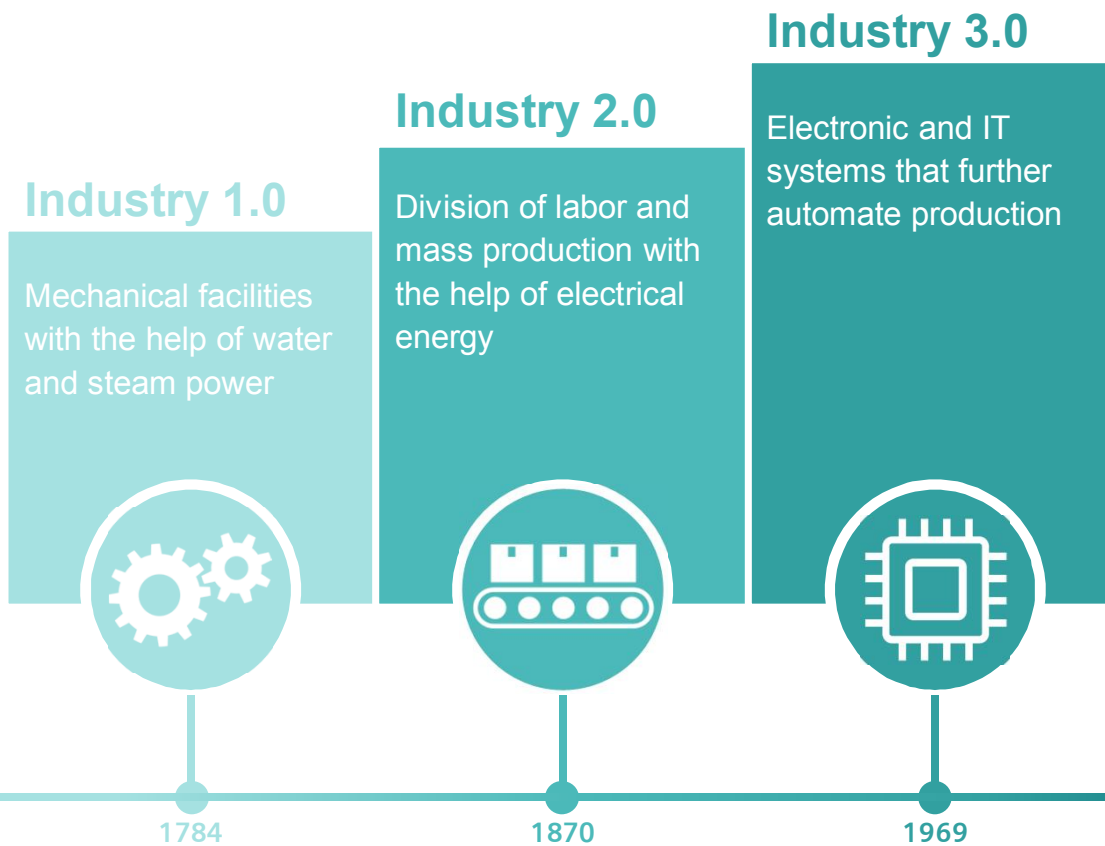**SIEMENS**
Ingenuity for life

Answering Industry 4.0 with Digital Enterprise and MindSphere

Shalabh Bakshi | Director, Siemens Canada
Digital Factory Division and Process Industries and Drives Division
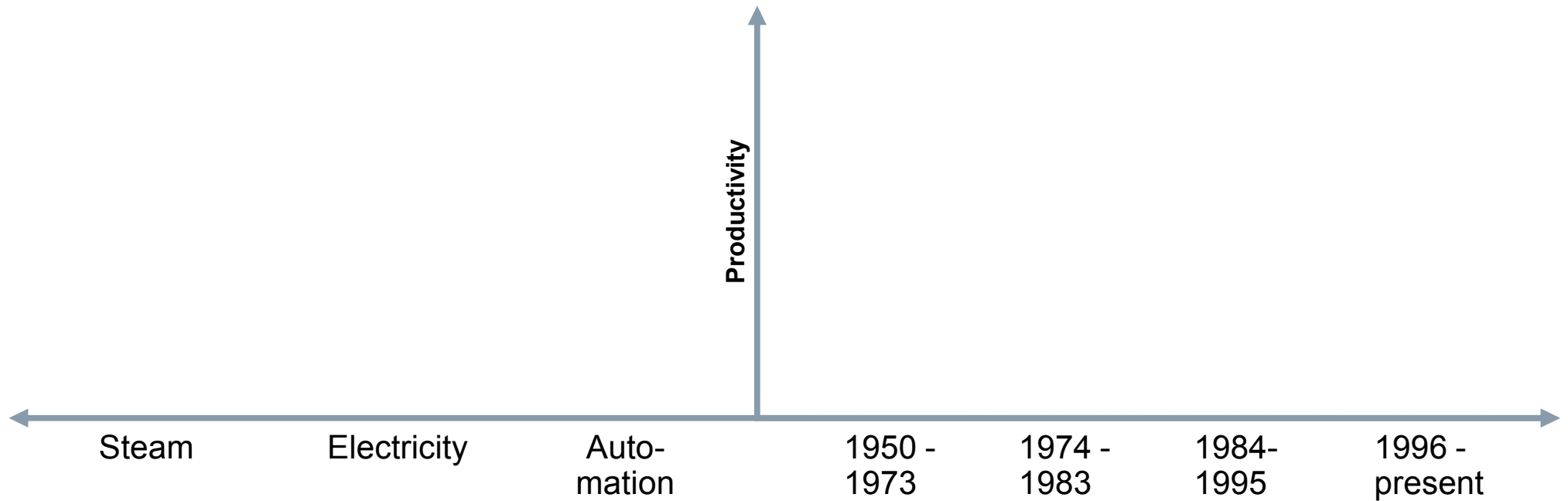AB Canada | May 08, 2018

siemens.com

Let's revisit the Industrial revolutions of the past!

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Industry 3.0

Electronic and IT systems that further automate production

Industry 2.0

Division of labor and mass production with the help of electrical energy

Industry 1.0

Mechanical facilities with the help of water and steam power

1784

1870

1969

Productivity Growth Across Major Countries
Has been falling since the 1970s

Productivity

Steam   Electricity   Auto-mation   1950 - 1973   1974 - 1983   1984-1995   1996 - present

New business models in the digital age disrupting complete markets

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From **bookstore** … … to **e-book** amazon

