



FASTEN

IOTWeek

Aarhus, 19 June 2019

FASTEN - Flexible and Autonomous Manufacturing Systems for Custom- Designed Products

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UFSC / INESC P&D BR / FASTEN project

Panel Session: Strategic Value Networks for Industry 4.0
chaired by John Soldatos

Overview

“The adoption of the IoT by Manufacturing is first and foremost a cultural and a management issue, rather than a technology issue” (IoTWeek 2018).

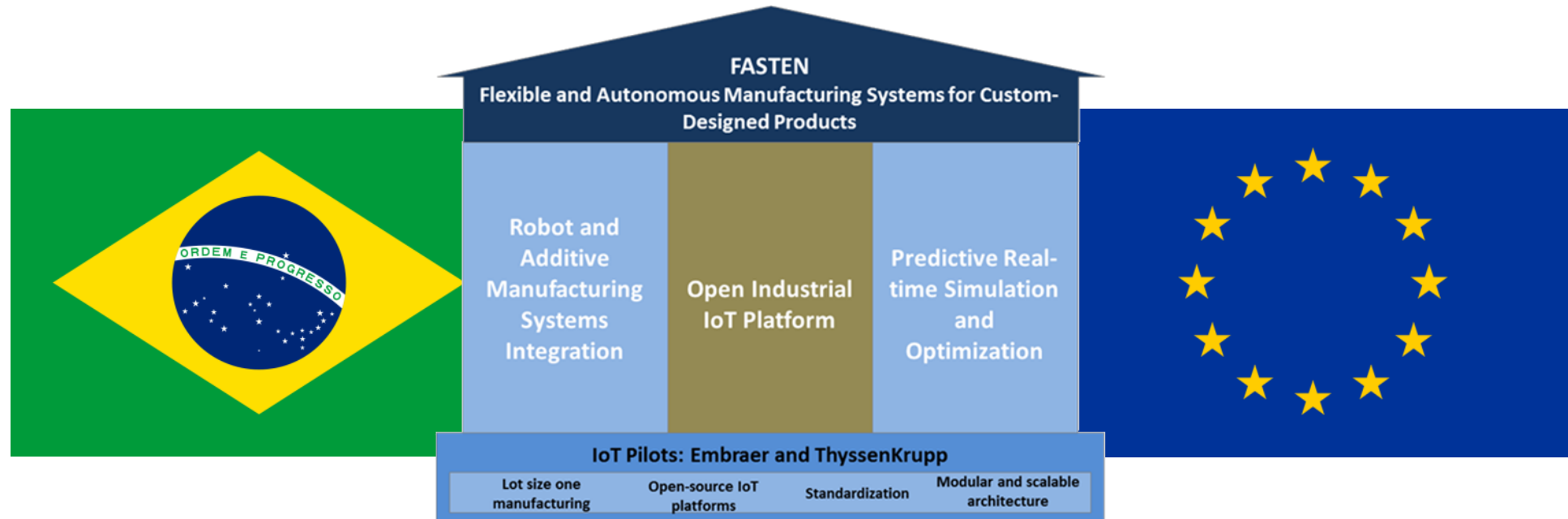
...

There is a huge potential for the proposition of tools that integrate physical processes and their virtual representation based on IoT data aiming at real-time decision-making capabilities (FASTEN D4.1 report).

My aims:

- To introduce an advanced manufacturing project dealing with a **pilot application of IoT technologies**, which helps developing the cultural and managerial framework.
- To discuss challenges and implications.

What is FASTEN?

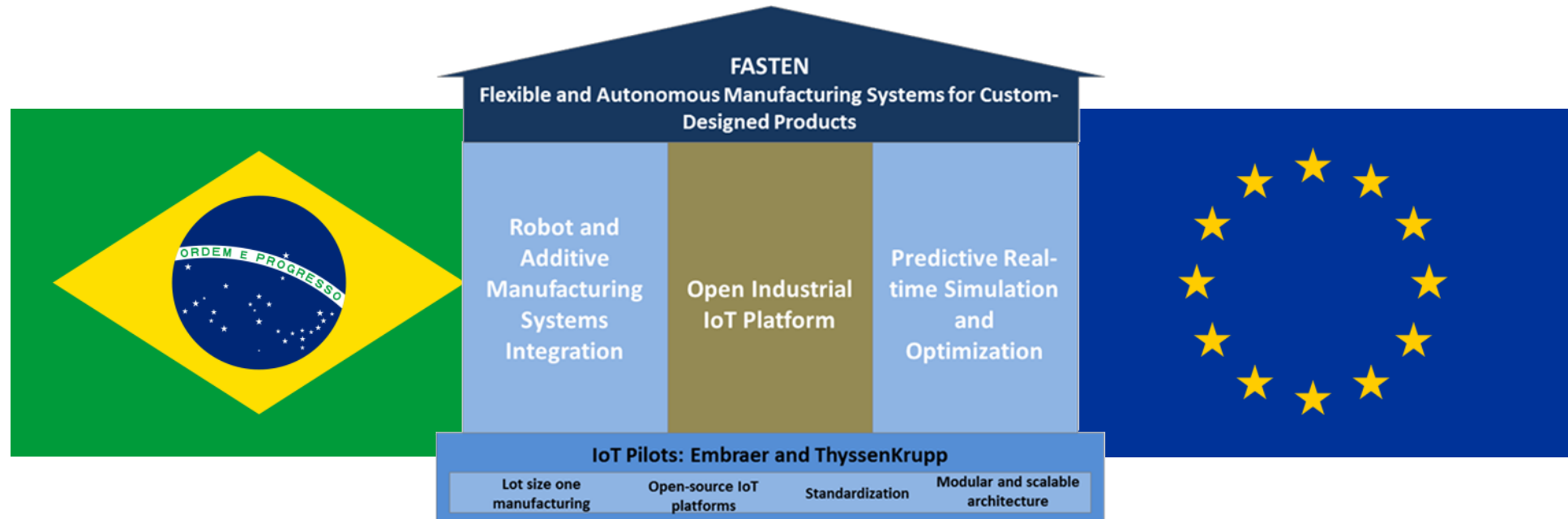


Foster digital manufacturing sustainability and be an enabler of technology development between Brazil and Europe

