Capgemini

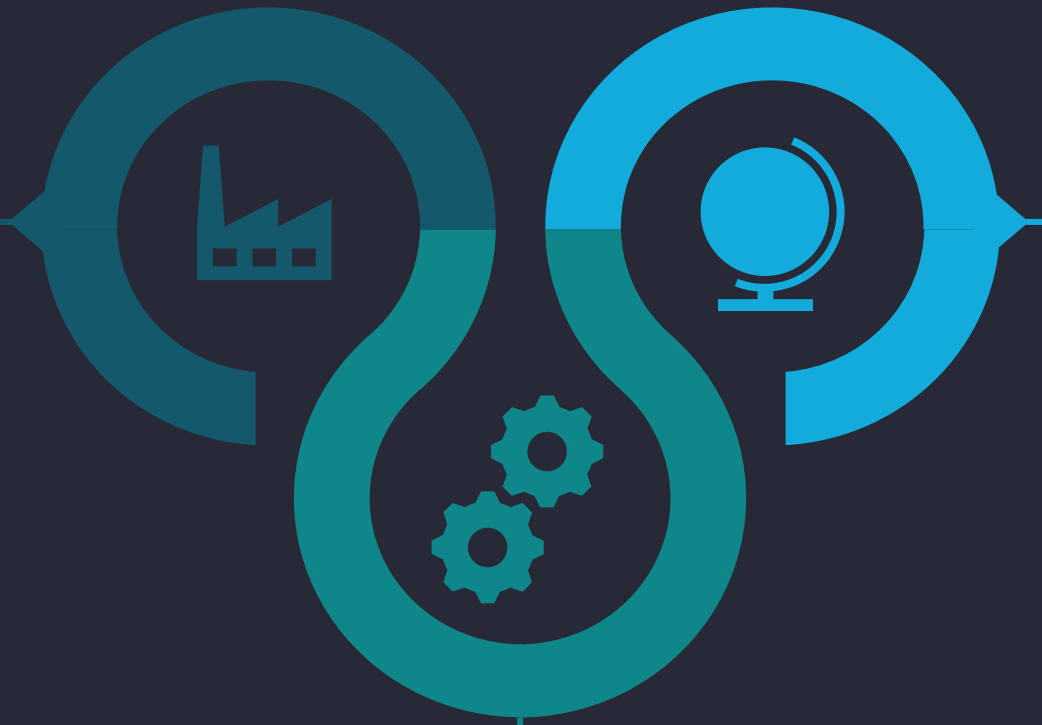
PLANT CONTROL TOWER

December 2021

FACTORY 2022 – 2025: A RADICAL PARADIGM SHIFT

Less than 30% of production lines are simulated before manufacturing

A factory is a complex and living system that must be first efficient by design, from greenfield to brownfield



76 % of manufacturers have a smart factory initiative underway, but just 14% are successful

Global scale is mandatory to consistently reach world-class levels of performance

Labor intensity is decreasing

Sustainability is a must

Industrial system efficiency is the next frontier in a world where all industries are more and more capital and resource intensive

Less than half of the manufacturers are adequately prepared to deal with cybersecurity concerns

