Innovations for Digital Manufacturing

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Why IoT and digital manufacturing are important …

SAP Leonardo
digital innovation system

- Reimagining new business processes to simplify process variability
- Rapid introduction of innovation and creating new business models
- Higher level of automation and changes in how people will work
- Enabling the “market of one” delivering individualized products

Business value benchmarks

Productivity improvements such as lower maintenance costs (up to 60%), or lower capital appropriations (25%)

New operational processes resulting in lower labor cost (30%) with improved OEE (5%–10%) and reduced scrap levels (30%–50%)

People process optimization leading to 10% to 30% higher productivity in the form of higher outputs and lower costs

Lower risks, such as reduced warranty cost by (10%) and improved compliance through 100% component and process traceability

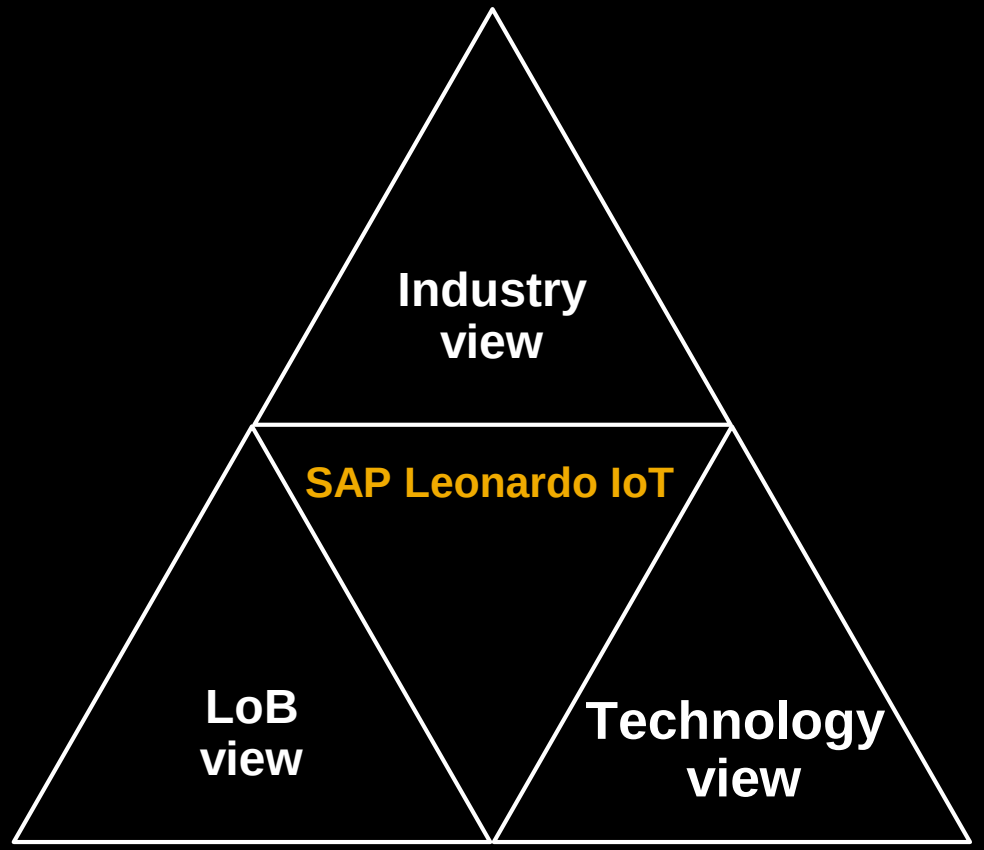



SAP Leonardo IoT – innovation portfolio

Line-of-business (LoB) digital supply chain

(Business process view)

- Digital **business planning**
- Digital **response and supply**
- Digital **logistics**
- Digital **product innovation**
- **Digital manufacturing**
- Digital **operations**



SAP Leonardo IoT

("Things" view)

- Connected **products**
- **Connected assets**
- Connected **fleet**
- Connected **infrastructure**
- Connected **markets**
- Connected **people**

Efficiency-led models

New business models

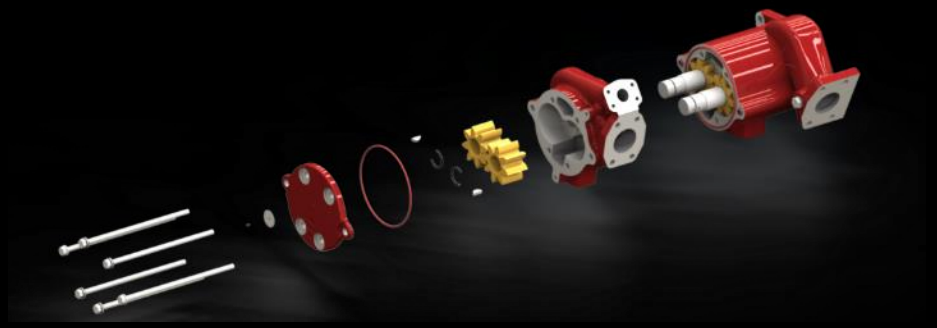
Digital transformation impact

Business processes

Business models

Work environment

Business model, change



Customer satisfaction

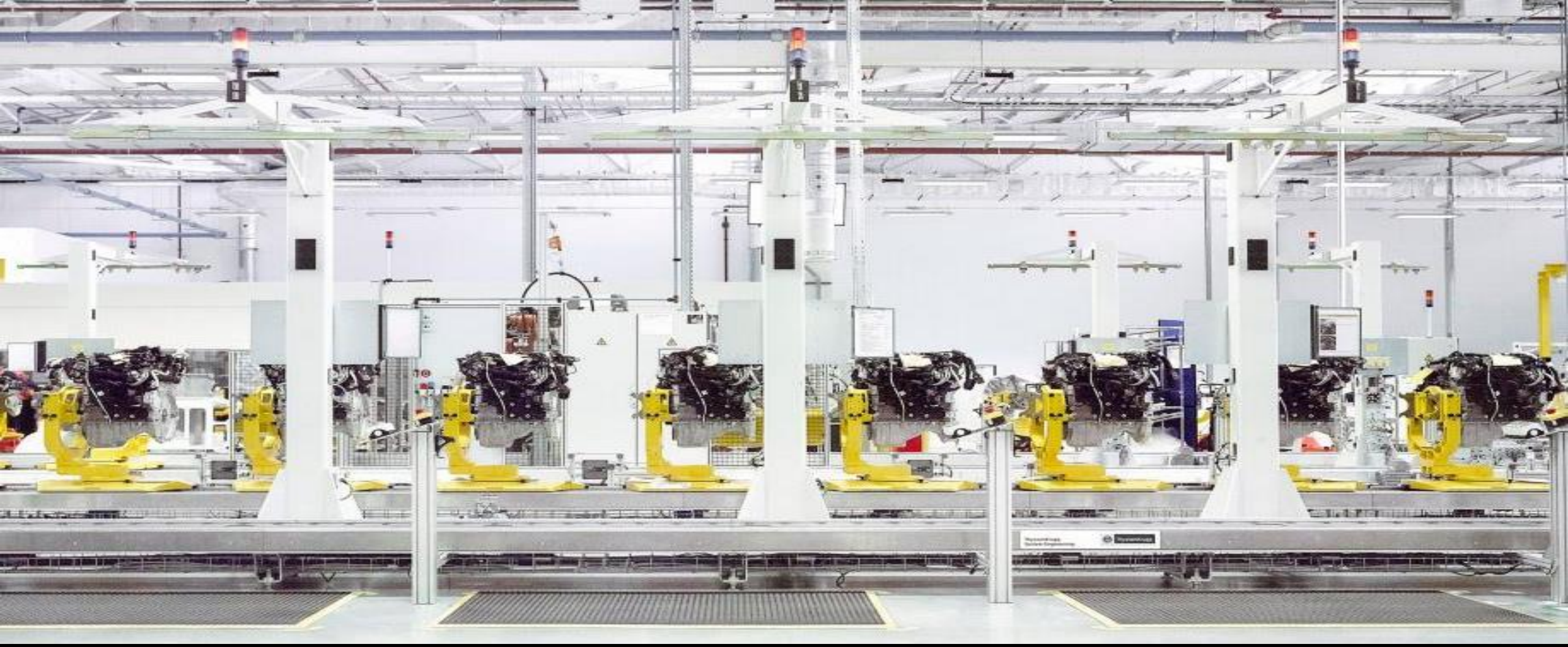
Competitive advantage

Higher profit

Smart manufacturing
Real-time insights on machine and environment

Improved efficiency
Lowering risk, through 3D visualization of work instructions and change orders

