Present and Future of Data Value from Digital Twin

Engineering Innovation - Where Business Meets Technology

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World Mobile Congress

Industry Data Value Workshop

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At a Glance: a Global Company

1.24 B€
REVENUE FY2020

+20
M&A LAST 4 YEARS

41% PROPRIETARY SOLUTIONS

47% APPLICATION MANAGEMENT & TRANSFORMATION

12% MANAGED SERVICES

+11.600
ASSOCIATES

+1.000
NEW HIRES PER YEAR

+16.000
PROJECTS IN 2020

+40
OFFICES AROUND THE WORLD

GLOBAL HQ
ROME, ITALIY

OFFICES IN EUROPE, NORTH AMERICA, LATIN AMERICA

RESEARCH & INNOVATION

+40m€ InvestimentS/YR
+100 Active Research Projects
+450 Data Scientists and Researchers

IT & MANAGEMENT ACADEMY
"ENRICO DELLA VALLE"

15.000 Man Days/YR Training
+1.000 Professional Certifications
+5.400 Courses & E-learning Courses

READ WHITE PAPER

Blending and Embracing All Markets

Working on Core Processes

OUR PORTFOLIO

THE WORLD **WE LIVE IN**

- **Smart Energy & Utilities**
- **Digital Media & Communication**
- **Augmented City**
- **Smart Transportation**

THE WORLD **WE WORK IN**

- **Digital Finance**
- **Digital Industry**
- **Digital Retail & Fashion**
- **Smart Agriculture**

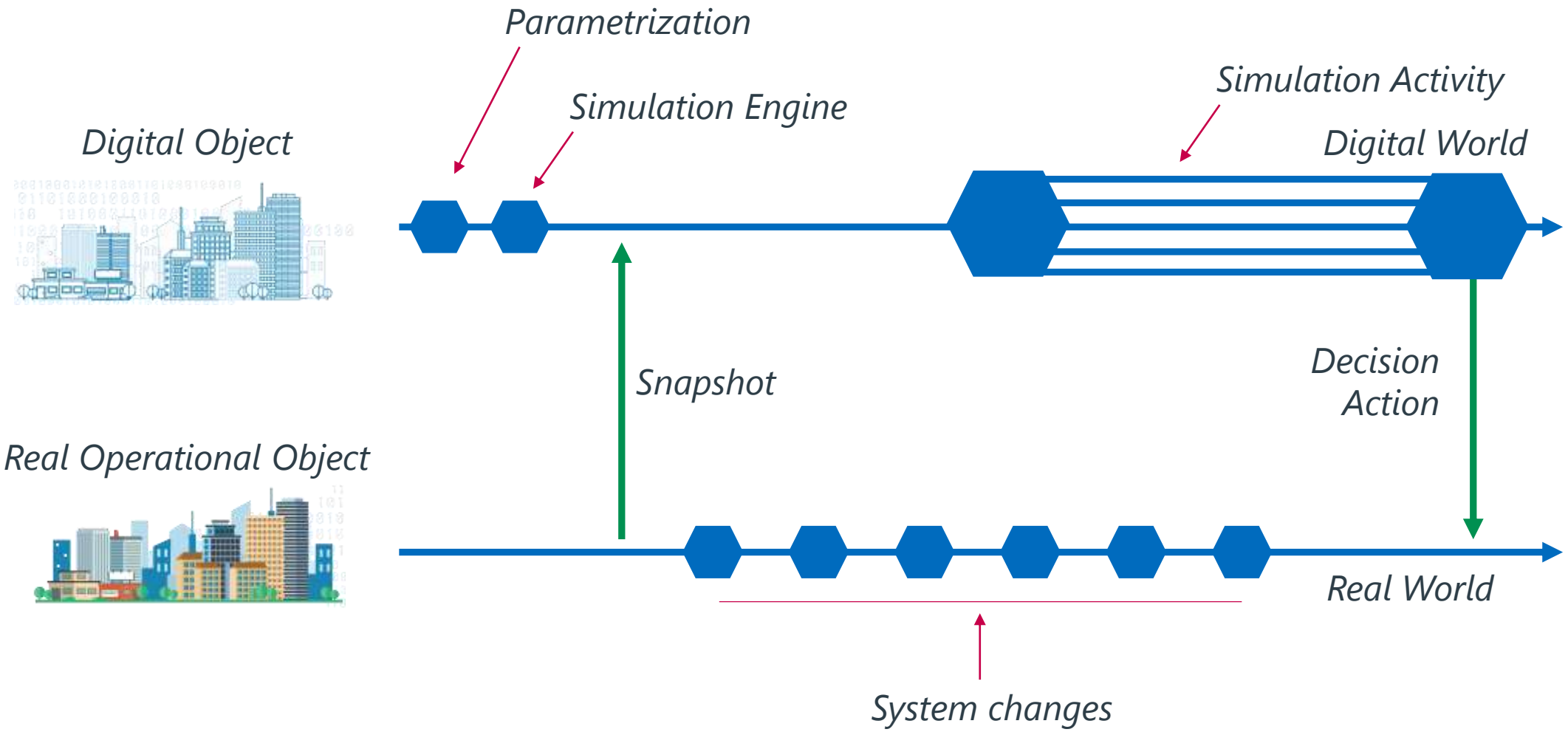
THE WORLD **THAT LOOK AFTER US**

- **Smart Government**
- **E-Health**
- **Digital Defense, Aerospace & Homeland Security**

