Analytics & AI/ML

2024 Market & Industry Forum—27 March 2024

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A Glimpse of the Future!

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GTC 2024 announcement: Project GR00T

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Key Takeaways

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Important learnings from the presentation

- Every product and service provided and consumed by industrial companies will have a form of embedded AI
- Human creativity, augmented with limitless ability to realize ideas (aided by AI) will lead to new products, services, and business models
  - Process and data management platforms are the key enablers
- The regulatory and legal framework lags the development curve
  - Need to be careful about use of open and proprietary data
- Investment in education (of internal staff and customers) needed
  - Focus on ethical and moral considerations at the outset

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Topics to be Discussed

- Introduction
- Generative AI
- Use Cases
- Business Opportunity
- Concluding Remarks

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Analytics & AI/ML: Historical Perspective

1940s-70s	1970s-1990s	1990s-2010s
• Turing Test: Machine's ability to exhibit intelligent/human-like behavior • Neural Networks (1940s-1960s): ANNs inspired by biological neural networks, (Warren McCulloch and Walter Pitts) • The Perceptron (Frank Rosenblatt in the late 1950s), earliest forms of a neural network capable of learning • Expert systems (1970s-1980s): Mimic the decision-making ability of human experts in specific domains	• Development of ML, NLP spread and "the backpropagation algorithm", (fruit of three decades of key discoveries) • Emergence of subfields: Computer vision, robotics, and expanding the scope of AI research and applications • Internet and big data (1990s): Vast amount of data for training and testing algorithms, leading to advancements in ML	• Statistical Methods (1990s-present): Statistical approaches, including Bayesian networks and support vector machines, gained prominence • 1997: Deep Blue, an IBM chess computer, defeated the reigning world chess champion, Garry Kasparov, in a six-game match • IBM Watson: Developed to answer questions on Jeopardy! and in 2011, won against champions Brad Rutter and Ken Jennings!

CIMdata 2019 Forum theme: "Augmented Intelligence"

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Augmented Intelligence at 2019 Forum

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2019 CIMdata PLM Market & Industry Forums

"Augmented Intelligence: Applications Across the Product Lifecycle"

- Event for PLM software and services providers; some financial attendees
- Theme should be clear from today's presentation
- Sessions in Ann Arbor MI (4 April 2019), Frankfurt (11 April), Pune (15 April), Beijing (19 April), Tokyo (24 April)

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Augmented Intelligence

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CIMdata's view on role of AI in PLM (from the 2019 PMIF)

- ***Augmented Intelligence*** or intelligence augmentation (IA) is not about replacing human intelligence but rather about amplifying or augmenting it by enabling humans to make use of the large volume of data we're generating by combining human and machine intelligence

Graphics from DALL-E

"Over the next decade, AI won't replace managers, but managers who use AI will replace those who don't."

Erik Brynjolfsson and Andrew McAfee, HBR (2017)

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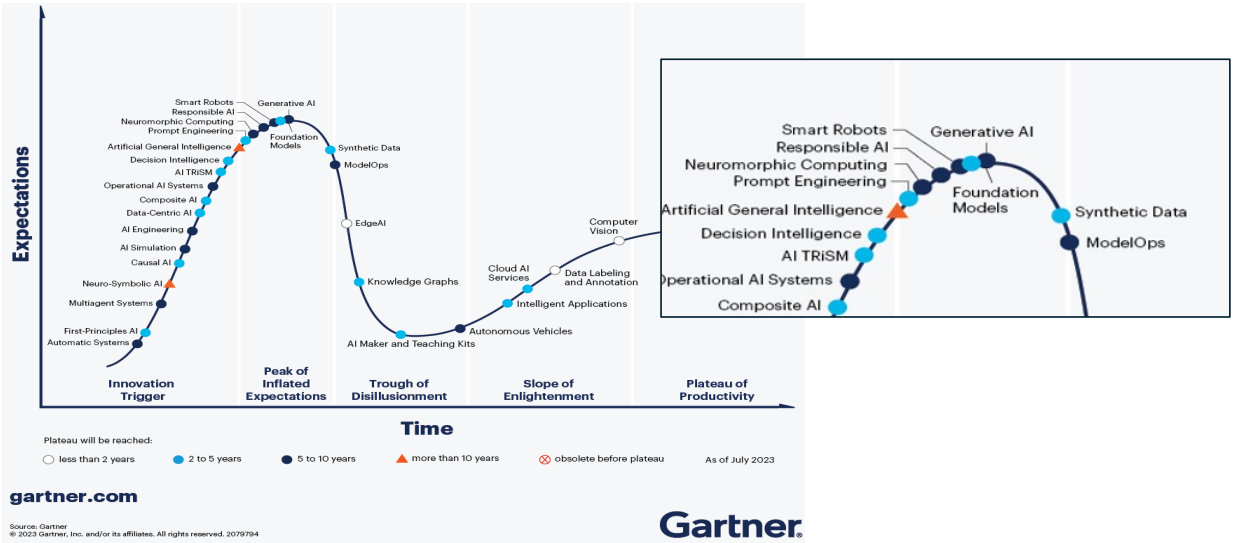
Hype Cycle for Artificial Intelligence, 2023



