models, rule-based models and graph models) remains an art much more than a science. A robust ModelOps approach will be necessary to efficiently manage and govern composite AI environments, not to mention its harmonization with other disciplines such as DevOps and DataOps.

The AI engineering discipline is also starting to take shape, but only mature organizations have started to apply its benefits in operationalizing AI techniques. Security, ethical model behaviors, models autonomy and change management practices will have to be addressed across the combined AI techniques.

#### Actions:

- Identify projects in which a fully data-driven, ML-only approach is inefficient or ill-fitted. For example, this is the case when not enough data is available or when the required type of intelligence is very hard to represent in current artificial neural networks.
- Leverage domain knowledge and human expertise to provide context to, and complement, data-driven insights by applying decision management with business rules, knowledge graphs or physical models in conjunction with ML models.
- Combine the power of ML in data science, image recognition or natural language processing with graph analytics to add higher-level, symbolic, spatiotemporal and relational intelligence.
- Extend the skills of ML experts or recruit/upskill additional AI experts to also cover graph analytics, optimization or other required techniques for composite AI. In the case of rules and heuristics, skills for knowledge elicitation and knowledge engineering should also be available.

#### Further Reading:

[Innovation Insight for Composite AI](#)

[Top Strategic Technology Trends for 2022: AI Engineering](#)

[Artificial Intelligence Primer for 2022](#)

## Hype Cycle for Artificial Intelligence, 2021

### Edge AI

**SPA:** By 2025, more than 50% of all data analysis by deep neural networks will occur at the edge, up from less than 10% in 2021.

**Description:** Edge AI refers to the use of AI techniques embedded in Internet of Things (IoT) endpoints, gateways and edge servers, in applications ranging from autonomous vehicles to streaming analytics. While predominantly focused on AI inference, more sophisticated systems may include a local training capability to provide in-situ optimization of the AI models.

**Why Trending:** The intersection of AI, IoT and big data processing is giving rise to exciting technology developments and new use cases. There are several factors driving the adoption of edge AI, such as the need for real-time processing, growth in IoT endpoints, stringent privacy requirements and enterprise infrastructure and workforces becoming more distributed. Although most enterprise data is currently generated inside centralized data centers or cloud regions, this pattern will change dramatically in the future. We predict that, by 2025, 75% of data will be generated outside these centralized facilities. As demand grows to process this data at the point of creation, in order to gain real-time insights, applications and AI training and inferencing will need to move closer to edge environments near IoT endpoints. We forecast that there will be 11.7 billion IoT devices by the end of 2025 and their capabilities will expand as compute, security and bandwidth technology evolves (particularly with more pervasive adoption of 5G), creating a rich foundation for edge analytics capabilities to be widely available. The continued investments in next-generation compute for the edge (GPUs, FPGA, ASIC), 5G, TinyML (neural networks native to low-power microcontrollers) and federated machine learning (FedML) bode well for the future of edge AI.

**Implications:** Edge AI offers the potential to deliver differentiated use cases for digital business. A common use case is to improve asset management and operational intelligence in areas such as healthcare diagnostic centers, construction, mining, utilities and other businesses with high-value assets. These areas can use edge AI to manage and improve their business operations and processes. Visual inspection, often leveraging edge computer vision by applying AI on video streams or images, is another emerging use case in manufacturing, energy and retail. The true power of edge AI in the long run is to move AI closer to the data sources for real-time training and inference in a highly distributed model without violating privacy needs of the endpoints and/or physical locations.

## Actions:

- Assess potential use cases for edge AI and measure them against measurable business value metrics such as cost savings, top-line growth, customer satisfaction scores and improved physical safety or security.
- Audit your edge and IoT environments, and task your core team to identify gaps and risks and mitigate them before rolling out edge AI use cases.
- Deploy use-case-specific packaged edge AI solutions to avoid implementation complexity in order to achieve faster ROI.
- Track emerging developments in AI to ensure continuous improvement and progress of your edge AI strategy. Provide frequent feedback to your suppliers to ensure they meet your evolving needs.

