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# WHAT IF YOUR DIGITAL TWIN IS SMARTER THAN YOURSELF? - HOW AI CAN ENHANCE THE IMPACT OF VIRTUAL TWINS FOR YOUR PRODUCTS

# OUTSMARTED BY YOUR DIGITAL TWIN

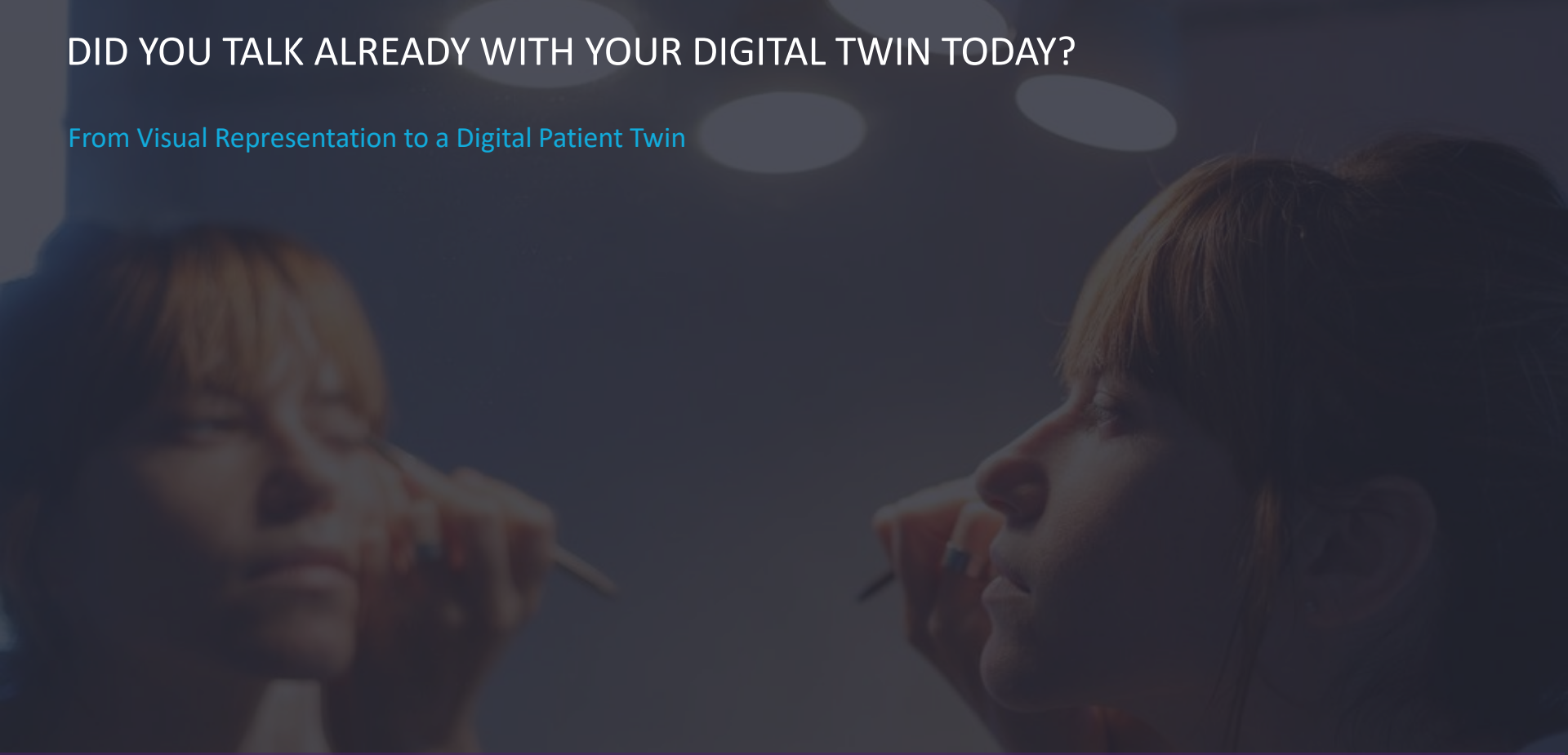
**HOW AI CAN ENHANCE THE IMPACT OF VIRTUAL TWINS FOR YOUR PRODUCTS**

DASSAULT 3DEXPERIENCE CONFERENCE, 16.-17.10.2024 MUNICH

UDO LANGE, VICE PRESIDENT CAPGEMINI INVENT GERMANY

# DID YOU TALK ALREADY WITH YOUR DIGITAL TWIN TODAY?

From Visual Representation to a Digital Patient Twin



VISUAL REPRESENTATION

COLLECTING DATA POINTS

REAL-TIMECONNECTIVITY

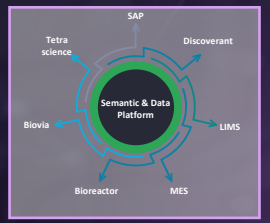
# MODELLING THE FUNDAMENTALS: DRIVE NEW, PLATFORM-BASED BUSINESS MODEL WITH A DIGITAL TWIN OF BIOREACTOR PROCESSES

## Capgenmini project experience: Digital Twin of a Bio Incubator

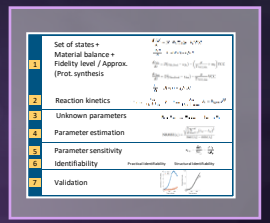
### Problem description

- From client current business model, biologics and particularly antibodies play an important role as medication for multiple therapeutic areas, even with the potential of personalized medication
- Enabling a faster process development and higher quality by smarter steering of the manufacturing increases “First Time Right” and therefore competitiveness and sustainability
- Digital Twins enable process and cost optimization, automated technology transfer, key value drivers of quality enhancements

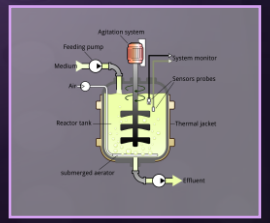
### Our solution



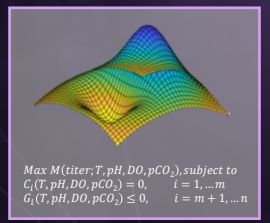

Data Manager




Digital twin generator




Digital twin Core




Process Optimizer