Click on portfolio items for extra details

DISCOVER MORE

How (unfortunately) sometimes Digital Twins work



Problem: actions refer to to a different system from the one we had at the beginning

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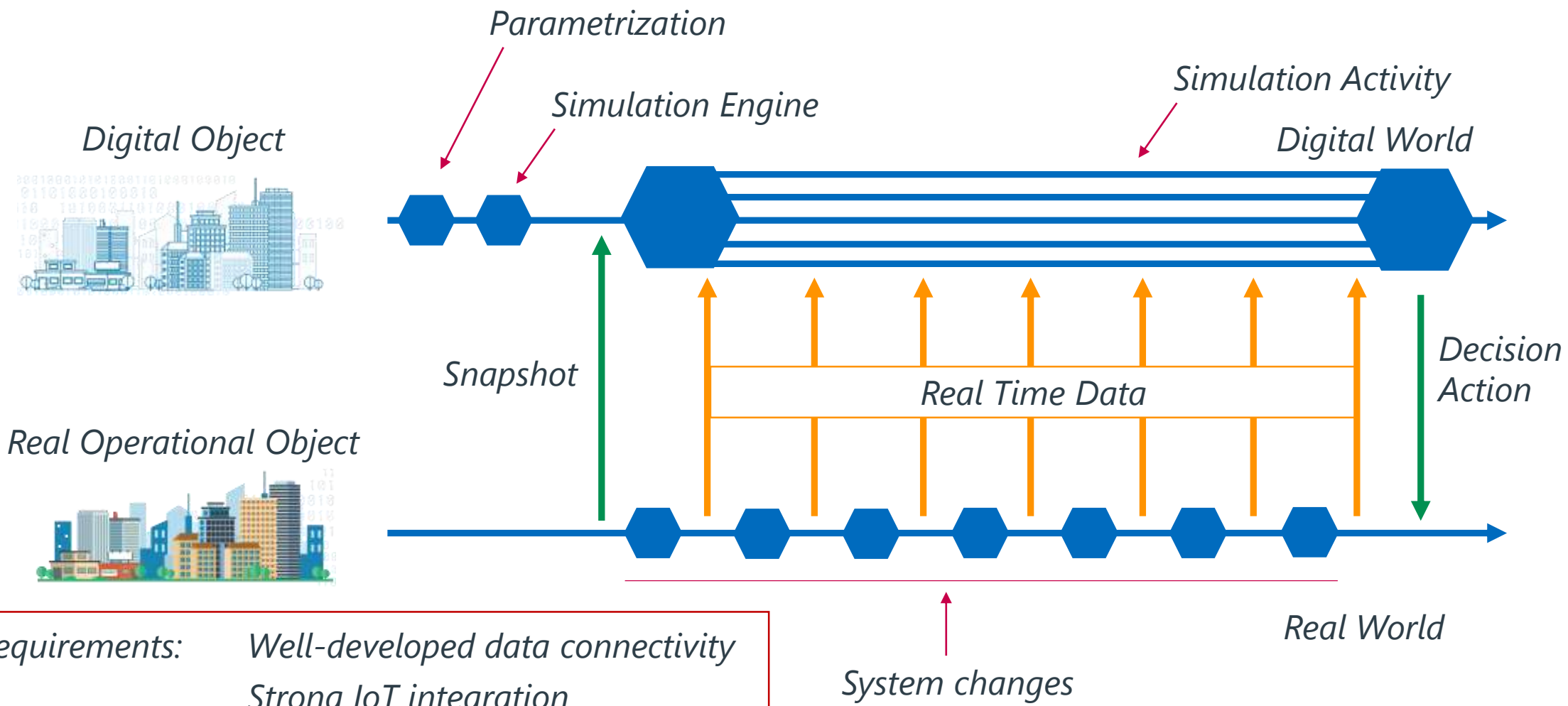
How Digital Twins systems should work



Requirements:

- *Well-developed data connectivity*
- *Strong IoT integration*
- *Flexible and deep parametrization*
- *High performance simulation*