Provide a multi-disciplinary decision support tool to improve trade-off analysis

Contribute to the competitiveness of Brazil and Europe

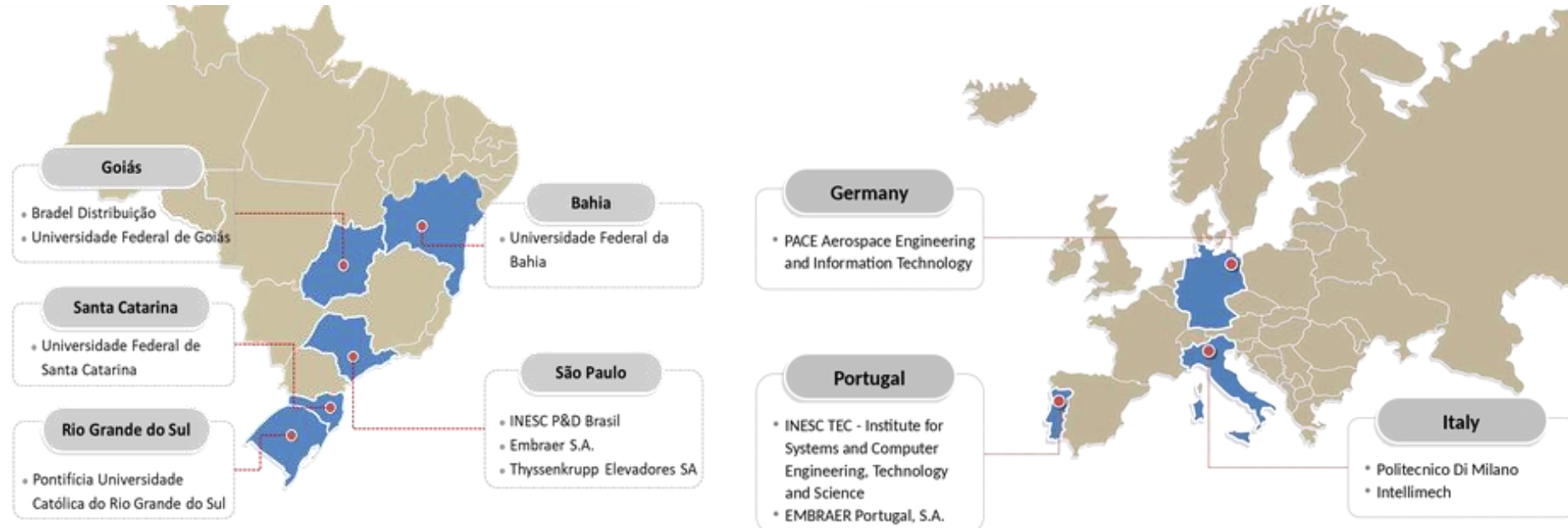
What is FASTEN?



The FASTEN “mission” is to develop, demonstrate, validate, and disseminate an integrated and modular framework for **efficiently producing highly customized products**.

FASTEN project will develop an **open and standardized framework** to produce and deliver tailor-designed products, and that is capable to run autonomously, and deliver fast and low cost additive manufactured products.

Combination of expertise and capabilities from Europe and Brasil



thyssenkrupp



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This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement N° 777096



RNP
REDE NACIONAL DE
ENSINO E PESQUISA



FASTEN

Main results



FASTEN Predictive
and Prescriptive
Analytic Tool



FASTEN Holistic
Simulator-
Optimizer Tool



Flexible and scalable
robotic system

 **FASTEN**
INDUSTRIAL
ANALYTICS
SUITE



FASTEN Real-time
Monitoring and
Performance
Management Tool



Open Industrial
IoT Platform for
custom-designed
products

1. Intelligent handling of custom objects
2. Full connectivity among hardware and software components
3. Improve accuracy and provide better insights regarding the near-future
4. Solid understanding of the system's behaviour and its sensitivity to different parameters
5. Consideration of involved legacy systems and affected people