Source: https://www.gartner.com/en/articles/what-s-new-in-artificial-intelligence-from-the-2023-gartner-hype-cycle August 17, 2023

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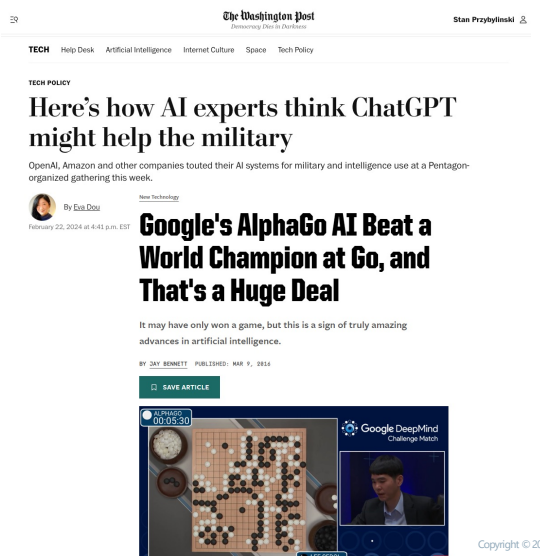
The Buzz Around Generative AI



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The Buzz Around Generative AI

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The Daily Mail

SEE PAGES 18-19

A.I. 'COULD WIPE OUT HUMANITY'

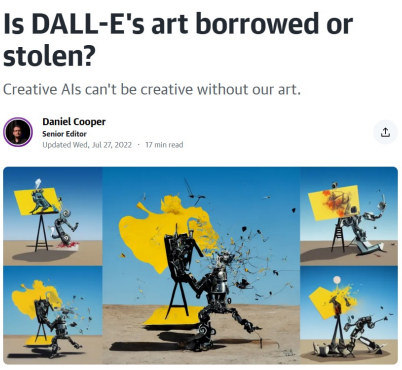
Threat 'as bad as nuclear war' MUST be tackled, say tech bosses

By Victoria Allen Science Editor

ARTIFICIAL intelligence could wipe out humanity, industry leaders warned yesterday.

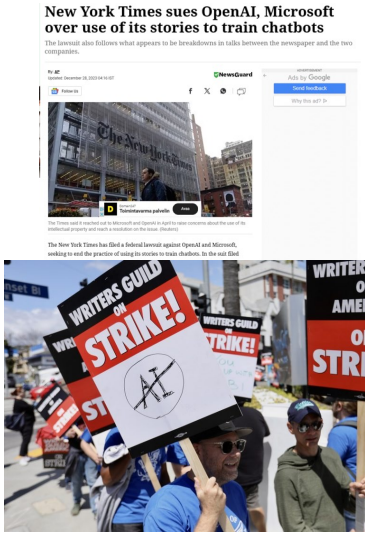
Daily Mail STANDING UP FOR FREE SPEECH

Academic at Oxford Union with 3 bodyguards ... price of


Is DALL-E's art borrowed or stolen?

Creative AIs can't be creative without our art.

Daniel Cooper
Senior Editor
Updated Wed, Jul 27, 2022 · 17 min read


New York Times sues OpenAI, Microsoft over use of its stories to train chatbots

The lawsuit also follows what appears to be breakdowns in talks between the newspaper and the two companies.

