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Applications of generative AI in manufacturing

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Large Lenguage Models in manufacturing domains

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- AI Technology: Transformers based neural architectures and Large Language Models (LLMs), such as GPT-3.5 and BARD.
- Method: This technology works by training LLMs to extract knowledge and insights from manufacturing data, documents, and reports.
- Manufacturing challenge: LLMs have been trained with non-specific manufacturing corpus. They must be adapted, re-train to the manufacturing environment
- Impact: Streamlined knowledge extraction in manufacturing, enabling better decision-making.
- Tecnalia Services: Support for resolving incidents (Control Production scheduling, warehouse management, Maintenance, Operator Support...) using LLMs.

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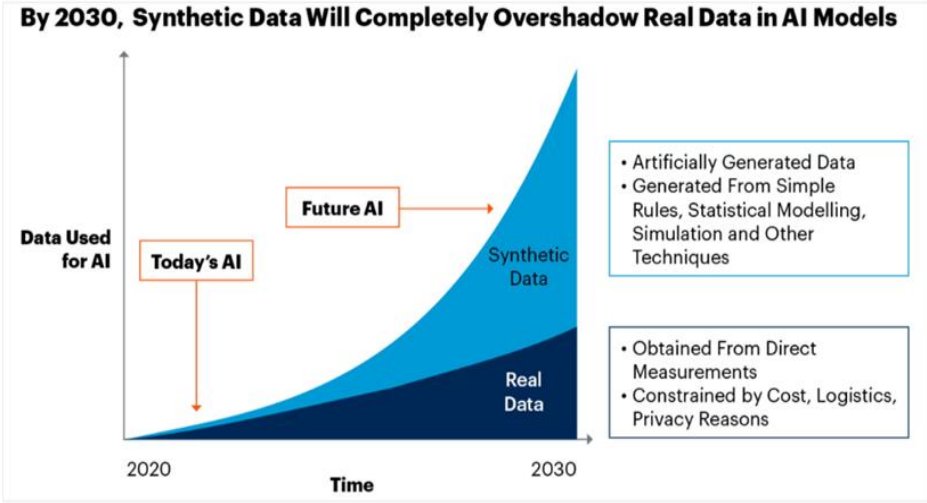
Synthetic data generation

- AI Technology: Generative Adversarial Networks or Variational Autoencoders.
- Method: This technology works by training neural networks to produce new data that is statistically similar to existing data.
- Manufacturing challenge: Adapt and improve existing methods to production data such us sensors, 3D data for quality part inspection and other process data.
- Impact: Enhanced training of machine learning models and reducing the need for massive real-world data collection.



An infographic from the Gartner report - source

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AIRISE – AI services for SMEs

Manufacturing areas

- Design and Engineering.
- Process monitoring and control
- Manufacturing Operations
- Production Chain
- Supply Chain

AI technologies are grouped into 4 areas:

- AI-1: Data Analysis. This group includes techniques that enable data analysis to enhance users' understanding of its functioning. It encompasses techniques such as data cleaning, univariate analysis, bivariate analysis, statistical inference tests, outlier identification and active learning.
- AI-2: Machine and Deep Learning. This group encompasses various algorithms used in classification and regression problems, such as neural networks, convolutional networks, random forests, SVM, among others.
- AI-3: Optimization Algorithms. This group includes algorithms used for modelling and solving single or multi-objective optimization problems. The algorithms belonging to this group include metaheuristic algorithms (such as genetic algorithms, bee colony optimization), mixed-integer linear programming, Bayesian optimization, or deep reinforcement learning.
- AI-4: Generative Models. This group includes technologies used to artificially generate data samples, such as Diffusion Models, Variational Autoencoders, and Generative Adversarial Networks.
    - Material Selection DSS.
    - Surface texture generation based on user criteria or preferences.
    - Labelled image dataset generation system.

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Running generative AI applications in Tecnalia

Areas

- Manufacturing.
- Health.
- Agriculture.
- Energy.

Some of the running initiatives with generative AI in Tecnalia are:

- Infraestructure as Code. Mastering the Future: Evaluating LLM-Generated Data Architectures leveraging IaC technologies | Oct, 2023 | Towards Data Science.
- Synthetic images generation, for example plant damage (Agriculture Deep convolutional neural network for damaged vegetation segmentation from RGB images based on virtual NIR-channel estimation – ScienceDirect), metals corrosion (Energy and Infrastructures) and Health (Autofluorescence Image Reconstruction and Virtual Staining for In-Vivo Optical Biopsying - IEEE).
- Incidents in maintenance and operator support.

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Thank you



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