From **Yellow Pages** … … to **marketplace** MyHammer

From **taxi** … … to **ride sharing** UBER
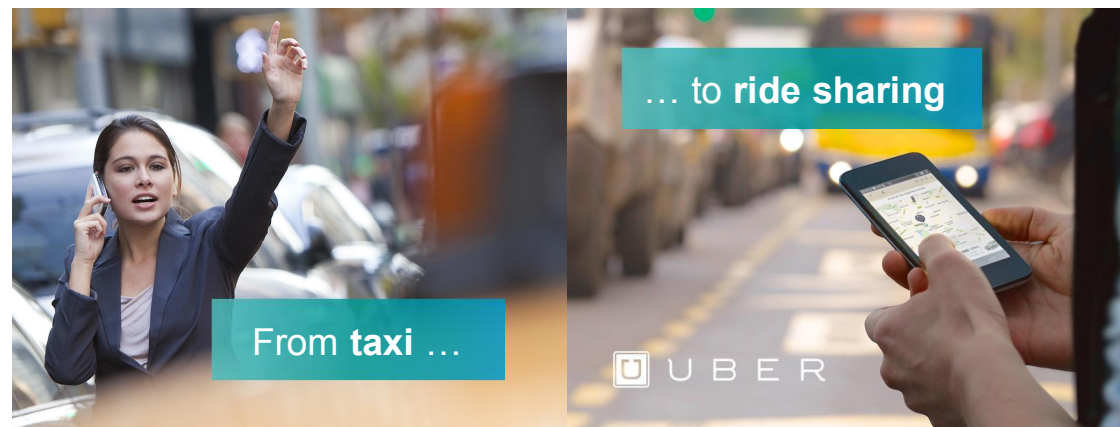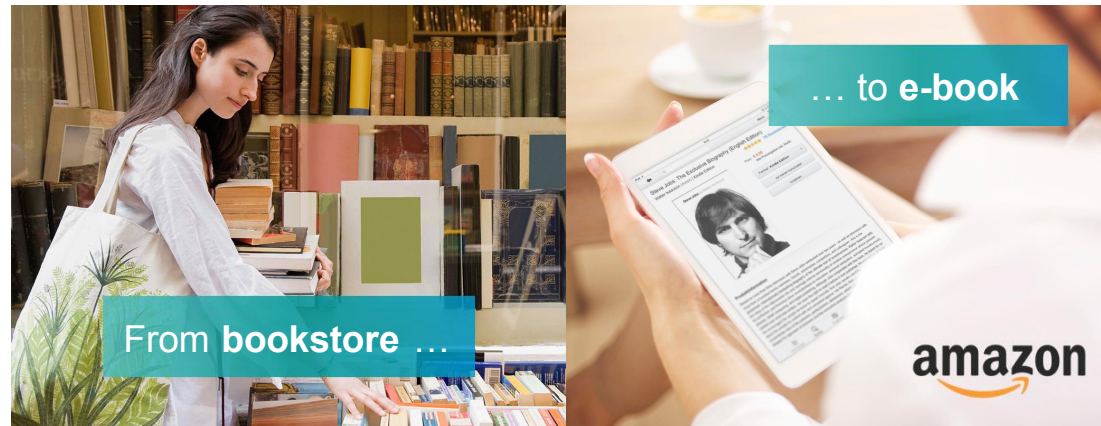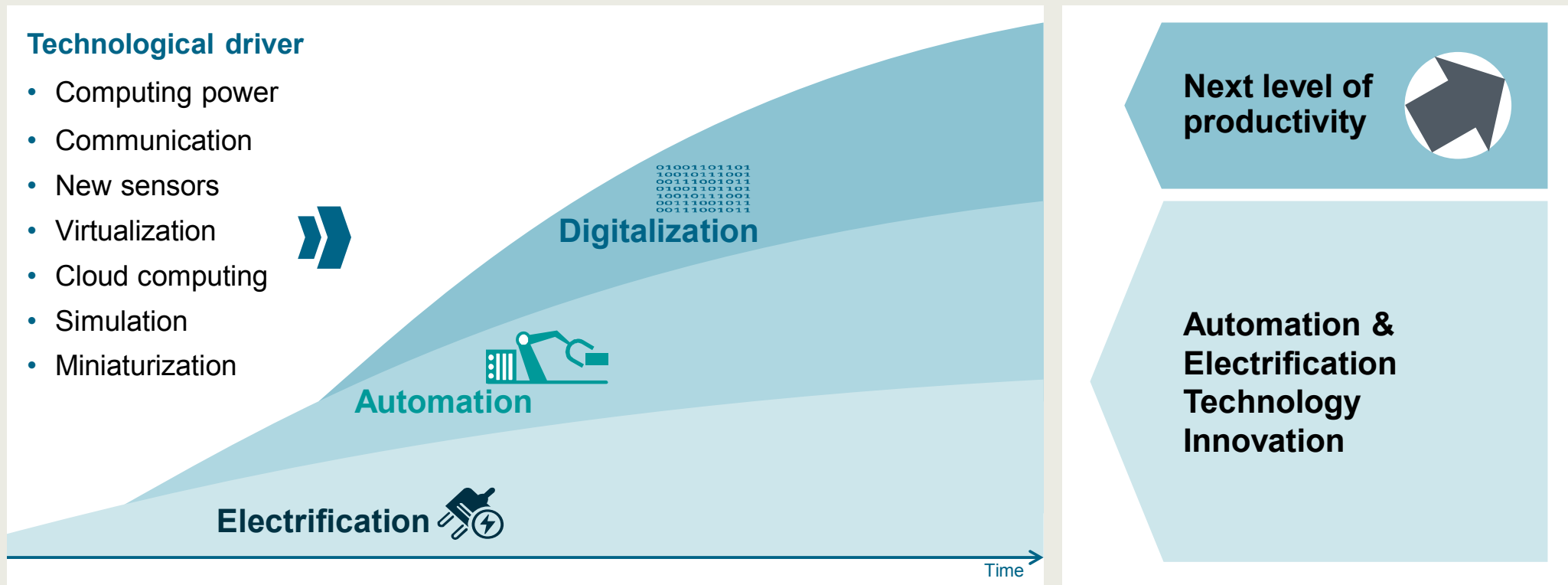
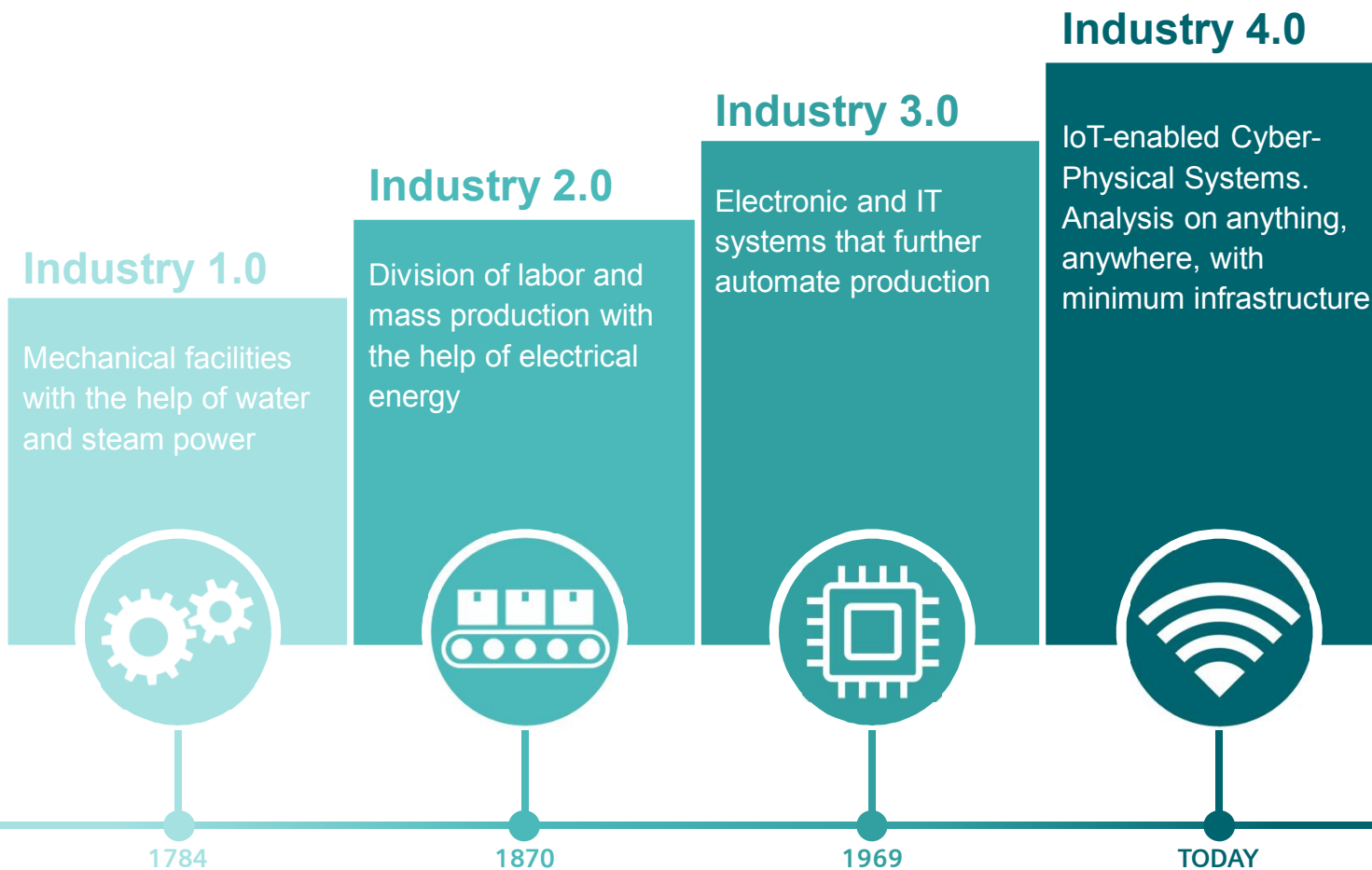# Similarly Technological drivers are disrupting the industries to embrace next level of innovation in production

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Electrification, Automation and Digitalization as levers to increase productivity

Technological driver

- Computing power
- Communication
- New sensors
- Virtualization
- Cloud computing
- Simulation
- Miniaturization

Digitalization

Automation

Electrification

Time

Next level of productivity

Automation & Electrification Technology Innovation

The Fourth Industrial Revolution
To drive the next level of productivity

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Industry 1.0

Mechanical facilities with the help of water and steam power

Industry 2.0

Division of labor and mass production with the help of electrical energy

Industry 3.0

Electronic and IT systems that further automate production

Industry 4.0

IoT-enabled Cyber-Physical Systems. Analysis on anything, anywhere, with minimum infrastructure

1784   1870   1969   TODAY

How do I gain the next level?