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The Buzz Around Generative AI

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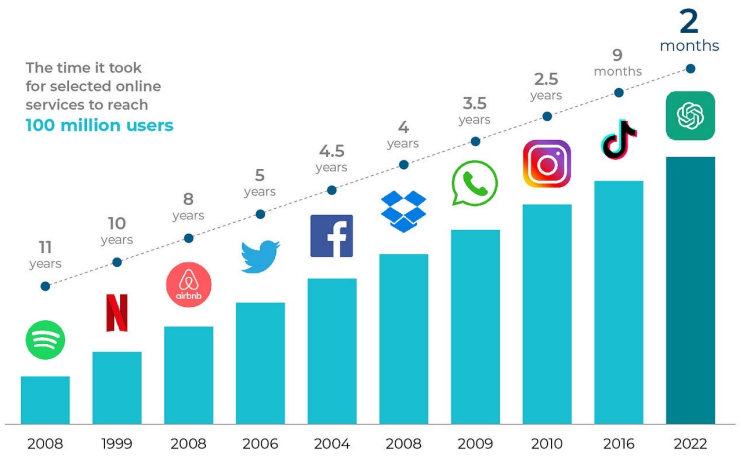
Chat-GPT sprints to 100 million users



Source: World of Statistics

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Generative AI to ChatGPT

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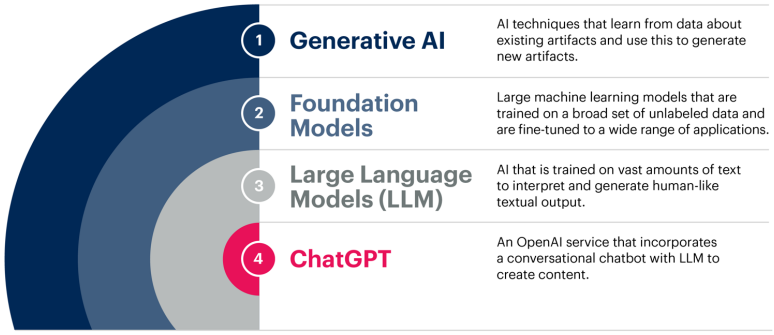
What Is Generative AI?



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Generative AI

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Images generated by DALL-E along with an AI-created definition of Generative AI

Prompt: Create an image to explain how generative AI works

Prompt: Can you explain both the images and the thought process behind it?

Answer: Actual answer was much more detailed.

"The thought process behind these images was to demystify the concept of generative AI by visually articulating its core functions: learning from data, processing that data through complex algorithms, and producing new, original content across various mediums. The aim is to make the abstract and often complex nature of AI technologies more accessible and understandable to a general audience."

Graphics from DALL-E

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Explainable AI

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Why Generative AI produces a certain response

What is explainable AI

- The practice of designing AI systems that provide understandable explanations for their decisions and actions.
- It aims to make AI models transparent and interpretable to humans.

Importance

- Building trust: Insight into their decision-making process.
- Ensuring accountability: To understand and potentially challenge the decisions.
- Detecting and mitigating bias: Factors influencing decisions.
- User understanding: Comprehend AI decisions, fostering collaboration between humans and machines.

Achieving explain-ability

- Model transparency: Easier to understand, such as using simpler algorithms or explicit rules.
- Post-hoc explanation Techniques: Analyzing model outputs to generate explanations
- Interpretable models: Building AI models that are inherently interpretable, like decision trees or linear regression models.

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Responsible AI

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Understanding the consequences of using AI

What is responsible AI?

- Responsible AI refers to the ethical and accountable development, deployment, and use of artificial intelligence (AI) systems.
- It encompasses principles, practices, and guidelines aimed at ensuring fairness, transparency, trustworthiness, and societal benefit in AI technologies.

Key aspects of responsible AI

- Ethical considerations: In AI design, development, and deployment. Accountability and governance: oversight, monitoring, and review processes.
- Privacy and data protection: Safeguarding personal data and ensuring compliance with privacy laws.
- Safety and robustness: Minimize risks and prevent harm.
- Societal impact and public engagement: Dialogue with public, policymakers, and civil society.