Source: Smart Factory @scale CRI report

OPTIMIZATION THROUGH DESIGN AND EFFECTIVENESS IN OPERATIONS WILL DRIVE BENEFITS EQUALLY OVER TIME

Hybrid capabilities and collaborations as close to the ground and the events

Optimization through design

From asset design to virtual commissioning

Virtual

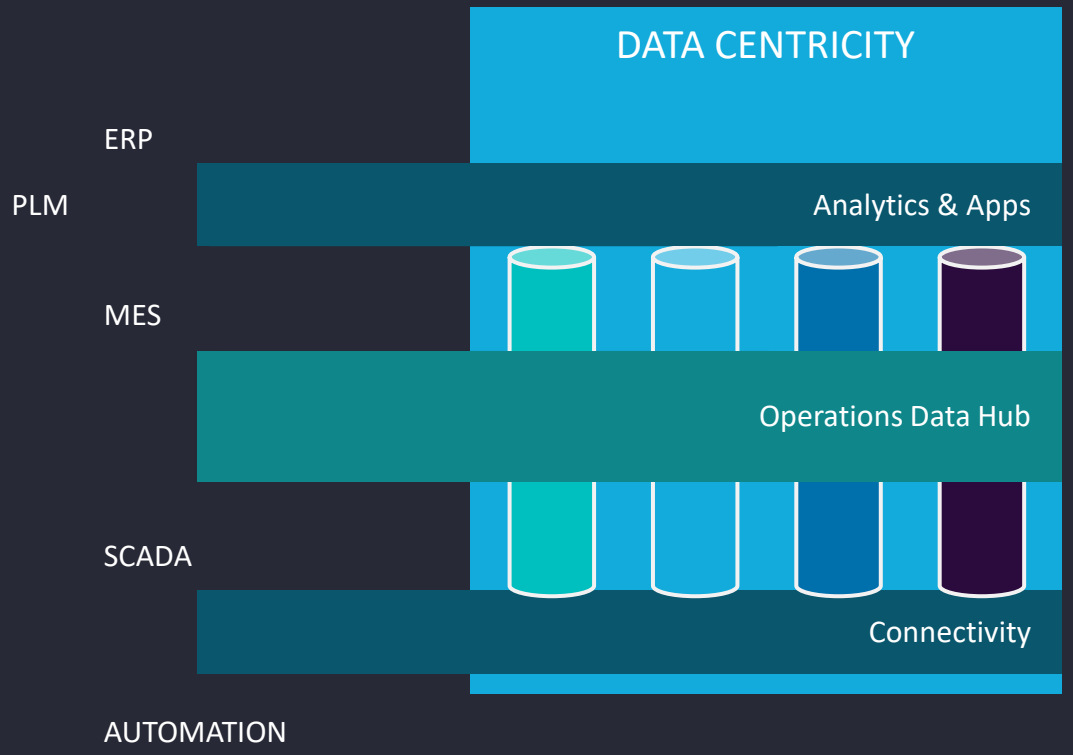
Loopback

Effectiveness in operations

From data to insights to self optimizing asset

Digital platforms and IT-OT convergence to ensure digital continuity and fuel extended collaborations

EFFECTIVENESS IN OPERATIONS: A DATA-DRIVEN TRANSFORMATION THAT MUST TAKE ADVANTAGE OF IOT & CLOUD, …



TYPICAL RESULTS

- DEFECTS: ÷ 2.8
- UPTIME: +1.3 pt
- PRODUCTIVITY: +5.7%
- ENERGY: - 6.5%
- PREMIUM QTY: +20%
- YIELD: +1.3 pt
- MATERIAL: - 4%
- STABILITY: +9.2%

…, while preserving IT/OT assets.

WHY A MANUFACTURING PERFORMANCE PLATFORM ?

OEE: A MUST

- OEE measurement, analysis and optimization is and will remain a must to constantly improve industrial performance
- OEE must now not only report availability , performance and quality but sustainability too

IT-OT LEGACY: LOCAL, NOT SECURED

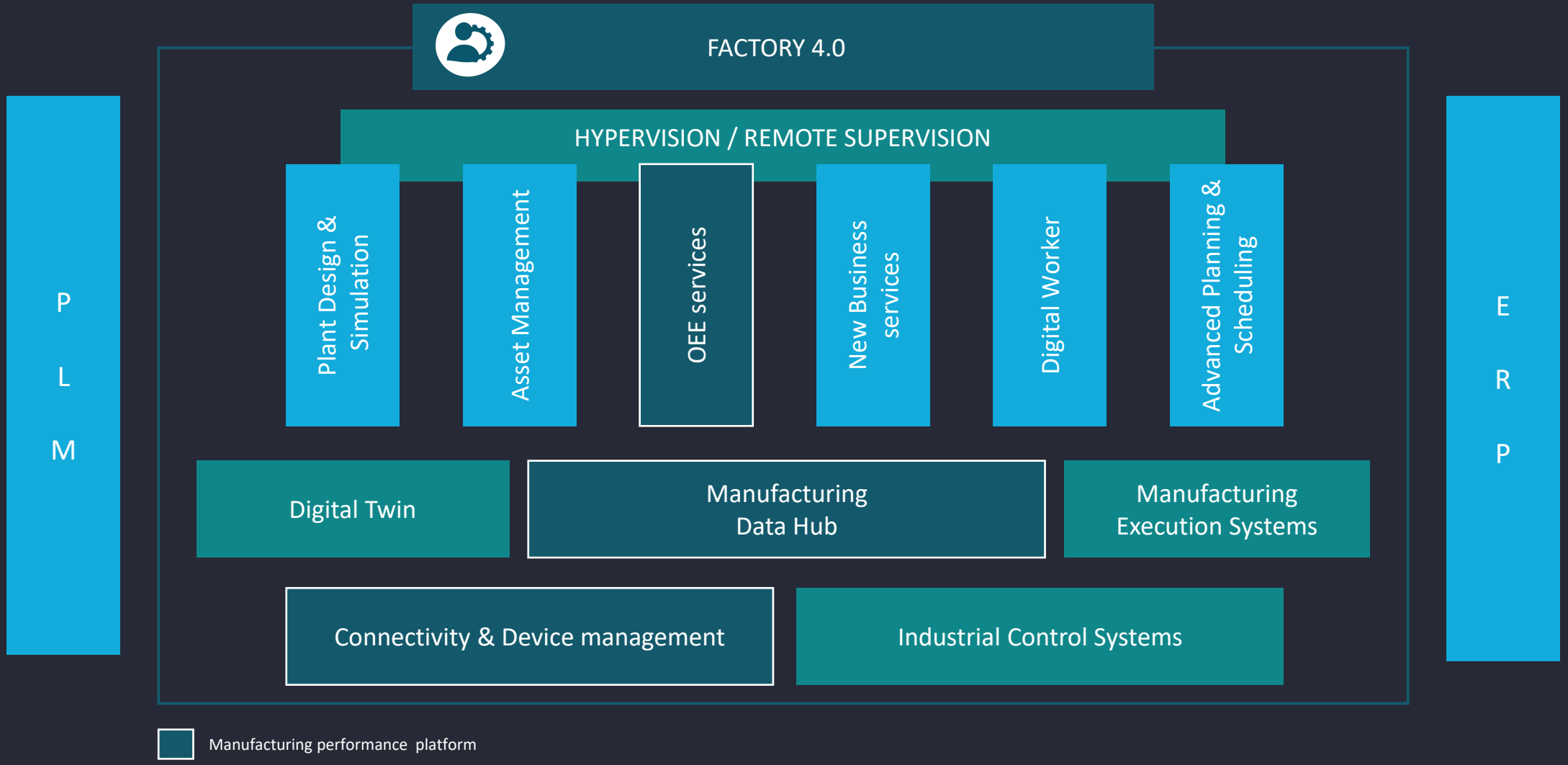
- If ERP core model is now the norm and is moving fast to cloud, MES - as the “ERP” of the shop floor – still remains very local
- Scada and PLC fleets are the heritage of several technological generations over decades even if OPCUA becomes a standard
- Renovation – integration of new sensors , … - of former industrial equipment is more and more mandatory to monitor and optimize their performance
- Connectivity and cybersecurity are still a significant challenge for manufacturers