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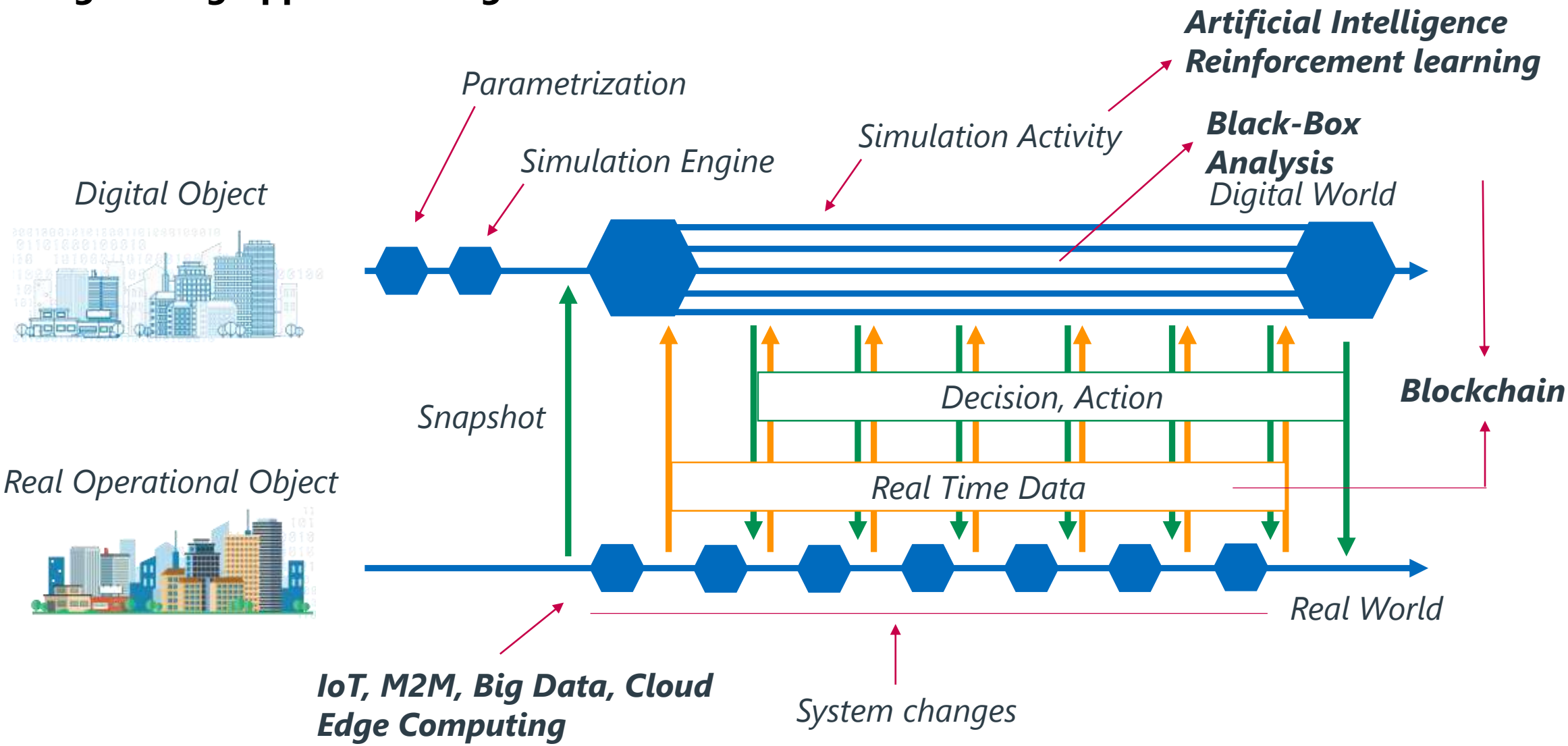
The Engineering Approach to Digital Twin



Goal: Autonomous Digital Twin

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Reinforcement learning

- *Reinforcement learning is the training of machine learning models to make a sequence of decisions.*
- *The goal of reinforcement learning is to train an intelligent agent how to behave (i.e. taking decisions or actions) in a given environment to maximize its future reward.*
- *The agent learns how to iteratively improve its decisions to reach its goal in the most efficient way. In Digital Twin it knows how the system works, what are the initial data, how data change in time.*
- *Reinforcement learning unlike supervised learning and unsupervised learning, aims to find an optimal strategy function, whose output varies with the environment.*

"Agent takes an action, its believes that maximizes its future reward"

"Environment evolves in time and returns instantaneous reward and the new observation of the state"

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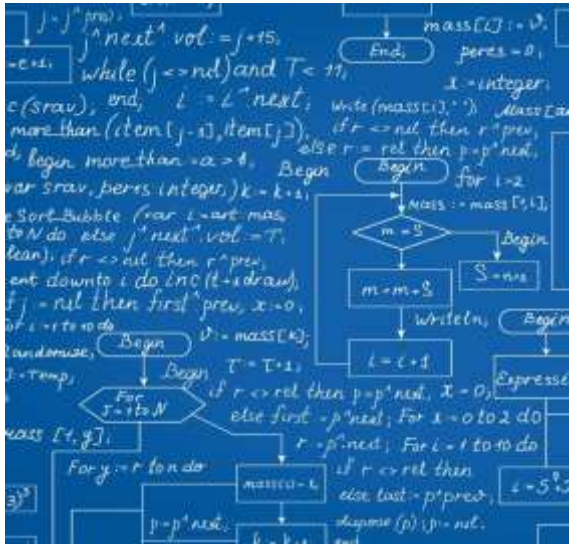
The Future of Digital Twin

Data quality (from real world to digital twin and vice versa) will get better over time.

The distance between the real world and the digital twin will shorten over time.

Eventually the paradigm of the autonomous digital twin will be realized.



New kinds of artificial intelligence algorithms will help to shorten the distances.

The Human Being will be the next actor in new digital ecosystems based on technology and Digital Twin.