Identify your benefit expectations

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Industry trends

Efficiency	Flexibility	Quality	Time-to-market
• Resource and energy efficiency • Demanded product/quantity • …	• Individualized mass production • Volatile markets • …	• Closed-loop quality • Traceability • …	• Fast innovation • More complex products • Lifecycle Management • …

Security

HSSE – Health & Safety | Environment | Regulations/Standard | …

What is needed?
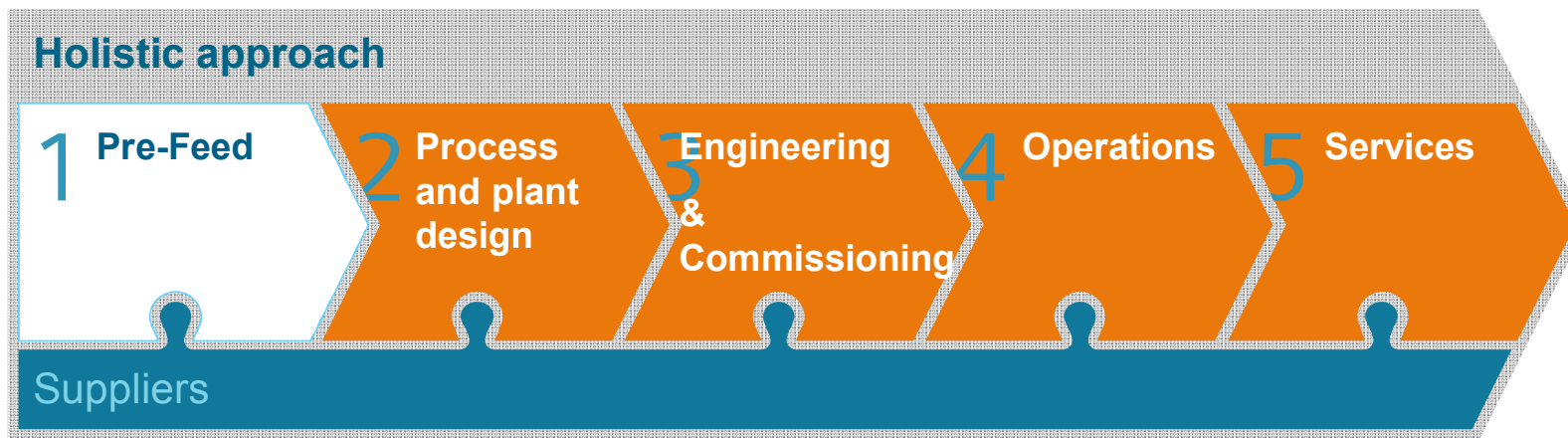## A holistic integrated approach across the value chain

SIEMENS
Ingenuity for life

2 **Process and plant design**

5 **Services**

3 **Engineering & Commissioning**

4 **Operations**

1 **Pre-Feed**

What is needed?
A holistic integrated approach across the value chain

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| Pre-Feed | Process and plant design | Engineering & Commissioning | Operations | Services |

What is needed?
A holistic integrated approach across the value chain

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Holistic approach

1 **Pre-Feed**

2 **Process and plant design**

3 **Engineering & Commissioning**

4 **Operations**

5 **Services**

Suppliers

Create the Digital Twin

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Holistic approach

1 Pre-Feed

2 Process

Engineering

4 Operations

5 Services

Supp

Digital Twin of the entire value chain

1 Pre-Feed

2 Process and Plant Design

3 Engineering & Commissioning

4 Operations

5 Services
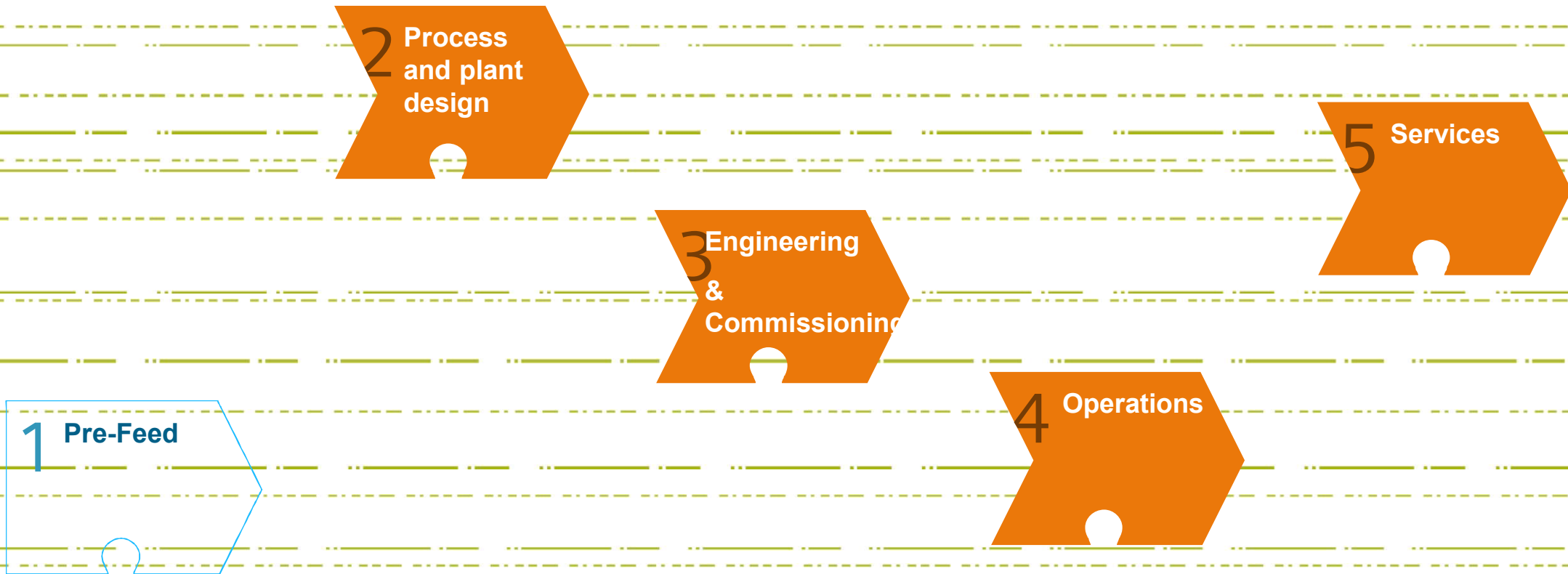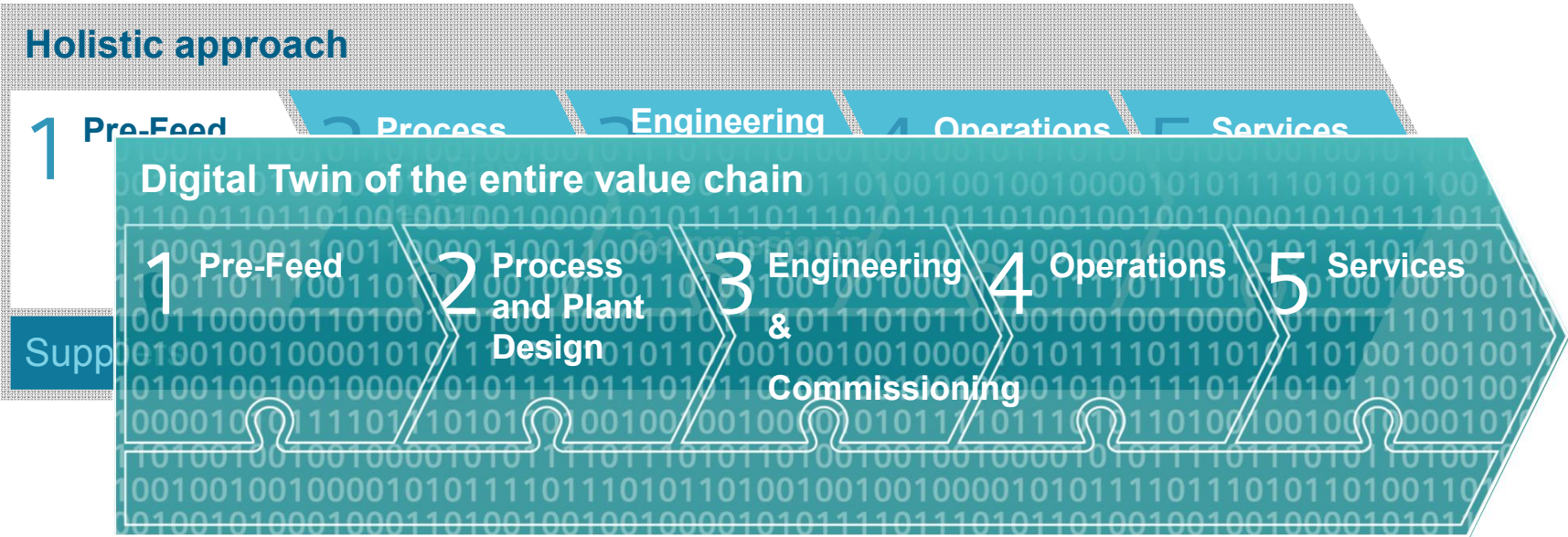
- Digital is not central to their corporate strategy