SOLUTION: CLOUD-ENABLED

- A cloud-enabled OEE data manufacturing platform – from secured device management ... to optimization tools – is the best solution to make it happen now!

* July 2021

MANUFACTURING PERFORMANCE PLATFORM IS A KEY COMPONENT OF FACTORY 4.0



MANUFACTURING PERFORMANCE PLATFORM FEATURES

BUSINESS SERVICES

OEE
- Shop floor monitoring-supervision
- OEE calculation per machine/process/shift
- OEE root cause analysis
- Multi-variate correlations (Optimistik integration : 06/2022)

Inline quality
- Quality prevention based on defined parameters
- Operators' manual entry

Condition Based Maintenance
- Failure prevention based on defined parameters
- Trends to evaluate the risk and time when will happen

Customs
- Predictive analytics
- Planning and Scheduling

FUNCTIONS FEATURES

Semantic
- Model management
- Semantic search
- Model transformation & visualisation

Device management
- Automatic device mapping and creation
- Device Provisioning
- PLC configuration auto-discovery

Engines
- Multi language programming
- Engine deployment on platform
- Engine status & management

Orchestration
- Process and scenario design
- Rule's creation and alerting associated
- Data exchange with external apps

Virtualization
- Connection to any model based simulation
- Emulation of real system architecture
- Execute and run data in time

PLATFORM FEATURES

Platform Management
- Scalability / Modularity / Redundancy
- Hybrid cloud
- Data base (SQL, Nosql, tsDB)

Data Management
- Data governance
- Master Data models
- Automatic data mapping & cleansing
- Data protection & privacy
- Data discovery & synchronization

Security Management
- Data encryption between edge and cloud
- Automatic discovery & security certificate update
- Connect any SSO or LDAP
- Secured data flows and user identification

Edge & Connectivity Management
- Data Buffer
- Edge Processing
- Cloud connectivity
- OPC-UA standardization
- Standard communication management (OPC-UA, MQTT)

WE HAVE WORKED WITH MAJOR MANUFACTURERS ACROSS THE WORLD TO DEPLOY MANUFACTURING PERFORMANCE SOLUTIONS

CLIENTS	PROJECT DESCRIPTIONS	# SITES	# MACHINES	USE CASES				
				OEE	SHOPFLOOR MONITORING	INLINE QUALITY	CBM	OTHER USE CASE
BAKER HUGHES a GE company	Deployment of real time connectivity and OEE monitoring platform	11	1 100	✓	✓		✓	✓
Unilever	integration and deployment of a group IoP platform: 15+ use cases	300	2 000	✓	✓	✓		✓
SANOFI PASTEUR	Factory 4.0 transformation and deployment of OEE monitoring and advanced scheduling systems	4	80	✓	✓			✓
PHILIP MORRIS INTERNATIONAL	Factory of the Future strategy, governance and deployment	20	1000	✓	✓	✓		✓
eramet	Factory of the Future strategy, governance and deployment	8	400	✓	✓	✓		✓

MANUFACTURING PERFORMANCE PLATFORM DEPLOYMENT KEY SUCCESS FACTORS

APPROACH : VALUE DRIVEN

- Identify a critical problem - Solve it locally and record gains – Consolidate and deploy
- Avoid a tunnel effect approach such as “Plan – Organize – Deploy”

TECHNOLOGY : PROVE FIRST

- First, start fast to prove solution value in a “stand-alone “mode
- Second, integrate within the IS/IT landscape of the company and industrial sites and scale up

CHANGE MANAGEMENT : CONTROLLABLE

- Equip operational people /managers with OEE measurement, analysis and controllable improvement tools such as: alerts, multi-variate correlations …and then predictive
- Avoid “black box” or “data scientist” traps