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AI/ML Opportunities Across The Lifecycle

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Common Uses of Artificial Intelligence (AI)

How Artificial Intelligence will transform businesses (2023)

- Some of the most standard uses of AI today are:
  - ***Machine learning***—used often in systems that capture vast amounts of data
  - ***Cybersecurity***—AI systems can recognize a cyberattack, as well as other cyberthreats, by monitoring patterns from data input
  - ***Customer relationship management***—AI is being used to self-update, auto-correct the system to stay on top of relationship management
  - ***Internet & data research***—AI is being used to identify patterns in people's search behaviors and provide them with more relevant information
  - ***Digital personal assistants***—AI bots can be used as personal assistants to help manage your emails, maintain your calendar, and even provide recommendations for streamlining processes

18 Source: https://www.businessnewsdaily.com/9402-artificial-intelligence-business-trends.html

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AI in MBSE

Use cases in aircraft design: Presented by AIRBUS expert in INCOSE community webinar (1 of 2)

Opportunity: ChatGPT & SysML v2

What is ChatGPT ?

Conversational Generative Pre-training Transformer : is a state-of-the-art language generation model developed by OpenAI.

Key features: "Uses unsupervised learning, pre-trained on a massive dataset of conversational data, capable of generating human-like responses to a wide range of prompts."

https://openai.com/blog/chatgpt/

Smooth Integration For Exploration

SysML

What is SysML v2 ?

System Modeling Language

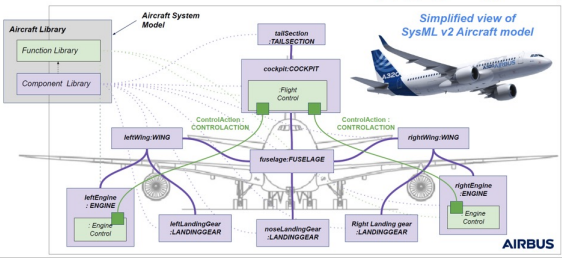
New version to improve the precision, expressiveness and usability of SysML v1

Innovation : Textual Language, Usage-focused modeling approach, Variability, View Points & View, API , Clear semantics for Model Execution….

https://www.omgsysml.org/SysML-2.htm

AIRBUS

Use-case : Aircraft Systems Architecture Definition



AIRBUS

19 Source: Exploration of AI in MBSE - Use cases in aircraft design: INCOSE webinar by Fabien Buffaron, AIRBUS MBSE Expert June 15, 2023

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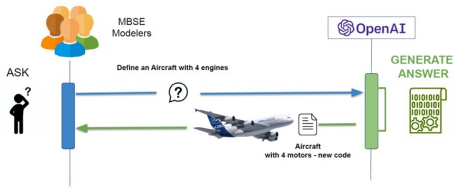
AI in MBSE

Use cases in aircraft design: Presented by AIRBUS expert in INCOSE community webinar (2 of 2)

Use Case : Aircraft architecture definition from a template



AIRBUS

Perspective : AI-based assistants in MBSE

Overview of existing and possible application areas for AI-based assistants in MBSE

(list defined by the Fraunhofer Institute for Mechatronic Systems Design)

https://www.sellve.de/ai-in-mbse/

ID	TITLE	ID	TITLE
[1]	Structure textual requirements	[19]	Exploration of the design space
[2]	Knowledge-based validation of system designs	[20]	Evaluation of requirements
[3]	Ensure requirements quality	[21]	AI assistant for engineers
[4]	Visualize related elements for requirements	[22]	Technology summarizer
[5]	Intelligent comparison of requirements documents	[23]	Automated fault analysis
[6]	Create data model automatically	[24]	Patent analysis of the specification model
[7]	Prioritize and weight requirements	[25]	Design-for-X evaluation
[8]	Reuse model requirements	[26]	Proposal for test procedures
[9]	Reuse textual requirements	[27]	Digitization assistance
[10]	Generate test scenarios	[28]	Defect detection
[11]	Create benchmark / decision basis for system design	[29]	AI-supported product innovation
[12]	Impact analyses on change requests	[30]	Consistent syntax
[13]	Identify design updates	[33]	Optimization of system architectures
[14]	Propose design updates	[34]	Test design based on data from predecessors
[15]	Identify user groups and preferences	[35]	Requirements generation
[16]	Check consistency of MBSE system architectures	[36]	Smart system design
[17]	Structure model requirements	[37]	Traceability analysis based on documents
[18]	Trace unrelated requirements through the development process		

AIRBUS

20 Source: Exploration of AI in MBSE - Use cases in aircraft design: INCOSE webinar by Fabien Buffaron, AIRBUS MBSE Expert June 15, 2023

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AI Using Historical CAE Data

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Airbag share prediction based on past CAE data