- They perceive digital only as a tool for incremental efficiency gains

- Companies invest in the latest point solutions or siloed digital technologies and fail to work horizontally ("localized optimization")

- They do not drive the necessary cultural changes for success

1 Pre-Feed
2 Process and plant design
3 Engineering Commissioning
4 Operations
5 Maintenance and Services

Answering Industry 4.0
Digital Enterprise With Integrated Engineering and Integrated Operations

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Pre-/ Feed	Design and Engineering	Fabrications and Commissioning	Operations and Maintenance

Lifecycle Solutions

Conceptual and Tender	Process Design and Simulation	Fabrication and Commissioning	Production and Maintenance	Asset Management
	Plant Design and Engineering			
	Product Design and Engineering	Modernization and Decommissioning		

Project Management

Digital Twin

Advanced Automation

IIoT

The Industrial Internet of Things
A Great First Step In Your Digitalization Journey

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First s-curve
1990s – 2000s

Second s-curve
2010 onwards

Impact

- 3D seismic
- 3D reservoir modeling
- Linear program optimization
- Advanced process controls
- Data automation

Technology enablers

- **Advanced analytics**
- **Process digitalization**
- **Robotics and automation**
- **Business model innovation**

- **Advanced analytics** in exploration and drainage
- **Analysis based production optimization**
- **Predictive analytics** for operations and maintenance
- Engineering productivity optimization
- Automated production systems
- Process digitalization and visualization
- Next generation BMI
- **Business model innovation**
- Supplier interface streamlining

1990s and before	2010s	2020s and beyond

Source: McKinsey

Siemens Knows IoT and Connected Devices

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Siemens is the #1 automation provider, delivering mission critical operation and automation technology, with:

- **30M automation systems**

- **75M contracted smart meters**

- **over 1M connected products** in the field today

Energy Management

Smart Cities

Digital Factory

IoT

Wind Power

MindSphere

Process Industries and Drives

Power and Gas, Power Generation Services

Healthcare

Mobility

Building Technologies

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MindSphere 3.0

Develop robust industrial IoT solutions faster

Open PaaS with native cloud accessibility

Extensive device and enterprise connectivity

Powerful industry solutions with advanced analytics

Global Partner Ecosystem

MindApps

Powerful applications and digital services for asset transparency and analytical insights

MindSphere

Open Platform as a Service (PaaS) for scalable, global IoT connectivity and application development

MindConnect

Secure plug and play connection of Siemens and third-party products and equipment

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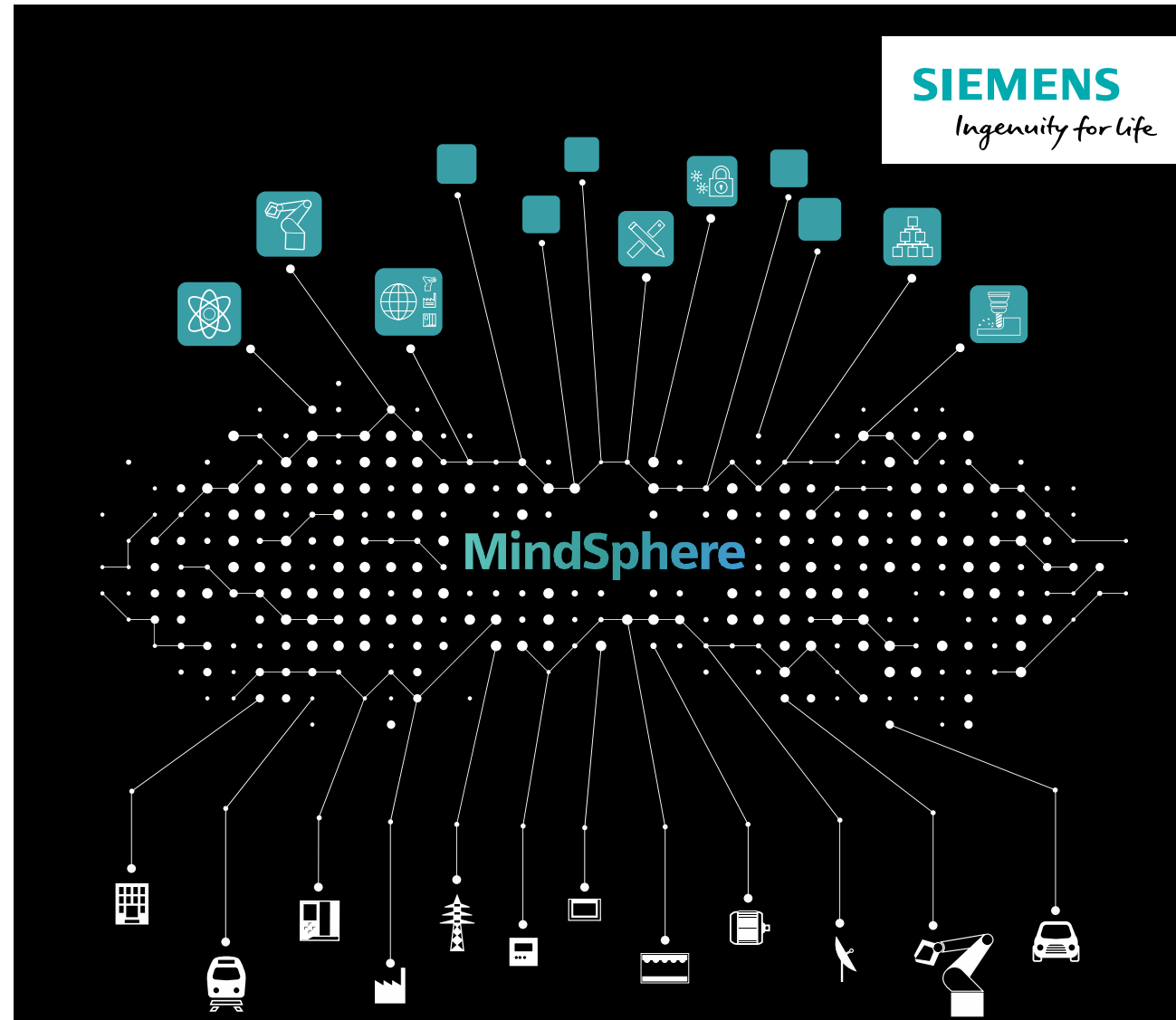
MindSphere

