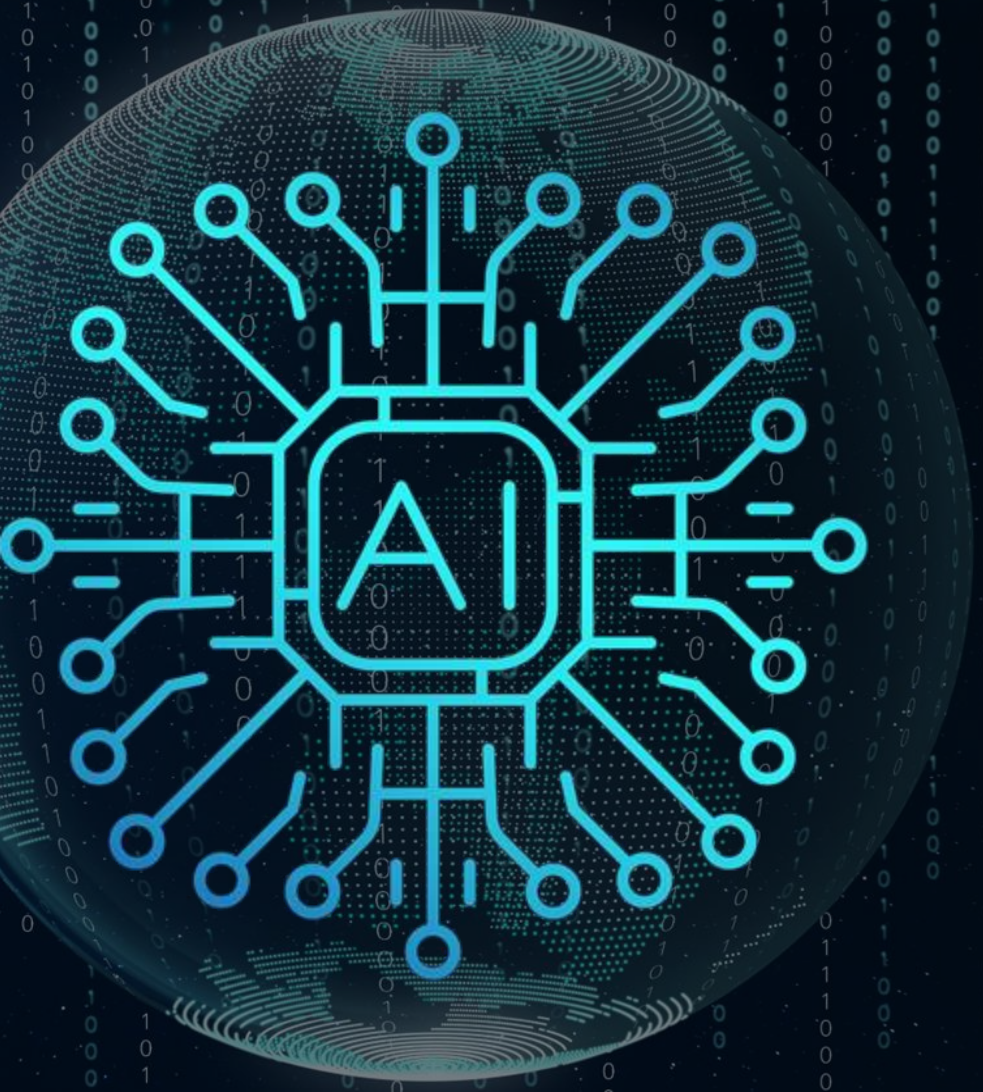


How to benefit from Generative AI in Manufacturing?

BCG BOSTON CONSULTING GROUP

Generative AI applicable in Manufacturing?!

Power
(model parameters)

Rule-based

1k

Machine Learning

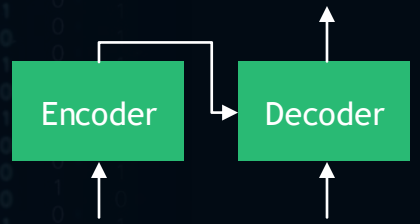
10k

Deep Learning
(via multi-layer neural networks)

10M

Generative AI
(e.g., via transformer based model)

>175B



Time

Systems follow a programmed set of rules
- Control systems
- Anomaly detection
- …

Systems automatically learn from data w/o being explicitly programmed, e.g., to predict values or identify correlations
- Learning from data
- Classification
- Prediction
- …
- Natural language processing
- Speech recognition
- Machine vision
- …

Systems use existing content to create new variations
- Text & code generation
- Image & video generation
- 3D model generation
- …

Deterministic behavior

Probabilistic behavior

How Generative AI will enhance the Manufacturing environment

Capability	Data Type	AI Technology
Creating Based on various data sources	ERP data CRM data SC data	Generative AI
Observing Processes & human actions	Pictures Videos	Deep Learning
Measuring Temp, pressure, velocity, …	Time series data	Machine Learning
Controlling PLC, NC, MC, RC, …	Rigid Control Logic	Rule-based

Potential application areas

Exemplary

1. **Product Design**
   Generation of alternative models, designs etc. in product development process
2. **Material Handling**
   Generation of synthetic data for pre-trained robots
3. **Automation Engineering**
   Generation of program code for, e.g., process automation
4. **Equipment Maintenance**
   Automated synthesis of (virtual) maintenance instructions
5. **Operator Support**
   Automated creation of text-, image- & video-based Standard Operating Procedures (SOPs)
6. **Advanced Shopfloor Automation**
   Embodied multi-modal model-based robotics for task automation (through integration of vision & language)

Six potential Generative AI application areas in Manufacturing

Exemplary

1 Product Design

Generation of alternative designs & topology optimization for products based on existing prototypes, 3D models etc.

- Material efficiency ↗
- Product performance ↗
- Production efficiency ↗

2 Material Handling

Generation of synthetic training data for automated material handling solutions using computer-vision (e.g., bin picking)

- Start-up time ↘
- Engineering costs ↘
- Production efficiency ↗

3 Automation Engineering

Automated generation of code based on natural language prompts for, e.g., process automation or data analysis tasks

- Production efficiency ↗
- Engineering costs ↘

4 Equipment Maintenance

Automated generation of (virtual) maintenance instructions based on multiple data sources & diff. data types (e.g., for remote field force)

- Equipment downtimes ↘
- Maintenance costs ↘

5 Operator Support

Enhancement of operations through automated creation/ updating of text-, image-, video-based or virtual SOPs (e.g., for product changes)

- Production efficiency ↗
- Workforce support ↗
- Engineering costs ↘

6 Advanced Shop-floor Automation

Improved shopfloor automation through autonomous robotic control via embodied multi-modal language model eliminating, e.g., human pre-processing or data annotation

- Production efficiency ↗
- Workforce support ↗
- Engineering costs ↘

Example: Application of Generative AI in Material Handling

Illustrative

Improvement of computer-vision based material handling

Example: Computer-vision based bin picking

Today:

- Mainly manual training of robots (e.g., data labeling)
- Start of operations with minimum required accuracy
- High accuracy achieved during first weeks of operation

Outlook:

- Generation of synthetic training data via Generative AI
- Entirely simulation-based training via digital twin
- High accuracy and reliability achieved upfront

Application impact

- Start-up time ↘
- Engineering costs ↘
- Production efficiency ↗