ML based Shape Prediction for Automobile Airbag

Key Highlights

- ML based prediction 3D shape on inflation
- App for application engineers for comparing various designs quickly without using CAE resources
- 8 hours saved per design in computational and manual efforts
- Overall 15% reduction in design cycle time

Objective

- Reduce the CAE licensing and computational costs
- Reduce the overall airbag design cycle
- Establish unified design process accepted by application engineers across different geographies

Solution

- Designed the image based input format for the flat airbag
- 250+ FEM datasets analyzed & ML based volume prediction
- Data based 2D shape prediction with image based geometrical shape correction using corners treatment
- ML based chamber wise maximum displacement prediction
- Physics guided prediction of chamber wise maximum displacement location
- 3D point cloud generation using normalization techniques
- Additional post prediction data correction & smoothening for better accuracy

21 Source: Intelimek Systems Case Study for a confidential airbag supplier

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AI in Pharmaceutical Trials

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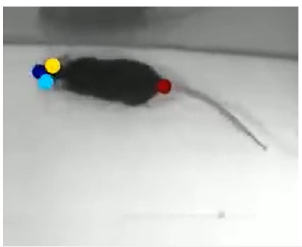
Animal testing of new drugs with computer vision

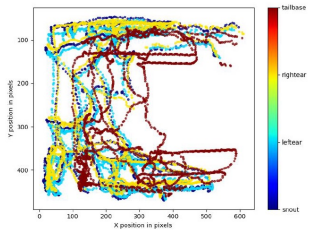
Computer Vision Applications in Pharma

Laboratory rat tracking and analysis

Top view camera captures the rat behavior 24 * 7. The analytics engine detects the ears, mouth and tail positions. This data can be further used for extracting information about the behavior



Detection of ears, mouth and tail from camera feed



The movement is tracked

22 Source: Intelimek Systems Case Study for a confidential pharma customer

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Simulation & AI/ML Adoption Trends

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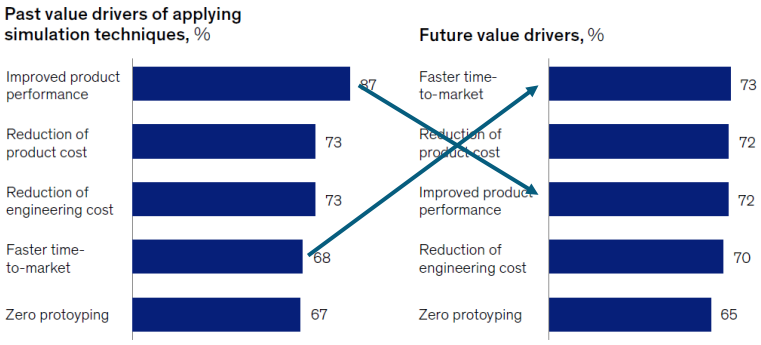
NAFEMS and McKinsey "Future of simulation" survey (Apr 2023) (1 of 4)

The business case for simulation is shifting, with faster time-to-market and reduced product cost as key future value drivers.



23 Unveiling the next frontier of engineering simulation: Digital engineering in an AI world. Collaborative effort by McKinsey and NAFEMS. Its authors include Alessandro Faure Ragani, Paul Stein, Roger Keene, and Ian Symington.

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Simulation & AI/ML Adoption Trends

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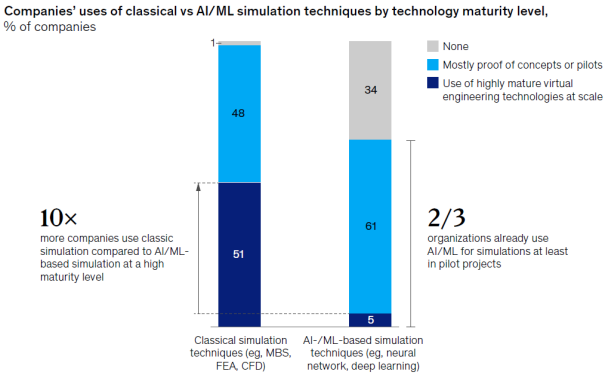
NAFEMS and McKinsey "Future of simulation" survey (Apr 2023) (2 of 4)

Classic simulation use is significantly ahead of AI- and ML-based simulation use.