MindSphere - The cloud-based, open IoT Operating System

MindConnect

MindConnect

Connecting Products, Plants, Systems and Machines with MindConnect

Open standards for connectivity, including OPC UA

Plug and play connection of Siemens and 3rd party products

Secure and encrypted data communication
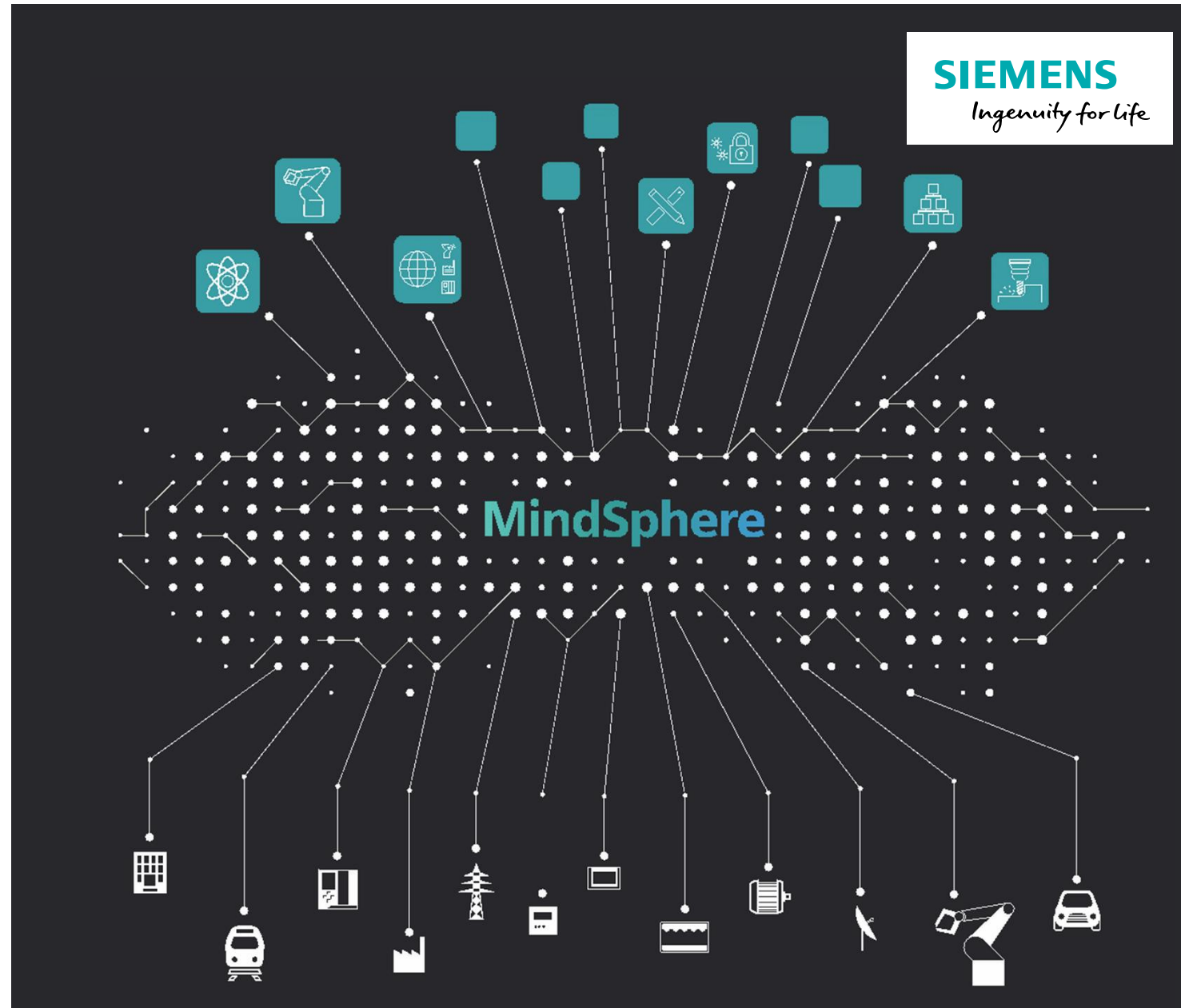
MindSphere - Connect Everything

SIEMENS
Ingenuity for life

CMMS

PLM

MindSphere

SCADA

MindConnect / APIs

MindConnect Hardware

S7   OPC UA

Field device	Field device

Open gateway

Field device	Field device

Field device	Field device
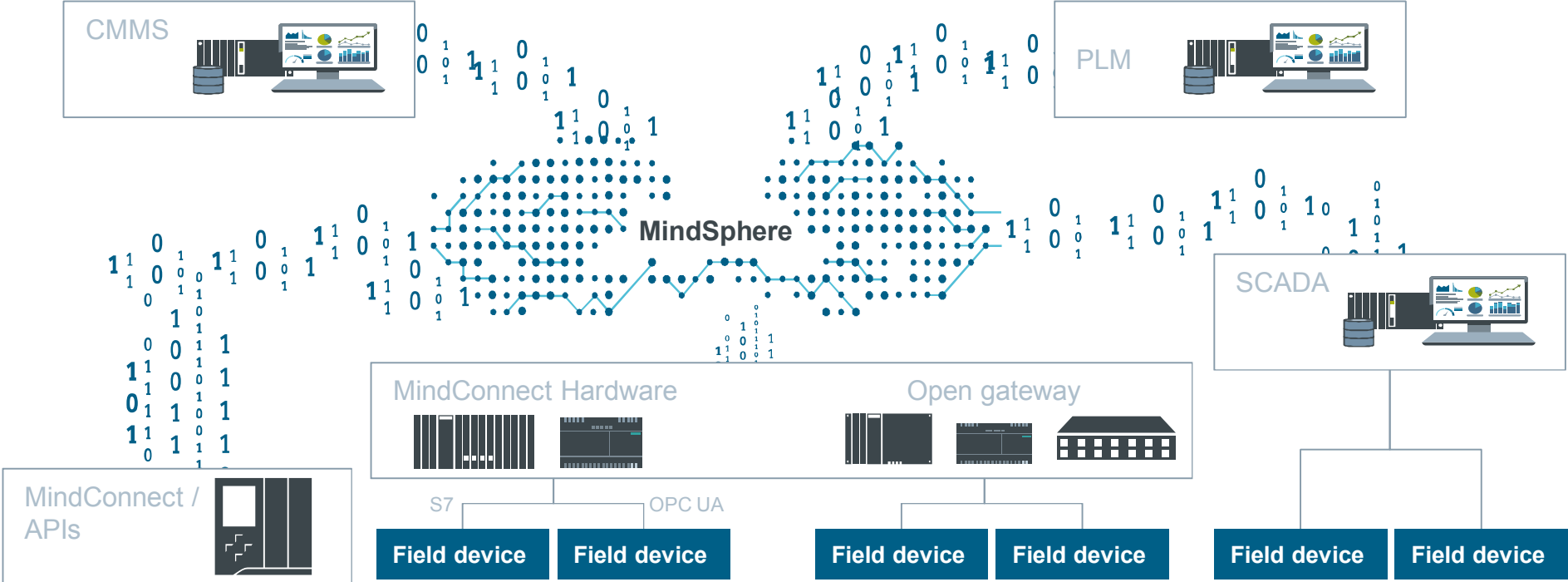
Wide Protocol Support and Enterprise Integration

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CRM PLM Historian Others…

ERP SLM MES Analytics

MindSphere

Infrastructure as a Service (IaaS)

