Alliance INDUSTRIE DU FUTUR

Unite
Accelerate
Transform

Digital Twin

Leveraging the Digital Transformation of the Industry

Solutions INDUSTRIE DU FUTUR

CONTENTS

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THE DIGITAL TWIN

Definition, mapping of use cases and value creation

The Digital Twin is a recent industrial concept that offers companies new applications to optimize their performance.
The aim of this publication is to provide an initial **overview of the adoption** of this concept within the French industry and then present **the benefits of using such a tool**.
For this purpose, the authors has deliberately taken the approach of presenting examples and use cases.
The aim is to inform and guide readers in their thinking about their own tools and the functions they want them to perform.

THE DIGITAL TWIN IS NOT AN OBJECTIVE IN ITSELF, BUT A MEANS TO ACHIEVE CERTAIN BENEFITS. THIS DOCUMENT IS INTENDED TO ILLUSTRATE THESE BENEFITS.

This document provides a **definition** of the Digital Twin and explains **many industrial use cases**.
The wording and nuances of the definition are discussed.

The use cases are explained in detail with their added value and areas of application. A future publication may cover the means of deployment and operation of a Digital Twin, as well as the associated technical challenges.

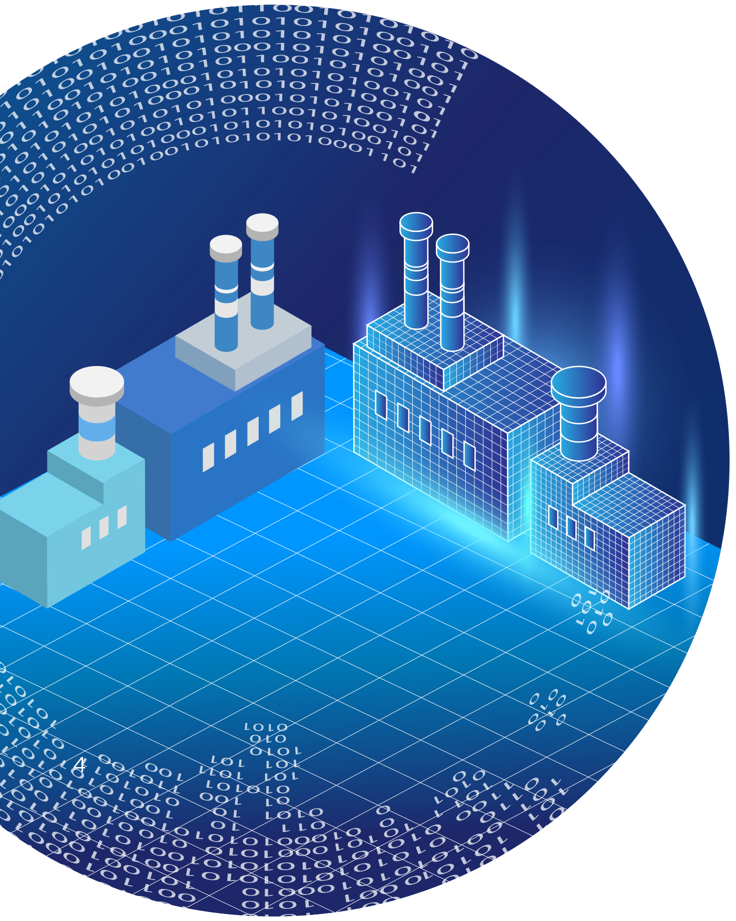
Finally, it is important to consider this publication as a **vision shared by a group of industrialists in our Sector** who are enthusiastic about the subject and who wish to promote this new tool to improve the efficiency of products and production systems.

I would like to thank all the participants of the "Digital Twin" Technical Committee who, as part of the CORI2DF of our "Solution Industrie du Futur" Sector, actively contributed to the production of this brochure.

Frédéric Sanchez
President of AIF
President of the Strategic Committee for the Solution Industrie du Futur Sector

WHAT IS A DIGITAL TWIN?

To qualify as a Digital Twin, a system must meet the following three criteria:



1 A Digital Twin is an **organized set of digital models** representing a **real-world entity** designed to **address specific issues and uses.**

The digital models can be diverse: 2D or 3D geometric models, topological models, physical and mathematical models, functional models, etc.

These models are organized; in other words, they are coherent and interconnected to represent different aspects of the twin.

Digital Twins can and should be assembled and nested according to the evolution of the desired uses and the studied scope (systems of systems).

The Digital Twin must represent an entity that actually exists. It is different from the digital model made before production.
This digital model is therefore not a Digital Twin.
However, a digital model can be part of a Digital Twin.
Furthermore, once the digital model is physically realized and synchronized with its physical realization, it becomes a Digital Twin.

The entity studied can be, for example, a product, a machine, a process, a department, a complete production facility, etc.

The Digital Twin is not an objective in itself, but a means to achieve specific objectives.

2 The Digital Twin is **updated in relation to reality,** with **a frequency** and **precision** adapted to its issues and uses.

If the models are not fed with data from the real world, they do not constitute a Digital Twin.

A simple simulation or model is therefore not a Digital Twin if it is not synchronized with reality.

The updates in relation to reality follow the life cycle of the entity being studied and are calibrated to the exact needs of the desired use(s). The updates are therefore not necessarily performed in real time.

The precision, granularity and content must also be chosen according to the right needs.
The Digital Twin may, for example, contain forms, states, functions, processes, behaviors, attributes, operational data, dynamics, reflect the environment, etc.

Absolute precision (from micro-atomic to macro-geometric level) is impossible and unnecessary.

3 The Digital Twin is equipped with **advanced operating tools,** including the ability to:

understand analyze
predict optimize

the operation and management of the real entity.

The advanced operating tools enable the desired objectives to be achieved. This document explains a number of possible uses.

A simple database without tools is therefore not a Digital Twin.

The Digital Twin always has an impact on the physical twin. However, this link is not always direct and automated.

VALUE OF THE DIGITAL TWIN

Digital Twins have a wide scope of applications. Following in the footsteps of pioneers such as NASA, the Digital Twin concept has taken root in the manufacturing industry, where it continues to grow.

The areas in which Digital Twins are developing most rapidly include:

- **CONSTRUCTION**
- **FACTORIES**
- **CITIES**
- **SMART TERRITORIES**

The Digital Twin is also studied in:

MOBILITY, TRANSPORT AND LOGISTICS
Digital Twin of a logistics network

TELECOMMUNICATIONS
Digital Twin of a 5G network

PORT AND AIRPORT INFRASTRUCTURE
Digital Twin of an airport

ROAD AND RAIL NETWORKS
Digital Twin of a railway station

The Digital Twin is also emerging in the field of science:

HEALTH
Digital Twin of the care pathway

MEDICINE
Digital Twin of the human heart

BIOLOGY
Digital Twin of the ocean

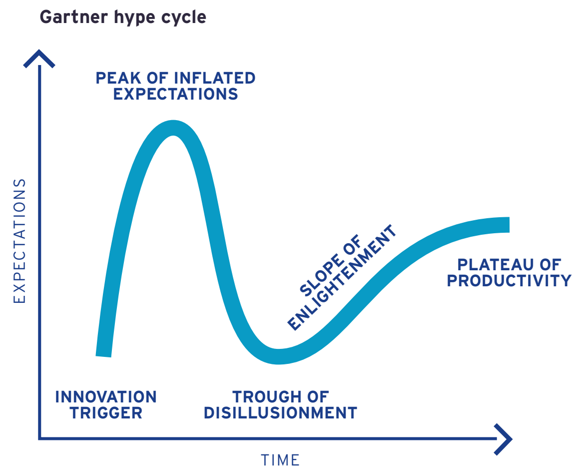
ENERGY
Digital Twin of a nuclear reactor

Digital Twins make it possible to maintain an up-to-date digital representation of entities of interest of the physical world in their environment, in order to provide a comprehensive understanding for optimal decision-making.

Digital Twins aim to use historical and current data to represent the past and present, to simulate or even predict possible futures. Typical uses of Digital Twins range from basic uses such as digitization and visualization (e.g., 2D, 3D, Virtual and Augmented Reality) to more advanced uses such as simulation, orchestration/management/control, or prediction (e.g., by using Artificial Intelligence algorithms based on the historical information stored in the Digital Twins).

Adoption

In a study published in July 2022,[1] Gartner places Digital Twin technology[2] in the "trough of disillusionment" of its Hype Cycle for Manufacturing Operations Strategy, meaning that interest in the technology wanes after inflated expectations have been created.



The next phase should be the "slope of enlightenment", in which more and more examples show how this technology can benefit companies. Indeed, one of the objectives of this publication is to demonstrate the many use cases for Digital Twins.

Gartner positions the Digital Twin as a "transformational" technology, providing the greatest benefits, and predicts widespread adoption in 2-5 years. The current estimated uptake of the technology is between 1 and 5% of the potential companies and organizations that could benefit from it.[3]

Gartner forecasted in February 2022 that the Digital Twins market would reach $183 billion by 2031.

Our study presents numerous use cases of Digital Twins, as well as the benefits they bring to the industry. Obstacles to the successful implementation of a Digital Twin include:

- The lack of a clear objective and a defined scope of application.
- The complexity of merging IT, Information Technology, and OT, Operational Technology for the shop floor, which the industrial Digital Twin involves.

It is therefore important, as stated in our definition, **to build a Digital Twin to "address specific issues and uses"**, define performance indicators and milestones, and also ensure the collaboration of IT departments with production and other project stakeholders.

(1) Source: Gartner Hype Cycle for Manufacturing Operations Strategy, Simon Jacobson, Janet Suleski, 29 July 2022.

(2) It should be noted that the Gartner study covers a broader spectrum than the industrial applications of Digital Twins presented in this paper, such as healthcare applications using a patient's Digital Twin.

(3) Source: Gartner Hype Cycle for Manufacturing Operations Strategy, Analysis of Digital Twin Technology chapter, Alfonso Velosa, Marc Halpern, 29 July 2022.

MAPPING OF USE CASES OF THE DIGITAL TWIN

This chapter presents different industrial use cases of the Digital Twin to illustrate its benefits. The following diagram of industrial production gives an overview.