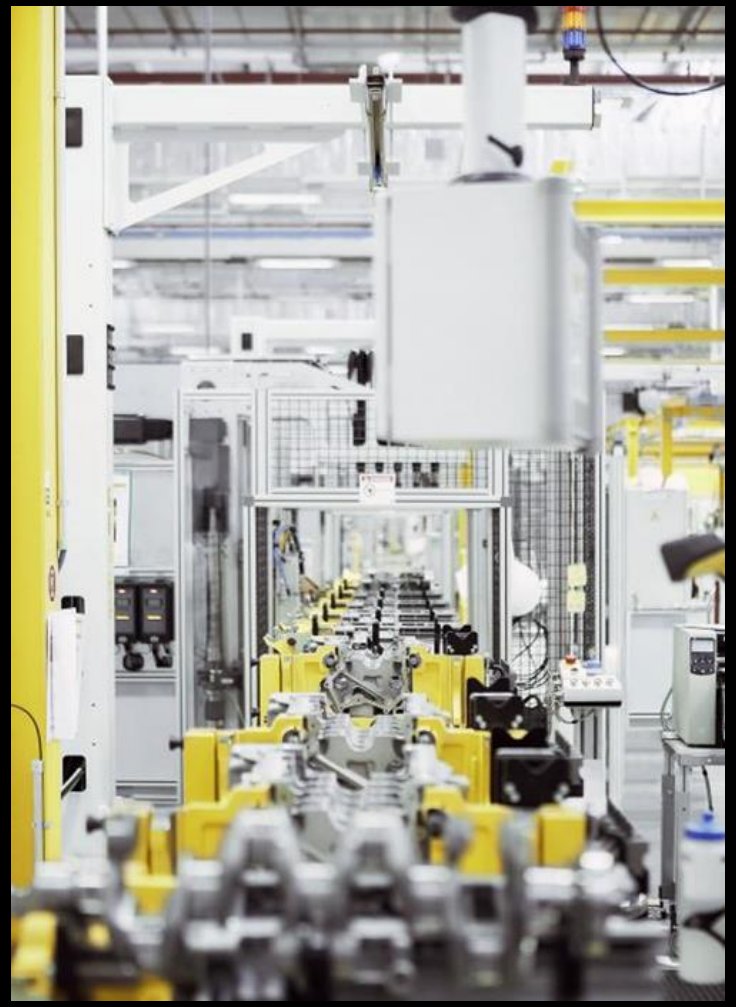
Reimagined products
Extending the solution portfolio to enable configuration for precision manufacturing

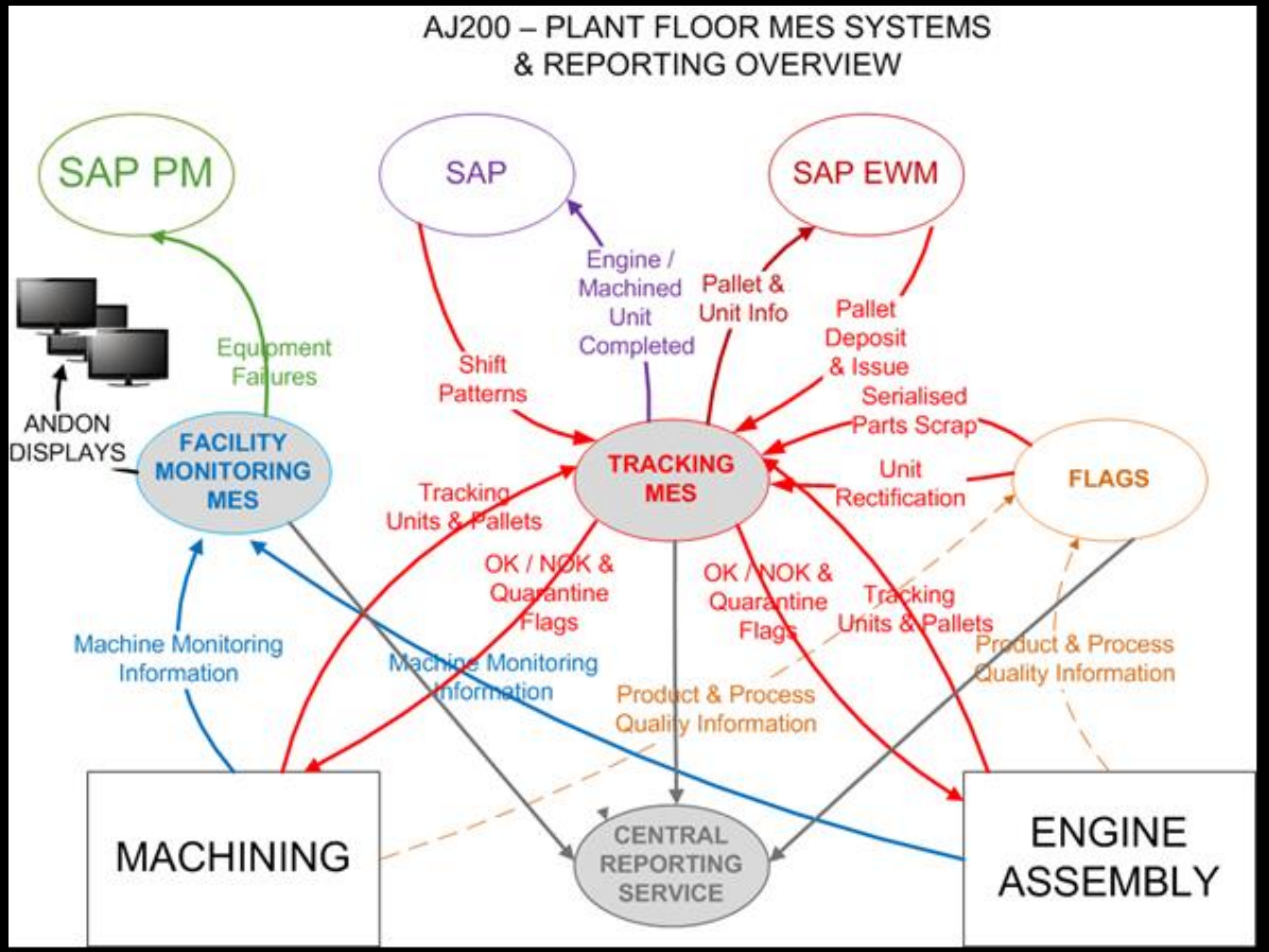


Three machining lines, one engine assembly line

- 37-second takt time per engine
- 5 plant connectivity / Kepware OPC server platforms / 20,000 tags
- 6,000+ transactions per minute at full rate

Integrated enterprise





Information on project

Facility health reports scope

- Bottleneck analysis by line and by constraint operation
- Downtime by state by operation and by machine
- State trend by operation and by machine
- MTBF and MTTR showing downtime in minutes and scheduled time minus downtime
- Top X fault trend by machine and operation
- Top fault by occurrence and time
- Run at rate (JPH capability)
- Over cycle analysis (engine assembly line only)
- OEE (including bottleneck station)
- Quality rate
- Hour counts by station and by process
- Part through station, including cycle time
- Right first time – without rectification
- First time through after rectification

Process and product quality reports scope

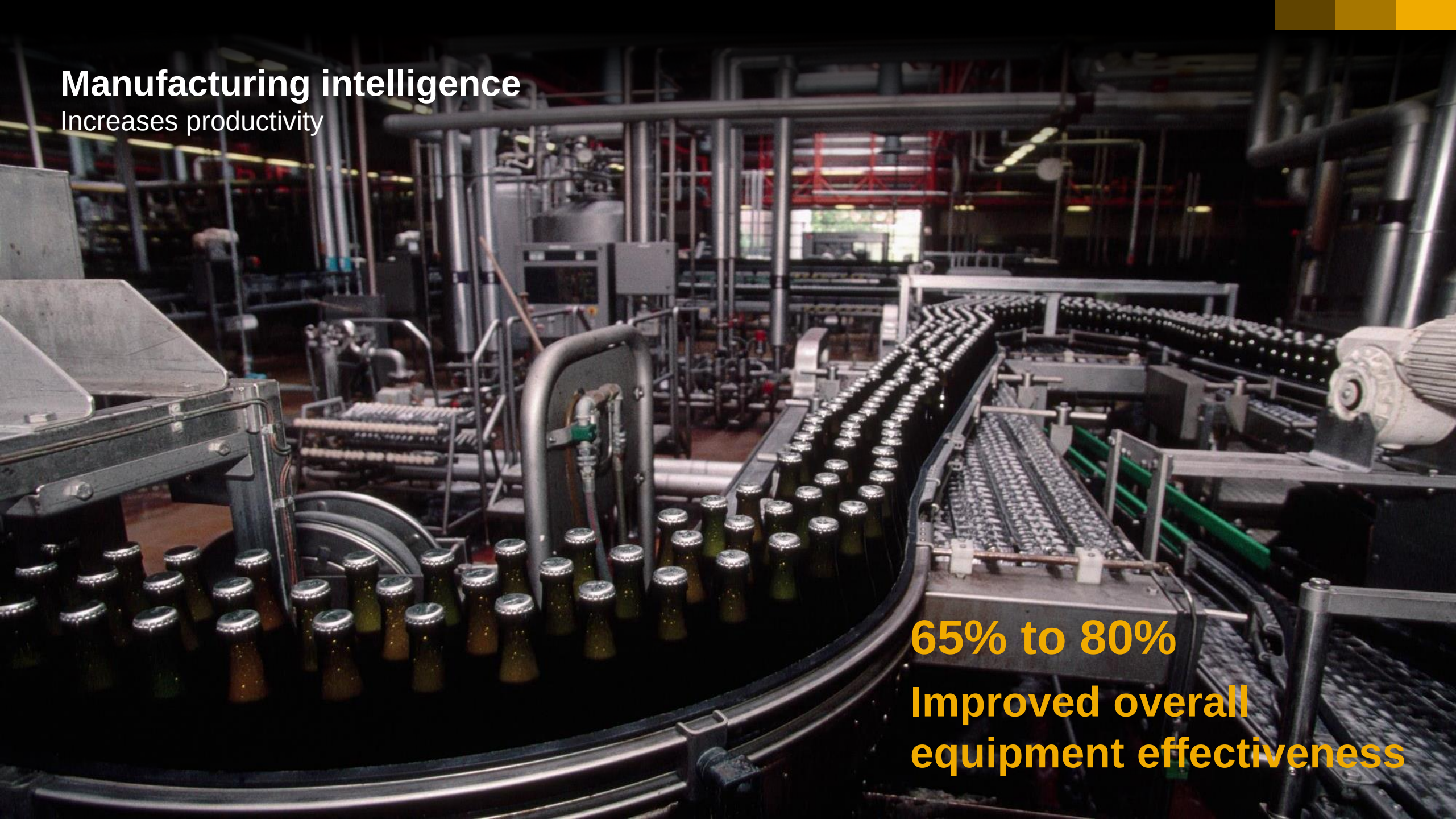
- By unit
- By operation station
- By process
- By engine type
- By adaptor plate/platen
- By on/nok/all
- Parameter requirement
- Linked to facility health analysis (complete engine birth certificate)
- Linked to tightening server – tightening spindle selectable (all/multi-selectable)
- Linked to cold test
- Linked to hot test
- Linked to leak test