### Objectives

**90%** reduction in cost of poor quality

**70%** reduction in new facility build time

**90%** reduction in product changeover time

**90%** reduction in OPEX and CAPEX



# COMBINING MODELS WITH MASS-DATA AND REAL-TIME INFORMATION IS CREATING INSIGHTS AS BASIS FOR DECISIONS

## Connecting the dots

MODELLING & SIMULATION TO MOLECULAR LEVEL

LABORATORY INFORMA-TION MANAGEMENT

CLINICAL TRIAL DATA ANALYSIS

ENHANCED DATA ANALYSIS & VISUALIZATION

BIOVIA

MEDIDATA

NETVIBES

3DEXPERIENCE® platform



# THE PATIENT TWIN OFFERS MANY DIFFERENT USE CASES TO IMPROVE HEALTHCARE TREATMENT

Overview about different use cases for Patient Twinning

## Digital Twins of Organs

- Simulate organ functions
- Develop personalized treatments
- Predict disease progression
- Plan surgical procedures

## Individual Patient Treatment

- Tailored treatment plans
- Reduced side effects
- Development of new therapies
- Improved decision-making

## 3D-Visualization

- Disease progression simulation
- Detailed localization of anatomy
- Physiological Data Visualization
- Early Detection of Issues

## Image processing

- Disease progression monitoring
- Improved diagnosis
- Automation of manual processes
- Increased efficiency



# COMBINING VARIOUS DATA SOURCES, EVENTUALLY WILL LEAD TO THE DIGITAL PATIENT TWIN ENABLING MULTIPLE USE-CASES

The patient twin from data to concrete impacts

## The Patient Twin

### Real-time data

Vital signs, lab results, imaging and data from patient's gadgets.

### Medical history

Previous illnesses, surgeries, medications, and allergies.

### Genetics

DNA sequence and genetic predispositions.

### Lifestyle factors

Diet, exercise and environmental influences.