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CASE STUDIES

Lagor

Production Line sequencing

ABOUT THE CHALLENGE

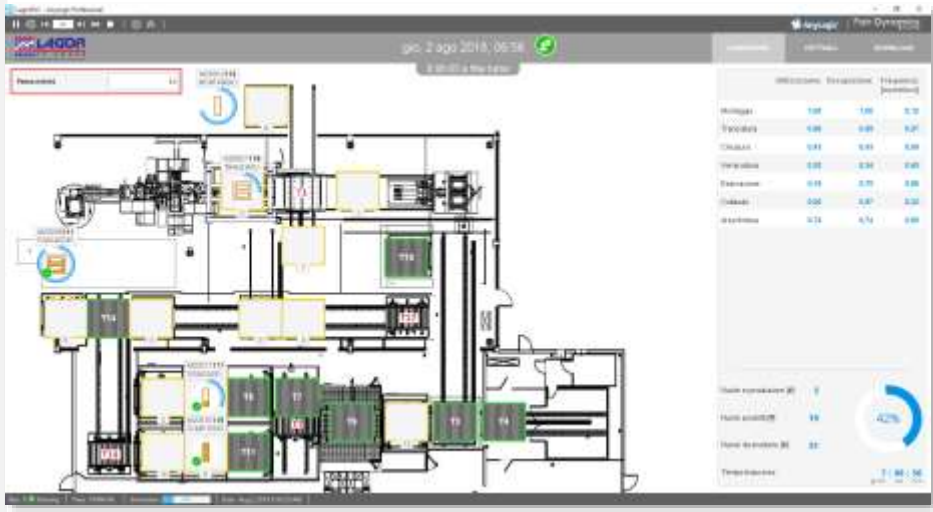
- Lagor is an Italian medium-sized company with about a 30 Mln € turnover. It is committed in the manufacturing of Power Transformer Cores.
- Depending on the design specifications, PT Cores must be moved through different working stations in the manufacturing shop floor, using appropriate platforms and conveyors.
- PT Cores do not follow a clockwise (or counterclockwise) direction, but their paths may cross.
- The simultaneous movement of many PT Cores may result in deadlocks, causing consistent delays in delivery times.

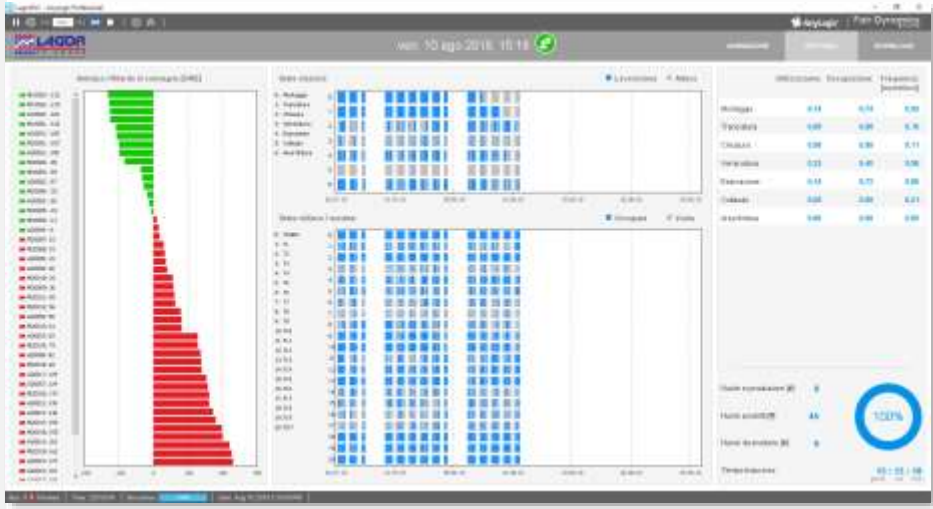
METHOD

- We created a digital replica of the shop floor through an agent-based modelling approach. This approach allowed us capturing many details.
- The replica implements custom heuristics that mimic the decision-making process of the production manager.
- The tool can connect to the company SCADA to upload the line initial status (location and stage of processing of the products) and simulate forward to anticipate possible deadlocks.
- Any simulated criticality results in a warnings signal.

BENEFITS

- The solution can be used both as:
  - a simulation tool to assess and, if needed, rearrange production sequences (*what-if* approach)
  - a Digital Twin that anticipates and reports system deviations from the desiderata.





LAGOR PT CORES
Guaranteed performance by Pass-Line

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CASE STUDIES

RFI – Italian Railway Network Manager

Crowd Modelling Tool

ABOUT THE CHALLENGE

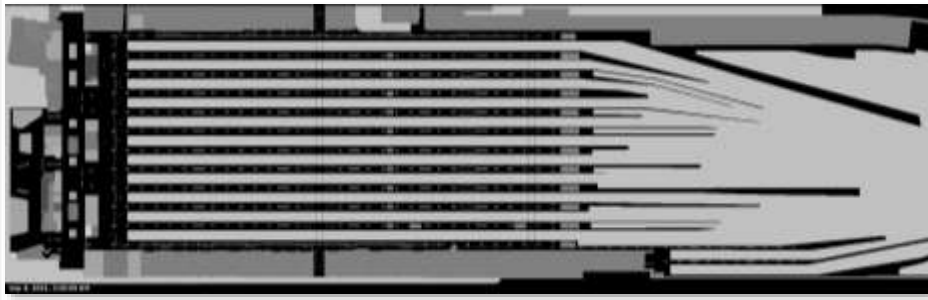
- The Corporate Protection Department is committed in ensuring safety within railway stations.
- At the main hubs, up to a hundred thousand people a day (passengers and visitors of commercial activities) can pass through. This can easily lead to overcrowding, with the associated risks in terms of safety. Also, recent SARS-COV2 containment measures call for increased attention to the issue.
- For these reasons, RFI's Corporate Protection Department wanted to equip itself with a tool capable of simulating and predicting the flow of people moving through stations.

METHOD

- We reproduced in a virtual environment a station of Rome, limited to the areas of interest (gates, platforms, and shops in front of the gates).
- Every 15 mins, the company information system provides the simulator with the train schedule for the next hour (arrivals, departures, delays).
- The system is initialized, simulates a real-world-hour by reproducing the flow of people moving through the station, and returns insights about possible overcrowding (people density) back to the company information system.
- People flows were modelled pedestrian by pedestrian, to guarantee the highest accuracy in modelling personal behaviour.