PDT = Product use case

PCA = Process use case Supply

PCP = Process use case Production

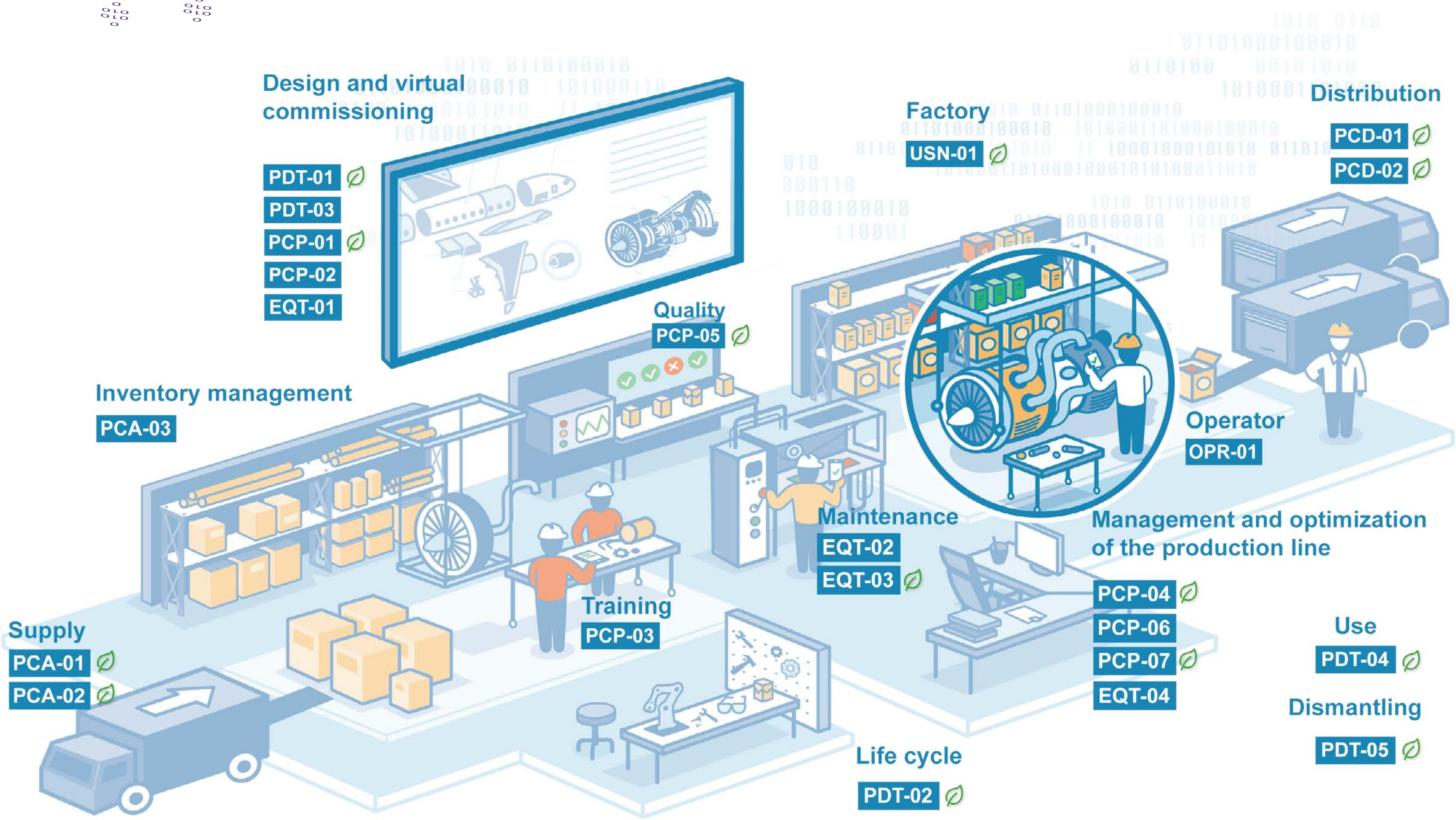
PCD = Process use case Distribution

EQT = Equipment use case

OPR = Operator use case

USN = Factory use case

= Reduced environmental impact



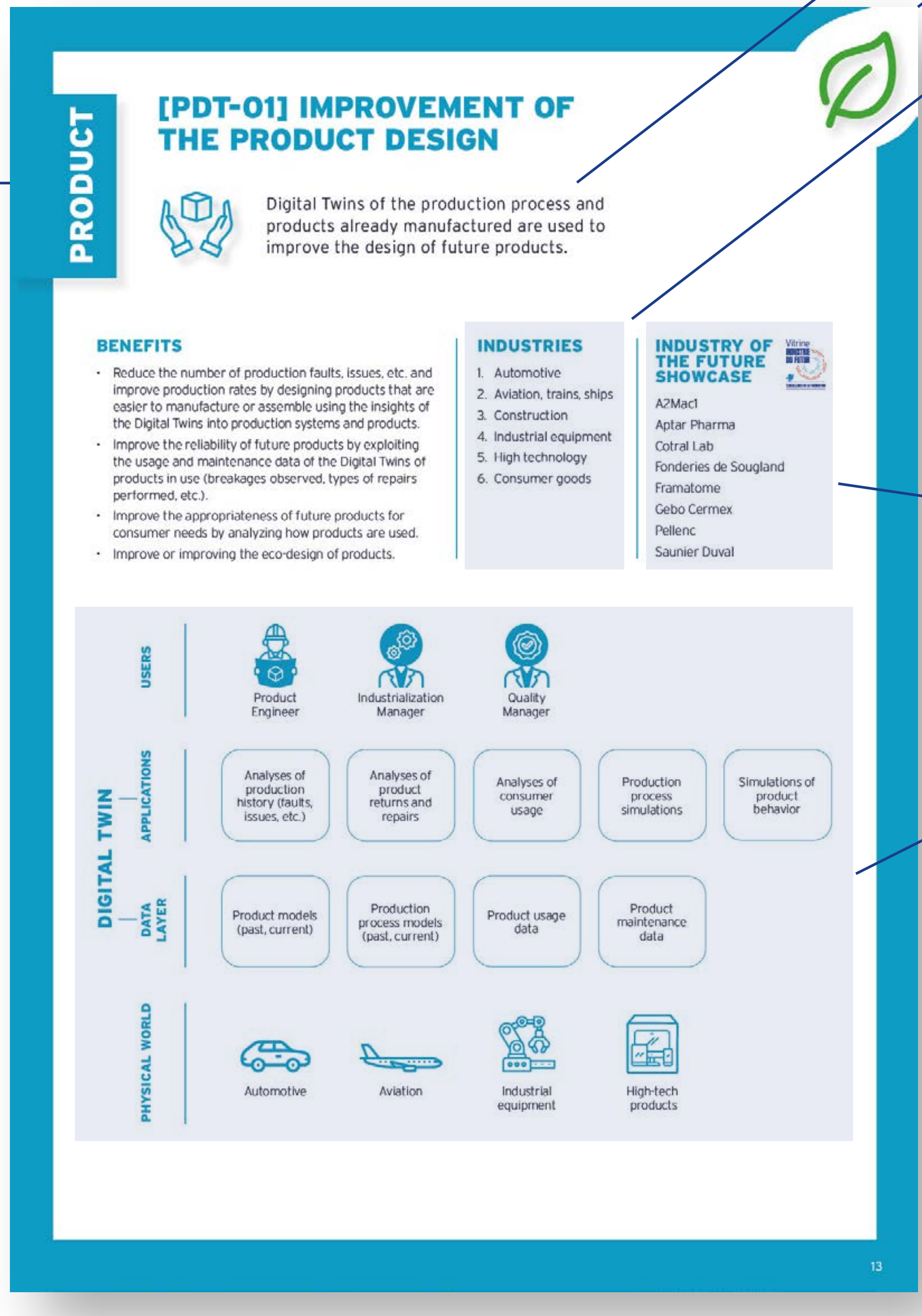
"INSTRUCTIONS" OF USE CASES

Use cases are classified according to:

THE NATURE OF THE REAL-WORLD ENTITY REPRESENTED BY THE DIGITAL TWIN.
IN AN INDUSTRIAL ENVIRONMENT, THIS COULD BE ONE OF THE FOLLOWING ENTITIES:

- A **product** to be manufactured
- An industrial **process**, such as:
  - The **supply** process for the materials and components needed for production
  - The **production process**
  - The **distribution** process of the finished product
- A necessary **resource** for production:
  - An **industrial equipment**, e.g., robot, CNC machine, etc. in the workstation environment
  - A **factory** as a whole (building, production lines, equipment)
- A human **operator** in their work environment

The use cases are presented in the order of the life cycle stages of the entity in question: design, production or commissioning, use, maintenance, recycling or dismantling.



PRODUCT

[PDT-01] IMPROVEMENT OF THE PRODUCT DESIGN

Digital Twins of the production process and products already manufactured are used to improve the design of future products.

BENEFITS

- Reduce the number of production faults, issues, etc. and improve production rates by designing products that are easier to manufacture or assemble using the insights of the Digital Twins into production systems and products.
- Improve the reliability of future products by exploiting the usage and maintenance data of the Digital Twins of products in use (breakages observed, types of repairs performed, etc.).
- Improve the appropriateness of future products for consumer needs by analyzing how products are used.
- Improve or improving the eco-design of products.

INDUSTRIES

1. Automotive
2. Aviation, trains, ships
3. Construction
4. Industrial equipment
5. High technology
6. Consumer goods

INDUSTRY OF THE FUTURE SHOWCASE

A2Mac1
Aptar Pharma
Cotral Lab
Fonderies de Sougland
Framatome
Gebo Cermex
Pellenc
Saunier Duval

Each use case includes:

A BRIEF DESCRIPTION OF THE USE CASE AS WELL AS THE EXPECTED BENEFITS.

AN ICON INDICATING WHETHER THE USE CASE REDUCES THE ENVIRONMENTAL IMPACT OF THE ACTIVITY.

THE LIST OF INDUSTRIES THAT CAN BENEFIT FROM THE USE CASE.

The selected list comes from the first level of the European Union's CPA*. Groupings and ad hoc changes have been made for simplicity. Ultimately, the list of relevant industries is as follows:

- Aviation, trains, ships
- Automotive
- Construction
- Industrial equipment
- High technology
- Oil and chemical
- Communication infrastructures
- Materials
- Energy production
- Consumer goods
- Pharmaceutical products
- Transport

A LIST OF ALLIANCE INDUSTRIE DU FUTUR SHOWCASES RELATED TO THE USE CASE.

Disclaimer: the links established between Showcases and use cases are the result of an interpretation of the AIF, and do not involve the companies mentioned.

FOUR LAYERS ILLUSTRATING THE DIFFERENT LEVELS OF THE USE CASE:

- The **users** identified by their roles (Data Scientist, Quality Manager, etc.)
- The **applications** offered to the user to benefit from the Digital Twin
- The **Digital Twins** and data **models** required for the operation of the applications
- The **entities of the physical world** represented by the Digital Twins

The entities of the three lower layers (applications, Digital Twins and models, physical world) communicate according to the adopted architecture. The data flows between layers are therefore not represented.

*European Union Classification of Products by Activity

CONTENTS OF USE CASES

PRODUCT

PROCESS

RESOURCE

OPERATORS

PRODUCT

[PDT-01] IMPROVEMENT OF THE PRODUCT DESIGN

Digital Twins of the production process and products already manufactured are used to improve the design of future products.

BENEFITS

- Reduce the number of production faults, issues, etc. and improve production rates by designing products that are easier to manufacture or assemble using the insights of the Digital Twins into production systems and products.
- Improve the reliability of future products by exploiting the usage and maintenance data of the Digital Twins of products in use (breakages observed, types of repairs performed, etc.).
- Improve the appropriateness of future products for consumer needs by analyzing how products are used.
- Introduce or improve the eco-design of products.

INDUSTRIES

1. Automotive
2. Aviation, trains, ships
3. Construction
4. Industrial equipment
5. High technology
6. Consumer goods

INDUSTRY OF THE FUTURE SHOWCASE

A2Mac1
Aptar Pharma
Cotral Lab
Fonderies de Sougland
Framatome
Gebo Cermex
Pellenc
Saunier Duval

PRODUCT

[PDT-02] TRACEABILITY OF THE ENVIRONMENTAL IMPACTS OF THE PRODUCTION OF A PRODUCT

The Digital Twin of the product incorporates all the environmental impacts of its production, from the extraction of the raw or recycled materials, the manufacturing process, storage in the warehouse and end of life. It takes into account the impacts of the production of components by subcontractors.

BENEFITS

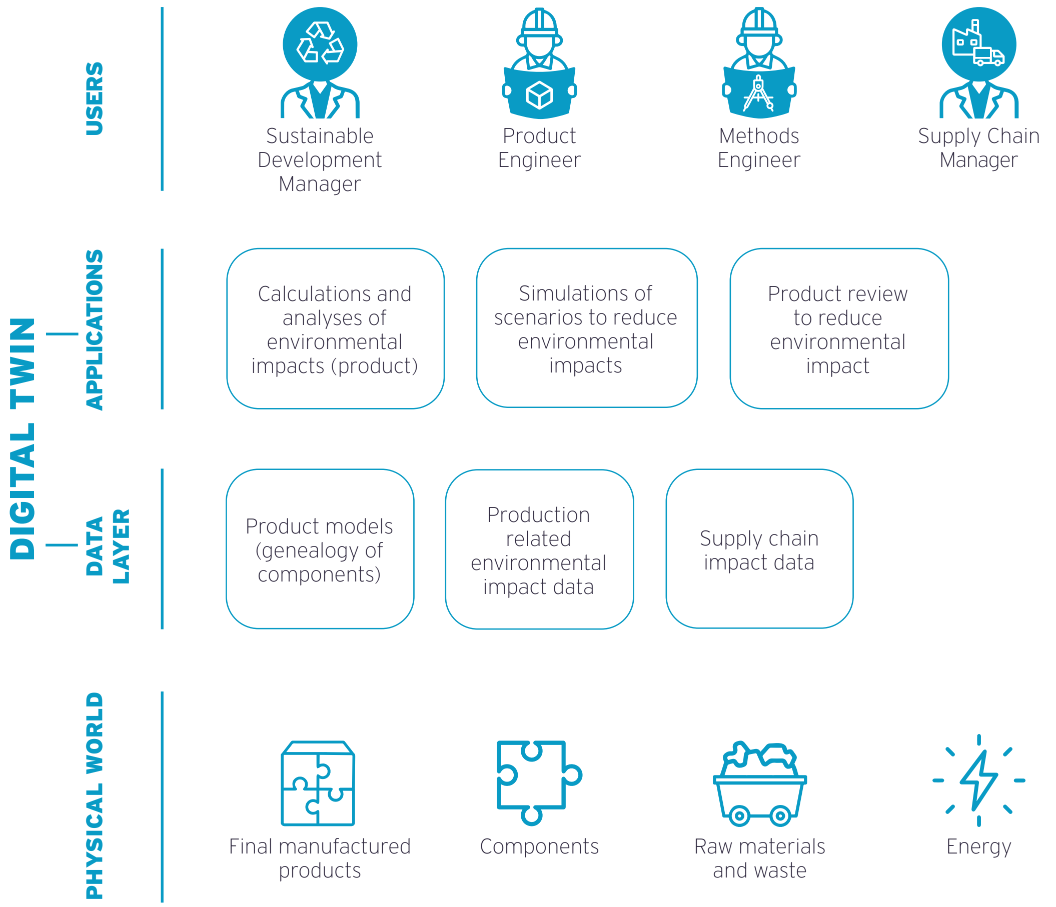
- Comply with current or future regulatory requirements, in particular concerning the calculation of a manufactured product's carbon footprint (digital product passport).
- Measure and then reduce the environmental footprint of products (greenhouse gas emissions, energy or water consumption, etc.) by decreasing the impact of industrial processes, changing subcontractors, etc.
- Trace the quantity of raw materials used and not used (waste) for each product.