The diagram illustrates a multi-layered architecture for an Industrial IoT ecosystem. At the base is a green bar labeled "Factory Automation and Robotic Systems", flanked by images of industrial machinery. Above this, a grey bar contains four interface components: "FI-ROS Interface", "OPC-UA MQTT IDAS Agents", "OPC-UA MQTT F4I Wrappers", and "F4I-ROS Interface". The main body of the architecture is a light blue area. On the left, a vertical dark blue bar represents "FIWARE SECURITY". To its right, a stack of components includes "FIWARE IDAS Backend Device Mgmt" at the bottom, which connects to "FIWARE CEP PERSEO" and "FIWARE ORION Context Broker". "FIWARE ORION Context Broker" is linked to "FIWARE CYGNUS Persistence". Above these are "FIWARE Wirecloud Widget Mashup" and "FIWARE Knowage Business Intelligence". At the top left, a green circle labeled "INDUSTRIAL IoT" contains icons of a forklift, a worker, and gears. In the center, a black cylinder represents the "IOT Event Repository InfluxDB". To the right, a dark grey bar is the "Data Interoperability Enterprise Service Bus", which connects to "APM Robotics (WP2)" and "Industrial Analytics Suite (WP4)" at the top. Below the bus is a box for "Enterprise Applications" featuring logos for ERP, MES, PLM, and SCM. At the bottom right, the "THE APACHE SOFTWARE FOUNDATION" logo is shown. A red bar labeled "F4I IoT Bus (Apache KAFKA)" is connected to the "OPC-UA MQTT F4I Wrappers" and the "F4I-ROS Interface". A double-headed arrow labeled "Interop" connects the "FIWARE IDAS Backend Device Mgmt" to the "F4I IoT Bus".

Predictive Real-Time Simulation and Optimization

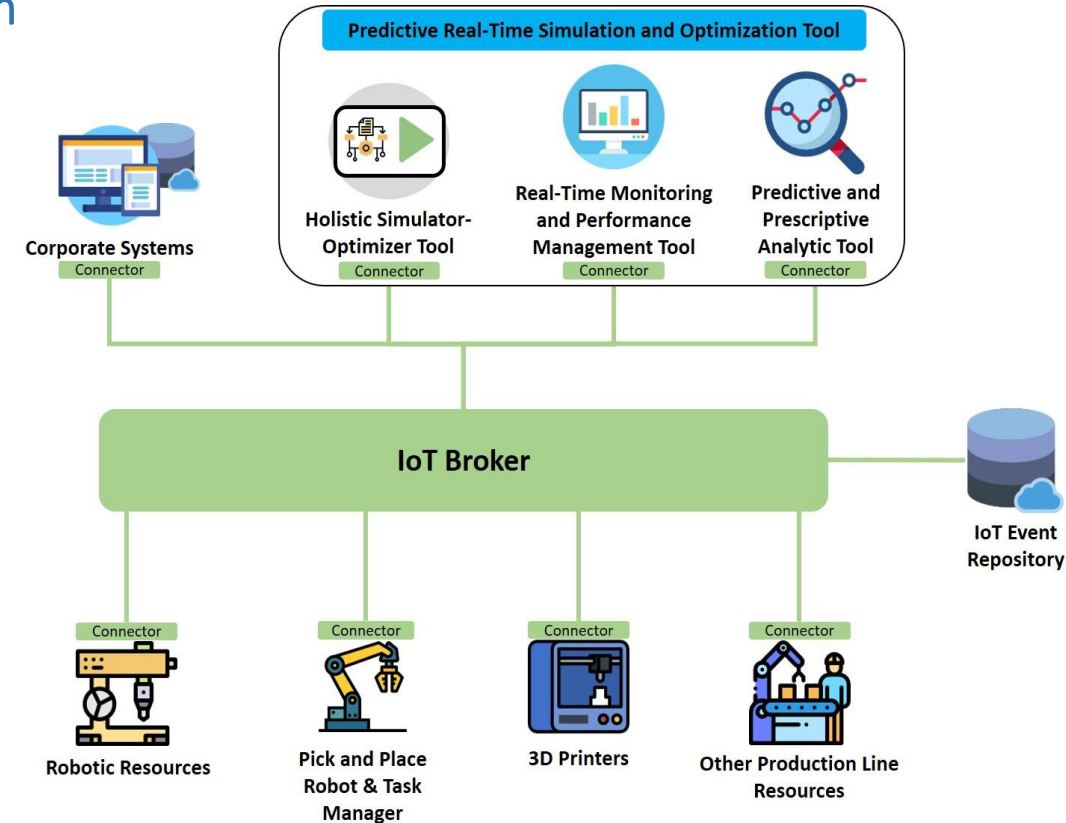
A real-time application for monitoring of manufacturing system performance, using simulation, virtual commissioning, optimization and predictive analytical tools.

High interaction with the Robot and Manufacturing Systems Integration and with the Unified IoT Cloud Platform.



Specific Objectives:

- ✓ Integrate optimization algorithms with a virtual representation of the production facility, providing a tool for understanding, experimenting on and optimizing the system without the downsides of doing so in the real version.
- ✓ Deliver interpretable insights from the manufacturing data and implement predictive models to aid the manufacturing processes.
- ✓ Develop an integrated system for real-time, online monitoring of performance of manufacturing systems, encompassing a decision-making data driven visualization dashboard.