BENEFITS

- The solution can be used both as:
  - a simulation tool to study and validate ex-ante the impact of positioning new security solutions in stations (LAYOUT ASSESSMENT)
  - a Digital Twin that anticipates and reports critical overcrowding situations (NEAR REAL TIME ANALYSIS).



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CASE STUDIES

Machining Centers Manufacturing (MCM)

Performance Evaluation Tool For Flexible Manufacturing Systems (FMS)

ABOUT THE CHALLENGE

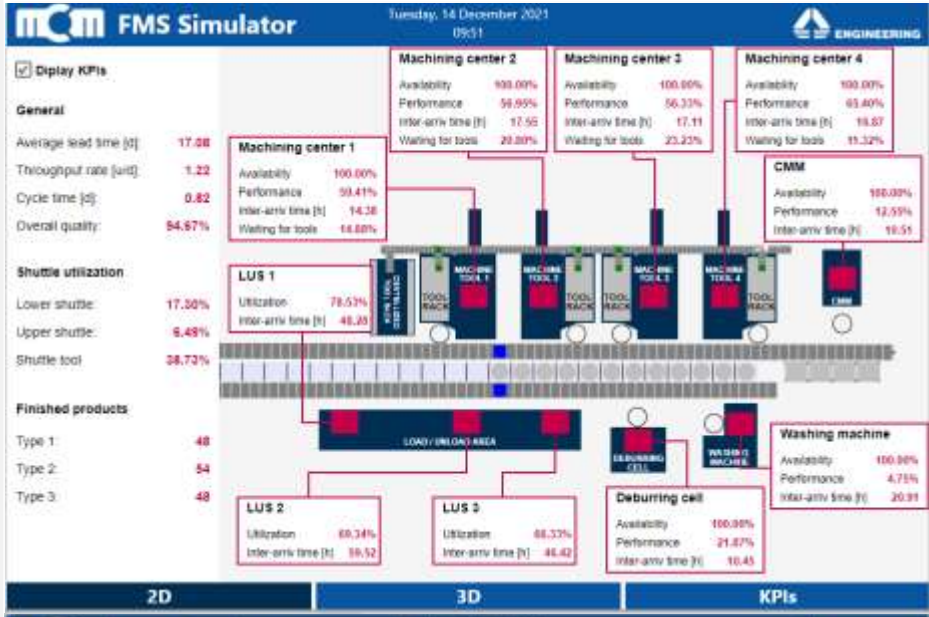
- MCM is a leading Italian company in the design and manufacture of high-precision machining centers and flexible manufacturing systems (FMS).
- Modern machining shop floor requires production systems capable of adapting to the evolution of production problems.
- For both technological and economic reasons, these systems should be automated, integrate multiple functionalities and guarantee long-term operability.
- This complexity implies: actual behavior not fully known after installation; reconfigurations required throughout the life cycle; need for control policies adaptable to the evolution of the system; precise dimensioning required to maintain competitiveness etc.

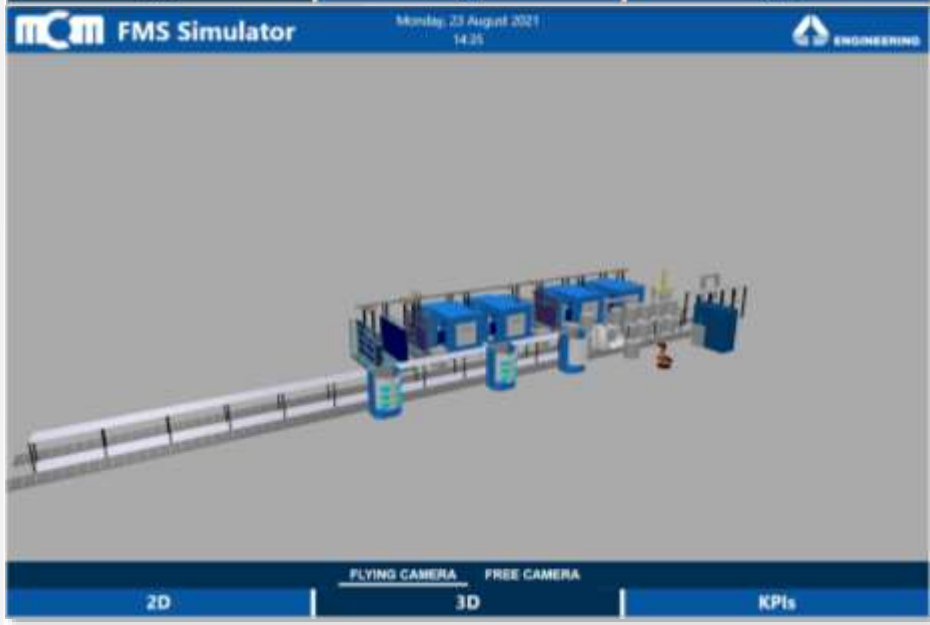
METHOD

- We developed a library of fundamentals components for the development of FMS models.
- These components can be dragged and dropped to create new layouts, and then be configured to reproduce the behaviour of the company production supervision software.
- Every single component has been developed to allow the quick creation of new layouts, but the control policies are customizable down to the finest detail.

