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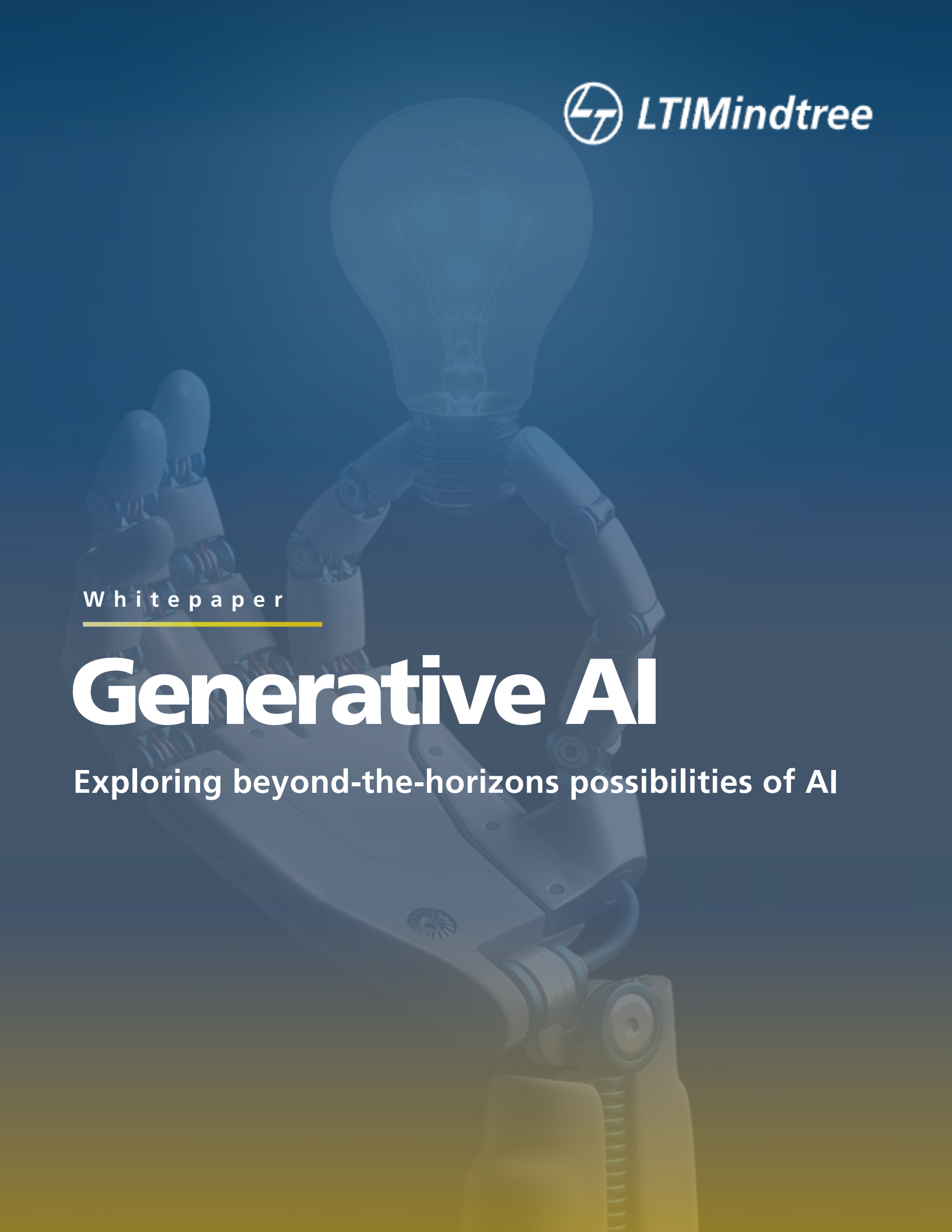

Whitepaper

Generative AI

Exploring beyond-the-horizons possibilities of AI

LTIMindtree

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01 Executive summary

Generative Artificial Intelligence (Generative AI) is a game-changing technology that can create novel and realistic content based on data and human input, such as text, images, audio, and video. This POV provides an in-depth analysis of Generative AI and its ability to disrupt and innovate various industry sectors.

We start by demystifying Generative AI and its technical capabilities, highlighting the challenges and responsibilities of its deployment, and emphasizing the need for responsible AI development. We then examine how Generative AI can deliver value for organizations by enhancing efficiency, enabling personalization, and fostering creativity. We also present industry use cases and a high-level roadmap for organizations looking to integrate Generative AI into their organization, ensuring a smooth and successful implementation.