INDUSTRIES

1. Automotive
2. Aviation, trains, ships
3. Construction
4. Industrial equipment
5. High technology
6. Oil and chemical
7. Communication infrastructures
8. Materials
9. Pharmaceutical products
10. Consumer goods

INDUSTRY OF FUTURE SHOWCASE

L'Oréal



PRODUCT

[PDT-03] ACCELERATION OF THE REALIZATION OF A COMPLEX EQUIPMENT WHILE WAITING THE RECEPTION OF SOME OF ITS COMPONENTS

The Digital Twin of the product makes it possible to progress in the production of complex machines before the reception of certain specialized sub-components, thus reducing the time taken to build the machines. Hardware-in-the-loop simulations are carried out.

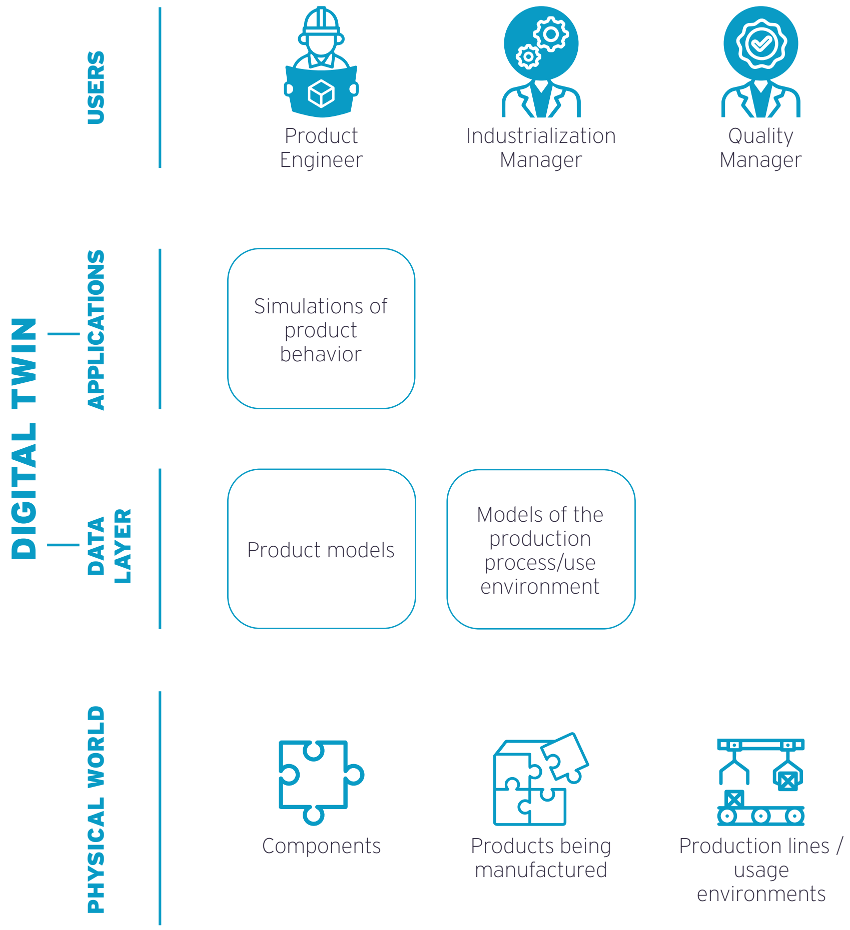
Example: A virtual sub-system for developing a robotic cell used to manufacture silicon wafers in the semiconductor industry allows for faster production.

BENEFITS

- Reduce the time taken to build the equipment without waiting for the delivery of specialized sub-components (which may be late).
- Develop the system software in parallel with the acquisition of the components of a sub-system.
- Facilitate the testing of complex machines even if some sub-components are missing.

INDUSTRIES

1. Industrial equipment
2. High technology
3. Communication infrastructures



PRODUCT

[PDT-04] DIGITAL TWIN OF THE PRODUCT IN USE

Delivered with the physical product, the Digital Twin of the product reflects all its features and options. It is then constantly updated via the cloud, based on data captured during the use and maintenance of the product, in order to optimize usage and maintenance.

BENEFITS

- Limit energy consumption or improve safety by sending personalized suggestions to the vehicle driver or by updating the embedded software according to the driving behavior recorded in the Digital Twin.
- Recommend a maintenance operation after analysis of the flight data to prevent a possible failure of the aircraft.
- Facilitate the repair of smartphones with an exact view of the different components and materials found in the device.

INDUSTRIES

1. Automotive
2. Aviation, trains, ships
3. Construction
4. Industrial equipment
5. High technology
6. Communication infrastructures
7. Energy production
8. Consumer goods
9. Transport and logistics

INDUSTRY OF THE FUTURE SHOWCASE

Gravotech
Lectra

PRODUCT

[PDT-05] REUSE / RECYCLING / DISMANTLING OF THE PRODUCT

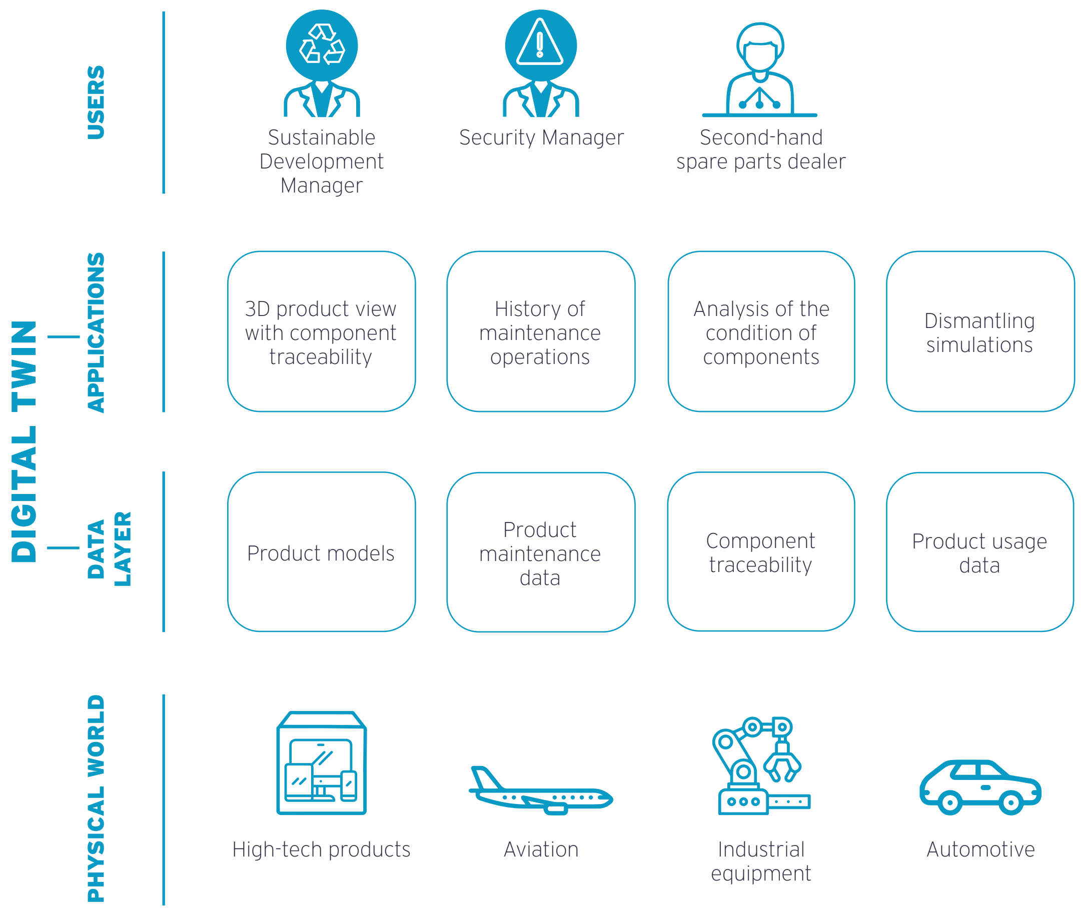
The Digital Twin of the product offers full traceability of product components and their wearing, facilitating reuse and/or recycling.

BENEFITS

- Limit the environmental impacts of industrial production through reuse and recycling.
- Facilitate reuse and recycling thanks to the traceability of various components and their usage & wearing data stored in the Digital Twin (e.g., the state of the battery, making it possible to decide whether or not it can be reused).
- Facilitate the recycling and dismantling of an aircraft by providing a complete and accurate view of the aircraft's condition.

INDUSTRIES

1. Automotive
2. Aviation, trains, ships
3. Construction
4. Industrial equipment
5. High technology
6. Consumer goods



PROCESS

[PCA-01] OPTIMIZATION OF THE SUPPLY NETWORK ACCORDING TO COST, QUALITY, TIME AND ENVIRONMENTAL IMPACT CRITERIA

The supply chain Digital Twin enables the optimization of the supply chain according to cost, quality, lead time and environmental impact criteria through simulations of supply logistics and inbound and outbound production flows.

BENEFITS

- Measure and then reduce the environmental footprint of the upstream chain.
- Manage risk, secure supply, and ensure resilience of the supply models.
- Optimize inventory level and reduce the risk of stock-outs by streamlining the choice of suppliers and supply methods.
- Optimize the storage chain (inbound and outbound).

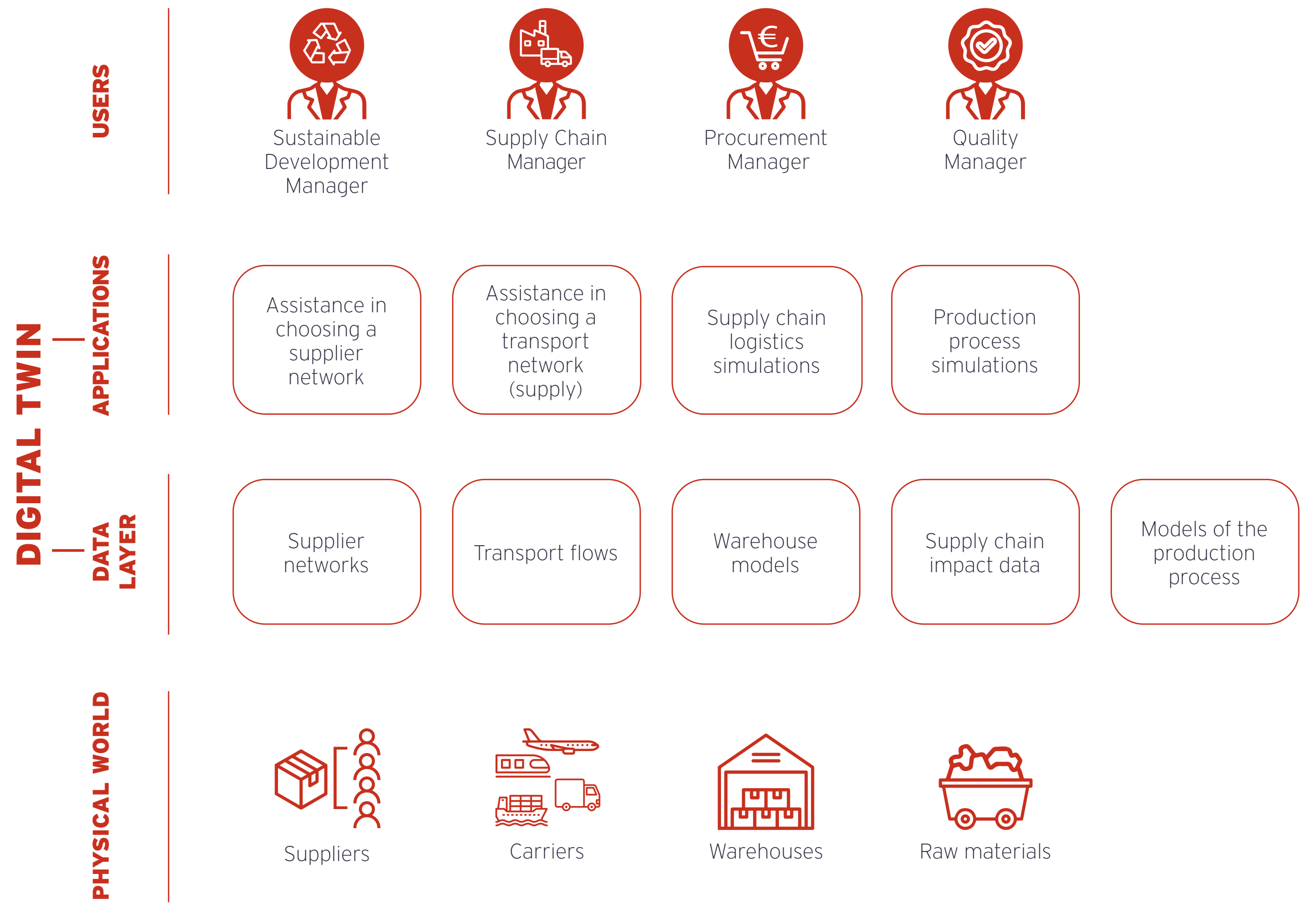
INDUSTRIES

1. Automotive
2. Aviation, trains, ships
3. Construction
4. Industrial equipment
5. High technology
6. Oil and chemical
7. Communication infrastructures
8. Materials
9. Energy production
10. Pharmaceutical products
11. Consumer goods
12. Transport and logistics