Integrated mining and steel

Real-time visibility across operations

Manufacturing intelligence

Increases productivity



65% to 80%

Improved overall equipment effectiveness

Work environment, change

Reduced costs

Improved productivity

Higher quality

Role expansion
Working across disciplines to design and manufacture smart products

Process change
Collaboration, networking

Business model
Customer centricity

Industry 4.0

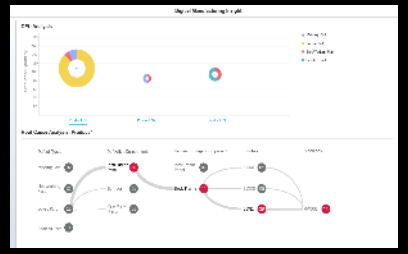
Building blocks

End-to-end integration, IT–OT convergence

User experience – wearables – augmented reality

Distributed manufacturing – additive manufacturing

End-to-end transparency – intelligent analytics – Big Data



Digital manufacturing

Linking the physical world to the digital world

Business world

Digital world

SAP Leonardo

Physical world

Design → Plan → Make → Operate → Deliver

General ledger
Procure to pay
Order to cash
Engineer to order
Configure to order
Make to stock
Inventory controls
Costing
CRM
SRM
Materials

¥ € £ $

Digital twin

"As designed"

"As built"

"As maintained"

"Performance"

SAP S/4HANA

Accelerate the enterprise success

Higher productivity due to simplification

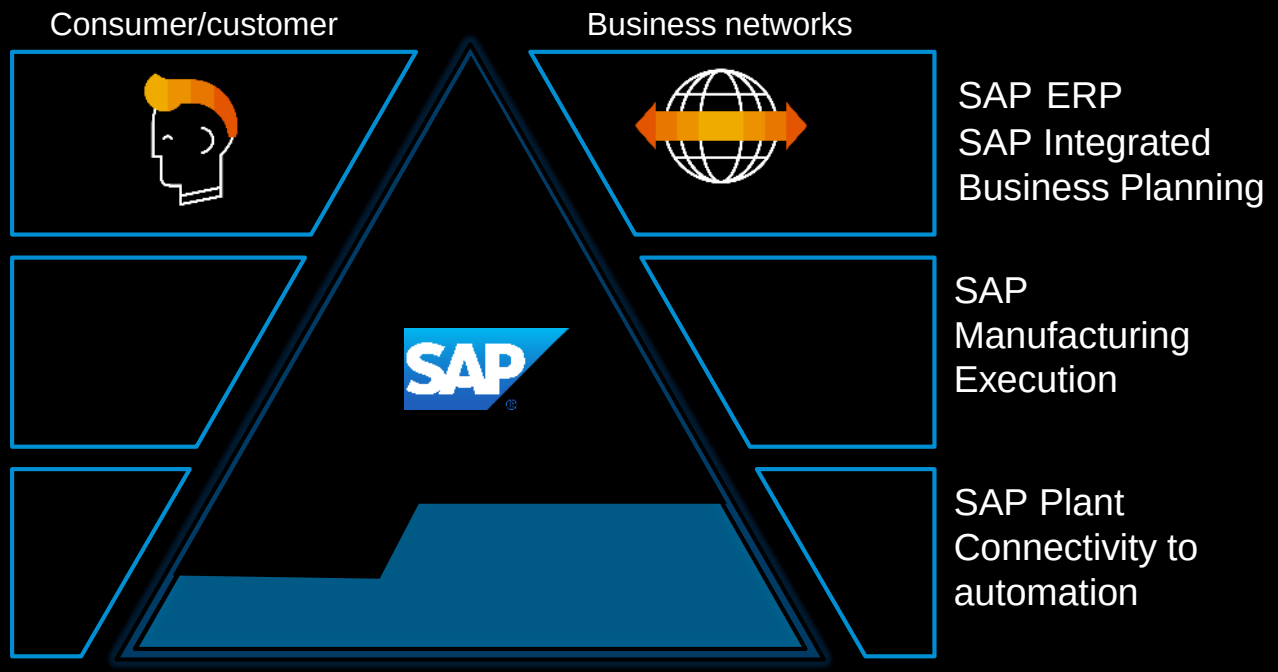
How to accelerate and grow productivity and profitability in complex business environment?
How to run business and production seamlessly integrated?

Need for **smart simplification**

(1) Top floor to shop floor

(2) Customer to operations

- Simplify
- Harmonize
- Reduce



Digital manufacturing with SAP for industrial IoT

SAP Ariba

SAP Digital Manufacturing Insights

SAP S/4HANA Enterprise Management

SAP Asset Intelligence Network

OEM cloud (MindSphere)

» Business context
» OEE, energy management

Digital manufacturing

SAP Manufacturing Execution

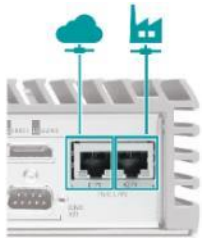
SAP Manufacturing Integration and Intelligence

SAP Plant Connectivity

» Multiple vendors
» Multiple machines

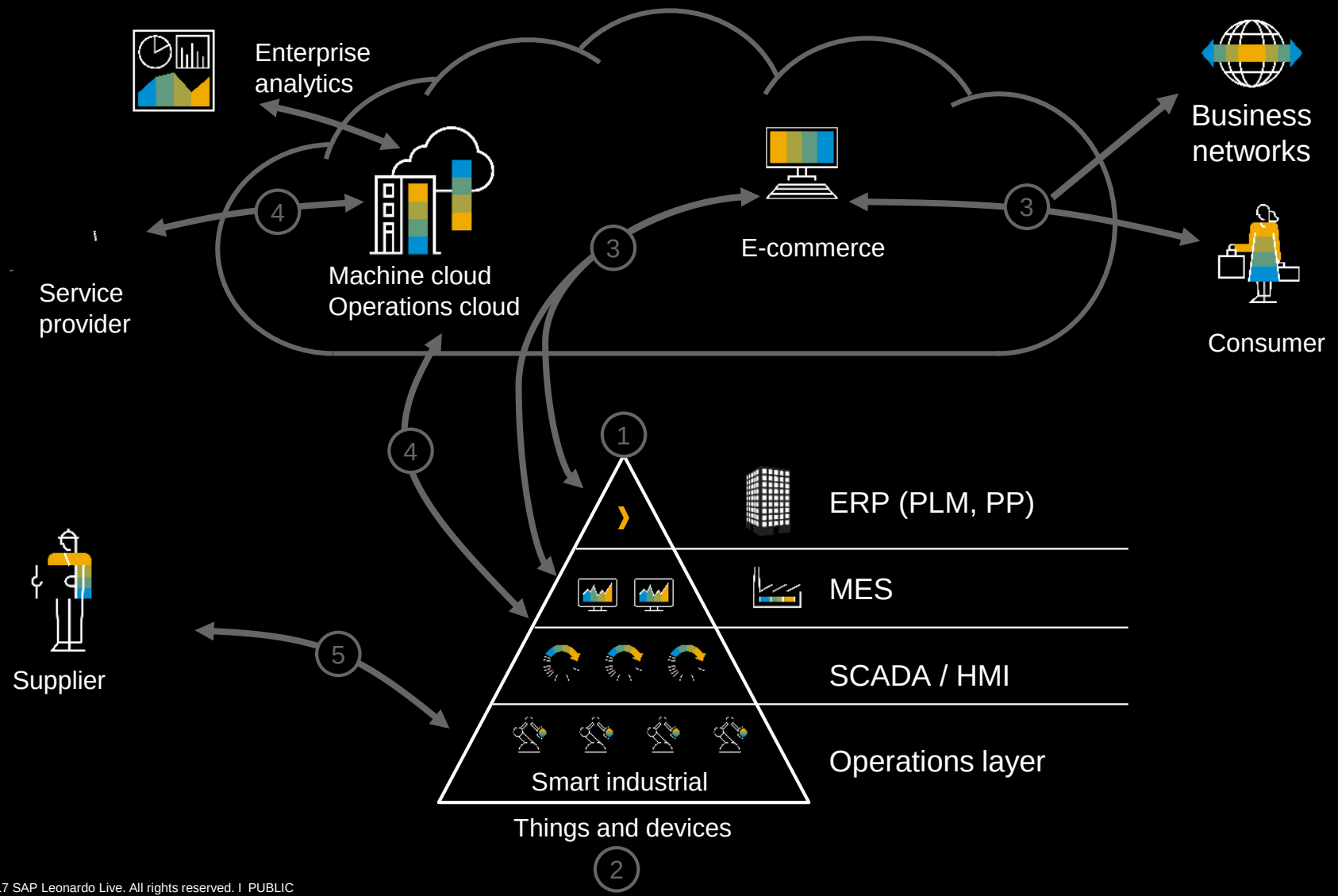
Shop-floor automation systems

PI SYSTEM OSIsoft.
BECKHOFF
Kawasaki Powering your potential Kawasaki Robotics
FESTO
Schneider Electric
EMERSON
Kepware TECHNOLOGIES
Honeywell
ABB
YASKAWA MOTOMAN ROBOTICS
BOSCH
EATON
KUKA
Rockwell Automation
SIEMENS