Generative AI is not a distant vision; it is a current reality that organizations must adopt to stay competitive and relevant. This POV empowers business leaders with the knowledge and insights needed to leverage the full potential of Generative AI while stressing the ethical responsibilities that come with its deployment.

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02 Introduction

Generative Artificial Intelligence (AI) made headlines when OpenAI unveiled its GPT model in November 2022. ChatGPT became the most rapidly expanding consumer application ever, with 100 million monthly active users in January 2023. Its ability to mimic human dialogues and decision-making skills left the world perplexed. It exhibited creativity like never seen before.

Generative AI as a concept is relatively old. Surprisingly, it was first conceived in the 1950s when scientists were experimenting with developing machines that could mimic human intelligence. Primitive generative models followed a predefined set of rules and generated simple outputs. The Eliza chatbot created by Joseph Weizenbaum in the 1960s was one of the earliest examples of generative AI. These early implementations used a rule-based approach that broke easily due to limited vocabulary, lack of context, and over-reliance on patterns, among other shortcomings.

The 21st-century Generative AI is an outcome of continuous algorithm advancement in the last 30 years. Today, generative models focus on creating new content, like images, videos, audio, or text, that imitate the style and features of actual data. It leverages techniques such as deep learning, natural language processing, computer vision, statistics, and probability to predict probabilities, model the underlying probability distributions of input data, and discover underlying patterns from input data to generate new content that adheres to these distributions.

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03 Barriers to adoption and implementation

AI has become an integral part of modern enterprise business strategies. However, organizations are facing unique challenges and risks with the emergence of generative AI.

Challenges

1. **Data scarcity** including large, high-quality training datasets
2. **Mode collapse** when a generative AI system only generates a limited number of outputs rather than a diverse range of outcomes, leading to repetitive or low-quality output
3. **Control and interpretability** in sensitive or regulated industries, such as healthcare or finance, since GenAI algorithms only create different combinations of trained data rather than entirely new images or texts
4. **Computational infrastructure and investment** in building a large corpus of training data, model training, execution infrastructure, a team of researchers and engineers, and large-scale testing

As with any emerging technology, generative AI is relatively immature. A lot of experimenting is required to find the best use cases, sifting through an ever-increasing and confusing list of available options and ways to integrate them into existing business processes.

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Risks

1. **Bias and fairness** are leading to socio-economic harm. For example, the generated content may be biased if the training data is biased.
2. **Adversarial attacks** where an attacker tries to trick the system into generating incorrect or malicious outputs.
3. **Malicious and fraudulent usage**, like scamming people through deep fakes for fun and malicious activities.
4. **Data privacy** due to the risk in training publicly available Large Language Models with proprietary data and sharing individual-level personally identifiable information.
5. **Copyright infringement** since the text produced may contain elements identical to existing works.
6. **Output quality** of current generative AI models, which may give incorrect but convincing responses.
7. **Lack of auditability** due to LLMs' growing complexity and evolution make explaining how these models work internally and reach their decisions challenging.

To avoid these risks, enterprises must carefully choose the right application areas and then build governance and oversight to mitigate the risks associated with AI. Companies need to pay attention to setting and managing corporate guidelines.

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04 Technical capabilities of generative AI

The following table maps these capabilities with different generative AI models as per their effectiveness and ease of use.

CAPABILITIES

MODELS

Industry	Text	Image	Audio	Video	Code	Synthetic Data
Generative Adversarial Network	■	■	■	■		
Variational Autoencoders	■	■	■			
Transformer	■	■			■	■
Autoregressive Convolutional Neural Network	■		■			
Large Language Models	■	■			■	■
Regressive Neural Network	■	■	■			

■ Technical capabilities present

Table 1: Technical capabilities of Generative AI

With the rising popularity of generative models such as GPT, there is a growing market for open-source generative AI tools. The demand is attributed to the emerging community of dedicated developers and the need for efficient and responsive AI solutions. These tools include speech recognition, natural language processing, and machine learning. The goal is to make generative AI models smarter using self-learning algorithms that can solve various problems. Hence, we have categorized multiple tools available today based on technical capabilities to provide a better understanding.