BENEFITS

- The solution can be used both as:
  - a high-level simulation tool for the sales phase, when little info is available (possibility of testing different layout configurations and of showing virtual previews);
  - a Digital Twin to monitor working plants or to carry out the Virtual Commissioning;
  - a test environment where to train complex policies using artificial intelligence (Deep Reinforcement Learning).





INTEGRATED MANUFACTURING SOLUTIONS

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CASE STUDIES

Avio Aero (a GE Aviation Business)

Engine Fleet Management Tool

ABOUT THE CHALLENGE

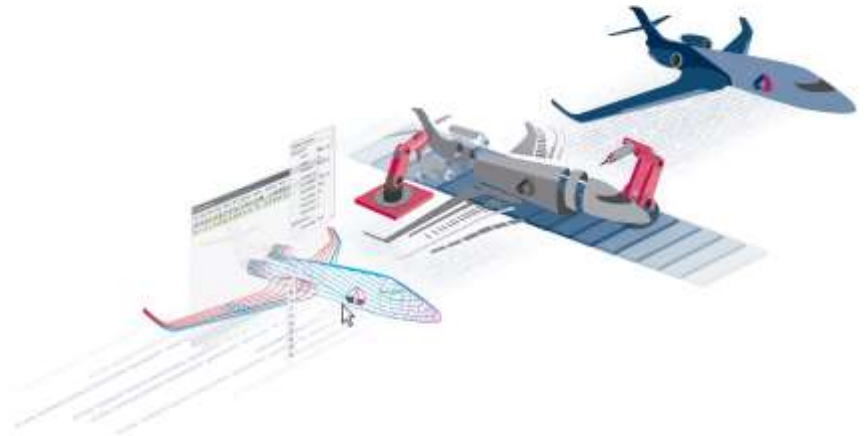
- As a leader in the engine manufacturing industry serving many airplane makers around the world, Avio Aero is committed to provide her customers with the world-class products and full-service maintenance.
- The business model of defense furniture is switching from a product-centric to a service-centric business model.
- The main challenge for Avio Aero is therefore to respect the established percentage of Engine operational availability (SLA) .

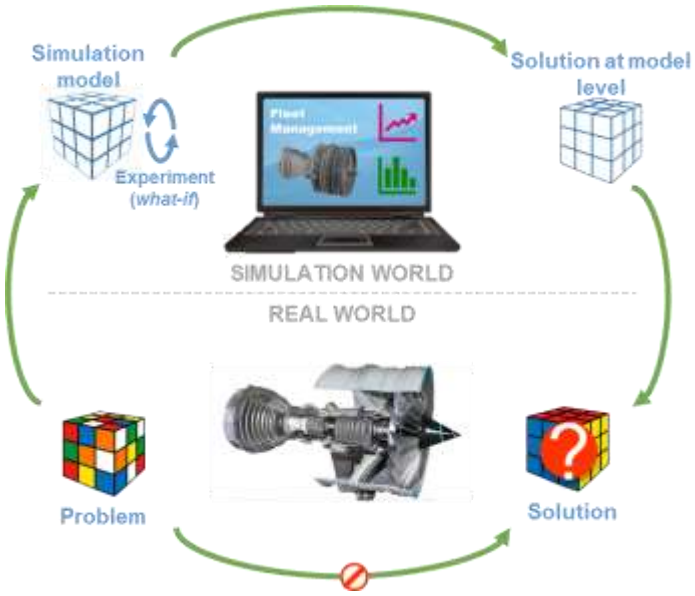
METHOD

- Fleet Management Module (FMM) is designed to reproduce in a virtual (and thus risk-free) environment the behavior of the fleet in order to simulate the maintenance activities of the related engines.
- FMM is implemented to model the operations/failures on the Aircraft and its engines.
- The FMM allows to combining data from disparate sources into meaningful and valuable information.

BENEFITS

- Evaluation and prioritization of risks with the related economical implication of resources (risk management) is the main objective of the FMM
- The result of FMM is the identification of the optimal maintenance plan that guarantees the best trade-off between total operating costs and SLA.





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GSK and Digital Twin: simulate to prevent

Virtually simulating the production process of vaccines and studying their behavior to manage uncertainties and critical issues.

APPROACH

GlaxoSmithKline (GSK) is a global leader in the production of influenza vaccines. A worthy role which, as such, which calls for responsability towards the whole of society, since it must necessarily ensure that the products meet the quantitative and qualitative requirements that are imperative for the population. The production of influenza vaccines is a long and complex biological process that begins with the selection and isolation of the viral strain in the laboratory and, after numerous steps, ends with the packaging stage. The most demanding challenge concerns the management of uncertainty due to critical phenomena such as epidemics, which require the production of a large number of doses in the shortest possible time, as well as unpredictable scenarios and events (for example, an epidemic that may deprive the company of the necessary work force).

SOLUTION

Each phase is subject to rigorous quality controls that must consider variable outcomes and scenarios for better coping with related uncertainty.

We at Engineering have had the distinction of supporting GSK in planning this process. Through the use of a digital twin we virtualized the entire production process that simulates the vaccines production line through a digital representation obtained using an intuitive graphic interface. An extremely reliable process thanks to inclusion in the model of the many variables, sources of uncertainty, that can influence the production process.

RESULTS

With the Industry 4.0 technologies of our Digital Twin model we have allowed our client to:

- Analyze operational practices and verify their effectiveness and efficiency in the presence of uncertainties (e.g. breakage of a component).