## Further Reading:

[Infographic: The Intelligent Edge Tops Emerging Technology Investments – Adopter Survey Findings](#)

[Hype Cycle for Edge Computing, 2021](#)

## Responsible AI

### SPAs:

By 2025, 80% of personnel hired for AI development and training work will have to demonstrate expertise in responsible development of AI.

By 2025, 70% of organizations will require a professional code of conduct incorporating ethical use of data and AI.

**Description:** Responsible artificial intelligence is an umbrella term for aspects of making appropriate business and ethical choices when adopting AI, which organizations often address independently. These include business and societal value, risk, trust, transparency, fairness, bias mitigation, explainability, accountability, safety, privacy and regulatory compliance. Responsible AI encompasses organizational responsibilities and practices that ensure positive, accountable AI development and exploitation.

**Why Trending:** There are several drivers for responsible AI practices within the enterprise, with the primary drivers being:

- **Regulatory oversight** — There is already a growing set of responsible AI guidelines issued by governments, regulatory authorities, academic institutions and industry bodies. Examples include the efforts by the European Commission to evaluate how data managed by AI tools is accessible, securely hosted and controlled and, of course, properly utilized to avoid unfair competition. AlgorithmWatch has cataloged over 80 such guidelines in its global inventory of AI ethics guidelines. Roadmap and policy guidelines for responsible AI were recently published by Business Roundtable, an association of CEOs from America's leading companies.
- **Consumer trust** — The risk of using AI without attention to ethics and responsibility will put the company in jeopardy, garnering it customer wrath in areas such as brand equity, client retention rates, Net Promoter Score and overall business trust.
- **Sustainability goals** — AI can be a "double-edged sword" in the quest for sustainable practices. On one hand, IT leaders will be keen to rein in their power consumption, given that AI is a compute- and data-intensive workload. On the other hand, applying AI to assess and reduce the impact of climate change offers immense potential.

Several techniques are becoming available to technology leaders in enabling responsible AI practices:

- **Synthetic data** — Enables enterprises to train algorithms on an artificially generated dataset, which preserves anonymity and can be balanced to contain the desired diversity of class distribution.
- **Differential privacy** — Enables researchers and data scientists to extract useful insights from datasets containing personal information, but offers stronger privacy protections. This is achieved by introducing "statistical noise." The noise is significant enough to protect the privacy of any individual, but small enough that it will not impact the accuracy of the answers.
- **FedML** — Enables local learning by training and retraining ML models in a decentralized runtime environment, without the need to share local data centrally or in a common runtime environment. This is particularly helpful in enabling AI use cases in smartphones, IoT devices or autonomous vehicles.

- **Explanations and counterfactuals** — A variety of toolkits are available to demystify the “black box” effect of AI models, with LIME and SHAP being the most prominent. Counterfactual explanations analyze the model and the data to find the easiest path to a different, more desirable outcome.

**Implications:** Responsible AI practices go beyond compliance and regulation. Creating and adhering to a responsible AI framework will necessitate a fine line that delineates between right and wrong and ensures compliance with applicable laws and ethical principles. It reinforces the belief that AI should always be human-centered and used as a tool to help humans and society reach higher goals, and must be supervised by humans to prevent unfairness and uncontrolled bias. Rolling out AI services to production without responsible AI practices can result in significant negative impact on brand reputation, erosion of customer trust, and financial and legal penalties from regulators.

#### **Actions:**

- Work with stakeholders within the organization, particularly chief analytics and legal officers, to establish your core principles and values for responsible AI.
- Set up training programs to educate the stakeholders and employees on the importance of responsible AI practices, and to appreciate the necessity of a trade-off between explainability and accuracy.
- Put the corporate values into action with guidelines that help employees identify the best steps to take when developing an AI service.
- Explore utilizing technologies such as synthetic data, FedML, differential privacy and explainability modules to adhere to your defined responsible AI practices.