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TEXT

Sr. No.	Type of Tool	Description	Example of Tools
1.	**Writing assistance tools**	Generate text automatically based on your input	Rytr, Copy AI, Jasper, Peppertype, Grammarly, Textio, etc.
2.	**Language translation tools**	Translate text and speech between multiple languages	Google Translate, DeepL, Microsoft Translator, Amazon Translate, IBM Watson Language Translator, Yandex. Translate, Papago, Promethean AI, Lilt, Matecat, SDL Trados Studio, etc.
3.	**Search tools**	Answer questions directly instead of showing links, allowing users to have a human-like conversation.	Twelve Labs, Algolia, Hebbia, You.com, Perplexity, etc.
4.	**Chatbot frameworks/platforms**	Enable businesses to create and deploy chatbots and virtual assistants	Ada Support, Rasa, Forethought, Botpress, ManyChat, Tars, Dialogflow, IBM Watson Assistant, Microsoft Bot Framework, etc.
5.	**Contact center tools/platforms**	Enhance customer engagement, automate interactions, and provide personalized support.	BirchAI, Uniphore, Cresta, Observe.ai, Ada Support, Amelia, Cognigy, DigitalGenius, Genesys, Intercom, LivePerson, etc.
6.	**Sales Intelligence**	Provide sales teams visibility and insights into their pipeline, forecast, and deal progress.	Gong, InsideSales, Clari, People.AI, Chorus.ai, Aircover, etc.
7.	**Product insight**	Analyzing data and generating predictions or recommendations gives businesses valuable insights into products and customers.	Monterey.ai, Viable, Enterpret, Cohere, Anecdote, etc.
8.	**Content moderation**	Generate synthetic examples of harmful content to train models and automatically generate alerts when harmful content is detected.	BirchAI, Uniphore, Cresta, Observe.ai, Ada Support, Amelia, Cognigy, DigitalGenius, Genesys, Intercom, LivePerson, etc.

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AUDIO

Sr. No.	Type of Tool	Description	Example of Tools
1.	**Conversational voice assistants**	Enable developers to build custom voice assistants for various purposes. Uses NLP and machine learning to understand and respond to user requests in multiple languages and domains	Sightengine, GPT, Google's Perspective API, Jigsaw's Tune, Logically, etc.
2.	**Music generator**	Create custom music based on a given prompt or input data. Create background music, soundtracks, and albums.	Jukedeck, Amper Music, and AIVA

IMAGE

Sr. No.	Type of Tool	Description	Example of Tools
1.	**Conversational voice assistants**	Enable developers to build custom voice assistants for various purposes. Uses NLP and machine learning to understand and respond to user requests in multiple languages and domains	Sightengine, GPT, Google's Perspective API, Jigsaw's Tune, Logically, etc.
2.	**Music generator**	Create custom music based on a given prompt or input data. Create background music, soundtracks, and albums.	Jukedeck, Amper Music, and AIVA

VIDEO

Sr. No.	Type of Tool	Description	Example of Tools
1.	**Video generator**	Create custom video content based on a given prompt or input data set. Different tasks like creating explainer videos, promotional videos, and even full-length movies use these tools.	Synthesia, Runway, MyHeritage, Studio.d-id, LeiaPix, etc.

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CODE

Sr. No.	Type of Tool	Description	Example of Tools
1.	**Code generation**	Generate code using techniques like neural networks and testing and optimizing it before deployment.	ChatGPT, Deepmind Alphacode, OpenAI Codex, CodeT5, etc.
2.	**Code completion**	Suggest code completions as developers type, saving time and reducing errors, especially for repetitive or tedious tasks.	BARD, GitHub Co-pilot, Tabnine, etc.
3.	**Code review and quality check**	Perform quality checks on the existing code and optimize it by suggesting improvements or generating alternative implementations that are more efficient or easier to read.	Codiga, Cogram, etc.

SYNTHETIC DATA

Sr. No.	Type of Tool	Description	Example of Tools
1.	**Synthetic data generation**	Can produce data that is statistically and structurally identical to the initial training data after training. However, all the data points are synthetic. Synthetic data subjects look real but are AI-generated and completely artificial.	Synthesis AI, Infinity AI

Organizations are collaborating with Open AI and leveraging its LLM models and libraries to build their own generative AI applications. They are using its services to replace rule-based approaches that require extensive programming. Many start-ups have evolved in this space, offering new functionality by leveraging generative AI capabilities. Hyperscalers provide some leverage to off-the-shelf models.