Public Regions Private
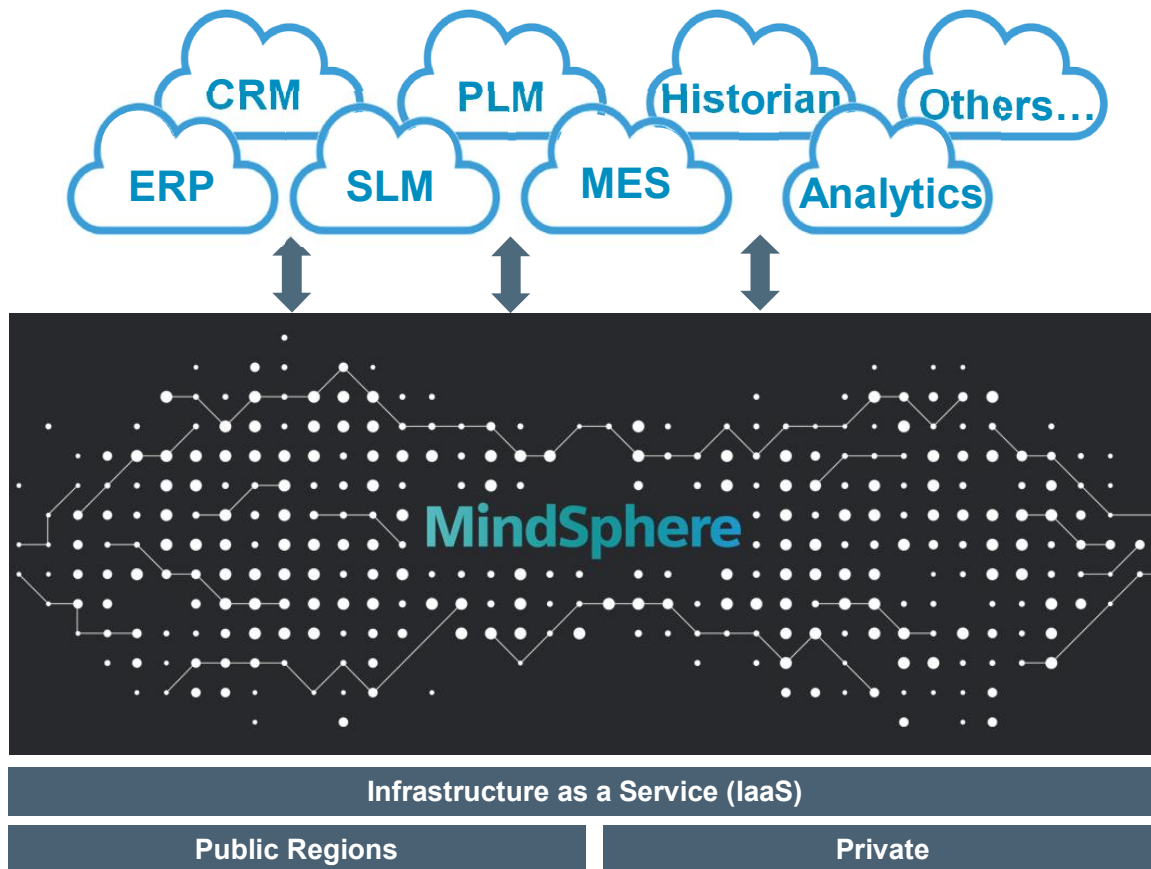
Protocols Gateways & Devices

- S7
- OPC UA
- HTTP
- MQTT
- AMQP
- LoRaWAN
- Modbus
- CoAP
- XMPP
- 6LowPAN
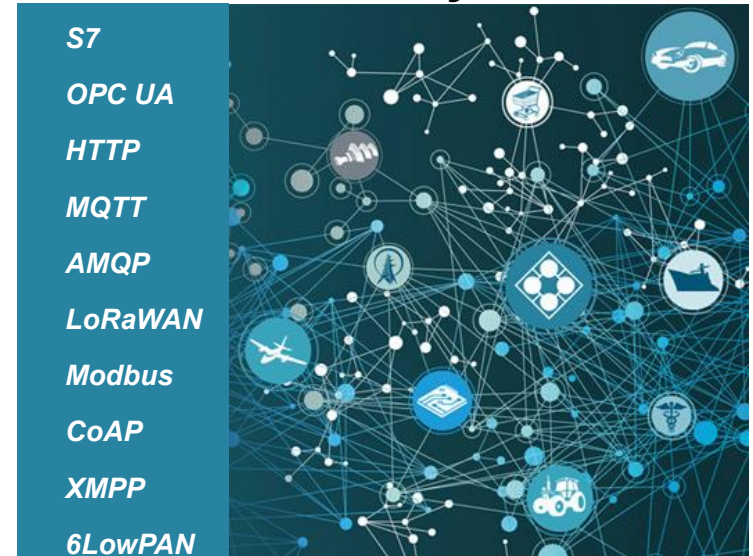
Connecting to MindSphere

SIEMENS
Ingenuity for life

Hardware

- **MindConnect Hardware** - Connects to PLC or Industrial Network
- Manage My Machines - Connects to NC Machines
- **MindConnnect IoT Extensions** – More Hardware Devices and Protocols

Software

- **MindConnect Lib** – Lightweight C based connectivity library
- **APIs** – RESTful APIs
- MindConnect IoT Extensions – Agents for MQTT, Java, and C++

Siemens Industrial Solutions

- S7 1500 PLCs – MindConnect Datablock
- Future Integration with Other Siemens Hardware/Software

MindConnect Integration

- Databases, ERP Systems, Historians, AWS Services, Files, etc

MindSphere

MindSphere

Open Platform as a Service (PaaS)

Open interfaces for development of customer and industry specific apps

Leading Cloud Infrastructure support: SAP, Atos, Amazon Web Services and Microsoft Azure offered as public, private or on-premise

SIEMENS
Ingenuity for life
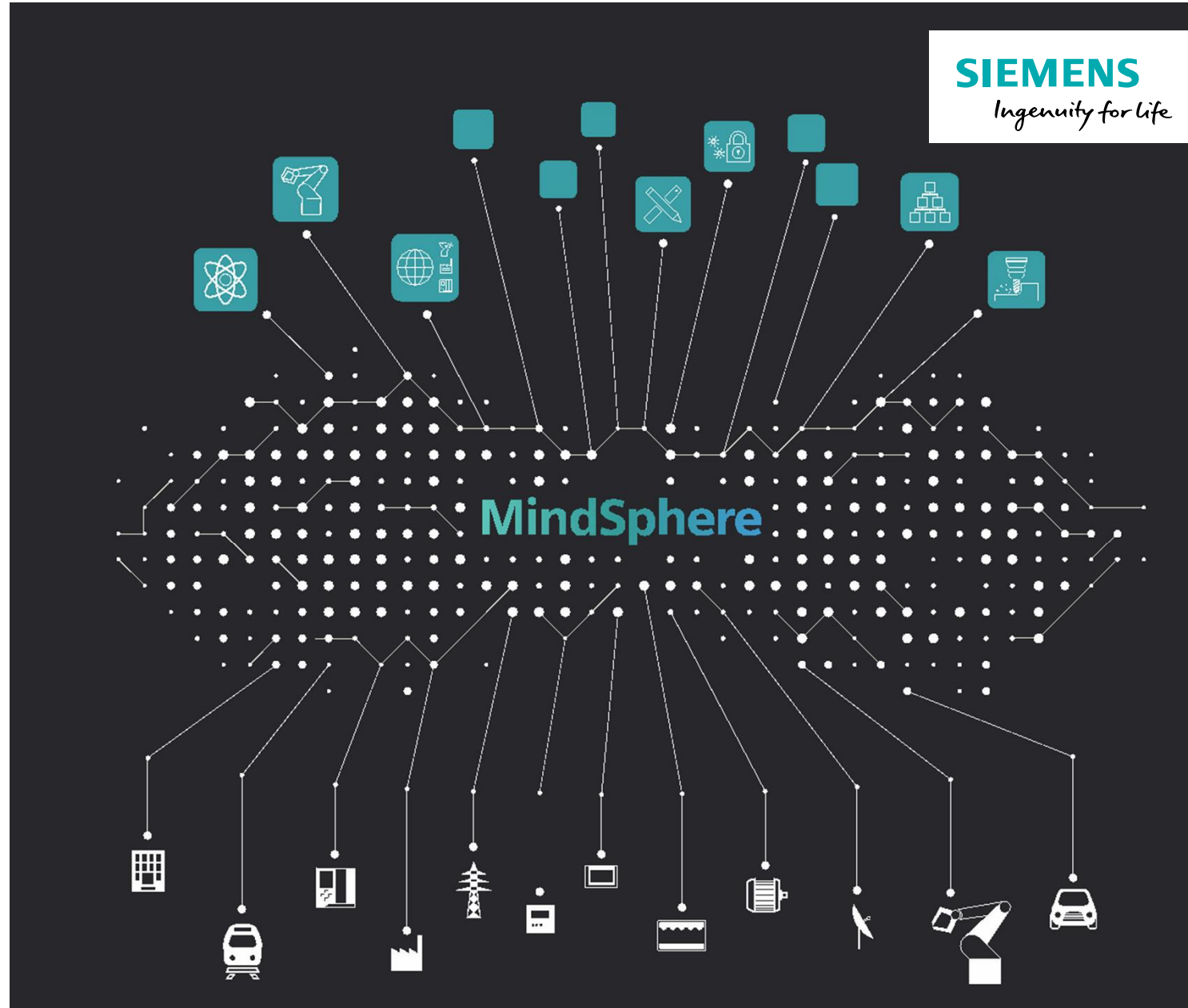
Highly scalable, cost efficient