Digital manufacturing with SAP

Five scenarios of “connectedness”

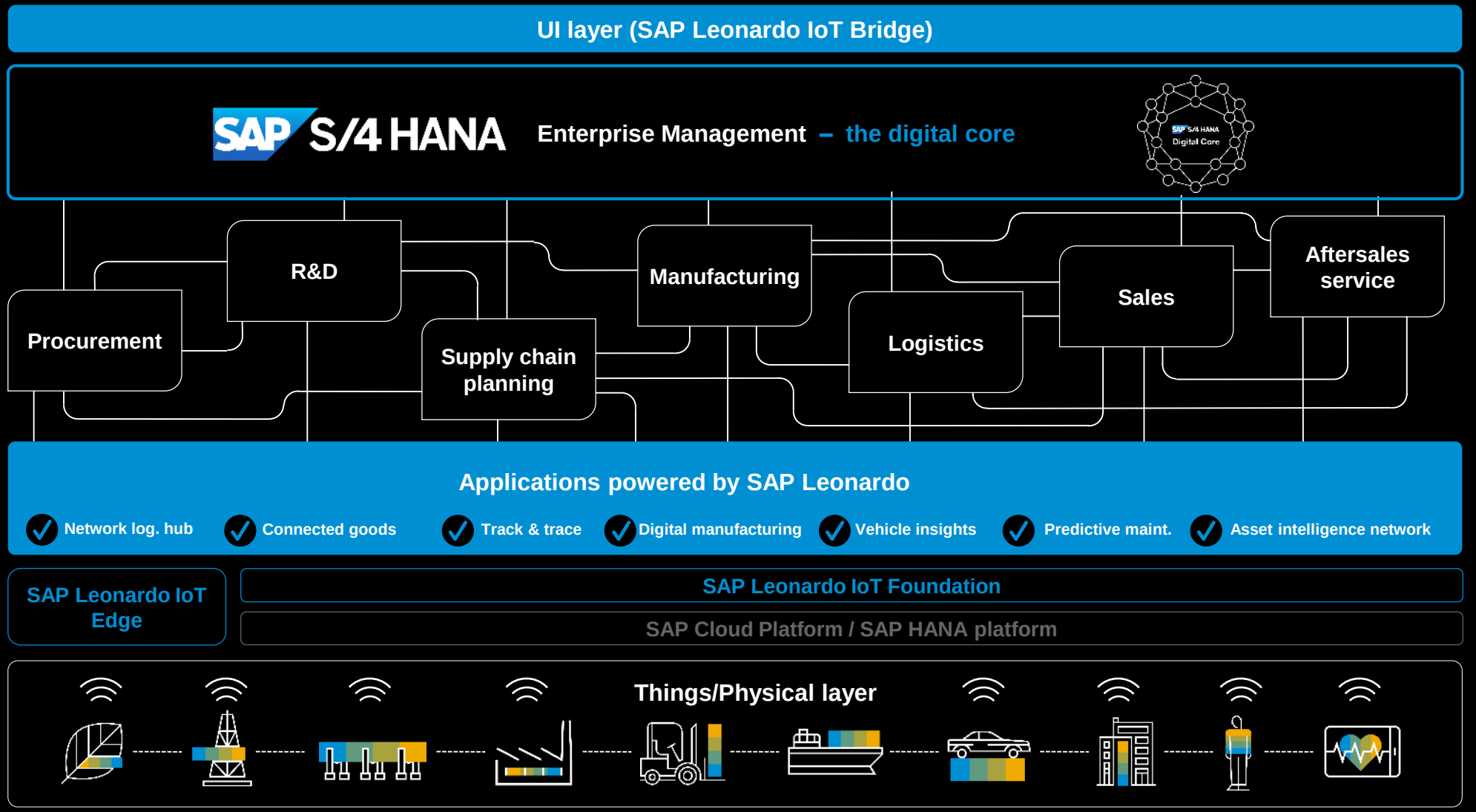


5 scenarios

1. Shop floor to top floor
2. Machine to machine
3. E-commerce integration
4. Machine/operations cloud
5. Direct replenishment

SAP Leonardo and digitalizing business: The big picture

SAP Leonardo
digital innovation system



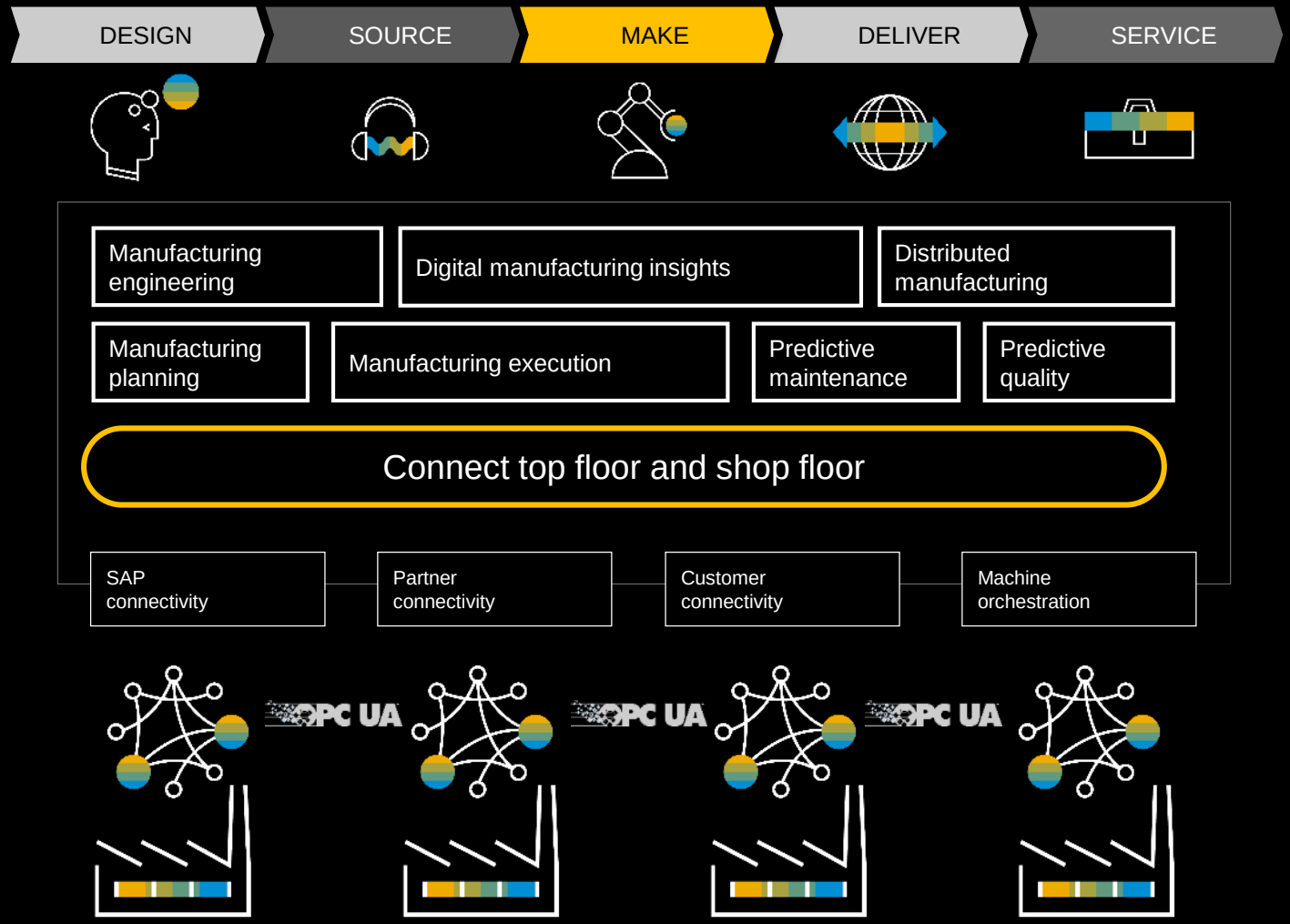
Digital manufacturing with SAP

Digital manufacturing wires the world of machines with business processes

- Shop floor to top floor (vertical)
- Machine-to-machine (horizontal)
- End-to-end integration
- Business partners
- Easy connectivity