* July 2021

YOUR MANUFACTURING PERFORMANCE SOLUTION

YOUR CONFIGURATION

- Configurable solution, easy to integrate within both your company and local IS/IT landscapes
- Ready to go and quick to deploy at scale, with a first set of algorithms to be progressively enriched

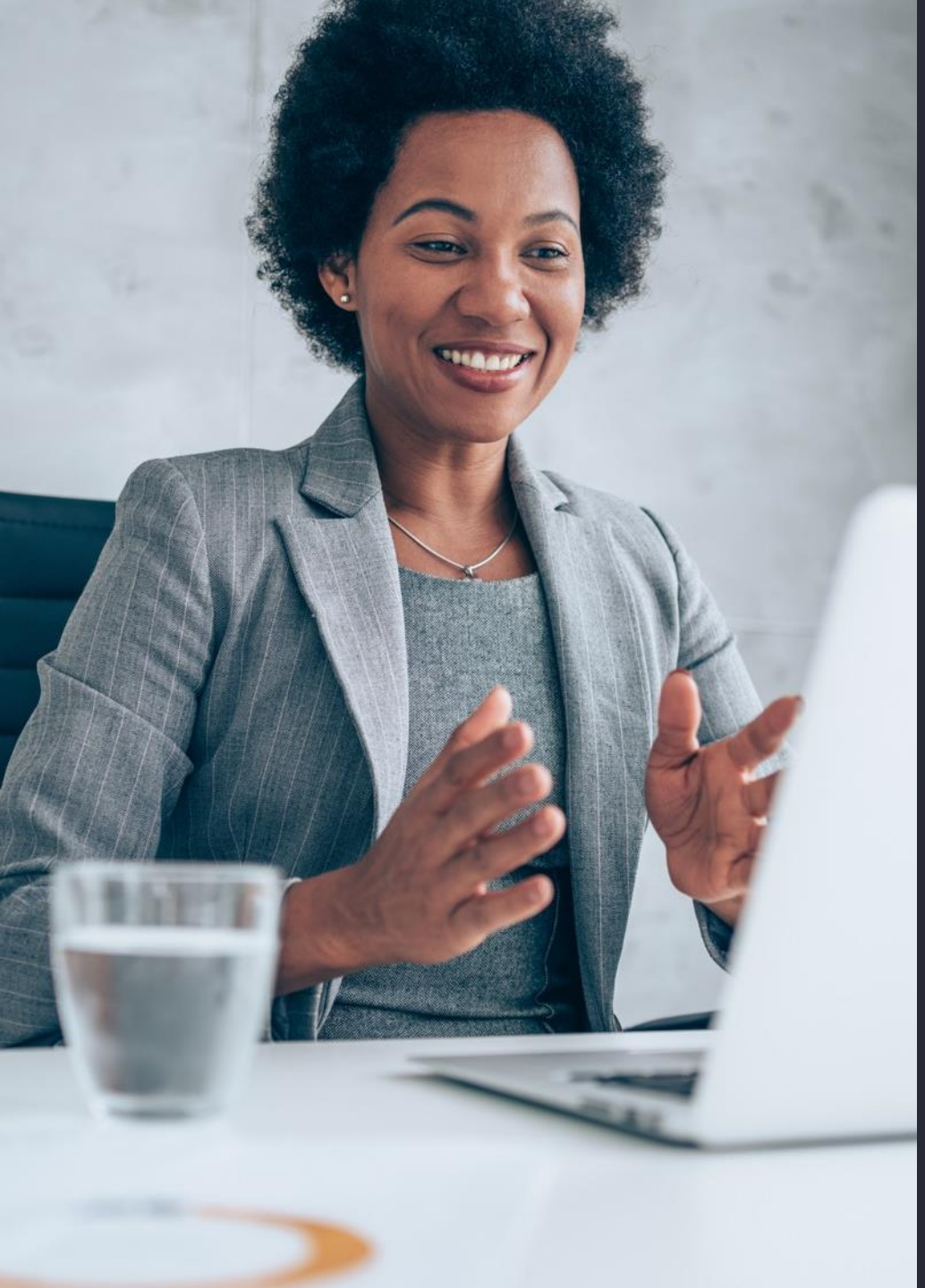
YOUR TECHNOLOGY

- Azure PaaS (IaaS)
- Open source (IaaS)

YOUR SOLUTION

- Foreground IP of the solution belongs to you
- Technology access fee
- No recurring license fees (but PaaS cost)
- 3 + 2 years Capgemini maintenance and support

* July 2021



APPENDIX

A – CREDENTIALS: ILLUSTRATIONS

B – REFERENCE ARCHITECTURE

A – OEE MANAGEMENT PLATFORM: BAKER HUGHES

Baker Hughes GE wanted greater visibility into its manufacturing processes as well as the ability to manage production in real time.

Up to:
- ↓15% lead time
- +5% machine utilization
- +1 inventory turns

Indirect saving
From Intuitions to Insights

Direct saving
Increase OEE

CLIENT OVERVIEW

- Capgemini and Baker Hughes GE implemented an Industrial Internet of Things (X-IoT) solution that transformed shop floor processes. With X-IoT, every machine is connected within a network that compiles data in order to generate a comprehensive report on the state of the production process

CAPGEMINI'S SOLUTION

- By partnering with Capgemini, Baker Hughes GE implemented an industrial internet solution that gathers data from all manufacturing devices and machines to provide operators and engineers with a new level of insight and the ability to adjust production at a moment's notice.