## APPLICATION EXAMPLES

- Real-time or history dashboards
- Collaboration and simulation tools
- AI-powered assistants
- Anatomical models in augmented reality

## PERCEIVED BENEFITS

- Faster overview of patient information
- Access to well-structured information
- Increased confidence in medical decisions
- Insights through comparison, simulation and collaboration
- Superior understanding and visualization of anatomy

## DEMANDS AND EXPECTED IMPACTS

### Providers operating on limit

- ☑ Supports healthcare teams to perform under time pressure
- ☑ Reduces efficiency bottlenecks in patient care processes

### Pressure for improved practices

- ☑ Enhances reliability of diagnostics and treatments
- ☑ Promotes early intervention and avoids critical health situations

### Focus on patient care outcomes

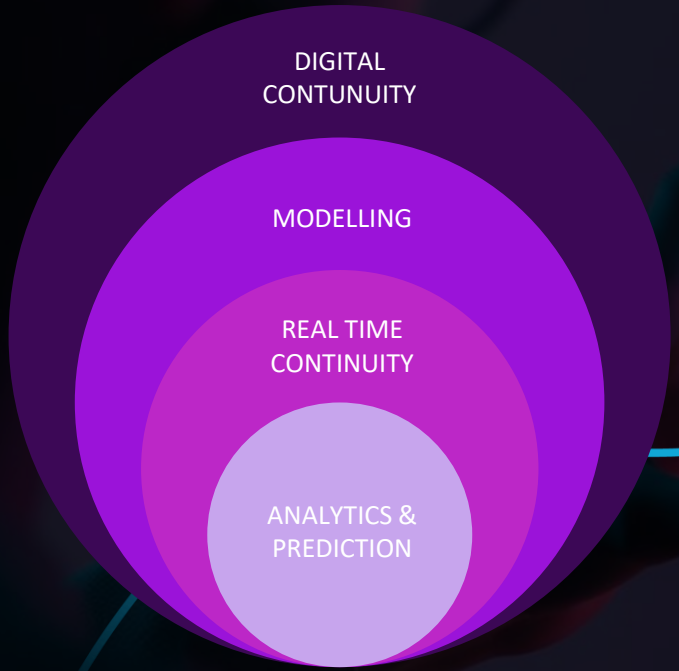
- ☑ Increases patient involvement and engagement
- ☑ Promotes personalized healthcare



# BUILDING THE FUTURE: UNVEILING THE ESSENTIAL ELEMENTS OF A DIGITAL TWIN IN INDUSTRY FOR ENHANCED INNOVATION

## Summary: Key capabilities to create virtual twins




**DIGITAL CONTINUITY:**

Creating consistent data models and digital threads that represent the physical objects in the virtual space

**MODELLING:**

Represent the behavior of physical objects in the virtual world in multiple domains

**REAL-TIME CONNECTIVITY:**

IoT-solutions to connect the physical objects with the digital representation

**ANALYTICS & PREDICTION:**

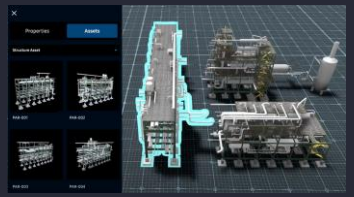
Converting information into insights and actionable recommendation considering swarm data

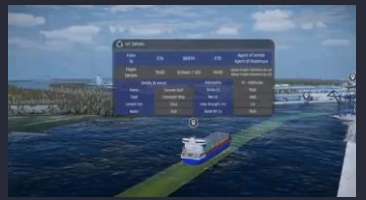


# DIGITAL TWINS ARE LEVERAGED ACROSS ALL LIFECYCLE STAGES

## End-to-End Digital Twin Use-Cases



**Design use-cases**

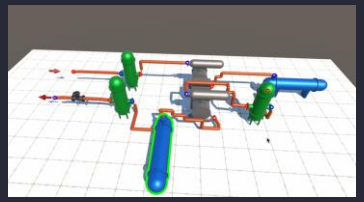
- Project visuali-zation
- Real-time design reviews
- Design configura-tors
- Design simu-lation

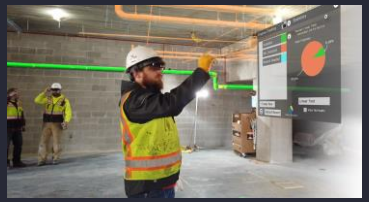
**Build use-cases**

- Site induction & training
- On-site coordi-nation & guidance
- QA/QC as-built verification
- Progress reporting & close-out