INDUSTRY OF THE FUTURE SHOWCASE

Soitec

Viwametal



PROCESS

[PCA-02] DYNAMIC OPTIMIZATION OF SUPPLY CHAIN LOGISTICS

The Digital Twin reflects the supply routes in real time thanks to information shared by the carriers on the location, contents and schedule of the various modes of transport.

BENEFITS

- Improve travel time and route selection, resilience to hazards.
- Optimize delivery times and responsiveness to orders.
- Optimize the refueling of means of transport.
- Improve energy efficiency.

INDUSTRIES

1. Automotive
2. Aviation, trains, ships
3. Construction
4. Industrial equipment
5. High technology
6. Oil and chemical
7. Communication infrastructures
8. Materials
9. Energy production
10. Pharmaceutical products
11. Consumer goods
12. Transport and logistics

INDUSTRY OF THE FUTURE SHOWCASE

OCP

SEW Usocome

Siemens

PROCESS

[PCA-03] OPTIMIZED MANAGEMENT OF STOCKS AND SUPPLY OF THE PRODUCTION LINE

The Digital Twin reflects the current state of stocks for production (stocks of components, sub-components, raw materials, tools, resources and flows, etc.) and compares it with the order book. Sensor data can be used to trigger alerts.

BENEFITS

- Optimize the production rate, responding to production forecasts and recycling defective parts back into the production line or sending them to other operators. All this is possible thanks to the inbound/outbound material and product flows and the status of storage areas, waste bins and raw material stocks, as updated in the Digital Twin of the process.
- Respond to supply incidents involving the production equipment for aeronautical parts, to ensure that production is sustained.

INDUSTRIES

1. Automotive
2. Aviation, trains, ships
3. Construction
4. Industrial equipment
5. High technology
6. Oil and chemical
7. Communication infrastructures
8. Materials
9. Energy production
10. Pharmaceutical products
11. Consumer goods
12. Transport and logistics

INDUSTRY OF THE FUTURE SHOWCASE

SEW Usocome

Siemens

DIGITAL TWIN

USERS	Production Manager	Planning Manager (long term)	Scheduling Manager (short term)	Warehouse Clerk	Supply Chain Manager
APPLICATIONS	3D view of the warehouse with status of stocks	Dashboards, alerts (stocks)	Receipt, monitoring and tracking of orders for the production line	Production line supply and component traceability	Storage of reusable waste
DATA LAYER	Warehouse models	Equipment models	Models of the material flows	Supplier supply schedules	Production status data
PHYSICAL WORLD	Factories	Warehouses	Industrial storage equipment	Materials and products being procured / manufactured	

PROCESS

[PCP-01] IMPROVEMENT OF THE DESIGN OF PRODUCTION LINES

Using simulations based on current and historical production line data and according to projected demand, the Digital Twin enables the improvement of the design of production lines.

BENEFITS

- Optimize the design of new production lines or adapt existing production lines to new products by exploiting the data from the Digital Twins. The Digital Twin benefits manufacturers and integrators, provided they manage to recover operating data from their customers.
- Assist in the decision to relocate production, build new factories or production lines, or modify the supply chain according to cost, quality and environmental impact criteria.

INDUSTRIES

1. Automotive
2. Aviation, trains, ships
3. Construction
4. Industrial equipment
5. High technology
6. Oil and chemical
7. Communication infrastructures
8. Materials
9. Energy production
10. Pharmaceutical products
11. Consumer goods

INDUSTRY OF THE FUTURE SHOWCASE

Alfi Technologie

Aptar Pharma

Elm.Leblanc

Latécoère

L'Oréal

Matra Électronique

Seco

DIGITAL TWIN

USERS	Production Line Designer	Industrialization Manager		
APPLICATIONS	Analysis of production history (incidents)	Analysis of product returns and repairs	Production process simulations	Optimization of the workspace
DATA LAYER	Line and equipment models (past, current)	Production process models (past, present)	Production data	Equipment maintenance data
PHYSICAL WORLD	Production lines	Industrial equipment	Supply flows	

PROCESS

[PCP-02] VIRTUAL COMMISSIONING OF A PRODUCTION LINE

The Digital Twin of the production line can simulate its commissioning or its evolution, so that the line can be approved before its real commissioning.

BENEFITS

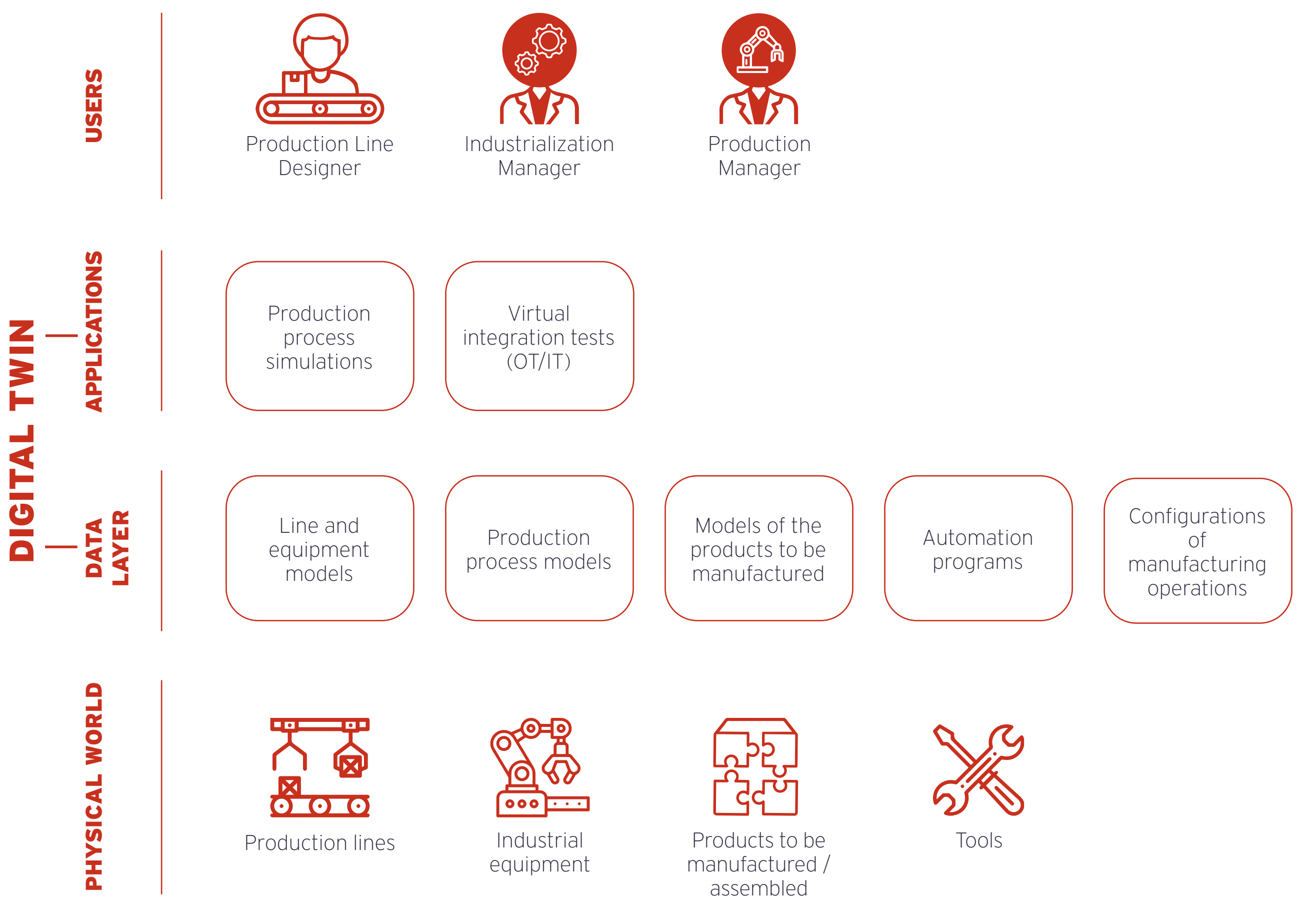
- Reduce the time taken by the IT team to physically test the machine and its connectivity after the line has been delivered, and thus reduce production downtime.
- Verify or anticipate future changes to the new production line when new car models are introduced, as well as test the improvements virtually without disrupting production.

INDUSTRIES

1. Automotive
2. Aviation, trains, ships
3. Construction
4. Industrial equipment
5. High technology
6. Oil and chemical
7. Materials
8. Energy production
9. Pharmaceutical products
10. Consumer goods

INDUSTRY OF THE FUTURE SHOWCASE

Alfi Technologie
Cauquil
Gebo Cermex
Lisi Aérospace (Aveyron)
Schneider Electric
Siemens
Sodistra



PROCESS

[PCP-03] TRAINING OF OPERATORS

The Digital Twin of the production line, its equipments, and its operators, allows the latter to be trained in their tasks, based on the instructions of the process in relation to the physical industrial equipment. This training in production and maintenance operations could be based, for example, on augmented reality techniques, such as the projection of operations to be performed or the use of augmented reality glasses.

BENEFITS

- Train without the need to halt or physically access the production line.
- Improve the quality of training (save time, increase quality, improve safety at work).
- Train to speed up specific production, continuous improvement.
- Provide assistance with job changes.
- Train in equipment maintenance.