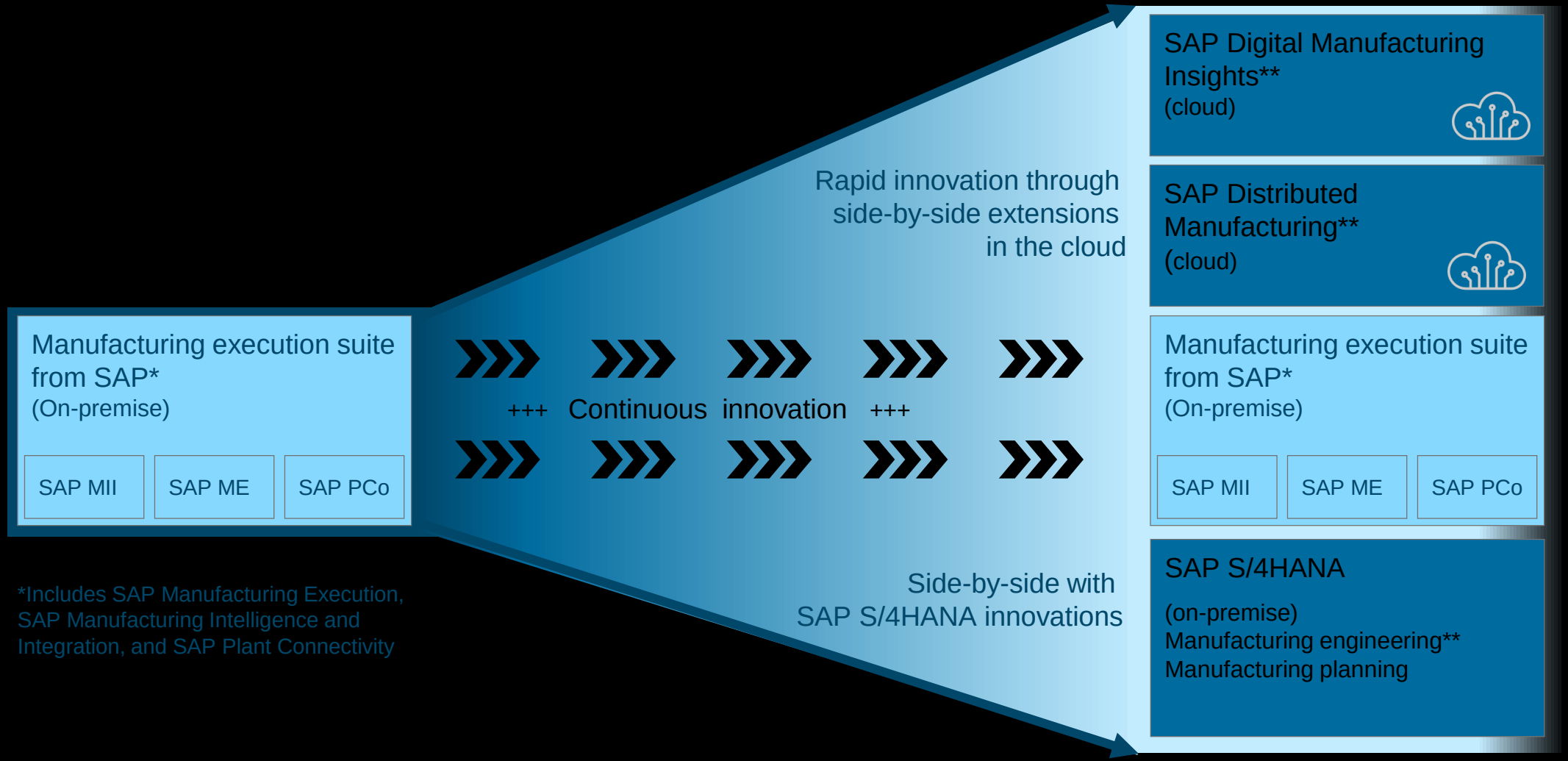
Build on an **open IoT-ready platform** supporting **Industry 4.0 manufacturing**

- Following the OPC UA standards
- Enabling a manufacturing network
- Connecting partners along the supply chain
- With flexible deployment options



SAP for Manufacturing solution portfolio

Innovation strategy



**Planned innovation not yet available, subject to change

SAP Manufacturing Execution

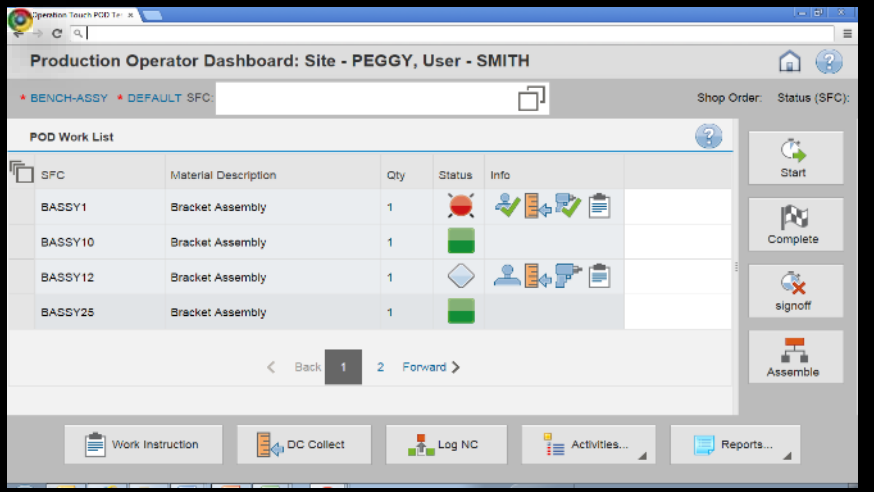
Main differentiators

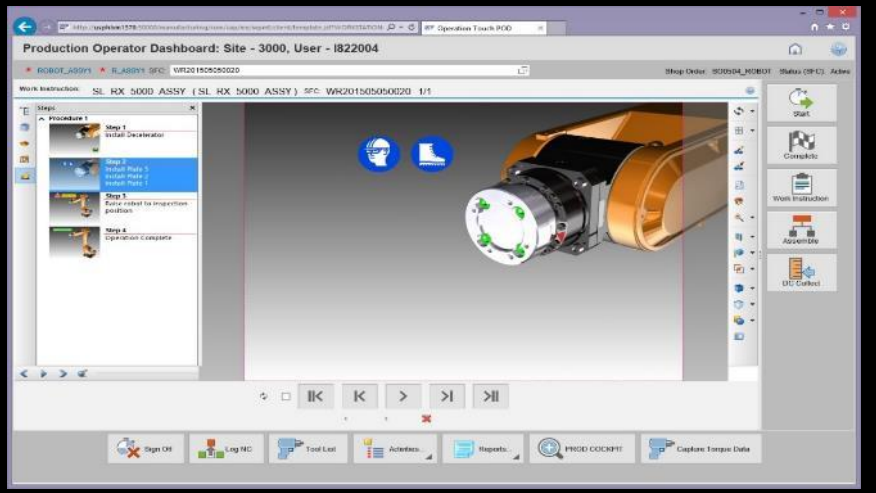
SAP Manufacturing Execution – what is it?

- Shop-floor execution system for the discrete industries

Main differentiators

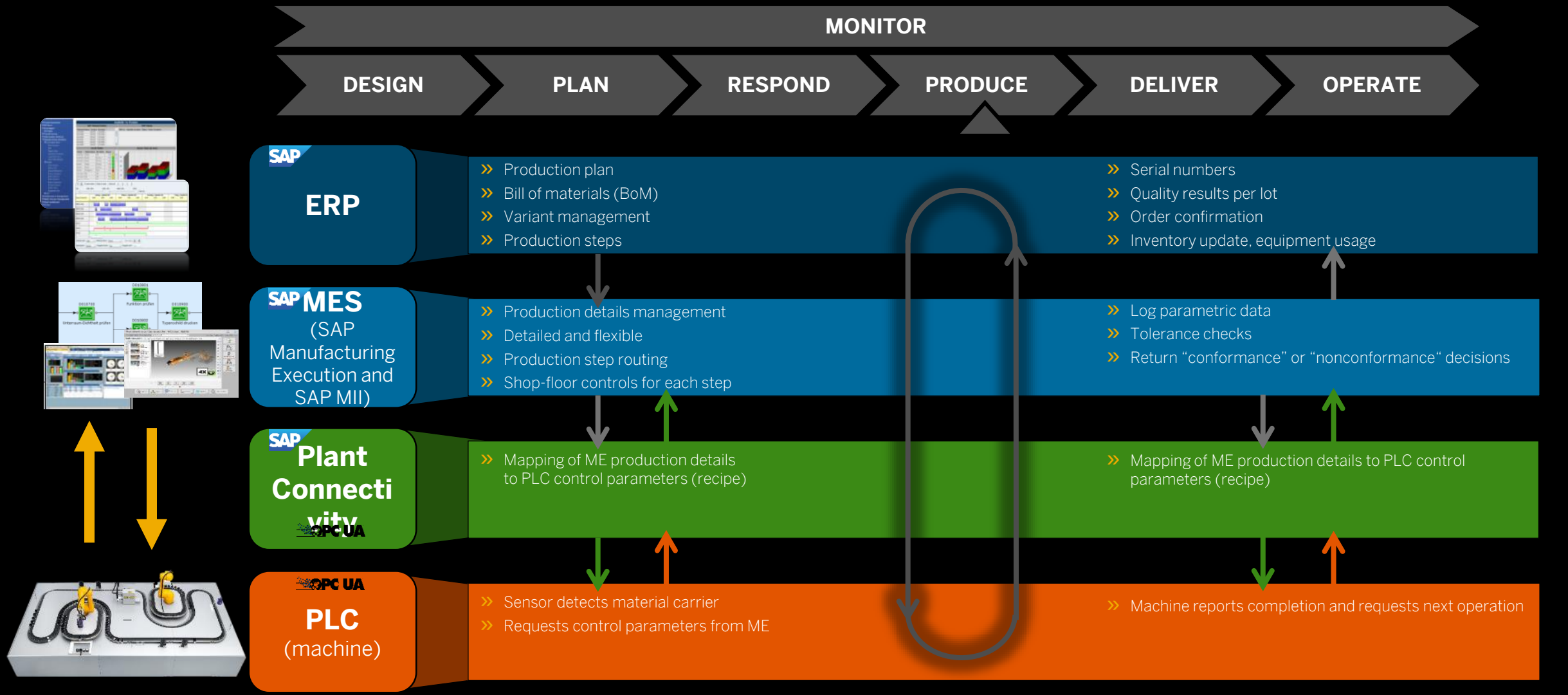
- ERP integration built in
- Ability to control production of every single unit (lot size 1)
- Easy interaction with shop-floor automation layer
- Unit-level tracking and tracing/genealogy
  What operation, tool, or machine was used, where parts came fro, …
- Comprehensive nonconformance management including in-line sampling and ability for visual test and repair
- Process interlocking
- High flexibility and extensibility; pure SOA-based architecture
- High usability with browser-based user interface
- Role-specific access and personalized dashboards for operators
- Flexible production process modeling without additional programming
- Active community of partners and customers