- **Highly scalable**, **cost efficient** cloud-infrastructure leveraging **Cloud Foundry**

Highest security standards

- MindConnect Elements based on ICS (Industrial Controls System) Security oriented to industry standard IEC 62443

- MindSphere Platform IT Security oriented to industry standard ISO 27001, IEC 62443, BSI

- **Data in rest** is located on SAP datacenters that comply to all required certificates

- **Data in motion** is always at least 256 bit SSL/TLS encrypted

Maximum confidentiality

- The customer controls these authorization levels and is the owner of this data

MindSphere Holistic Security Concept
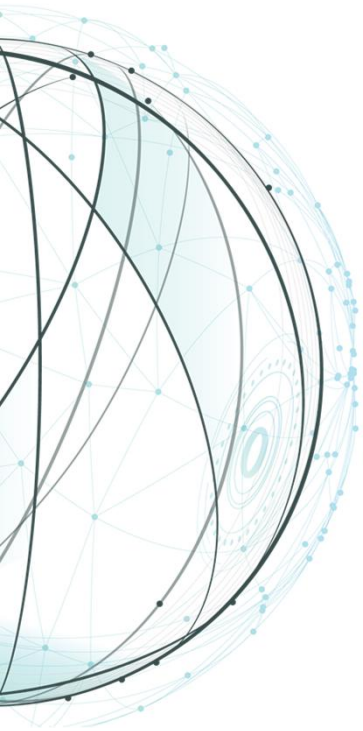
- **Application Programming Interfaces (API)** for development of customer and partner owned analytical applications

- Optimized for **industrial IoT App development** with reusable supporting modules

- **MindAccess Developer** offering provides cloud resources, documentation and support

Developing Applications on MindSphere
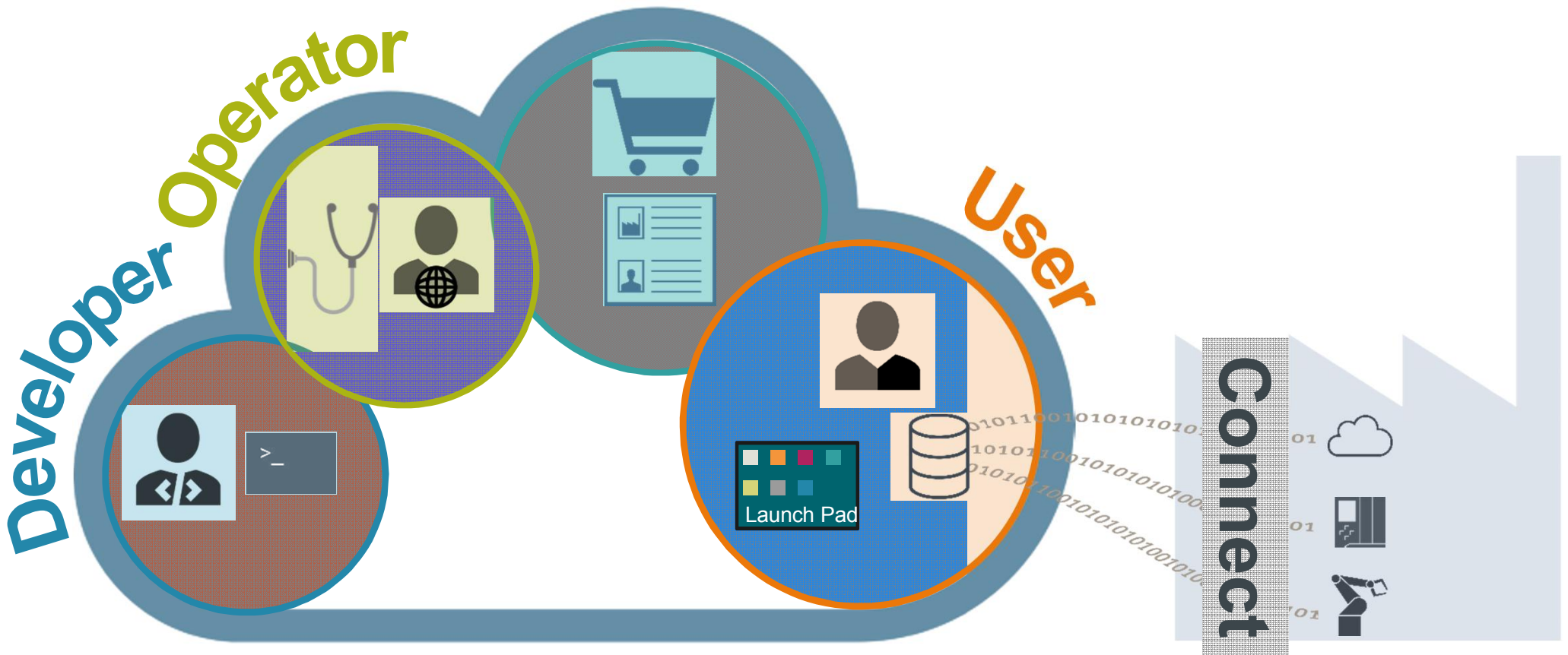
MindSphere Open Partner Ecosystem

What can partners do?

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Consulting / Strategy partners

- Provide digital transformation services based on MindSphere
- Develop vertical apps

Application Developer / ISV

- Develop vertical apps
- Sells apps based on MindSphere

System Integrator

- Connect other enterprise systems on the cloud (ERP, CMMS, etc.)
- Provide connectivity & implementation services

Technology Partners

- Enhance capabilities as well as adoption of MindSphere platform utilizing analytics, AI & Big Data

Hybrid OT Partners

- Partners from automation, instrumentation background who will develop IoT applications and provide services

Connectivity Partners

- Develop connectivity into products
- Sell connectivity products

MindApps

Optimization of the performance of assets, energy and resource consumption, maintenance, services…
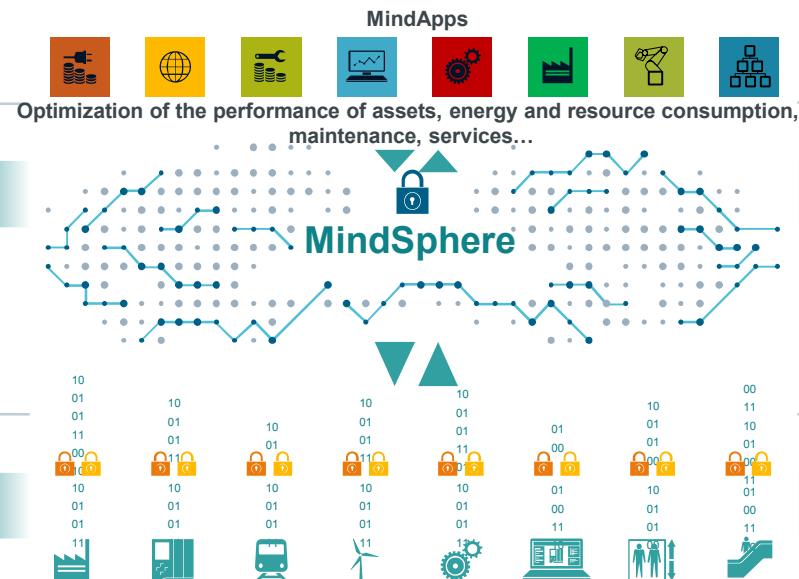
MindSphere