Smart Robotic Additive
Manufacturing Network



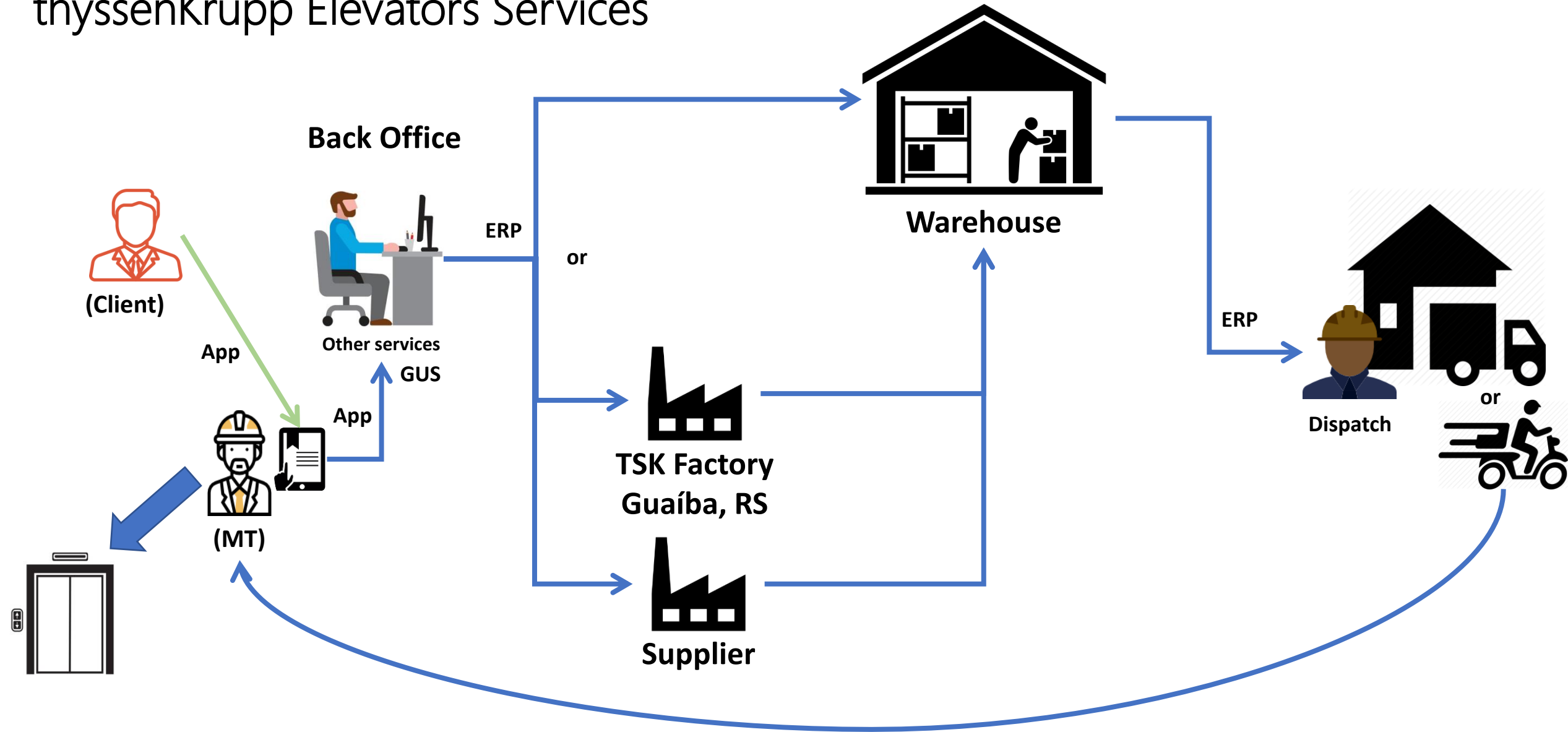
Manufacturing systems at
Embraer Portugal

ThyssenKrupp Elevators Services

- Services represents 80% of TSK Brazil Revenue
- **Preventive Maintenance**
 - Periodic visit of the Maintenance Team (MT)
 - Performs necessary cleaning, lubricating and adjusting
 - If necessary, calls Corrective maintenance
- **Corrective Maintenance**
 - Can be triggered either by the preventive Maintenance Team or by the Client
 - Repair and fix any eventual problem that might be causing elevator malfunction or lack of operation.
 - Based on a network of 61 Back-Offices in different cities of Brazil, and a 24-hour availability for emergency calls and breakdowns