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05 Industry use case

Healthcare and Life Science

Medical image generation can train healthcare professionals, simulate medical procedures, and help diagnose rare diseases. Generative AI can also create 3D images of anatomy for education.

Electronic health record enable automated extraction of information from patient records and generating new forms with relevant information.

Drug discovery can be aided by identifying and designing new molecules, virtual screening, and drug optimization. This can accelerate the discovery process, reduce costs, and improve new drugs' efficacy and safety profiles.

Retail and Consumer

Personalized conversational retail experience can be provided with personalized recommendations and support through chatbots, voice assistants, and personalized promotions. Analyzing customer data can increase customer loyalty and sales for retailers.

Customized product designs and recommendations: make for a personalized shopping experience and increase customer loyalty and sales for fashion and home decor retailers.

Product details and photography generation 3D visualizations, and augmented reality can improve customer experience and sales for retailers.

Banking and Financial Services

Fraud simulation, pattern detection and detecting anomalies help identify fraudulent activities that traditional methods may miss. It can also simulate potential fraud scenarios to test and improve detection systems. This allows training on large data sets without exposing sensitive

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customer information and enables quick adaptation to emerging fraud patterns.

Tax and compliance audit and scenario testing help identify potential compliance issues without violating laws or exposing sensitive information. Generative AI can create a range of scenarios, from simple to complex, to test the effectiveness of tax and compliance policies. It can also identify potential weaknesses by analyzing enormous volumes of data.

Financial reporting analysis and insight generation: help financial analysts and executives identify trends and patterns, generate automated financial reports, and mitigate financial risks. Its use in financial reporting can save time, reduce errors, and improve financial performance.

Media and Entertainment

Fictional content, script/score, and subtitle generation analyzing storylines, characters, and plots can assist writers in coming up with new ideas and inspirations. It can tailor and translate stories per reader preferences, language, and interests. It can also generate novel music notes by analyzing multiple artists for inspiration. Generative AI can create subtitles for video content in various languages with high accuracy.

Personalized news curation is possible by analyzing user data, including interests, viewing history, and inputs. It can suggest more relevant, engaging content and a personalized experience through recommendation engines and virtual assistants.

Trailer and short video generation can be done for movies and TV shows without losing the essence and giving away the story. It can also identify content from videos for promotional materials and adjust it to different target audiences.

Original games creation is possible by analyzing user preferences, behaviors, and game mechanics. It can generate personalized games that provide unique experiences for individual players. It can also assist in game asset creation, such as generating 3D models, textures, and sound effects. It can reduce the time and resources required for game development while enhancing the quality and diversity of the game content. Additionally, generative AI can adapt games to different platforms, optimizing the game's performance and user experience

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Manufacturing, Energy and Utilities

Predictive maintenance and defect identification can be done by identifying patterns in the data collected from sensors and other sources. Generative AI can also detect product defects and anomalies by analyzing images and other data.

Generative design and simulation help envision a finished product's appearance and highlight its weaker sections. Generative AI can create custom 3D models based on multiple input parameters and customer requirements. In real-time, it can optimize product design, change the manufacturing material, improve feature placement, and generate lighting and texture.

Geological assessment for oil exploration can be done by generating models of subsurface rock formations and identifying potential oil reserves. It can optimize drilling plans, assess risks, and generate 3D models of subsurface environments.

Government and Public Sector

Rapid research can be facilitated by analyzing a large corpus of government data and providing new insights in infographics, images, videos, or written text. These insights can be leveraged in government research, simulating population census, generating forecasting models, and statistical reports.

Fraud, waste, and abuse prevention reports can help detect anomalies and outliers in data, patterns of fraudulent behavior, and identify fake or fraudulent documents. This is possible by conducting a multi-variable analysis over datasets about law enforcement, benefits offices, the land registry, personal credit, etc.

Virtual disaster simulation: can help public and government sectors prepare for and respond to emergencies. The technology simulates the impact of different response strategies, assisting decision-makers in determining the best course of action in a crisis.

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The mapping of industry use cases to the technical capabilities of generative AI are shown below. It is a mix of use cases already implemented and made possible because of generative capabilities.