INDUSTRIES

1. Automotive
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3. Construction
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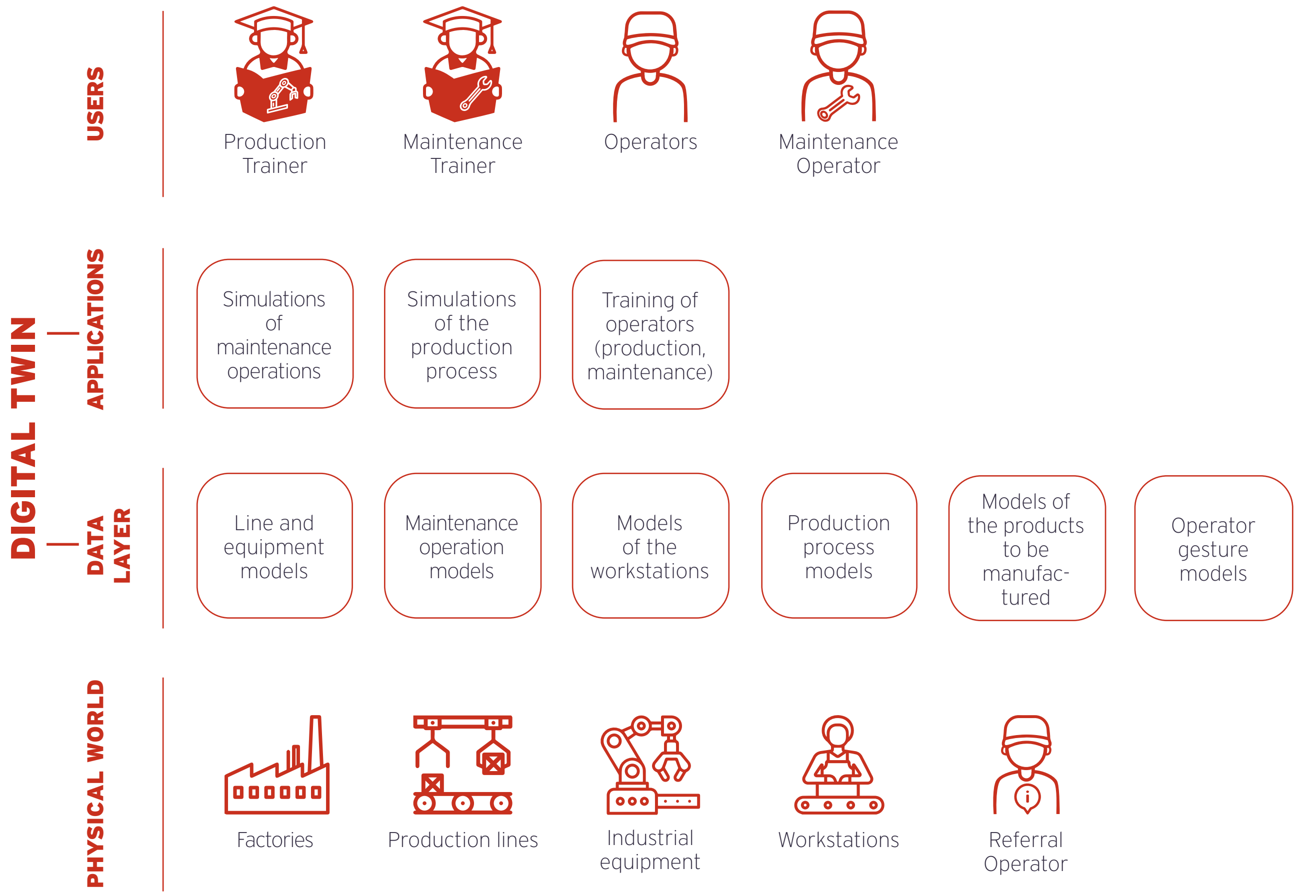
INDUSTRY OF THE FUTURE SHOWCASE

Alfi Technologie
FPT Industrial
L'Oréal
Orano
Schneider Electric
Sunna Design



PROCESS

[PCP-04] OPTIMIZATION OF THE PRODUCTION LINE

The Digital Twin of the production line makes it possible to optimize the uptime of the line, for instance by providing sufficient production buffers and conveyor belts, thereby reducing bottlenecks by increasing output.

BENEFITS

- Optimize the real-time routing of automatically guided vehicles (AGVs) based on vehicle geolocation and the Digital Twin of the production process and factory.
- Optimize the production process based on the location of the products being manufactured. Reduce machine waiting time and movements of operators.

INDUSTRIES

1. Automotive
2. Aviation, trains, ships
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7. Materials
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9. Pharmaceutical products
10. Consumer goods

INDUSTRY OF THE FUTURE SHOWCASE

Vitrine Industrie du Futur

Air Liquide
Airbus Helicopters
Aptar Pharma
Claas Tractor
Cotral Lab
Figeac Aéro
Latécoère
Lisi Aérospace (Val-d'Oise)
Matra Électronique
MG Tech
Safran
Saunier Duval
Schaeffler
Schneider Electric
Siemens
SNCF
Soitec
Velum

USERS: Production Manager; Quality Manager; Scheduling Manager; Maintenance Manager; Operators; Security Manager

DIGITAL TWIN

APPLICATIONS: Real-time 3D view of production lines; Dashboards, alerts (production delays); (Re-)scheduling of production orders (automatic)

DATA LAYER: Models of the production lines; Equipment models; Models of the production process; Production schedules; Production status data

PHYSICAL WORLD: Factories; Production lines; Industrial equipment; Products being manufactured; Electricity or communication networks

PROCESS

[PCP-05] IMPROVEMENT OF PRODUCT QUALITY BASED ON PRODUCTION HISTORY

The Digital Twin of a production line and the products being manufactured makes it possible to improve the quality of the products based on past production data, including the quality issues observed. This data can be used to replay operations, provide predictions and recommendations during production, and simulate alternative operations.

Examples of applications: pneumatics, manufacture of composite materials, vaccines, etc.

BENEFITS

- Identify the causes of past incidents by observing previous end-to-end operations.
- Improve the understanding of the causes of defects, if the model allows it (explanatory model).
- Predict possible incidents based on the production process model built from historical data.
- Improve the quality of the final product by simulating alternative processes to avoid/reduce the predicted incidents and by implementing recommendations.

INDUSTRIES

1. Automotive
2. Aviation, trains, ships
3. Construction
4. Industrial equipment
5. High technology
6. Oil and chemical
7. Materials
8. Energy production
9. Pharmaceutical products
10. Consumer goods

INDUSTRY OF THE FUTURE SHOWCASE

Vitrine Industrie du Futur

Airbus Helicopters
Latécoère
Siemens

USERS: Production Manager; Data Scientist; Production Line Designer; Product Engineer; Quality Manager

DIGITAL TWIN

APPLICATIONS: Analyses of production history (incidents); Construction of predictive models; Predictions of quality defects; Production process simulations; Recommendations for measures to prevent manufacturing defects

DATA LAYER: Models of the material flows; Production process models (past, current); Manufacturing execution settings; Production status data; Product models (past, current)

PHYSICAL WORLD: Production environments (humidity, UV, particles, temperature, etc.); Production lines; Materials and products being procured / manufactured

PROCESS

[PCP-06] REAL-TIME CONTROL OF THE PRODUCTION LINE

The Digital Twin reflects the current production status (production lines, workstations, equipment used, progress of products being manufactured) and compares it with the production schedule. Sensor data can be used to trigger alerts.

BENEFITS

- Have a real-time overview of the progress of production orders for an assembly or manufacturing line. Respond immediately to alerts issued in the event of an incident at a workstation in order to reduce disruption. Automatically or manually re-schedule production following identified incidents and delays.
- Respond to operational incidents involving power generation equipment to ensure the safety of people and sustain production. Be aware of long-term deviations in order to sustain optimal operation.

INDUSTRIES

1. Automotive
2. Aviation, trains, ships
3. Construction
4. Industrial equipment
5. High technology
6. Oil and chemical
7. Materials
8. Energy production
9. Pharmaceutical products
10. Consumer goods

INDUSTRY OF THE FUTURE SHOWCASE

Air Liquide
Airbus Helicopters
Bosch
Cauquil
Cotral Lab
Engie
JPB Système
Lisi Aérospace (Val-d'Oise)
Lisi Automotive
Magafor
Matra Électronique
Michelin
Pellenc
Safran
Schaeffler
Schneider Electric
Soitec
Sunna Design

PROCESS

[PCP-07] REDUCTION OF THE ENVIRONMENTAL IMPACT OF THE PRODUCTION LINE

The Digital Twin makes it possible to monitor the environmental impact of the production line in order to optimize it (production using less energy or water) and comply with regulations.

BENEFITS

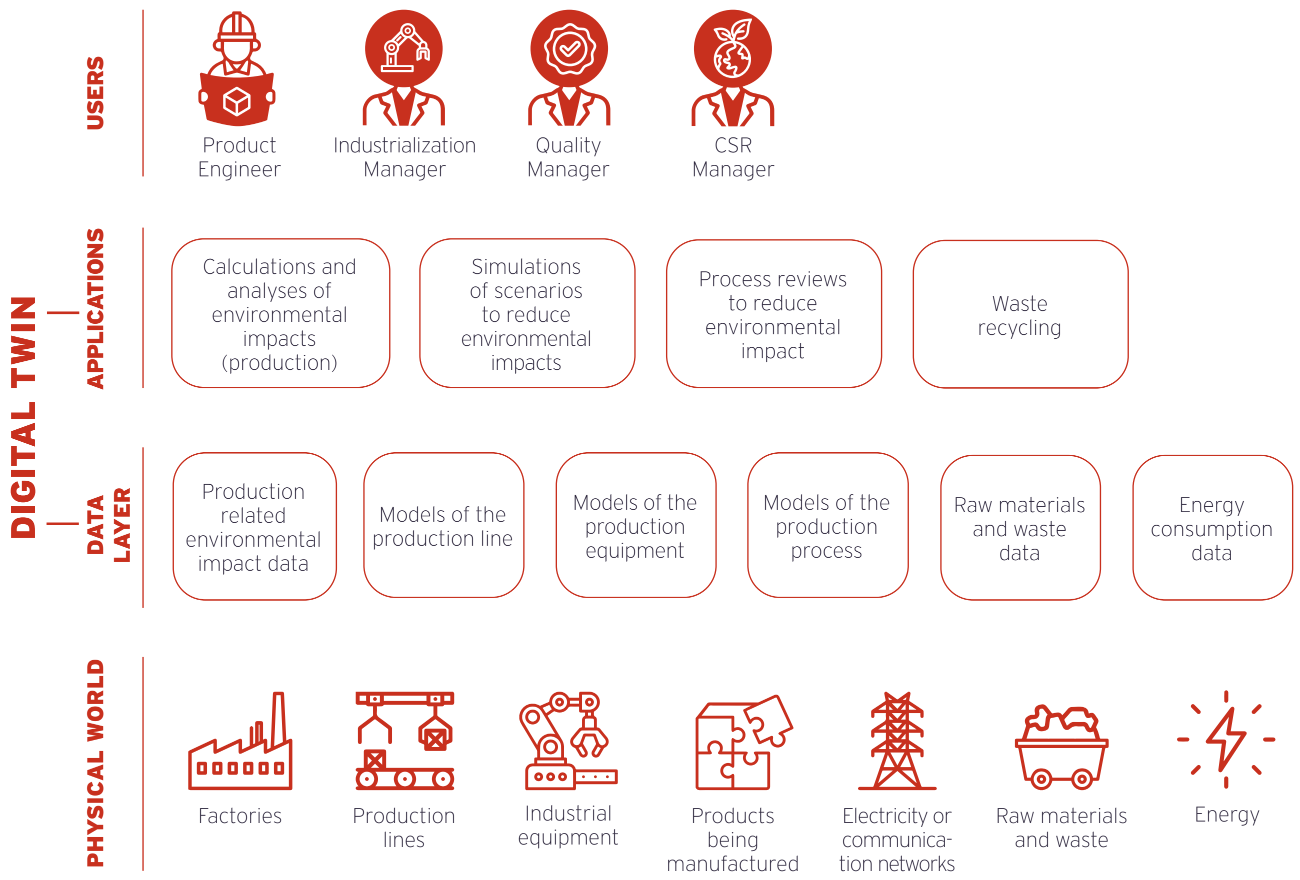
- Reduce the environmental footprint of the production line.
- Contribute to the calculation of the environmental footprint of the product during production.

INDUSTRIES

1. Automotive
2. Aviation, trains, ships
3. Construction
4. Industrial equipment
5. High technology
6. Oil and chemical
7. Communication infrastructures
8. Materials
9. Energy production
10. Pharmaceutical products
11. Consumer goods

INDUSTRY OF THE FUTURE SHOWCASE

Air Liquide
Schaeffler
Siemens



PROCESS

[PCD-01] OPTIMIZATION OF THE PRODUCT DISTRIBUTION NETWORK ACCORDING TO COST, QUALITY, TIME AND ENVIRONMENTAL IMPACT CRITERIA

The Digital Twin of the distribution network assists in the choice of carriers in order to optimize the delivery process according to different criteria such as cost, quality, time and environmental impact. It also makes it possible to study the impact of changes on the current delivery process.