SAP Connected Manufacturing – architecture

The connected plant in the extended supply chain



SAP Manufacturing Integration and Intelligence (SAP MII)

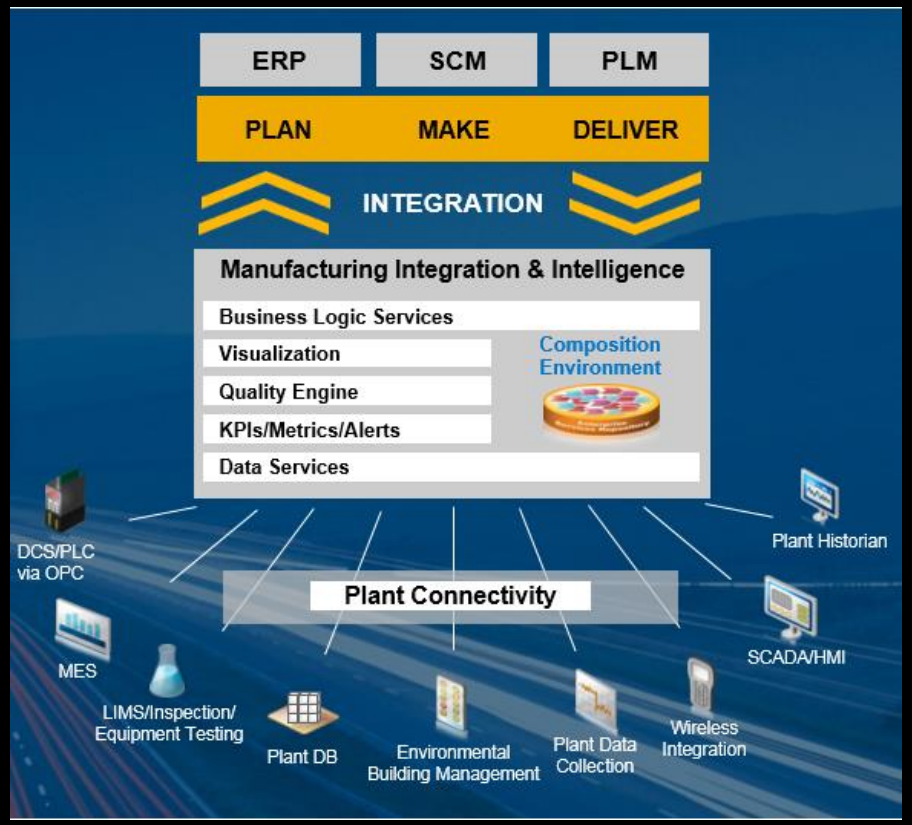
Main differentiators

SAP Manufacturing Integration and Intelligence – what is it?

- **Extensible** manufacturing platform allowing rapid adaption to any manufacturing process

Main differentiators

- **Integration:** Provide interoperability between shop-floor solutions and enterprise ERP (production planning, plant maintenance, materials management, quality management functionality)
- **Intelligence:** Visualize data and include KPIs from any of the above sources
  - Provide simple and efficient local user interface and dashboards
- **Innovation:** Powerful SOA-enabled business logic to enable customer-specific processes for planning, execution, maintenance and quality
  - Fast prototyping to achieve fast ROI
  - Broad and extensive partner network
  - Applicable to all manufacturing industries and utilities

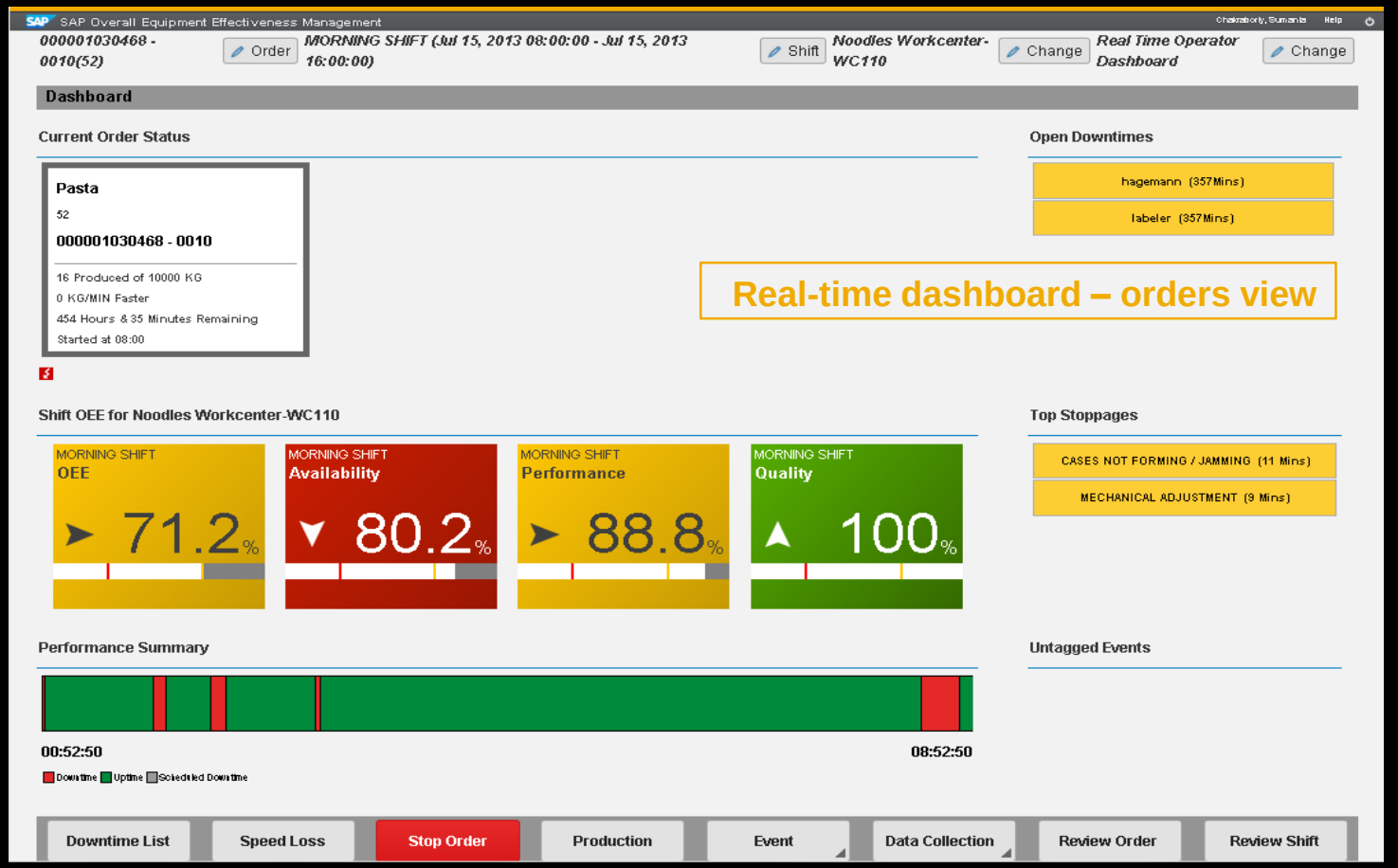


SAP Overall Equipment Effectiveness Management with SAP MII

KPI management with prebuilt business process execution

Solution highlights

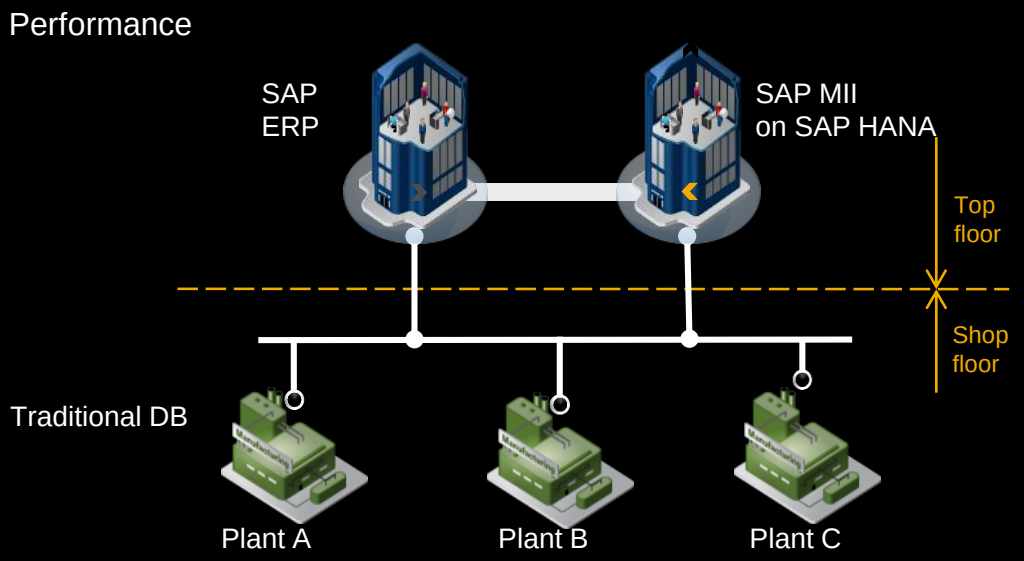
- Single, common framework for all plants
- Enterprise-wide repository of operational data
- Cross-plant performance comparison
- Combined with business context
- Broader business implications of performance loss
- Framework for performance capability and production improvement