**Operate use-cases**

- Sales and marketing
- Operator training & guidance
- Operatio-nal digital twin
- Asset simu-lation & planning



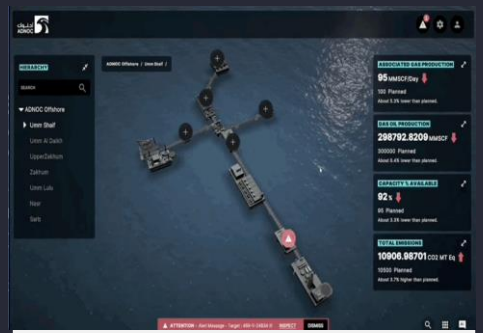




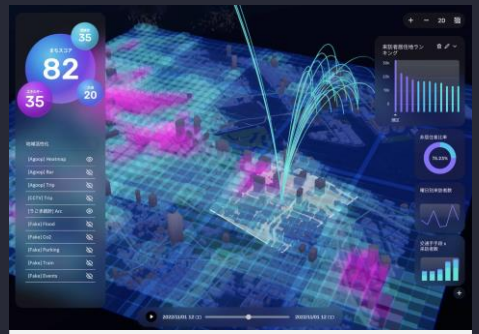
# OPERATIONS FOR COMPLEX, REMOTE AND RURAL INFRASTRUCTURE INSTALLATIONS CAN BE OPTIMIZED USING THE DIGITAL TWIN

## Benefits of Operations Digital Twins



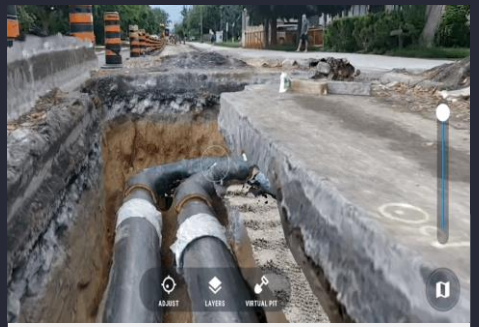

### Increased Efficiency

Digital Twins can help streamline operations, optimize resource utilization, and improve overall efficiency by providing a common operating picture of how an asset operates.




### Improved Decision Making

Digital twins create a virtual replica of physical assets, processes, or systems. This allows businesses to run simulations, test scenarios, and optimize performance without impacting the real-world operations.




### Break down silos & Innovate

Digital twins enable innovation by allowing designers and engineers to test new ideas and iterate quickly in a virtual environment, accelerating the development of new products and solutions.

# Hyundai Motors

## Manufacturing facility of the future

In order to meet the future demands for mobility solutions, Hyundai's HMGICS factory has moved away from traditional assembly line manufacturing to a novel cell-based approach enabling high levels of customization, multi-model construction and personalization.

### Challenge

The HMGICS factory is a 7 story building the equivalent of 6 soccer fields. This vast environment interconnects humans, robots and logistics through various technologies. This required the implementation of a Digital Twin in order to efficiently manage the operations of the facility.

### Solution

Our team worked alongside Hyundai to create a real-time 3D Digital Twin. Virtualization of the physical space was accomplished by ingesting CAD models into 3D model data which would be rendered in a performant manner. Furthermore, the team integrated client back-end services to drive real time locations of various robots in the factory.

### Results & Value

Delivery of Digital Twin engagement on time despite factory opening being delayed 2 times