- Facilitate decision of the most appropriate measures for achieving certain required levels of performance.

- Facilitate strategic planning of resources.

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Industries eXcellence Global

Digital Twin in the Caspian Sea

Through our solution we support the operations to exploit the largest oil field discovered in the last 40 years

ABOUT THE CUSTOMER

Our stakeholder is a special purpose company for the development and exploitation of the largest oil field discovered in the last 40 years. The oil field is located in the middle of the North East Caspian Basin in Kazakhstan. Developing this field presents enormous technical challenges: the field is located in a very shallow area (with a water depth of 3m), subject to ice and wind-driven water surge events in a context of continuous water drop, with a high presence of H2S in a very unique environmental environment (mammals, birds…)

Since 2006, an archipelago of 10 artificial islands has been built and according to some sources, the cost of the project is one of the most expensive in human history. The project is still ongoing and many more islands need to be built to maximize the revenue for the Republic of Kazakhstan and to reduce the operating expenditure. It is a race against time, as the sea is drying up at an observed rate of 10 cm per annum with some fluctuations due to wind-driver events (called "up or down-surges"), so much so that within 15-20 years it is estimated that it will no longer be navigable by marine vessels, thus making it impossible to reach the field with the equipment needed to support the ongoing and future operations considering this ever more challenging environment.

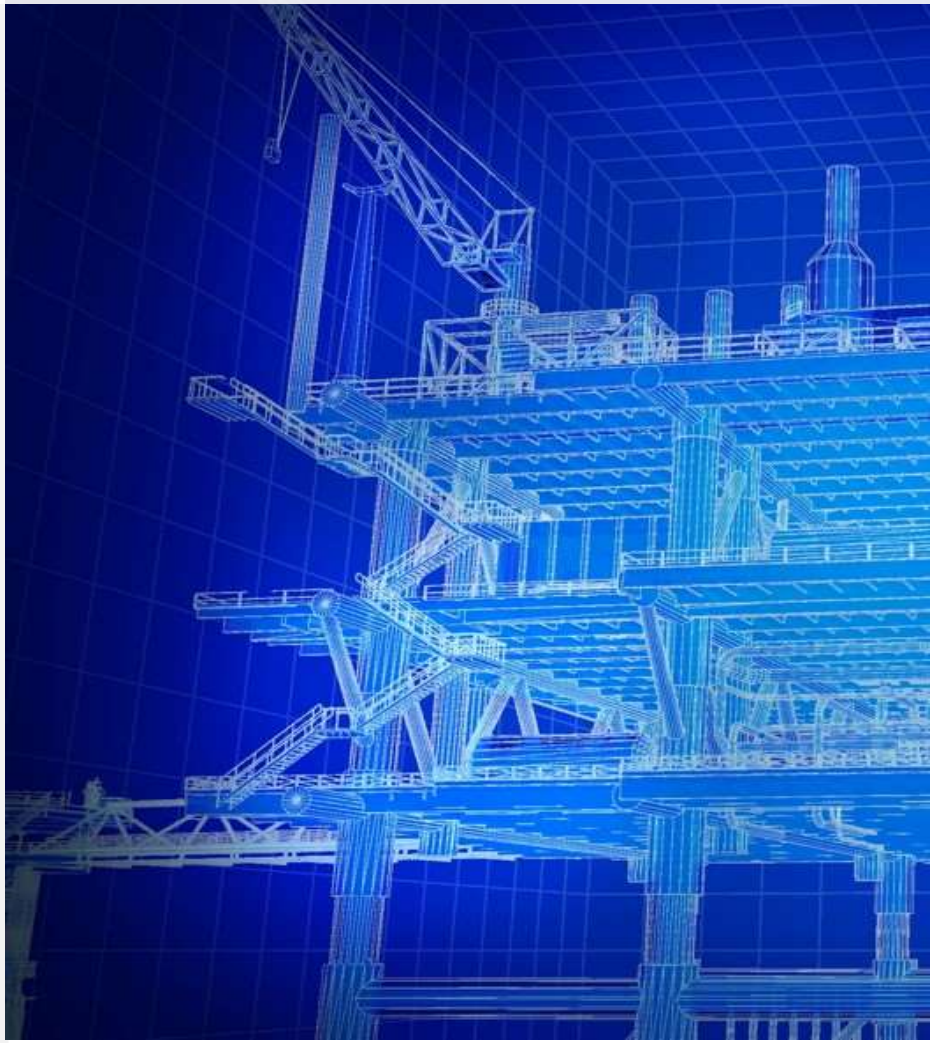
SOLUTION

We at Engineering were called in to create a simulation model that faithfully replicates the entire supply chain, allowing to determine the optimum size of the fleet of vessels and equipment needed to logistically support the construction and drilling operations in this battle against time.

The extreme flexibility of the solution created will allow to evaluate in advance the advantages and disadvantages of the various alternatives, enabling to test even the extreme events in order to choose the most resilient logistical configuration at the lowest possible cost.