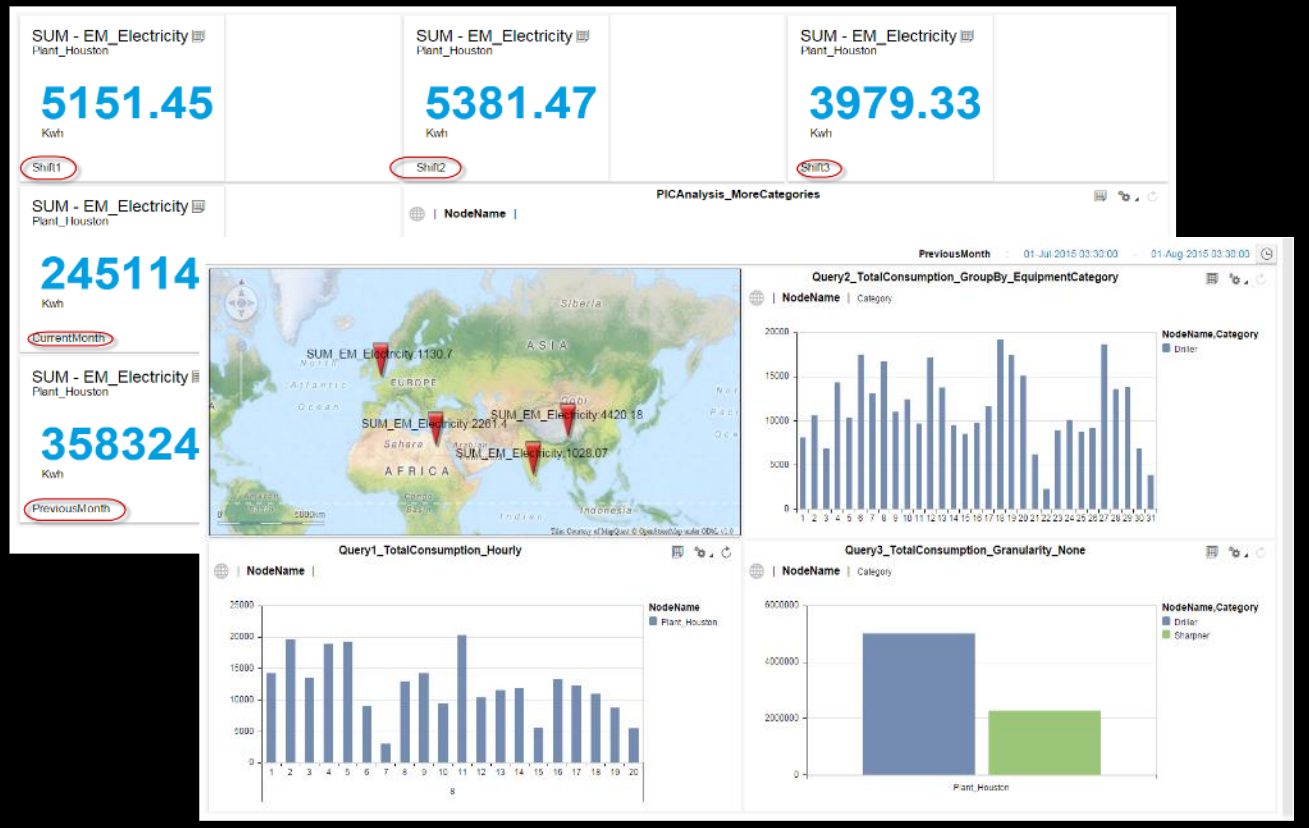


Energy monitoring and analytics with SAP MII

Enterprise operations management

Provide **real-time visibility** to energy consumption across the enterprise – **insight to action** – energy, fuel, steam, and water use is optimized in line with production schedules and energy contracts.





SAP Digital Manufacturing Insights

Unlocking the benefits with insights into digital manufacturing

SAP Digital Manufacturing Insights –
role-based insights to enable intelligent decisions

- ✓ Set up manufacturing KPI governance in line with corporate objectives
- ✓ Review and benchmark revenue, cost, delivery performance, quality & customer satisfaction across manufacturing plants
- ✓ Expedite decisions

CxO

Quality | Cost | Delivery | Productivity | Safety

Key performance indicators

- ✓ Monitor and analyze manufacturing performance indicators
- ✓ Improve adherence to production schedule through real-time production insights and expedited actions
- ✓ Gain continuous improvement of yield/through put, product quality, vendor quality through advanced analytics (predictive, statistical process control …)

Plant and unit heads

Manufacturing performance indicators

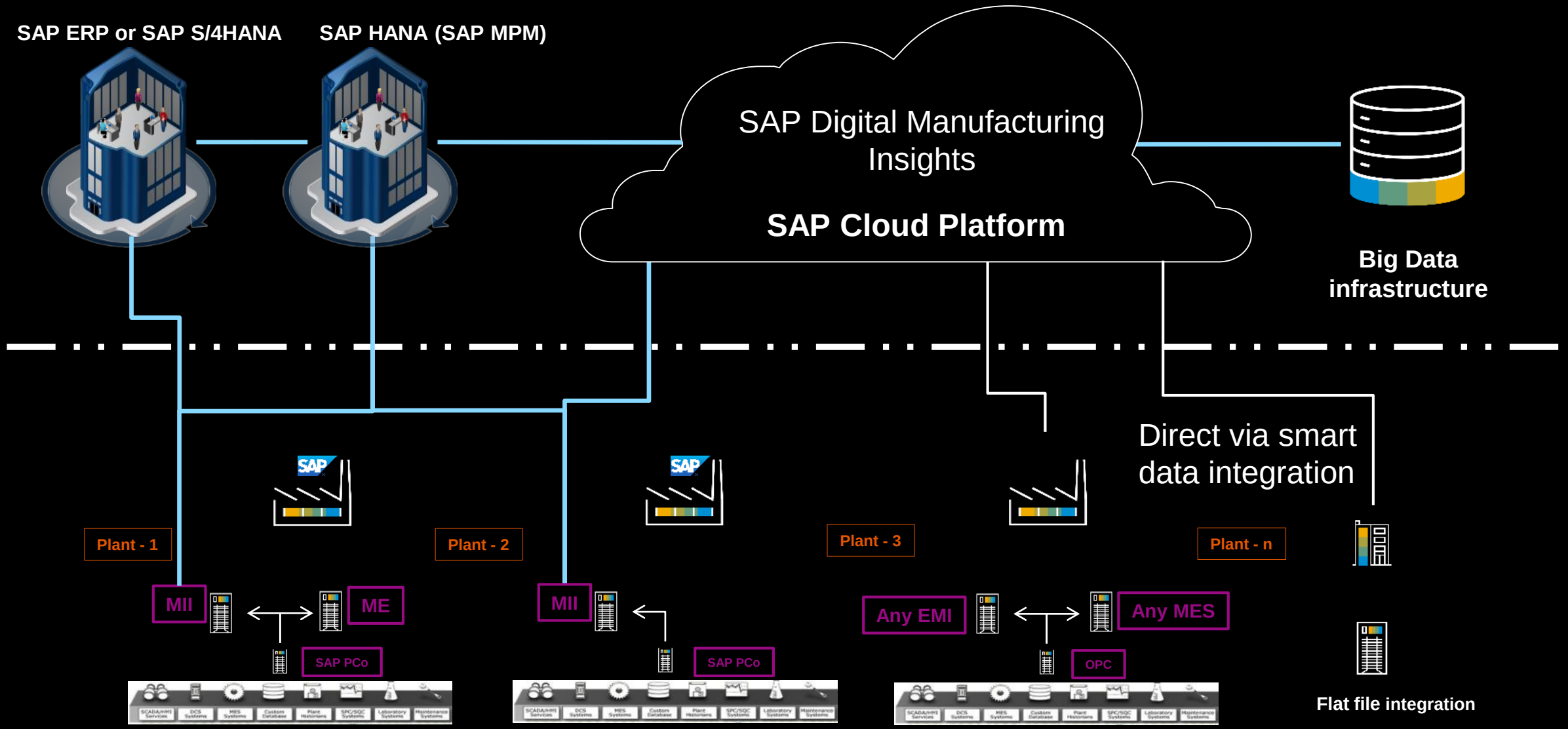
- ✓ Achieve advanced algorithm-based insights pointing to causes
- ✓ Analyze and review prioritized causes and their impact and initiate corrective actions