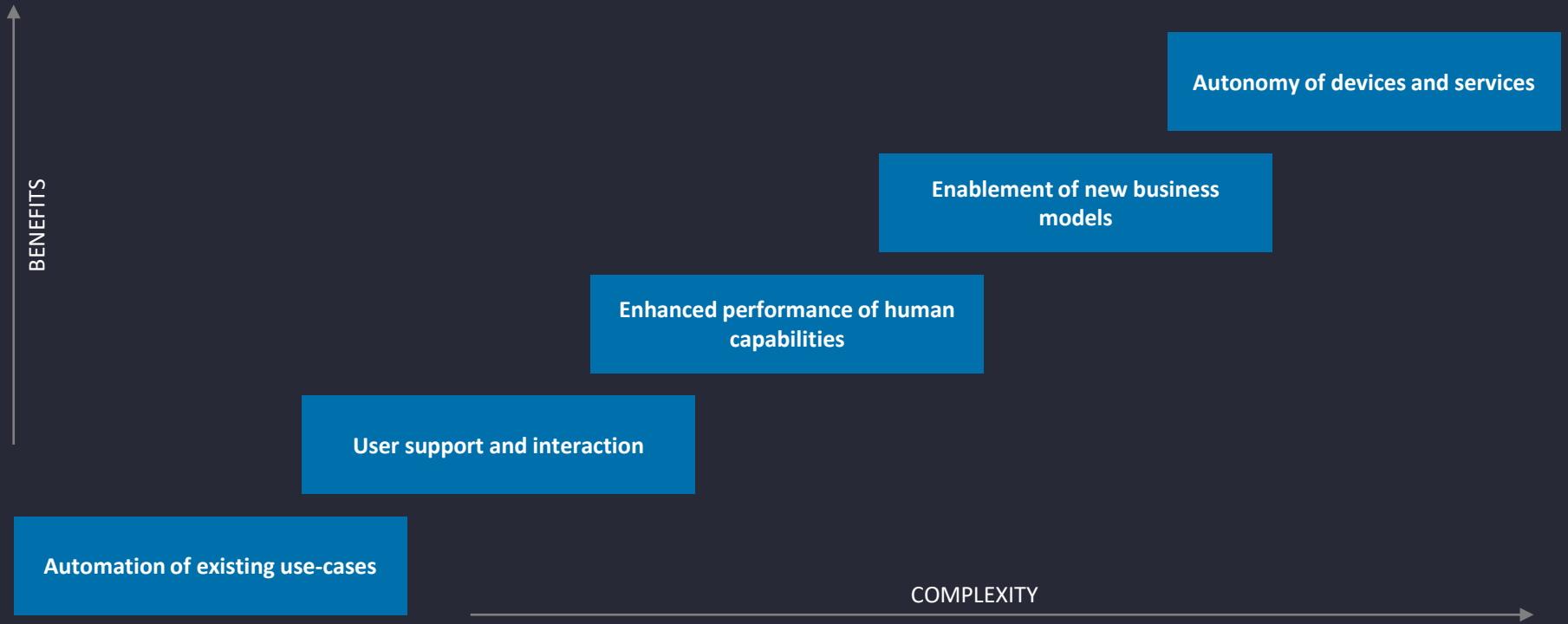
Successful implementation of foundational Digital Twin components advancing part way to Level 1, Virtual Twin, and Level 2, Connected Twin.



# AI OFFERS MULTIOPLE APPLICATION AREAS WITHIN THE ENGINEERING DOMAIN WITH VARYING DEGREE OF COMPLEXITY

## Application Areas for (Gen)AI in Engineering





# IT IS IMPORTANT TO DIFFER AI BY ITS MODELS TO ACHIEVE A MAXIMUM BENEFIT FOR THE SPECIFIC REQUIREMENTS

## AI types

### ANN

Artificial neural networks are mathematical models inspired by biology. They consist of interconnected neurons.

### Machine Learning

Machine learning is training computer systems to learn and adapt without explicit programming, using algorithms and statistical models to analyze data patterns.

### Deep Learning

Deep learning is a further development of machine learning and uses deeper neural layers and more data sets to recognize more complex patterns.

### NLP

Natural language processing is a specific form of artificial neural network trained with deep learning algorithms.

### GenAI

Generative AI uses models such as GANs (Generative Adversarial Networks) to generate new content from data.

| Process Optimization | Image Recognition | Computer Vision | Chatbots | Product Design |
|---|---|---|---|---|
| TOYOTA CATERPILLAR | Google PHILIPS | WAYMO TESLA | gm Hewlett Packard Enterprise | AIRBUS BOEING |
| **Predictive Maintenance** | **Quality Control** | **Drug Discovery** | **Sentiment Analysis** | **Data Augmentation** |
| SIEMENS | Ford BOEING | Pfizer NOVARTIS | Meta IBM | NVIDIA |



# WE HAVE ALREADY A COUPLE OF AI-APPLICATIONS REALIZED OR UNDER DEVELOPMENT, INSIDE AND AROUND THE CORE PRODUCT DEV.

## Exemplary AI-applications

### R&D (Gen)AI USECASES

**MvP**

**Specifications to ALM**

- Structure a „requirements sheet“ in **functional and performance** Requirements
- Insert Requirements into ALM solution