Outdated Spare Parts + High Lead Time

thyssenKrupp Elevators Services



Problems Faced by TSK

FASTEN Solutions

Lack of **real-time information** to the back-office and MT

IIoT

70% of **elevators** demands **one-of-a-kind** spare parts

Additive Manufacturing

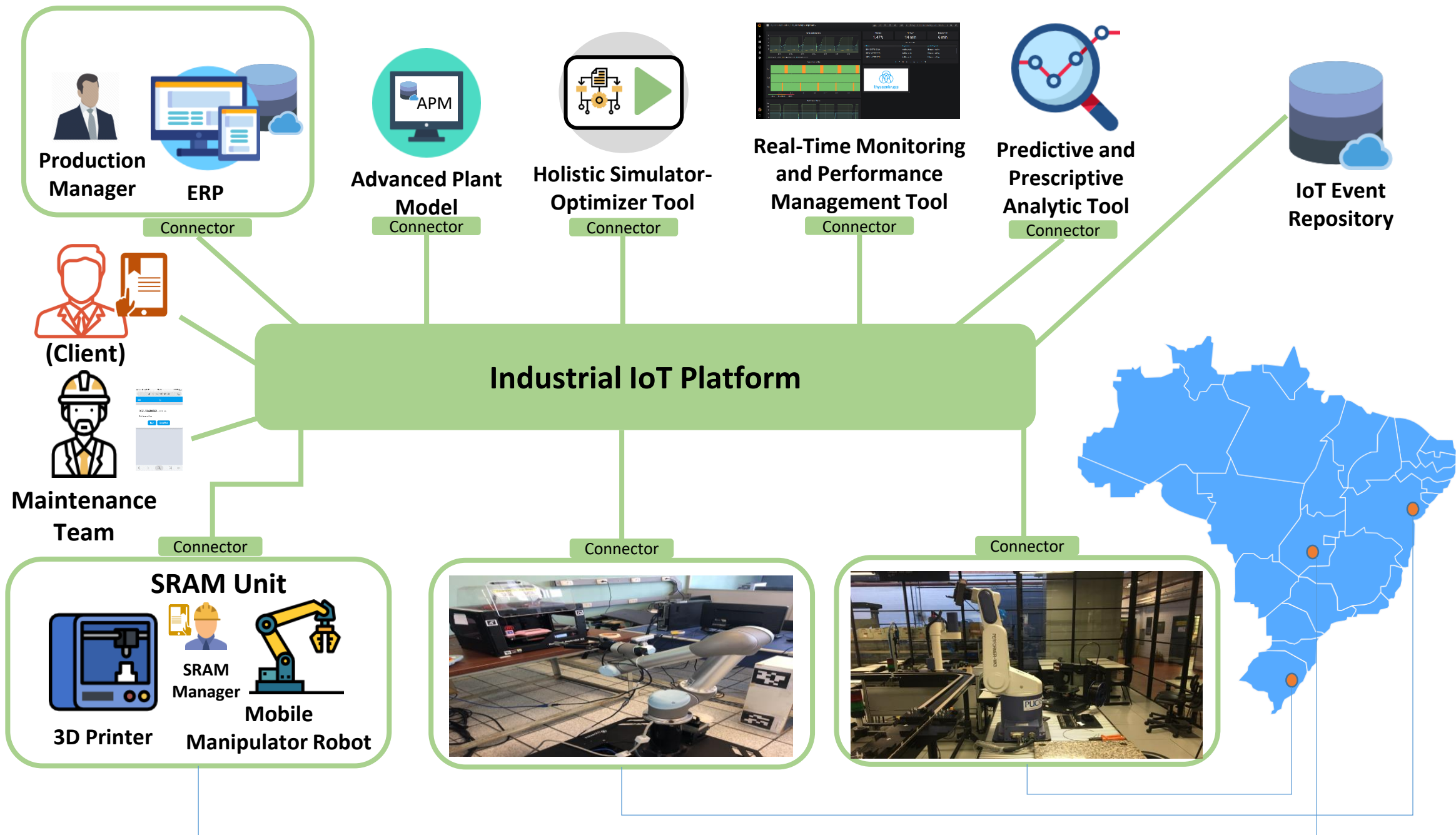
Delivery cost and time of spare parts to MTs along the different regions of Brazilian territory.

Optimization

Use Case Objectives

Objective 01	To develop a Smart Robotic Additive Manufacturing (SRAM) Unit, composed of 3D printers and a MMR, aiming to provide flexibility, scalability and agility to cope with spare parts demand.
Scenario 01	Smart Robotic Additive Manufacturing Unit
Objective 02	To develop and demonstrate a set of Optimization, Simulation and Predictive tools, not only capable of designing an optimal manufacturing network system configuration and spare parts production scheduling, but also perform these goals through real-time monitoring systems , improving responsiveness and supporting decision making.
Scenario 02	Smart Manufacturing Network