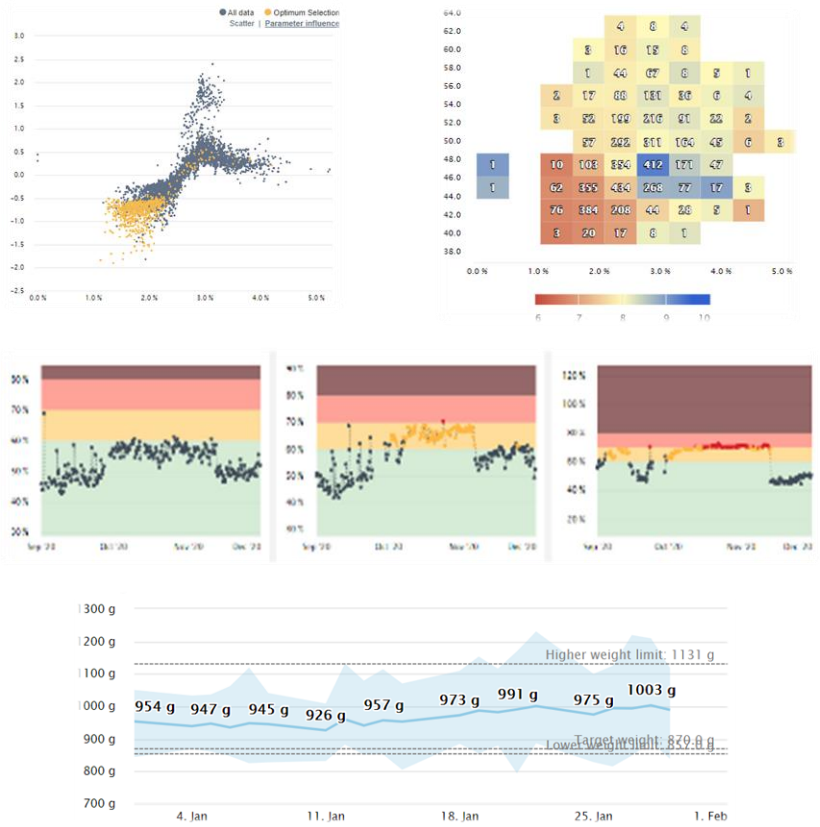
KEY BENEFITS DELIVERED

10 plants – 1000 machines connected

- Enhanced visibility and insight – Process optimization / Root cause
- Real time management of manufacturing processes provides nearly 50 users with real-time status updates, analysis of historical data, and visual metrics dashboards
- Prevention of 26,000 hours of downtime in 2017
- 12% increase in machine utilization five months after the deployment of the solution

A - FACTORY OF THE FUTURE PHILIP MORRIS INTERNATIONAL

PMI develops, manufactures, and delivers tobacco products, including new generation “cigarettes”



CLIENT OVERVIEW

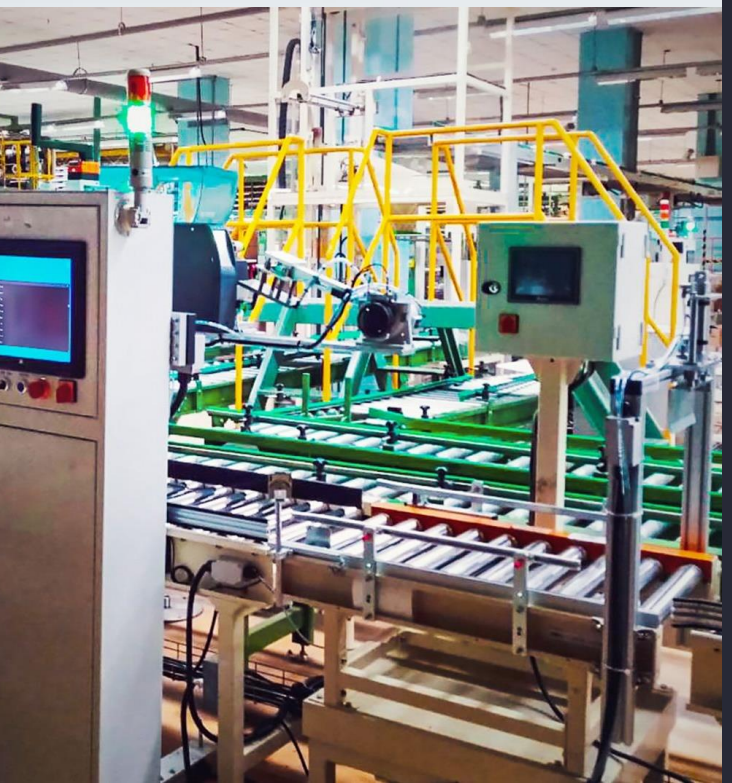
- PMI takes strong measures to adapt to tobacco consumer good market and take the leadership position in this disruption, introducing new, reduced risks generation of products. PMI defined its Factory-of-The-Future late 2019, and started implementation in 2020
- PMI intends to leverage analytics, AI… and other I4.0 solutions to achieve predictive quality, ascertain the corresponding benefits and shape its scale-up