**Prod**

**Embedded AUTOSAR.AI**

- AI-assist for code- review, -generation, tests scripts, requirements & architecture
- Contextualized model with client architecture

**MvP**

**R&D Data bot**

- Internal search engine (predict) was enriched with an external LLM
- „translation“ from scientific text blocks

**MvP**

**SGP Paris Managing Requirement**

- Tool for reconstructions of loss of requirements traceability
- PowerBI and Data bricks interface

**MvP**

**Beetle AI**

- Completion of Software release-notes
- Atlassian (Confluence, Jira) Interface to analyze Input data

### Other (Gen)AI USECASES

**Prod**

**Airbus Skywise „Health-monitoring“**

- Implementation of a Big data platform for health-monitoring applications
- Implementation of a AI & data innovation delivery pipeline

**Prod**

**„Total Energies“ Trading Bot**

- Conversational Trading bot, to analyze trading patterns for a trading Unit
- Realtime (Streaming) trading data analysis

**MvP**

**Fleet Manager Bot**

- Costumer interactive bot, to analyze truck fleet data
- AWS cloud based interactive bot, with real-time data analysis

**MvP**

**SWD Data Insights Assistant**

- Smart data analyze and reporting for internal data lake (Databricks)
- PowerBI and Data bricks interface

**Prod**

**OEM Data Ingestion**

- Data ingestion use cases for a Azure data factory
- Azure Data lake storage architecture



# AI APPLICATIONS WILL AFFECT ALL PHASES OF A PRODUCT LIFECYCLE – EVENTUALLY WITH QUITE DISRUPTIVE IMPACT

## Today and tomorrow (AI application use-cases)

EXCERPT

### Product Development

**SPECIFICATION**
**Global system** requirements

**ARCHITECTURE**

Design for each **sub-system**

**INTEGRATION**
Each **sub-system** reaches its goal

**The global system**

**Closing the Loop: The self-generating product**

**REQUIREMENT MANAGEMENT**
- Write requirements & associated sub-requirements
- Suggest **relevant standards**

**VALIDATION & COMPLIANCE**
- Acceleration of compliance verification

**PRODUCT DESIGN**
- Generate CAD/CAE model design based on requirements & constraints
- Generate software code based on requirements & constraints, launch relevant testing loops & inspect results
- Create test cases and analyze results
- Generate homologation documents

**KNOWLEDGE, IP & EXPORT CONTROL MANAGEMENT**
- Identify relevant documentation/applicable patents/open-source knowledge for application.
- Check originality of innovation
- Propose attributes & classification for engineering deliverables

**INSTAL. & IN-SERVICE TESTS**
- Play complex full scale test procedures
- Non-conformities classification & RCA
- Accelerate test bench analysis
- Extract data for product compliance verification

**PROCESS MANAGEMENT**
- Optimize and design processes

**PROJECT MANAGEMENT**
- Identify incoherences in activities and gate planification

### OPERATION

**USAGE**
- Real-time BOT interaction
- Identify usage patterns and functional gaps

**PRODUCT**
- Embedded AI-functions for self-optimization
- Automated operations
- Automated self-testing in final-assembly test