RESULTS

- Logistical support of operations
- Optimisation of time and costs
- Extreme flexibility of the solution



NCOC
NORTH CASPIAN OPERATING COMPANY

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Gucci

Supply Chain simulator

ABOUT THE CHALLENGE

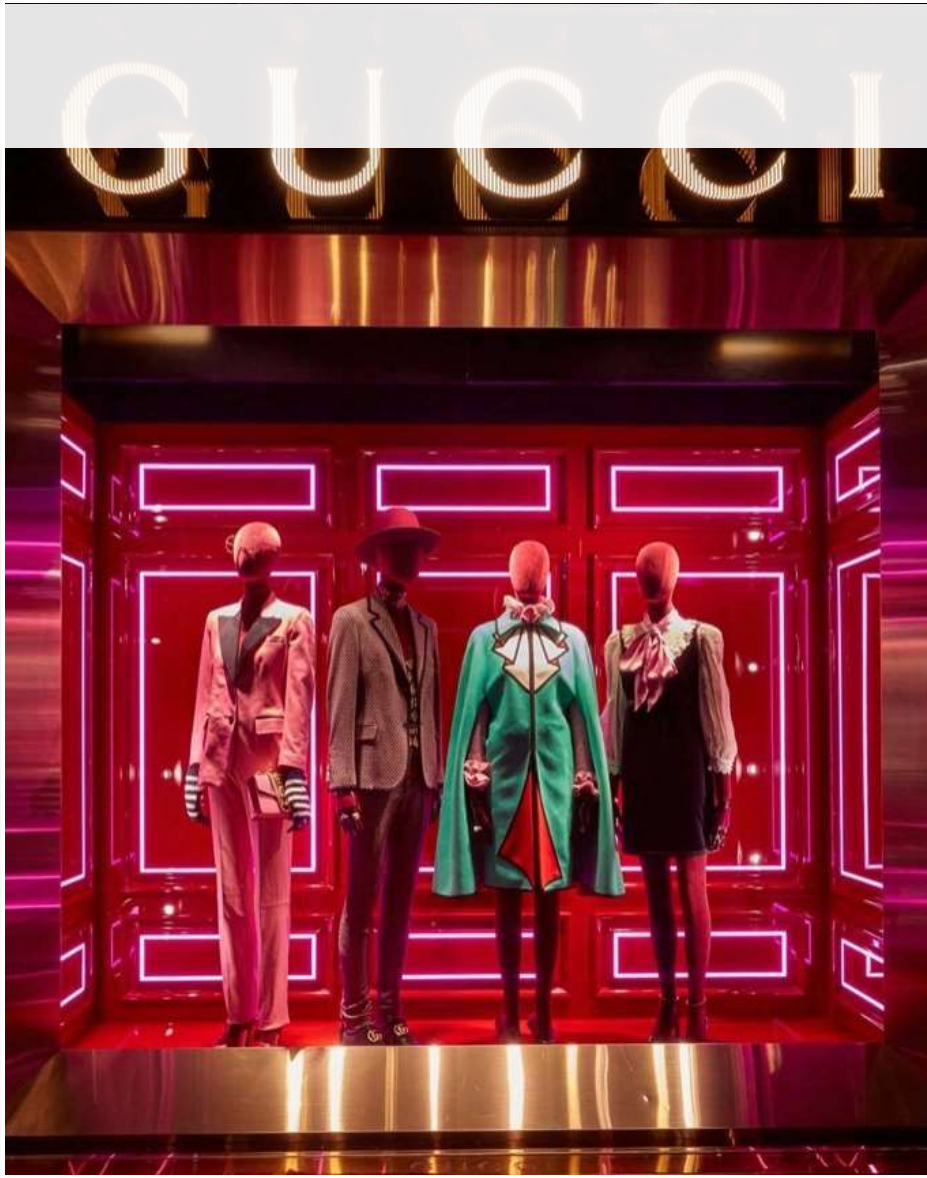
- Gucci is an Italian luxury fashion house based in Florence (Italy) with a revenue of over € 7 billions. Its main products include handbags, shoes, ready-to-wear clothing, different types of accessories and perfumes.
- The project was about analyzing the actual Gucci supply chain network (from the movement of raw materials to the delivery of finished goods) of three specific categories of products: handbags, men belts and women shoes.
- Gucci SC is characterized by different stages, each of which uses specific algorithms, approaches or logics to predict and fulfil product orders.
- The considered products are managed at SKU detail level and the orders are sent weekly through the SC .

METHODS

- We implemented an agent-based model in order to create a digital copy of the customer's Supply Chain. The tool is able to simulate both the as-is SC and the to-be SC, recreating all their specific stages and logics and allowing the user to compare them.
- For every product, the model generates different KPIs and indicators at a very low level of details.
- The implemented tool was uploaded in a private cloud of the client so that different users could use it simultaneously. The outputs are then available in an online repository.

BENEFITS

- Facilitate a deep analysis of the actual SC and allow a comparison with a SC with future changes/improvements.
- Simulate effects on the SC caused by high products demand volatility and stochastic lead times.
- Give to the user the possibility to perform Monte Carlo experiments of the simulation model.
- Use a *what-if* approach to find the best values for parameters used in implemented algorithms and formulas.



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Enabling Digital Transformation

Click on the eight buttons for extra details

ENABLING TECHNOLOGIES

- AI & Advanced Analytics
- Cloud
- Cybersecurity
- IoT
- Intelligent Automation (RPA)
- AR / MR / VR
- Blockchain
- Digital Twin

CONTINUOUS RESEARCH AND INNOVATION ON EMERGING TECHNOLOGIES

CONTINUOUS UPSKILLING AND TRAINING IT & MANAGEMENT ACADEMY

STARTUP AND INCUBATOR LABS

Thank you!

Massimo Canducci

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