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Simulation & AI/ML Adoption Trends

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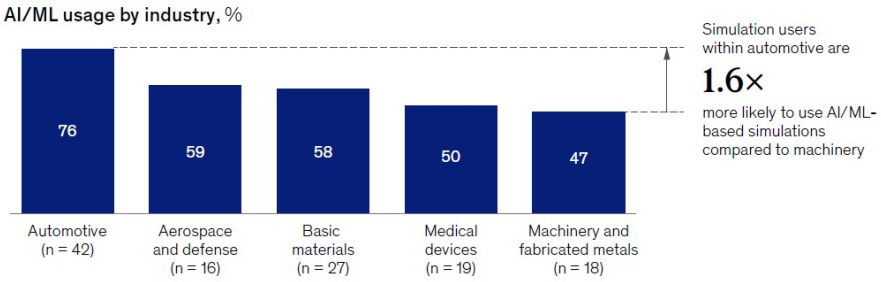
NAFEMS and McKinsey "Future of simulation" survey (Apr 2023) (3 of 4)

Automotive pulls away as the leading industry to put AI and ML to use.



25 Unveiling the next frontier of engineering simulation: Digital engineering in an AI world. Collaborative effort by McKinsey and NAFEMS. Its authors include Alessandro Faure Ragani, Paul Stein, Roger Keene, and Ian Symington.

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Simulation & AI/ML Adoption Trends

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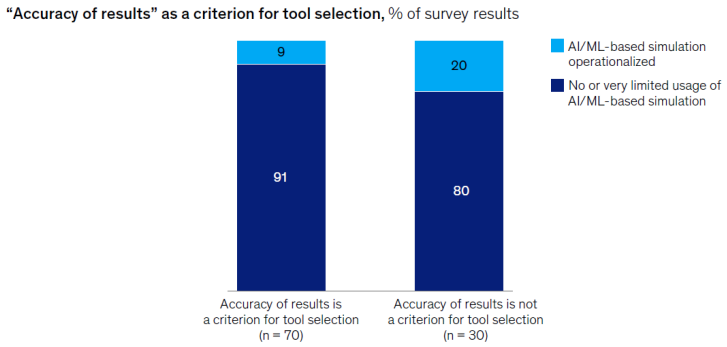
NAFEMS and McKinsey "Future of simulation" survey (Apr 2023) (4 of 4)

Confidence in the capabilities of AI and ML is driving adoption.



26 Unveiling the next frontier of engineering simulation: Digital engineering in an AI world. Collaborative effort by McKinsey and NAFEMS. Its authors include Alessandro Faure Ragani, Paul Stein, Roger Keene, and Ian Symington.

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Generative AI in Product Development

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Design R&D, creativity and productivity

Generative AI ushers in a new era of creativity and productivity across the product design life cycle.

Market and user research
Can reveal untapped market opportunities and overlooked consumer needs and expectations

Enables teams to gather, synthesize, and make sense of market and consumer data faster

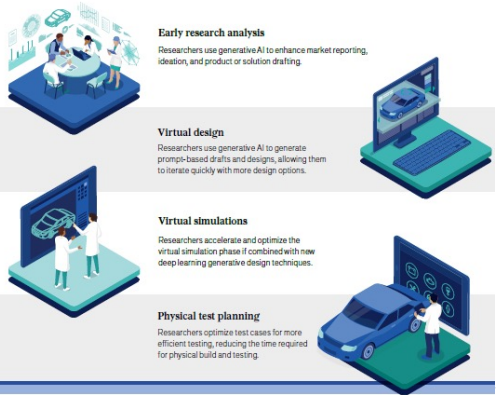
Concept development
Ability to generate novel, lifelike images sparks bolder exploration and potentially first-of-their-kind ideas

Frees industrial designers of time-consuming tasks when preparing concept images, mood boards, and storyboards

Concept refinement
Enables industrial designers to refine product style and map future concepts in hours instead of weeks

Concept testing
Brings new concepts to life for business leaders and consumers for more meaningful discussions

How product R&D could be transformed



Sources:
- The economic potential of generative AI: The next productivity, Michael Chui, et al , McKinsey and Company, June 2023 .Design but no magic wand Article March 5, 2024. Article

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Potential Impact of Generative AI

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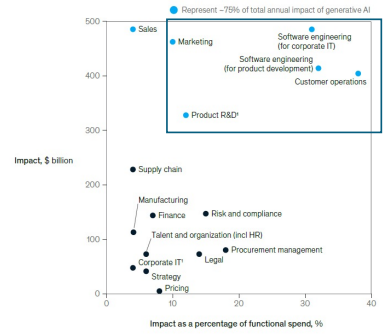
Functional and industry wise trends

Using generative AI in just a few functions could drive most of the technology's impact across potential corporate use cases.