BENEFITS

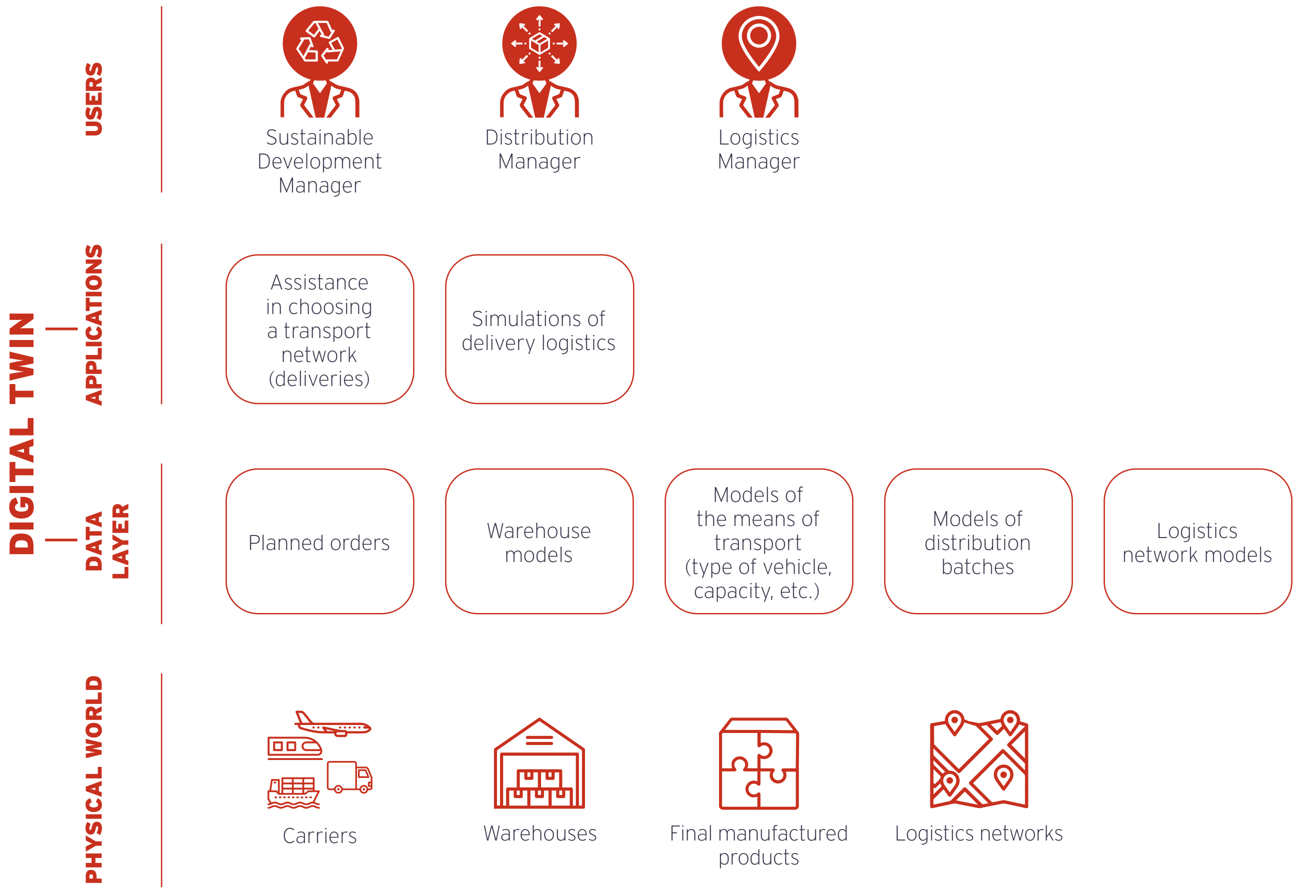
- Measure and then reduce the environmental footprint of the downstream chain.
- Secure deliveries, manage risk, and ensure resilience of the delivery model.
- Streamline the choice of carriers for delivery to optimize the quantities in stock and reduce the risk of delivery delays.
- Experiment with new scenarios, such as the introduction of a deposit process involving the recovery of empty bottles.

INDUSTRIES

1. Automotive
2. Aviation, trains, ships
3. Industrial equipment
4. High technology
5. Oil and chemical
6. Materials
7. Energy production
8. Pharmaceutical products
9. Consumer goods
10. Transport and logistics

INDUSTRY OF THE FUTURE SHOWCASE

OCP



PROCESS

[PCD-02] DYNAMIC OPTIMIZATION OF THE DISTRIBUTION OF A PRODUCT TO CUSTOMERS

The Digital Twin of the complete logistics network and its resources will optimize the real-time distribution of a product to customers through information on shipping planning, determining and adjusting the route, and tracking the receipt of orders.

BENEFITS

- Optimize delivery times and responsiveness to orders.
- Optimize distribution time.
- Reduce the carbon footprint.
- Be resilient to transport contingencies.

INDUSTRIES

1. Automotive
2. Aviation, trains, ships
3. Industrial equipment
4. High technology
5. Oil and chemical
6. Materials
7. Energy production
8. Pharmaceutical products
9. Consumer goods
10. Transport and logistics

RESOURCE

[EQT-01] VIRTUAL COMMISSIONING OF EQUIPMENT

The Digital Twin of a piece of equipment and its tools, presented in the context of the product to be manufactured, makes it possible to virtually validate the introduction (or evolution) of a piece of equipment and its tools or the introduction of a new product before its operational implementation.

BENEFITS

- Reduce production disruptions through prior validation of the production cell, including automation logic.
- Save time through teamwork between robotic engineers, mechanical engineers (designing tools, conveyor belts, workpiece carriers) and automation engineers in a virtual environment.
- Guarantee safety, as the experiments are carried out virtually and not in the workshop.

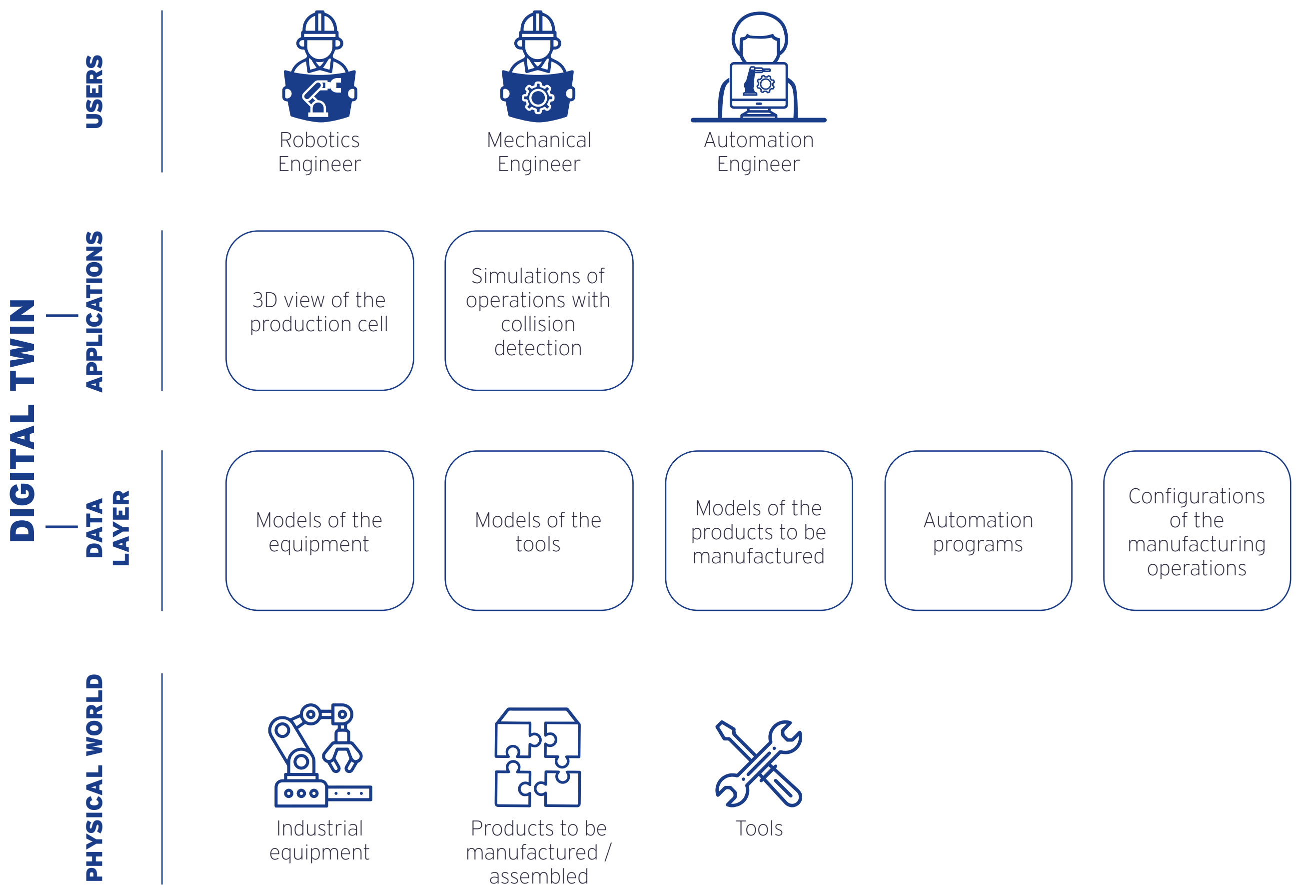
INDUSTRIES

1. Automotive
2. Aviation, trains, ships
3. Construction
4. Industrial equipment
5. High technology
6. Oil and chemical
7. Communication infrastructures
8. Materials
9. Energy production
10. Pharmaceutical products
11. Consumer goods
12. Transport and logistics

INDUSTRY OF THE FUTURE SHOWCASE

Vitrine Industrie du Futur

Alfi Technologie
Gebo Cermex
Latécoère
L'Oréal



RESOURCE

[EQT-02] MAINTENANCE ASSISTANCE

The Digital Twin of a piece of industrial equipment, an industrial plant, or a complex system facilitates maintenance operations.

BENEFITS

- Save time and reduce the error rate by training operators in the maintenance of industrial equipment, possibly using augmented reality (e.g., projection of operations to be performed).
- Reduce the environmental impact and save time through remote maintenance of complex equipment or systems. An expert, who has a Digital Twin that reflects the exact status and configuration of the equipment on the customer's premises, remotely guides an operator on site.
- Prepare a maintenance operation for industrial and nuclear facilities in order to reduce the duration of the operation and guarantee its safety.
- Work on a Digital Twin for a semiconductor supplier, which puts the physical equipment in failure conditions thanks to the recovery of the last memory state. The correction is worked out remotely and then applied and tested on site.

INDUSTRIES

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8. Materials
9. Energy production
10. Pharmaceutical products
11. Consumer goods
12. Transport and logistics

INDUSTRY OF THE FUTURE SHOWCASE

Vitrine Industrie du Futur

Alfi Technologie
Bosch
Lectra
L'Oréal
Savréso
Siemens

RESOURCE

[EQT-03] PREDICTIVE MAINTENANCE OF EQUIPMENT

The Digital Twin of a piece of equipment can predict the occurrence of breakdowns, provide maintenance recommendations and, if the predictive model allows it, assist in troubleshooting. A predictive model is built beforehand based on observed failures and historical equipment usage data.

Examples of data: vibrations, acoustic signals, infrared images, machine parameters.

BENEFITS

- Reduce the number of unexpected breakdowns that can potentially disrupt production.
- Reduce equipment unavailability as maintenance is only carried out when necessary and not according to a pre-determined schedule.
- Improve the understanding of the causes of breakdowns, if the model allows it (explanatory model, as opposed to a black box model).

INDUSTRIES

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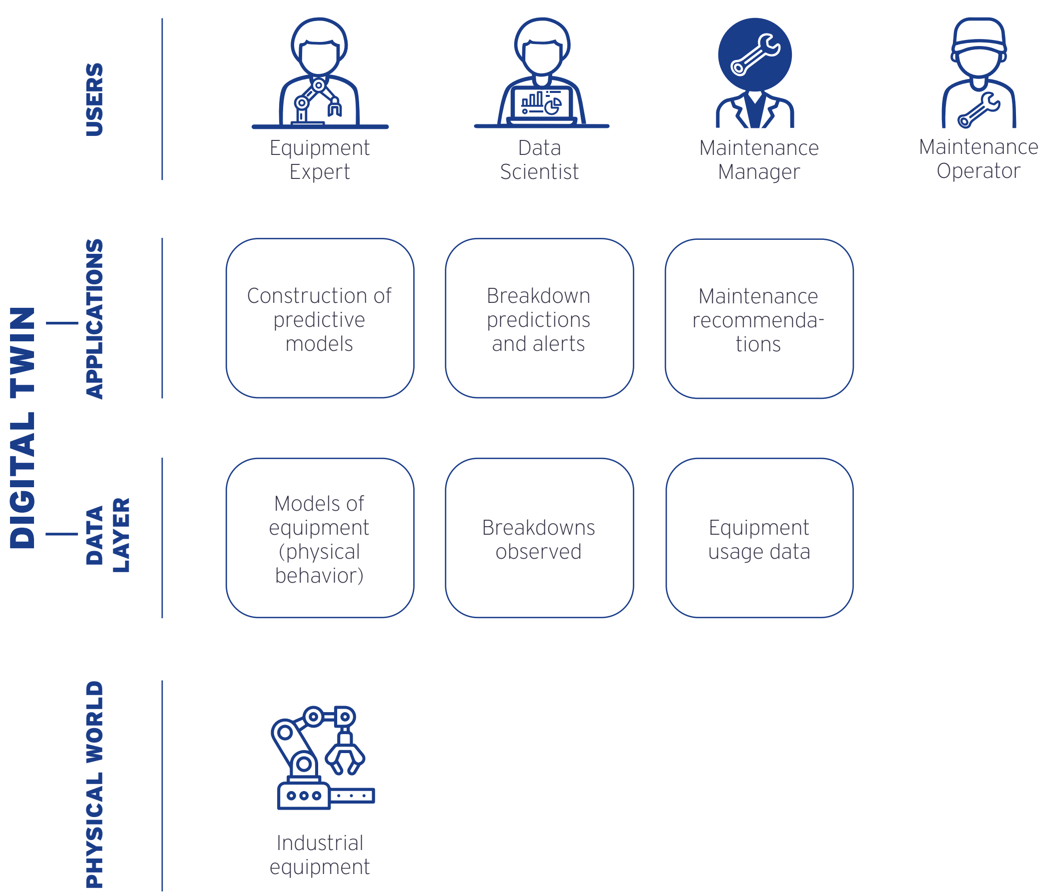
8. Materials
9. Energy production
10. Pharmaceutical products
11. Consumer goods
12. Transport and logistics

INDUSTRY OF THE FUTURE SHOWCASE

Vitrine Industrie du Futur

Air Liquide
Elm.Leblanc
Engie
FPT Industrial
Gebo Cermex
L'Oreal (Aisne)
Schneider Electric
Siemens
SNCF



RESOURCE

[EQT-04] DESIGN AND ADMINISTRATION OF A FACTORY OT/IT ARCHITECTURE

The Digital Twin reflects the current state of the communication network of a factory.