Mature

Nascent



# WITH INCREASING APPLICATION OF AI, DIGITAL TWINS WILL EVENTUALLY BE AUTONOMOUS, SELF-HEALING AND SELF-IMPROVING

## Maturity states of digital twins

EXAMPLE: AUTOMOTIV

Ability to (re)act

Decision-making capabilities

Interconnected and collaborative

Internet of Digital Twins

STEP 1
Digital Twin

STEP 2
Collaborative Digital Twins

Cognitive Digital Twins

STEP 3
Self-learning system

STEP 4
Prescriptive simulation and insights models

Autonomous Digital Twins

STEP 5
Self-healing system

STEP 6
Acting system

Data

Experience

Intelligence



# OUR APPROACH ENABLES DATA- OR USE CASE-DRIVEN AI EXCELLENCE FOR LONG-TERM AND PEOPLE-CENTRIC SUCCESS

## Capgemini approach to AI

**“Our first challenge is to invent the right relationship between AI and the people who use it.”**

*[Luca De Meo, CEO, Renault]*


| | AI & DATA STRATEGY | BUSINESS USE CASES | IMPLEMENTATION & VALIDATION | ROLLOUT & ENABLEMENT |
|---|---|---|---|---|
| VALUE | A robust AI and data strategy sets the foundation for successful implementations, ensuring that technologies align with business objectives. | Relevant business use cases allow targeted implementation to generate tangible value. | Careful implementation and validation of AI models ensure accuracy and effectiveness in real business scenarios. | The rollout and integration of AI into business processes create sustainable usage and foster acceptance within the organization. |
| RESULTS | ▪ High Level Target Architecture<br>▪ Identification of key resources/technologies<br>▪ Selection of strategic AI partners<br>▪ Risk assessment and integration of compliance measures | ▪ Prioritized list of business use cases<br>▪ Feasibility and impact analysis on business and AI strategy<br>▪ Definition of success metrics | ▪ Developed and trained AI models according to use cases<br>▪ Validation of models through comprehensive testing<br>▪ Continuous optimization based on validation results | ▪ Smooth rollout of AI solution into operational workflows<br>▪ Training and empowerment of employees<br>▪ Mechanisms of continuous monitoring and improvement |



# AI WILL IMPACT ALL PHASES OF THE PRODUCT LIFECYCLE – HOWEVER COMPANIES SHOULD CREATE A STABLE FOUNDATION TO GAIN BENEFITS

## Summary & Recommendations

### DIGITAL TWIN RELATED

- Develop and maintain process and systems landscaspes that generate digital continuity and data consistency along the full product lifecycle
- Plan your Digital Twin environments with specific, business-driven use-cases as driver

### AI RELATED

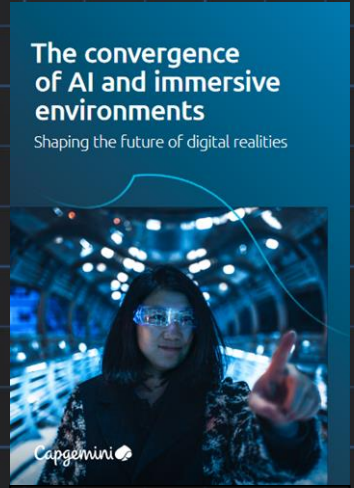
- Establish a scalable, stable governance for AI application in your company
- Create the technical foundation for AI-applications (e.g. LLM)
- Enable the organization with appropriate training and communication
- Start small and scale fast – but have the scaling in mind upfront
- Consider the implications of the EU AI Act early up

- AI will **impact every phase of a product lifecycle** and will **significantly increase the experience of Digital Twins** during product usage
- There are **significant benefits to gain** but also **disruptive changes to come**
- **Leveraging** and **scaling AI** requires a **consistent** and **structured strategic approach for companies**

# DOWNLOAD OUR POINTS OF VIEW


Capgemini
Industrial Metaverse
Point of View


The future of Learning is Immersive




The convergence of AI and immersive environments



# ANY QUESTIONS? REACH OUT!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## About Capgemini Invent

As the digital innovation, design and transformation brand of the Capgemini Group, Capgemini Invent enables CxOs to envision and shape the future of their businesses. Located in over 30 studios and more than 60 offices around the world, it comprises a 12,500+ strong team of strategists, data scientists, product and experience designers, brand experts and technologists who develop new digital services, products, experiences and business models for sustainable growth.

Capgemini Invent is an integral part of Capgemini, a global business and technology transformation partner, helping organizations to accelerate their dual transition to a digital and sustainable world, while creating tangible impact for enterprises and society. It is a responsible and diverse group of 340,000 team members in more than 50 countries. With its strong over 55-year heritage, Capgemini is trusted by its clients to unlock the value of technology to address the entire breadth of their business needs. It delivers end-to-end services and solutions leveraging strengths from strategy and design to engineering, all fueled by its market leading capabilities in AI, cloud and data, combined with its deep industry expertise and partner ecosystem. The Group reported 2023 global revenues of €22.5 billion.

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DASSAULT SYSTEMES

Virtual Worlds for Real Life

# THANK YOU FOR YOUR INTEREST