#### **Further Reading:**

[Innovation Insight for Bias Detection/Mitigation, Explainable AI and Interpretable AI](#)

[What Non-Technology Executives Should Do in Support of Responsible AI Initiatives](#)

[Expert Insight Video: What Is Responsible AI and Why You Should Care About It?](#)

[Case Study: Make AI Models Credible, Not Explainable \(Unity Health Toronto\)](#)

## Generative AI

**SPA:** By 2025, use of synthetic data created with generative AI will halve the volume of real data needed for training and testing machine learning models.

**Description:** Generative AI refers to AI techniques that learn a representation of artifacts from the data and use it to generate brand-new, completely original artifacts that preserve a likeness to original data. Generative AI can produce totally novel media content (including text, image, video and audio), synthetic data and models of physical objects.

**Why Trending:** Generative AI has only been recently introduced and there is a tremendous focus on the technology from the research community, with new use cases popping up frequently. The majority of efforts to date have been on generating media content such as photorealistic images of people and things. Generative AI also can be used for code generation, creating synthetic data and designing pharmaceuticals and materials with specific properties.

A number of AI techniques are used in generative AI, but the most notable are generative adversarial networks (GANs), variational autoencoders (VAEs), transformers (large language models) and reinforcement learning. For more information on these AI techniques, see [Innovation Insight for Generative AI](#).

**Implications:** There are many challenges that generative AI can address, including:

- Accelerating the drug discovery process or materials design process, shaving years off traditional methods. (See Alphabet's attempt to reimagine the drug discovery process from first principles with an AI-first approach — [Introducing Isomorphic Labs](#).)
- Generating synthetic data that, in turn, can be used to protect privacy, augment real data and control bias in AI training data.
- Generating computer code, reducing the development burden for software engineers (see OpenAI's new AI model that can translate natural language to code — [OpenAI Codex](#)).
- Optimizing component placement in semiconductor chip design (floorplanning), reducing the time from weeks with human experts to hours with generative AI.

- Revoicing (dubbing) films in different languages using the actor's original voice or doing automated text captions, significantly reducing the time and cost of localization — just one of many use cases in the media/marketing industries (see [Netflix Builds Proof-of-Concept AI Model to Simplify Subtitles for Translation.](#))

No technology is inherently good or bad. However, when used with malicious intent, generative AI can bring great harm. Deepfakes are the result of generative AI when used for content creation with malicious intent.

#### Actions:

- Determine the business impact of generative AI to your industry and organization by understanding the potential use cases.
- Work with various stakeholders to evaluate generative AI use cases for business opportunities and business model threats, and to assess the technology feasibility, organizational readiness and external factors for adoption.
- Upskill data scientists in generative AI techniques and/or collaborate with top/nearby academic institutions and startups.
- Work with security and risk management leaders to proactively mitigate the risks of deepfakes and support legislation to regulate the malicious use of generative AI technology.

#### Further Reading:

[Top Strategic Technology Trends for 2022: Generative AI](#)

[Innovation Insight for Generative AI](#)

[Client Question Video: What Do I Need to Know About Generative AI?](#)

[Predicts 2022: Generative AI Is Poised to Revolutionize Digital Product Development](#)

[A CTO's Guide to Top Artificial Intelligence Engineering Practices](#)

## Evidence

The analysts conducted detailed interviews with prominent vendors with deep AI research investments, such as Alibaba, Amazon, Baidu, Google, IBM, Intel, Microsoft, Nvidia and Tencent. In addition, briefings were conducted with several startups that offer open-source and commercial products that align with these trends.

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## Recommended by the Authors

Some documents may not be available as part of your current Gartner subscription.

[Tool: AI Strategy Document](#)

[Applying AI in Industries](#)

[Applying AI in Business Domains](#)

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<b>Outcomes</b>	Scarcity of data scientists should no longer hinder the adoption of AI in the organization.	Leverage composite AI techniques to lower AI TCO and expand AI use cases.	Process high-velocity data on the edge with deep neural networks to enable real-time analytics.	Mandate a professional code of conduct across the organization, incorporating ethical use of data and AI.	Reduce costs of AI projects and accelerate time to value. In the long term, improve new product innovation and R&D economics.

Note: AI = artificial intelligence; TCO = total cost of ownership

Source: Gartner (April 2022)