BENEFITS

- Detect breakdowns.
- Optimize and improve in order to meet future demand. Optimize performance and energy consumption.
- Automate to ensure that service quality targets are met.
- Simulate failures and potential changes in the OT/IT architecture.

INDUSTRIES

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RESOURCE

[USN-01] MANAGEMENT OF INDUSTRIAL INFRASTRUCTURE THROUGHOUT ITS LIFE CYCLE

The Digital Twin allows for better management of the infrastructure from its design to its operation. Information is contextualized and available in real time. This allows each stakeholder to be independent in their contribution and decision-making.

The Digital Twin model is created at the design stage. Its data, models and visualizations are used throughout the life cycle. Operations can develop the Digital Twin and also provide feedback for the design.

BENEFITS

Design and construction stages:

- Control the CAPEX by optimizing the design of the equipment.
- Reduce the risk by consolidating data, not duplicating it.
- Control the environmental impact by integrating the construction elements.

Operation stage:

- Control the time taken for commissioning infrastructure and for operators to get familiar with it.
- Access data and records for maintenance operators from the outset, and capture feedback for the design.
- Control risks by detecting failures, issuing alerts and simulations.

INDUSTRIES

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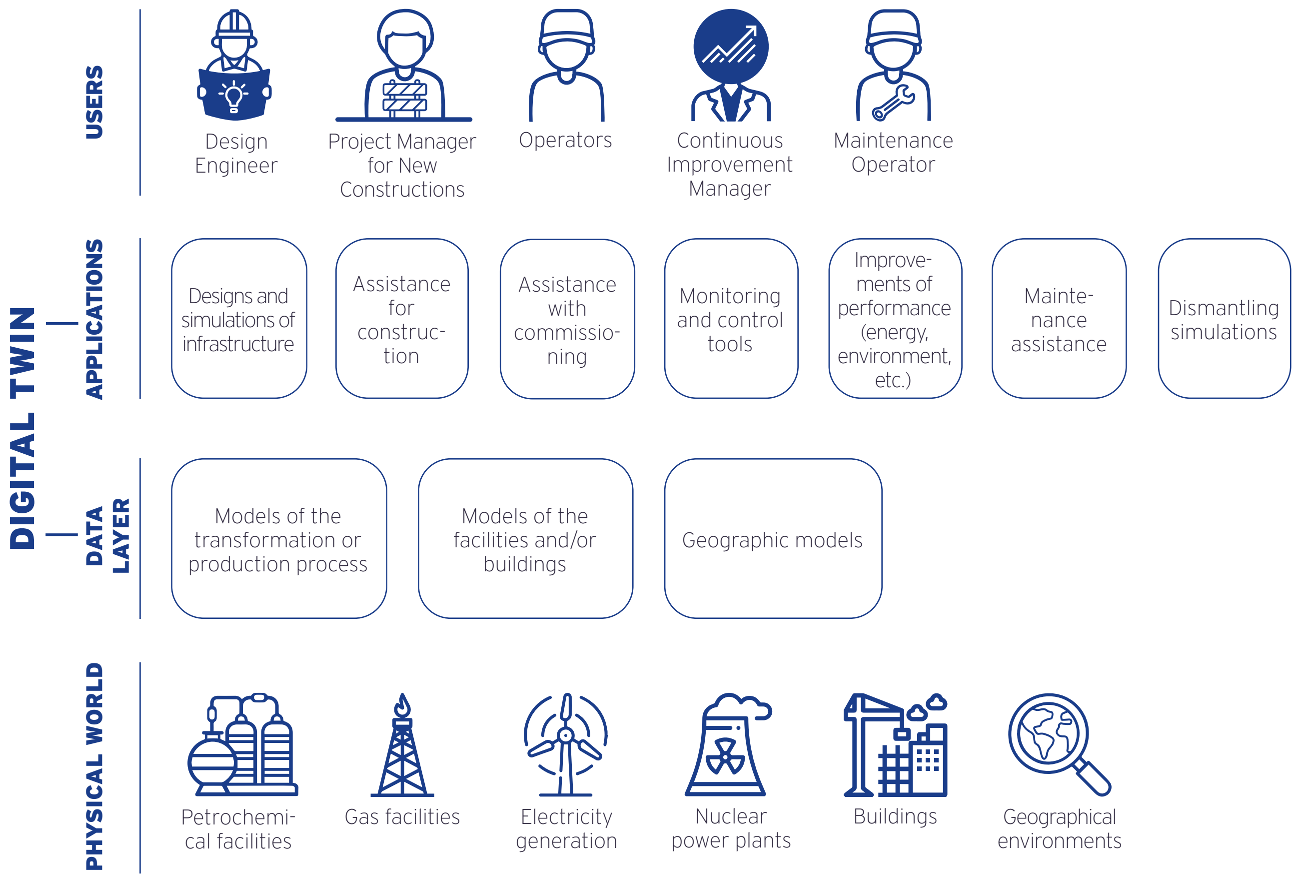
8. Energy production
9. Pharmaceutical products
10. Consumer goods
11. Transport and logistics

INDUSTRY OF THE FUTURE SHOWCASE

Vitrine Industrie du Futur

Air Liquide
Latécoère
Lisi Aérospace (Aveyron)
Groupe Monnoyeur
Schaeffler
Schneider Electric
Siemens
Sodistra



OPERATORS

[OPR-01] IMPROVEMENT OF THE ERGONOMICS OF THE WORKSTATION

The Digital Twin of an operator, in the context of their workstation, can simulate their activity and detect painful or dangerous postures or movements. The operator's body type can be reflected in the Digital Twin, and the areas subject to stress (lumbar region, arm muscles, etc.) are highlighted during the simulation of movements.

The cognitive load of the operator can be optimized: design of the dashboard, process cockpit, etc.

BENEFITS

- Reduce musculoskeletal disorders and improve health and well-being at work.
- Improve work efficiency by detecting unnecessary or awkward movements and experiment with corrections.
- Make fewer errors related to cognitive load.

INDUSTRIES

1. Automotive
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3. Construction
4. Industrial equipment
5. High technology
6. Oil and chemical
7. Communication infrastructures
8. Materials
9. Energy production
10. Pharmaceutical products
11. Consumer goods
12. Transport and logistics

INDUSTRY OF THE FUTURE SHOWCASE

Vitrine Industrie du Futur

Elm.Leblanc
FPT Industrial
Pellenc
Schneider Electric
Seco
Wilo

WHAT WAS IMPOSSIBLE YESTERDAY IS POSSIBLE TODAY!

Since 2011 and the Industry 4.0 initiative, with the arrival of the cloud and its computing and storage power, the rise of new technologies and digital engineering has been driving the new industrial revolution.

At the heart of this paradigm shift, the Digital Twin offers a way to represent a real-world entity to address specific issues and uses.

The Digital Twin has a positive impact on organizational, technological, environmental, societal and financial issues for companies. Updating data with a frequency and precision adapted to the issues and uses will encourage companies to question and even reinvent themselves in order to cope with global competition.

The benefits of the Digital Twin as a solution for understanding, analyzing, predicting and optimizing operations will also encourage companies to consider new business models and new uses.

WHAT WAS IMPOSSIBLE YESTERDAY IS POSSIBLE TODAY.

Savings of 30% during the design phase and 50% throughout the industrial value chain, lead times halved, machine downtime reduced by 20% and significant reductions in environmental impact are all made visible by the performance indicators calculated by the Digital Twin.

The current cost of a Digital Twin ranges from €50,000 to over €500,000, depending on whether it is an equipment twin or a factory twin. However, the return on investment is a more relevant indicator than the cost.

As **the Industry of the Future Showcases*** demonstrate, the return on investment can be achieved in just a few months, because the expected gains throughout the value chain are identified and demonstrated, and form part of the capitalization of knowledge. The benefits will then add up with the implementation of new use cases based on the Digital Twin already built.

The holistic dimension of the Digital Twin enables digital continuity between the different business lines of the company and along the upstream and downstream value chains, throughout the product life cycle. It therefore promotes the convergence of IT systems and industrial operations, to the benefit of the sustainability of companies and greater knowledge of ecosystems and markets.

HOW CAN AN INDUSTRIAL DIGITAL TWIN BE IMPLEMENTED?

It requires a step-by-step approach, which will be the subject of an upcoming AIF document that will address, among other things, the issues of information flows (IT) and internal operational technologies (OT).

***find out more**

APPENDICES

A USE CASE FOR EVERYONE

The tables in the appendices allow readers to find the most relevant use cases according to their profiles.

THERE ARE 5 DIFFERENT FILTERS:

- **User**: Data Scientist, Quality Manager, etc.
- **Applications offered by the Digital Twin**: production process simulations, maintenance recommendations, etc.
- **Data & models used by the Digital Twin**: production data, equipment model, etc.
- **Real-world objects represented**: industrial equipment, warehouses, etc.
- **Relevant industries for the use cases**: automotive, construction, etc.

This will allow you to explore the possibilities of using the data and models of a Digital Twin for other similar use cases, thereby increasing the return on investment.

FILTER 1: USER

USER \ FAMILY	PRODUCT	PROCESS	RESOURCE	OPERATORS
Automation Engineer			EQT-01	
Project Manager for New Constructions			USN-01	
End customer		PCD-02		
Production Line Designer		PCP-01, PCP-02, PCP-05		
Driver	PDT-04			
Data Scientist		PCP-05	EQT-03	
Equipment Expert			EQT-03	
Maintenance Trainer		PCP-03		
Production Trainer		PCP-03		
Warehouse Manager		PCA-02		
Mechanical Engineer			EQT-01	
Methods Engineer	PDT-02			OPR-01
Product Engineer	PDT-01, PDT-02, PDT-03	PCP-05, PCP-07	USN-01	
Robotics Engineer			EQT-01	
Warehouse Clerk		PCA-03, PCD-02		
Operators		PCP-03, PCP-04, PCP-06	USN-01	
Maintenance Operator		PCP-03	EQT-02, EQT-03, USN-01	
Embedded Systems Programmer	PDT-04			
Technician	PDT-04			
Procurement Manager		PCA-01		
Continuous Improvement Manager			USN-01	
Supply Chain Manager	PDT-02	PCA-01, PCA-02, PCA-03		
Cybersecurity Manager			EQT-04	
Sustainable Development Manager	PDT-02, PDT-05	PCA-01, PCD-01		
Distribution Manager		PCD-01, PCD-02		
Industrialization Manager	PDT-01, PDT-03	PCP-01, PCP-02, PCP-07		
IT Manager			EQT-04	
Logistics Manager		PCA-02, PCD-01, PCD-02		
Maintenance Manager		PCP-04, PCP-06	EQT-02, EQT-03, EQT-04	
Scheduling Manager		PCA-03, PCP-04, PCP-06		
Planning Manager		PCA-03		
Production Manager		PCA-03, PCP-02, PCP-04, PCP-05, PCP-06		
Quality Manager	PDT-01, PDT-03, PDT-04	PCA-01, PCP-04, PCP-05, PCP-06, PCP-07		
Quality Manager	PDT-03, PDT-04	PCA-01, PCP-04, PCP-05, PCP-06, PCP-07		
CSR Manager (Corporate Social Responsibility)		PCP-07		
Occupational Health Manager				OPR-01
Security Manager	PDT-05	PCP-04, PCP-06		
Second-hand spare parts dealer	PDT-05			
Ergonomics Specialist				OPR-01