CAPGEMINI’S SOLUTION

- **3 main, staged goals**:
  - Ambition definition, target operating model devising, use cases elicitation, prioritization and scoping (why, when, how)
  - Program launch and execution support: governance model implementation, digital solutions test and deployment processes definition
  - I4.0 / Factory-of-The-Future use cases proof-of-values execution and roll-out / deployment

KEY BENEFITS DELIVERED

- 1/3/5-year transformation roadmap following a staged approach with value creation at each phase
- Accelerated ramp-up by achieving shortened breakeven by 2 years
- Predictive Quality and Maintenance analytics successfully tested on PoV scope, ready for scale-up
- Smart / AI based HVAC control system rolled-out over ~20 sites for significant savings & CO_2 footprint reduction

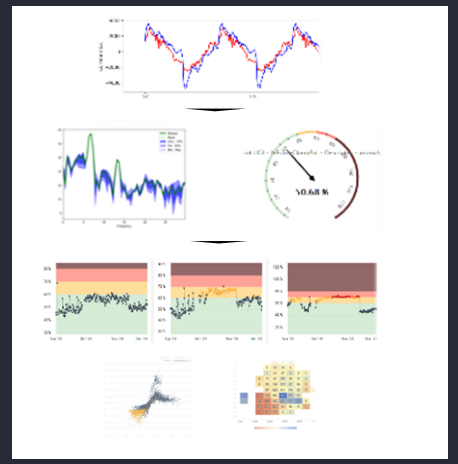


PREDICTIVE MAINTENANCE OF ELECTRICAL MOTORS IN CP INDUSTRY

CLIENT OVERVIEW

Equipment: 43 inter-connected mechanical assemblies, powered by electrical motors with a High-speed production of 400 products / minute

Problem statement: For sensitive systems, each breakdown generates damage to surrounding assemblies. There are also high spare part costs and unpredictable downtimes. These problems lead to constraining and costy preventive maintenance (1200 h lifespan)



CAPGEMINI'S SOLUTION

APPROACH

- System hourly samples all motors parameters (2 s. @ 500 Hz.)
- Current Position Following Error

1. FMEA
2. Design descriptors list (signal processing)
3. Train a model per assembly
4. Set-up monitoring and alerting system

KEY BENEFITS DELIVERED

RESULTS

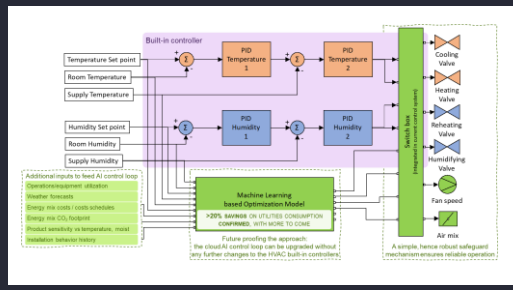
- 80% Breakdowns avoidance
- 45% Defects reduction

→ More than 40% Maintenance costs reduction (540K€ /year / site)

SMART HVAC WITH AI

CLIENT OVERVIEW

Problem statement: A rationale for industrialization & fast deployment of AI HVAC control to speed-up the realization of smart HVAC management benefits
An "external" regulation loop can override the P.I.D. integrated in PLCs that control HVAC units. This machine learning based loop integrates additional parameters compared to the relatively basic one, built into the HVAC units, to optimize HVAC utilization and reduce utilities consumption.



CAPGEMINI'S SOLUTION

APPROACH
Quickly roll out of the solution over most of its factories:

- Phase 1+2 comprises 19 sites totaling ca. 600 units using a breadth of controller technologies
- In 3 phases totaling 27 sites and ca. 800 units of 12 different vendors and 37 controller technologies

KEY BENEFITS DELIVERED

RESULTS

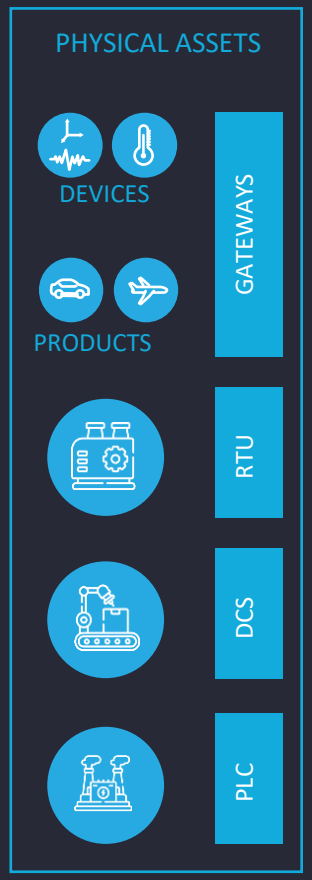
~20% on energy consumption were thus obtained on the site where this solution was initially developed and implemented (30%+ savings deemed as achievable)

APPENDIX

A – CREDENTIALS: ILLUSTRATIONS

B – REFERENCE ARCHITECTURE

PLANT CONTROL TOWER IS BUILT ON A REFERENCE ARCHITECTURE



INTEGRATION & COMMUNICATIONS

- 4G/5G
- Others Protocol
- IoT Protocol
- Industrial Protocol / OPC
- Edge Analytics
- OPC-UA Standard.