Supervisors

Manufacturing activity indicators

SAP Digital Manufacturing Insights

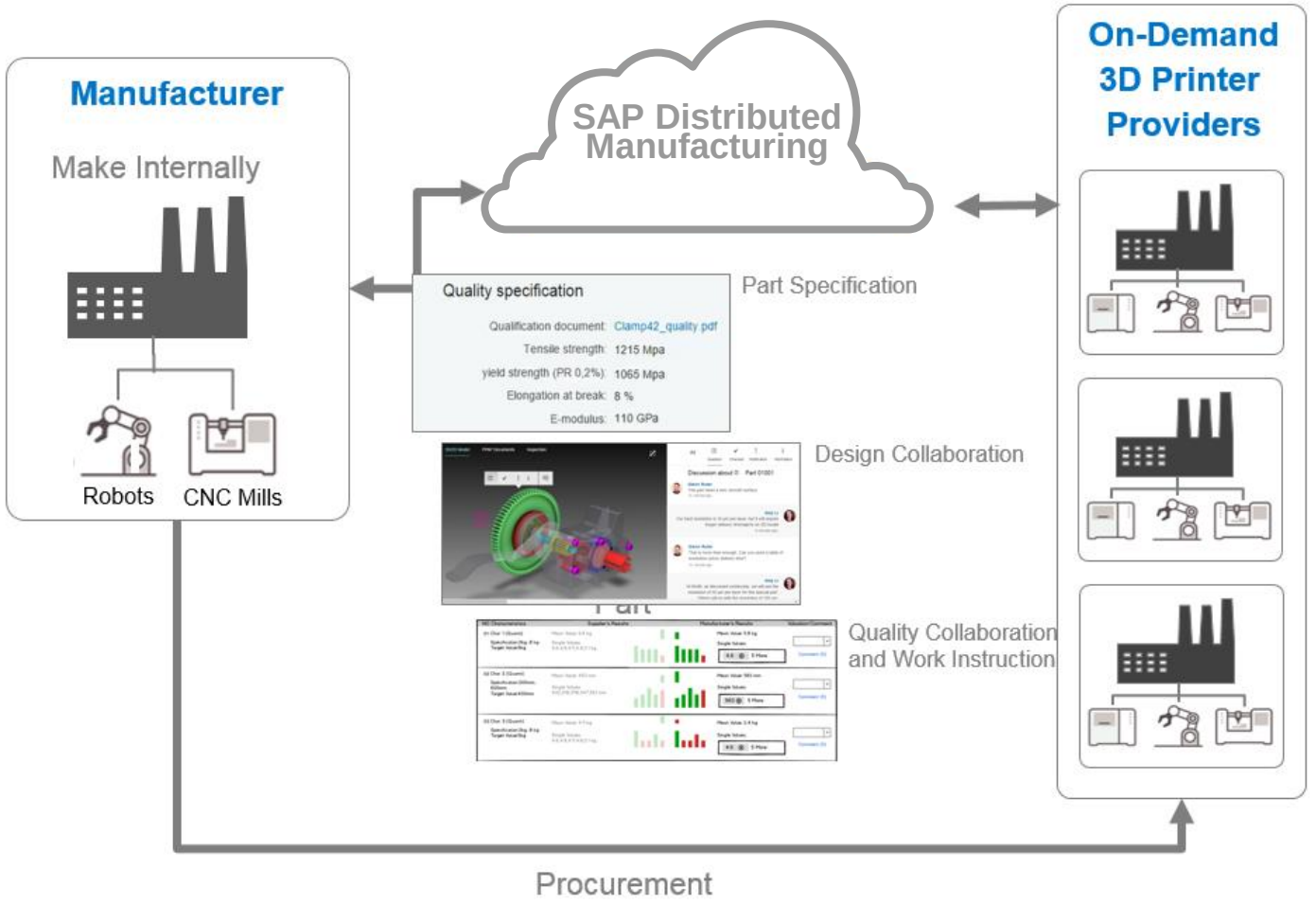
System landscape



SAP Distributed Manufacturing

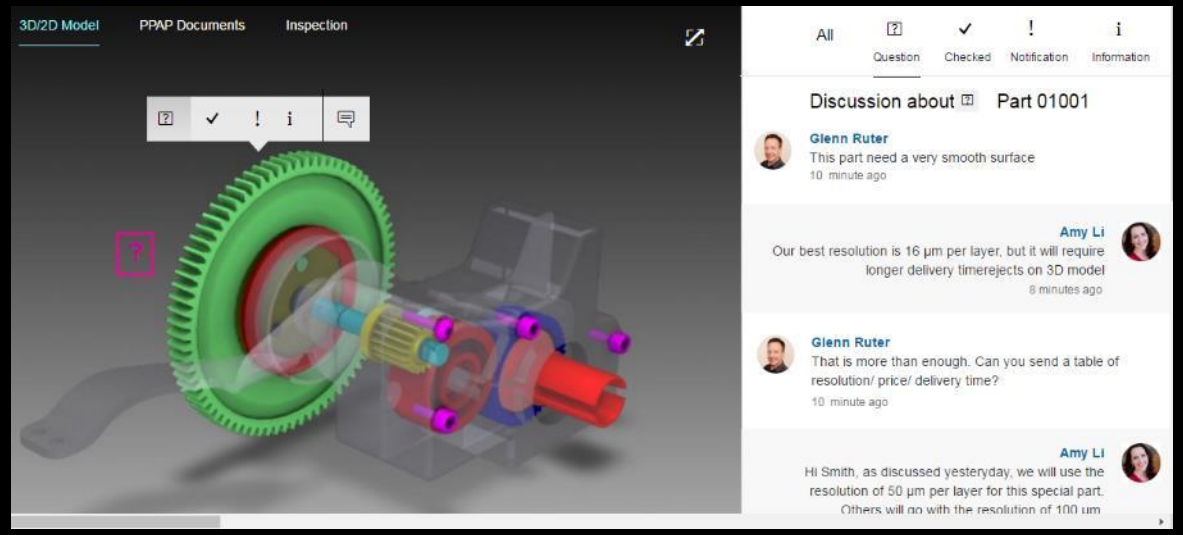
Unlocking the power of additive manufacturing

SAP Distributed Manufacturing



SAP Distributed Manufacturing:

Design collaboration to optimize part design for 3D printing



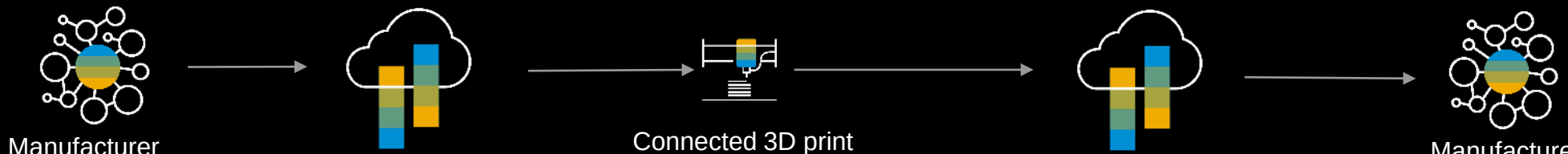
Design collaboration

- Allows both parties to collaborate on lightweight VDS viewing file (CAD original automatically converted when uploading) – no need to send large CAD originals back and forth
- Possibility to chat based on embedded screen-shots
- Design can be approved, added to part, and converted into STL file

Provides CAD design (converted when uploading into VDS viewing file)

Clarifies his questions on design; manufacturer can provide updated design file

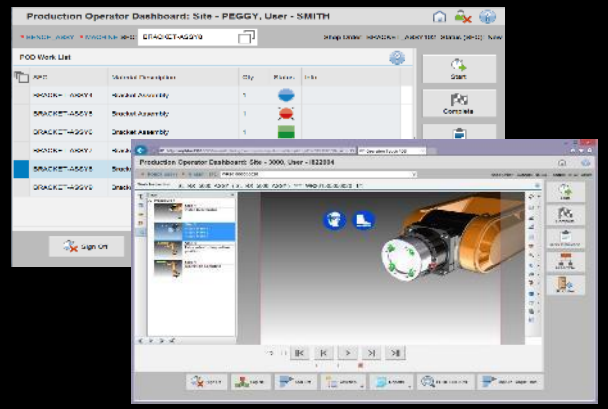
Approves design and converts CAD file into printable STL file (added to collaboration)



Digital manufacturing with SAP – Industry 4.0 meets IoT

SAP Manufacturing Execution

Enforced execution
Work instructions
Machine integration
Data collection
Track and trace
“As built” record



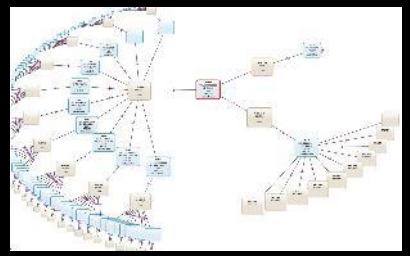
SAP Manufacturing Integration and Intelligence

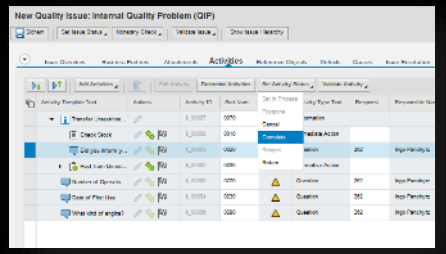
Real-time dashboards
Manufacturing analytics
Simplified user interface
Shop-floor visibility
OEE
Energy management

Quality networks

Global batch traceability

Genealogy minimizes quality escapes





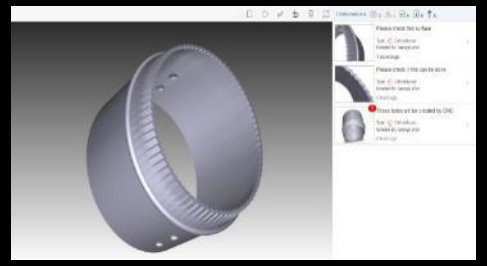
Quality issue management

CAPA-based issue resolution

Cloud-based offerings

SAP Digital Manufacturing Insights

Cloud-based performance management



SAP Distributed Manufacturing

Outsourced collaboration for 3D printing

Thank you!

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LoB Manufacturing

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