FILTER 2: APPLICATION

APPLICATION OF THE DT \ USE CATEGORY	UNDERSTAND	OPTIMIZE	EXPLOIT
Assistance for construction	USN-01		
Assistance with maintenance of infrastructure	USN-01		
Assistance with commissioning of infrastructure			USN-01
Troubleshooting assistance		PDT-04	
Repair assistance	PDT-04		
Assistance in choosing a supplier network		PCA-01	
Assistance in choosing a transport network		PCA-01, PCD-01	
Assistance in dynamically selecting the best distribution route		PCD-02	
Improvements of infrastructure performance			USN-01
Analyses of the condition of components	PDT-05		
Analyses of production history	PDT-01,PCP-01,PCP-05		
Analyses of product returns and repairs	PDT-01, PCP-01		
Analyses of consumer usage	PDT-01		
Production line supply and component traceability		PCA-03	
Calculations and analyses of environmental impacts	PDT-02, PCP-07		
Designs and simulations of infrastructure	USN-01		
Packaging of deliveries		PCD-02	
Construction of predictive models		PCP-05, EQT-03	
Detection of threats (cyber security)	EQT-04		
Experimentations with modifications to the workstation		OPR-01	
Training of operators	PCP-03, EQT-02		
Self-adaptive management of network resources	EQT-04		
History of maintenance operations	PDT-05		
Storage of reusable waste		PCA-03	
Consumption optimization		PDT-04	
Optimization of the workspace		PCP-01	
Optimization of the logistics route		PCA-02	
Optimization of the refueling of vehicles		PCA-02	
Monitoring and control tools			USN-01
Shipping schedules		PCD-02	
Breakdown predictions and alerts			EQT-03
Predictions of quality defects		PCP-05	
Receipt, monitoring and tracking of orders for the production line			PCA-03
Recommendations for measures to prevent manufacturing defects		PCP-05	
Maintenance recommendations		PDT-04, EQT-03	
Product use recommendations		PDT-04	
(Re-)scheduling of production orders			PCP-04, PCP-06
Process or product reviews to reduce environmental impact	PDT-02, PCP-07		
Simulations of maintenance operations	PCP-03, EQT-02		
Simulations of product behavior	PDT-01, PDT-03		
Simulations of operator movements	OPR-01		
Simulations of ITOT networks	EQT-04		
Simulations of scenarios to reduce environmental impacts	PDT-02, PCP-07		
Simulations of operations with collision detection	EQT-01		
Dismantling simulations	PDT-05, USN-01		
Supply chain logistics simulations		PCA-01	
Simulations of delivery logistics		PCA-01	
Production process simulations	PDT-01, PCA-01, PCP-01, PCP-02, PCP-03, PCP-05		
Tracking the distribution of batches of products		PCD-02	
Tracking of the delivery by the customer		PCD-02	
Dashboards, alerts			PCA-03, PCP-04, PCP-06, EQT-01
Remote maintenance			EQT-02
Virtual integration tests (OTIT)		PCP-02	
Waste recycling		PCP-07	
3D view of the warehouse with status of inventory levels			PCA-03
3D view of the production cell	EQT-01		
3D view of the operator in their working environment	OPR-01		
3D view of network coverage	EQT-04		
Real-time 3D view of production lines			PCP-04, PCP-06
3D product view with component traceability	PDT-04, PDT-05		

APPENDICES

FILTER 3: DATA & MODELS USED BY THE DIGITAL TWIN

DIGITAL TWIN \ FAMILY	PRODUCT	PROCESS	RESOURCE	OPERATORS
Planned orders		PCD-01		
Vehicle energy consumption data		PCA-02		
Equipment maintenance data		PCP-01		
Product maintenance data	PDT-01, PDT-04, PDT-05			
Production data		PCA-03, PCP-01, PCP-04, PCP-05,PCP-06		
Supply chain environmental impact data	PDT-02	PCA-01		
Production-related environmental impact data	PDT-02	PCP-07		
Equipment usage data			EQT-03	
Product usage data	PDT-01, PDT-04,PDT-05			
Transport flows		PCA-01		
Packing list and delivery constraints		PCA-02		
Operator gesture models		PCP-03	EQT-02	OPR-01
Models of the operator				OPR-01
Models of stress on the human body				OPR-01
Warehouse models		PCA-01, PCA-03, PCD-01, PCD-02		
Equipment models		PCA-03, PCP-01, PCP-02, PCP-03, PCP-04, PCP-06, PCP-07, PCD-02	EQT-01, EQT-02, EQT-03	
Models of connected equipment			EQT-04	
Models of the production lines		PCP-01, PCP-02, PCP-03, PCP-04, PCP-06, PCP-07	EQT-02	
Models of distribution batches		PCD-01, PCD-02		
Models of the means of transport (type of vehicle, capacity, etc.)		PCA-02, PCD-01, PCD-02		
Models of maintenance operations		PCP-03	EQT-02	
Models of tools			EQT-01, EQT-02	
Models of the buildings			EQT-04, USN-01	
Models of the material flows		PCA-03, PCP-05		
Models of the workstations		PCP-03		OPR-01
Models of the production process	PDT-01, PDT-03	PCA-01, PCP-01, PCP-02, PCP-03, PCP-04, PCP-05, PCP-06, PCP-07	EQT-04, USN-01	
Models of the network (OTIT) edge - cloud			EQT-04	
Logistics network models		PCA-01, PCA-02, PCD-01, PCD-02		
Models and status of logistics networks (GPS coordinates, traffic, etc.)		PCA-02, PCD-02		
Geographic models			USN-01	
Product models	PDT-01, PDT-02,PDT-03, PDT-04, PDT-05	PCP-02, PCP-03, PCP-05	EQT-01	OPR-01
Breakdowns observed			EQT-03	
Configurations of manufacturing operations		PCP-02, PCP-05	EQT-01	
Supplier supply schedules		PCA-03		
Delivery schedules		PCD-02		
Production schedules		PCP-04, PCP-06		
Automation programs		PCP-02	EQT-01	
Component traceability	PDT-05			

FILTER 4: REAL-WORLD OBJECTS REPRESENTED

PHYSICAL WORLD \ FAMILY	PRODUCT	PROCESS	RESOURCE	OPERATORS
Cars, planes, high-tech products...	PDT-01, PDT-04, PDT-05		EQT-02	
Other connected equipment			EQT-04	
Components	PDT-02, PDT-03			
Energy	PDT-02	PCA-02, PCP-07		
Warehouses		PCA-01, PCA-02, PCA-03, PCD-01, PCD-02		
Production environments		PCP-05		
Geographical environments			USN-01	
Industrial equipment		PCA-03, PCP-01, PCP-02, PCP-03, PCP-04, PCP-06, PCP-07, PCD-02	EQT-01, EQT-02, EQT-03, EQT-04	
Supply flows		PCP-01		
Suppliers		PCA-01		
Energy infrastructures		PCA-02		
Petrochemical, gas and electricity production facilities, nuclear power plants, construction, etc.			USN-01	
Production lines	PDT-03	PCP-01, PCP-02, PCP-03, PCP-04, PCP-05, PCP-06, PCP-07	EQT-04	
Raw material and waste	PDT-02	PCA-01, PCP-07		
Operators		PCP-03		OPR-01
Tools		PCP-02	EQT-01	
Workstations		PCP-03		OPR-01
Products to be manufactured/assembled		PCP-02	EQT-01	OPR-01
Products being manufactured or supplied	PDT-03	PCA-03, PCP-04, PCP-05, PCP-06, PCP-07		
Final manufactured products	PDT-02	PCD-01, PCD-02		
Electricity or communication networks		PCP-04, PCP-06, PCP-07	EQT-04	
Logistics networks		PCA-02, PCD-01, PCD-02		
Carriers		PCA-01, PCA-02, PCD-01, PCD-02		
Factories		PCA-03, PCP-03, PCP-04, PCP-06, PCP-07	EQT-04	

FILTER 5: RELEVANT INDUSTRIES FOR THE USE CASES

INDUSTRY \ FAMILY	PRODUCT	PROCESS	RESOURCE	USER
Automotive	PDT-01,PDT-02, PDT-04,PDT-05	PCA-01, PCA-02, PCA-03, PCP-01, PCP-02, PCP-03, PCP-04, PCP-05, PCP-06, PCP-07, PCD-01, PCD-02	EQT-01, EQT-02, EQT-03, EQT-04, USN-01	OPR-01
Aviation, trains, ships	PDT-01,PDT-02, PDT-04,PDT-05	PCA-01, PCA-02, PCA-03, PCP-01, PCP-02, PCP-03, PCP-04, PCP-05, PCP-06, PCP-07, PCD-01, PCD-02	EQT-01, EQT-02, EQT-03, EQT-04, USN-01	OPR-01
Construction	PDT-01,PDT-02, PDT-04,PDT-05	PCA-01, PCA-02, PCA-03, PCP-01, PCP-02, PCP-03, PCP-04, PCP-05, PCP-06, PCP-07	EQT-01, EQT-02, EQT-03	OPR-01
Industrial equipment	PDT-01, PDT-02, PDT-03, PDT-04, PDT-05	PCA-01, PCA-02, PCA-03, PCP-01, PCP-02, PCP-03, PCP-04, PCP-05, PCP-06, PCP-07, PCD-01, PCD-02	EQT-01, EQT-02, EQT-03, EQT-04, USN-01	OPR-01
High technology	PDT-01, PDT-02, PDT-03, PDT-04	PCA-01, PCA-02, PCA-03, PCP-01, PCP-02, PCP-03, PCP-04, PCP-05, PCP-06, PCP-07, PCD-01, PCD-02	EQT-01, EQT-02, EQT-03, EQT-04, USN-01	OPR-01
Oil and chemical	PDT-02	PCA-01, PCA-02, PCA-03, PCP-01, PCP-02, PCP-03, PCP-04, PCP-05, PCP-06, PCP-07, PCD-01, PCD-02	EQT-01, EQT-02, EQT-03, EQT-04, USN-01	OPR-01
Communication infrastructures	PDT-02, PDT-03, PDT-04	PCA-01, PCA-02, PCA-03, PCP-01, PCP-03, PCP-07	EQT-01, EQT-02, EQT-03, EQT-04, USN-01	OPR-01
Materials	PDT-02	PCA-01, PCA-02, PCA-03, PCP-01, PCP-02, PCP-03, PCP-04, PCP-05, PCP-06, PCP-07, PCD-01, PCD-02	EQT-01, EQT-02, EQT-03, EQT-04, USN-01	OPR-01
Energy production	PDT-04	PCA-01, PCA-02, PCA-03, PCP-01, PCP-02, PCP-03, PCP-04, PCP-05, PCP-06, PCP-07, PCD-01, PCD-02	EQT-01, EQT-02, EQT-03, EQT-04, USN-01	OPR-01
Pharmaceutical products	PDT-02	PCA-01, PCA-02, PCA-03, PCP-01, PCP-02, PCP-03, PCP-04, PCP-05, PCP-06, PCP-07, PCD-01, PCD-02	EQT-01, EQT-02, EQT-03, EQT-04, USN-01	OPR-01
Consumer goods	PDT-01, PDT-02, PDT-04,PDT-05	PCA-01, PCA-02, PCA-03, PCP-01, PCP-02, PCP-03, PCP-04, PCP-05, PCP-06, PCP-07, PCD-01, PCD-02	EQT-01, EQT-02, EQT-03, EQT-04, USN-01	OPR-01
Transport and logistics	PDT-04	PCA-01, PCA-02, PCA-03, PCP-03, PCD-01, PCD-02	EQT-01, EQT-02, EQT-03, EQT-04, USN-01	OPR-01

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Created in 2015, the Alliance Industrie du Futur (AIF) is a non-profit association which organizes and coordinates, on a national level, the initiatives, projects and work of SMEs for the modernization of industrial tools and the transformation of their economic model, in particular through the contribution of new technologies.

With Frédéric Sanchez as its president since March 2021, it is responsible for the **Solutions Industry of the Future** Sector, certified by the National Industry Council: **www.solutionsindustriedufutur.org**.

To this end, it leads the project groups of the Strategic Sector Contract. Its commitment: to integrate the employee, with their expertise and interpersonal skills, as a key element in the success of this process. The goal is to reposition the French offer of solutions for the industry of the future at the heart of the country's industrial revival.

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