Industry	Use Cases	Texts	Image	Audio	Video	3DModel	Code	Others
Healthcare & Life Sciences	Medical Image Generation		■					
	Electronic Health Records	■	■	■	■			
	Drug Discovery	■						■
Retail & Consumer	Personalized Conversational Retail Experience	■	■					
	Customized Product Designs & Recommendations	■	■			■		
	Product Details and Photography Generation	■	■					
BFS	Fraud Simulation & Pattern Detection	■					■	
	Tax And Compliance Audit & Scenario Testing	■					■	
	Financial Reporting Analysis & Insight Gen.	■						■
Media & Entertainment	Fictional Content, Script/Score, and Subtitle Generation	■		■				
	Personalized News Curation	■	■		■			
	Trailer & Short Video Generation	■	■	■	■			
	Original Games Creation	■	■	■	■	■	■	
Manufacturing, Energy & Utilities	Predictive Maintenance and Defect Identification	■	■	■	■		■	
	Generative Design and Simulation		■			■	■	
	Geological Assessment for Oil Exploration	■	■			■		■
Governmnet	Rapid Research	■	■	■	■			
	Fraud, Waste & Abuse Prevention Reports	■	■					■
	Virtual Disaster Simulation	■				■		

■ Technical capabiltities present

Table 2: Mapping of industry use cases to the technical capabilities of generative AI

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06 The value of generative AI

Currently, ChatGPT is leading the generative content generation and translation-based use cases. Gartner also says that most use cases have less than 1% adoption in their target markets, except for generative content creation. Based on the technical capabilities of generative models and implementation areas, we have summarized the value of generative AI into four categories from a business perspective.

1. Generating content, ideas, and code across a range of modalities, such as a video advertisement or even a new protein with antimicrobial properties
2. Improving efficiency by automating and accelerating manual or repetitive tasks, such as writing emails, coding, or summarizing large documents
3. Personalizing experiences tailored to a specific audience, such as chatbots for personalized customer experiences or targeted advertisements based on customer's behavioral patterns
4. Adaptable applications with the ability to adapt to changes in data and environments by retraining algorithms. For example, training of generative AI-powered intrusion detection software in a specific environment to improve detection and reduce false positives

A tech stack is required to create and deploy AI-driven software applications. It comprises generative models, services, programming languages, cloud infrastructure, and data processing tools. The right combination of these can improve operational efficiencies and strengthen results. Generative models like GPT-3.5, BARD, BERT, and GitHub Co-Pilot offer pre-built models for generating images, text, and music. Generative service providers like Azure OpenAI offer tools and APIs for building and training models.

Programming languages establish a balance between ease of use and model performance. Python is popular due to its simplicity, readability, and library support, while other languages used are R and Julia. Cloud infrastructure offers a large amount of computing power and storage capacity; and plug-and-play data processing tools handle large datasets efficiently and provide data visualization and exploration capabilities. Cloud providers like AWS, GCP, and Azure offer services

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like virtual machines, storage, and machine learning platforms that provide the scalability and flexibility needed to deploy generative AI systems.

Organizations are linking off-the-shelf generative models with their in-house applications using API programming. Open-source generative AI frameworks or libraries offered by third-party generative services help develop these models and train with proprietary data for particular use cases. These models can be highly customizable and tailored to meet specific business needs, allowing organizations to create specialized outputs that off-the-shelf models do not provide. Using open-source frameworks will enable developers to access resources and support communities to build highly customizable models that meet specific business needs. It democratizes access to generative AI technology and fosters innovation and creativity.

> *We believe the upcoming set of generative AI platforms and frameworks will be focused on leveraging deep learning models. It will be possible to develop applications capable of interactive conversation, insights generation, interpretation, and even hyperautomation in a few years. These new frameworks will be capable of handling multiple data formats and unsupervised learning models to develop generative solutions.*

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07 Conclusion

Given the risks of generative AI, evolving regulations, and government laws, enterprises have been cautious in adopting generative AI. They are currently investing in learning, developing internal capabilities, and exploring use cases. Based on this, a broad set of providers will emerge in the next three years.

1. Hyper scalers will come up with newer and mature offerings as they are heavily investing in computing infrastructure and have access to a vast database
2. The emergence of numerous inference-as-API on a pay-per-use model from leading API providers
3. End-to-end generative solutions and platforms catering to generative solution developers
4. Product vendors provide vertical-specific generative solutions, while incumbents will embed generative AI as a feature/enhancement in existing applications/products

Considering generative AI's technology and market maturity, we advise organizations to take an incremental approach to developing generative AI capability. This approach will allow teams to experiment with generative models and quickly deliver interesting use cases while improving the capabilities required to tackle complex use cases.

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