FIELD GATEWAY

DATA HUB SERVICES

- Digital Twin
- Equipment's
- Production Line
- Manuf. Process

DATA MODELS

- Data / Process Orchestration
- Data Ingestion

DATA INTEGRATION

- Data Trans-formation
- Data Enrichment
- Storage

- System Integration

ENTERPRISE INTEGRATION [1]

- Data Cleansing

DATA SERVICES

REAL-TIME DATA STORE

INFORMATION SERVICES

- Algorithms Library
  - KPI
  - Correlation
  - AI / Predictive
- Analytics Orchestration
- Service Modeling

FUNCTIONAL SERVICES

- BI & Analytics / AI
- APIs
- APPs services
- Self service

BUSINESS SERVICES

- Condition monitoring
- Predictive maintenance
- Plant Control tower
- Paperless production
- Augmented worker
- Process simulation
- Energy management
- Track & Tracing
- Collaborative Vision

DATA TRUST FOUNDATION

- Master Data Management
- Data Discovery
- Data Governance
- Data Protection And Privacy

SECURITY FOUNDATION

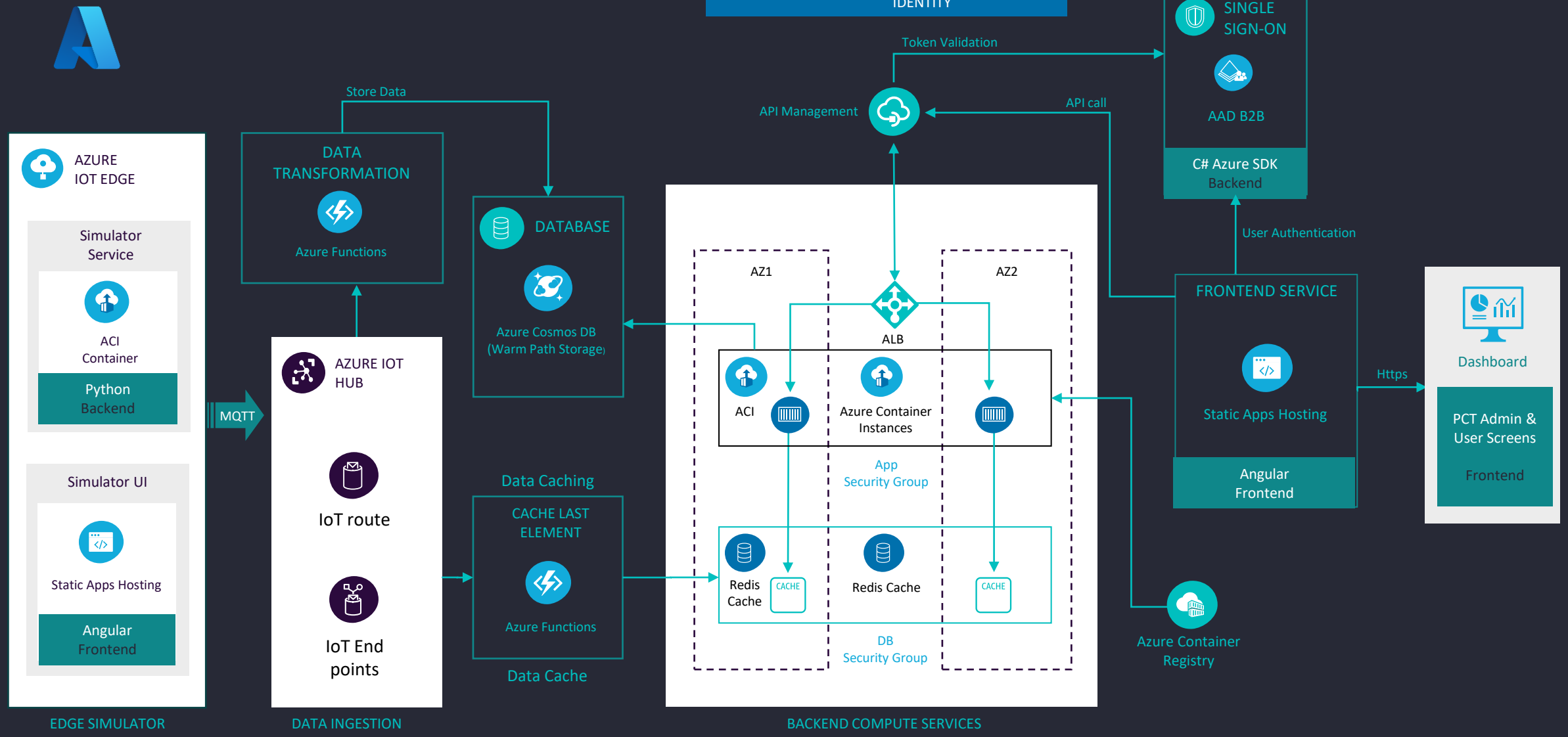
- IAM
- Firewall Management
- Certificates Management
- Network & End Point Security