Note: Impact is averaged.
Excluding software engineering.
Source: Comparative Industry Service (CIS), IHS Markit; Oxford Economics; McKinsey Corporate and Business Functions database; McKinsey Manufacturing and Supply Chain 360; McKinsey Sales Navigator; Ignite, a McKinsey database; McKinsey analysis

Generative AI use cases will have different impacts on business functions across industries.

Generative AI productivity impact by business functions[1]

Low impact — High impact

	Total, % of industry revenue	Total, $ billion	Marketing and sales	Customer operations	Product R&D	Software engineering	Supply chain and operations	Risk and legal	Strategy and finance	Corporate IT	Talent and organization
			760–1,200	340–470	230–420	580–1,200	290–550	180–260	120–260	40–50	60–90
Advanced electronics and semiconductors	1.3–2.3	100–170									
Advanced manufacturing[2]	1.4–2.4	170–290									
Energy	1.0–1.6	150–240									
Healthcare	1.8–3.2	150–260									
High tech	4.8–9.3	240–460									
Basic materials	0.7–1.2	120–200									
Chemical	0.8–1.3	80–140									
Construction	0.7–1.2	90–150									
Consumer packaged goods	1.4–2.3	160–270									

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The economic potential of generative AI: The next productivity, Michael Chui, et al , McKinsey and Company, June 2023 .

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Impact on business value

- Reduction in time spent in routine and mundane tasks
- Evaluation of multitude of options early in the design cycle, leading to reduction in costly mistakes
- Higher predictability of quality of products and services

Significant improvements and productivity gains in internal business operations
Enabling new products and services for customers and continuously improving overall customer experience

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Concluding Remarks

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AI & PLM: Beyond all the Hype (1 of 2)

- Analytics & AI/ML discussions are dominating boardrooms, as well as Wall Street—as PLM professionals, we know where it fits
  - Every product and service provided & consumed by industrial companies are likely to have, at some point, a form of embedded AI
  - Commercial opportunities that analytics and AI/ML will unlock will be significant—they will be transformative and not just incremental
- Human creativity will be augmented with limitless ability to realize the ideas (with the help of AI)—this will result in new products, services, and business models
  - The best AI is the AI that helps/enables the innovation engine

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Concluding Remarks

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AI & PLM: Beyond all the Hype (2 of 2)

- We need to look to our product innovation platform providers to be key enablers and implement AI technologies within their solutions
- We need to remember that regulatory & legal frameworks around these technologies will lag the development curve
- You will need to be mindful and will need to develop long-term strategies around using and sharing data—data governance is critical
- We will need to upgrade skills, educate the customers, and deal with ethical & moral considerations associated with AI

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Concluding Remarks

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Intelligence: Indian philosophical perspective

Buddhi (Intellect): Buddhi is the cognitive faculty that discerns, analyzes, and understands. Ability to differentiate between right and wrong.

Ahamkara (Ego): Sense of 'I-ness' or ego, crucial for individual identity but also responsible for attachment. Intelligence that helps in navigating the social world and asserting oneself

Manas (Mind): Seat of thought and emotions, Responsible for processing sensory inputs, desires, doubts, and inclinations. Everyday processing of the external world.

Chitta (Consciousness or Memory): Related to memory, storage of past experiences, and subconscious tendencies. Inner workings of the mind and the accumulation of knowledge over time.

Pragya (Wisdom or Practical Intelligence): Discernment, deeper understanding, and insight, associated with spiritual wisdom and the ability to see the ultimate reality or truth beyond the surface level of things

Viveka (Discriminative Intelligence): Viveka is the ability to distinguish between the eternal and the transient, the real and the unreal. It's a higher form of intelligence that guides spiritual liberation.

Medha (Retention): Medha refers to the capacity to retain and recall information, an aspect of intelligence linked to memory and learning.

Dhi (Intuitive Intelligence): Dhi represents higher reasoning and intuitive intelligence, the ability to grasp profound truths through intuition rather than analytical reasoning alone.

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Questions & Answers

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What's on your mind?

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