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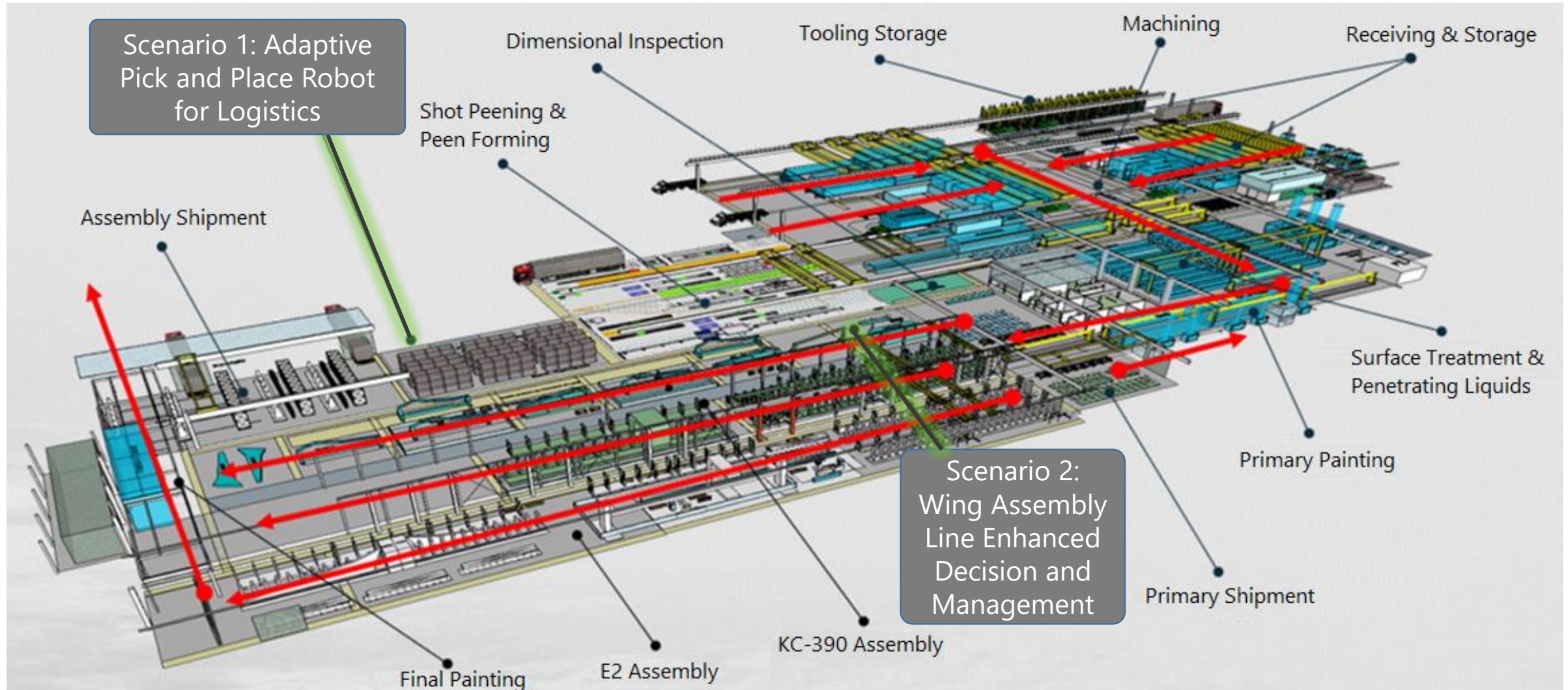
Smart Robot Additive
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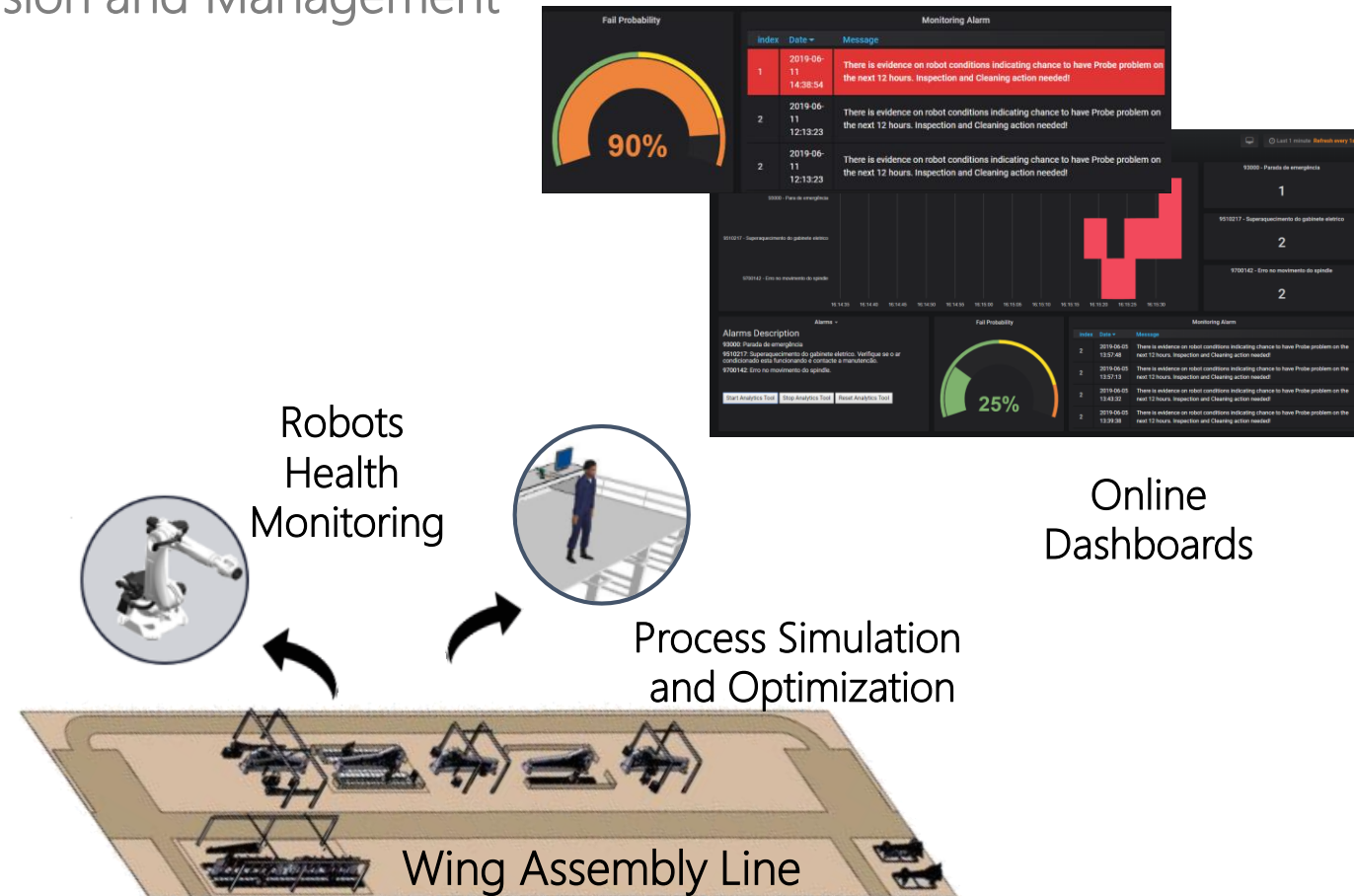
Embraer Physical Layout