MANAGEMENT FOUNDATION

- Platform Management
- Device / Edge Management
- Monitoring
- Devops Automation

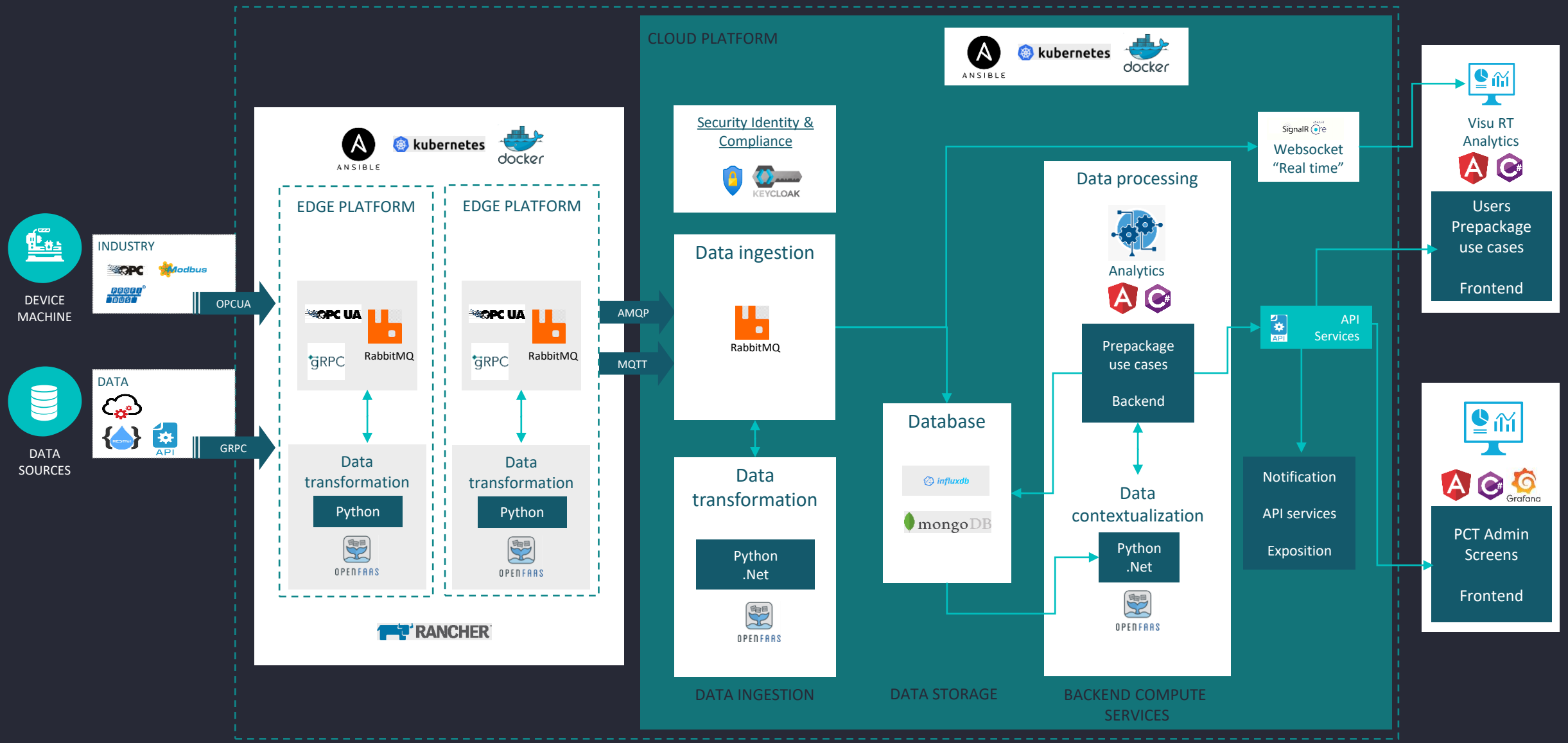
1: Communication with: Manufacturing IT systems, Enterprise IT systems, External systems

AZURE ARCHITECTURE



Note : Highlighted in RED is not in scope, will be enabled in feature

OPEN SOURCE ARCHITECTURE



About Capgemini

Capgemini is a global leader in partnering with companies to transform and manage their business by harnessing the power of technology. The Group is guided everyday by its purpose of unleashing human energy through technology for an inclusive and sustainable future. It is a responsible and diverse organization of 290,000 team members in nearly 50 countries. With its strong 50 year heritage and deep industry expertise, Capgemini is trusted by its clients to address the entire breadth of their business needs, from strategy and design to operations, fueled by the fast evolving and innovative world of cloud, data, AI, connectivity, software, digital engineering and platforms. The Group reported in 2020 global revenues of €16 billion.

Get the Future You Want | www.capgemini.com