Use Case Context



Embraer Use Case

Scenario 2: Wing Assembly Line Enhanced Decision and Management

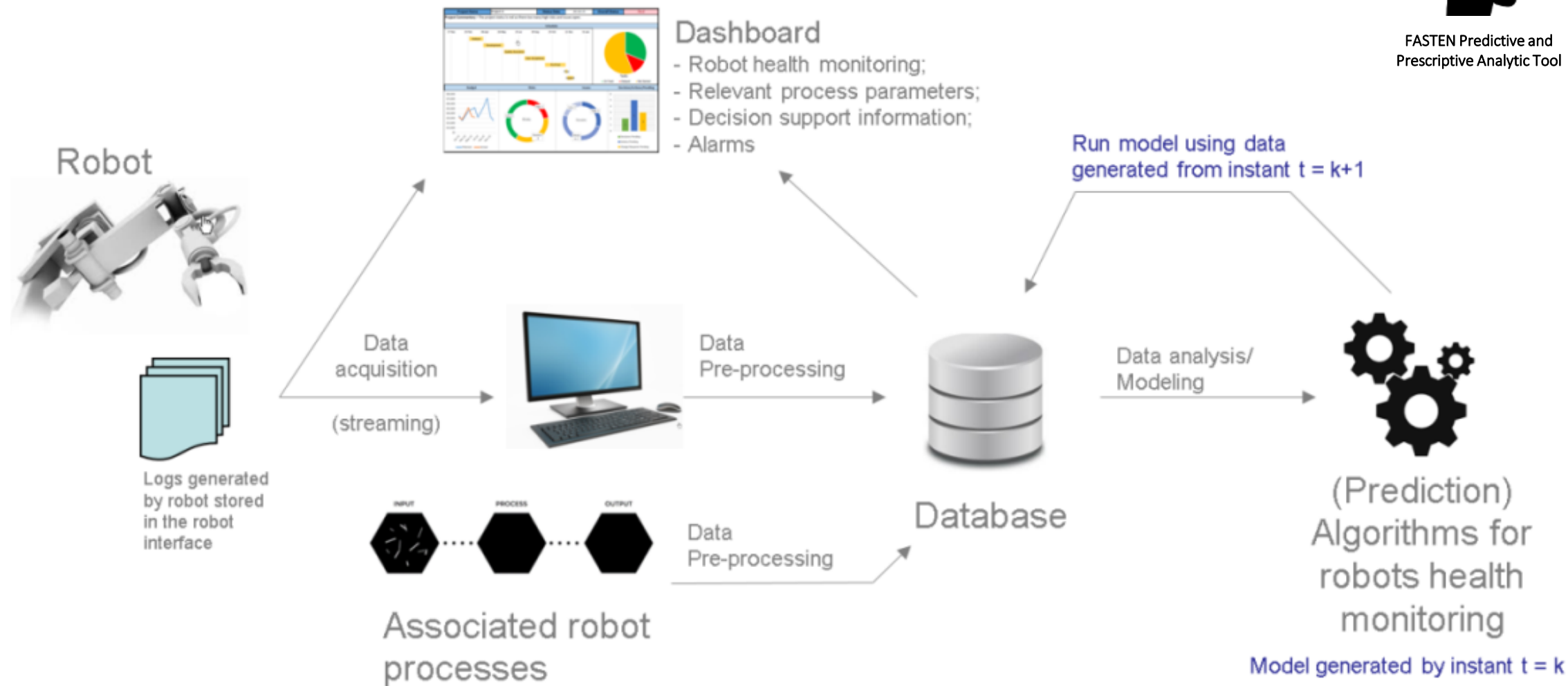


IoT Enabled and Coordinated for:
Disruption Simulation & Optimization and Analytics for Prediction and Prescription

Embraer: towards prescriptive maintenance



FASTEN Predictive and Prescriptive Analytic Tool



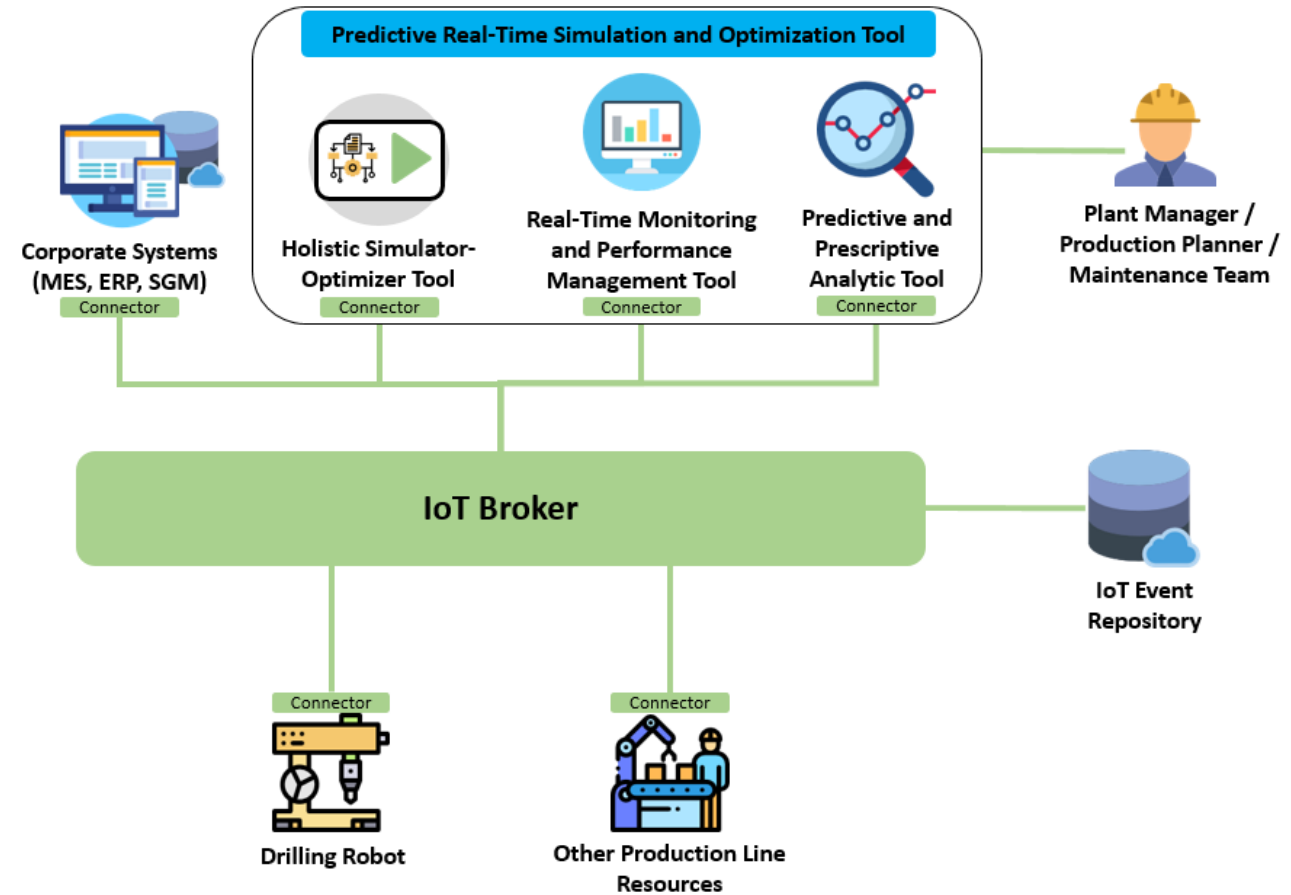
Predictive Real-Time Simulation and Optimization

Embraer Use Case - Requirements

- Scenario 2: Wing Assembly Line Enhanced Decision and Management Support

- Main functionalities

- Provide Scenario Analysis to Support WAL Balancing
- Load Balance for New Product or Product Change
- Calibrate Model Parameters with Real Data
- Provide Best Date for Maintenance Event
- Predictive Model Update



The impact of emerging IoT technologies and associated concepts will be huge in the manufacturing industry.

Research and application-oriented projects, as well as strategies and policies formulation and implementation underway.

Key takeaway points:

- A great moment for manufacturing, despite the challenges.
- Data
 - Manufacturing digitalization*
- Decision making models, procedures, capabilities
 - Increasing reliance on modelling, optimization and simulation*
- **Emergence of knowledge-based + data-driven decision making models**
- **People**
 - People, people, people everywhere. **Care about them! Leverage their knowledge.**
 - Social (distributed) manufacturing
 - **Socio-cyber-physical systems (more interaction, not less!)**

*https://www.researchgate.net/publication/318430955_Smart_manufacturing

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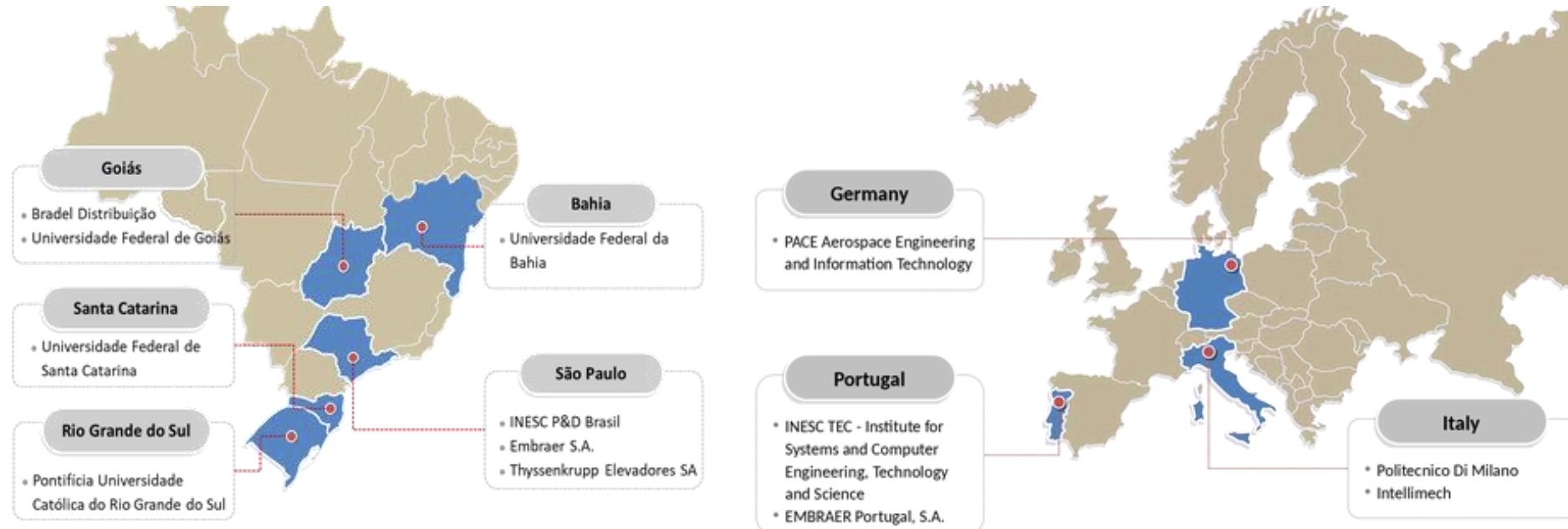
Thank you
Questions?

www.fastenmanufacturing.eu

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P A C E