MindApps

MindApps

MindApps are powerful industry applications and digital services for asset transparency and analytical insights from Siemens

Partners and Customers can also develop their own applications that run on MindSphere
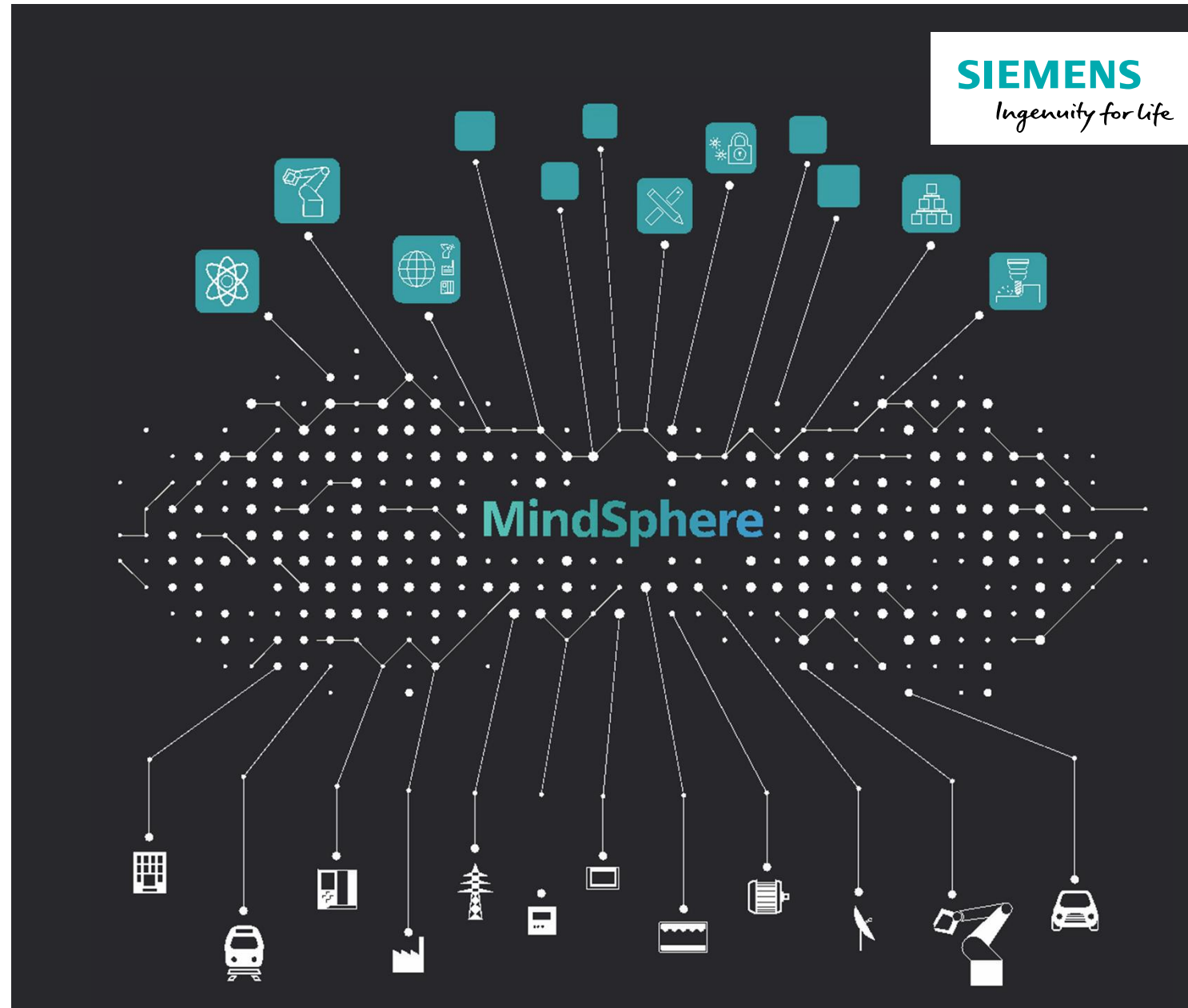
Analytics in MindSphere

MindSphere

Core Functionality
- Asset Management
- Condition Based Monitoring with Alerting
- Dashboards / KPIs
- Visual Workflows

Digital Exchange
- Siemens Apps
- Partner Apps

Advanced
- Data Science Workbench
- Custom Apps
- Amazon Services
- APIs
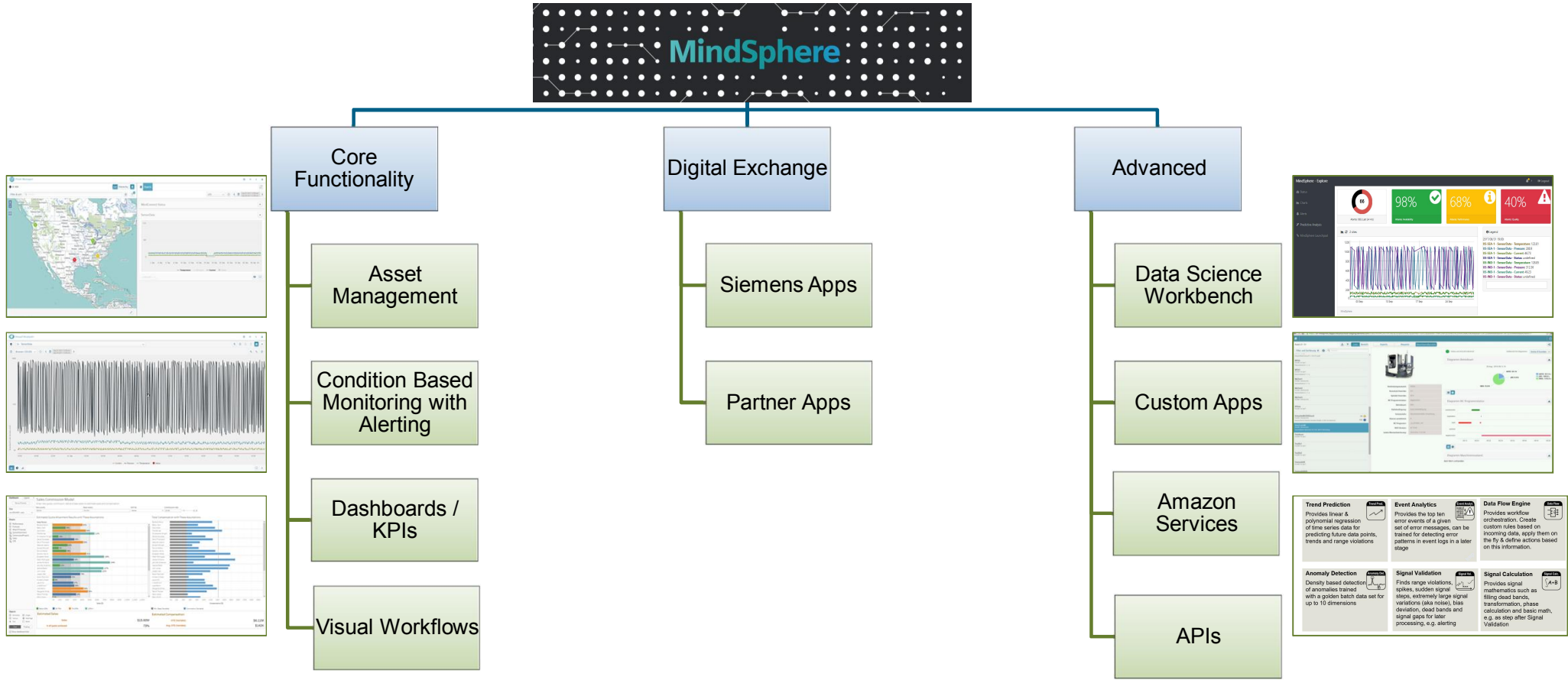
Fleet Manager
Visual Analyzer

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Additional features adding value to core component

- Search for assets using map location
- Simple asset-based export
- Asset explorer
- Get an overview over variables/tags of an asset
- Create "virtual aspects"
- Rules with email notification
- Visual Analyzer as base for simple analytics
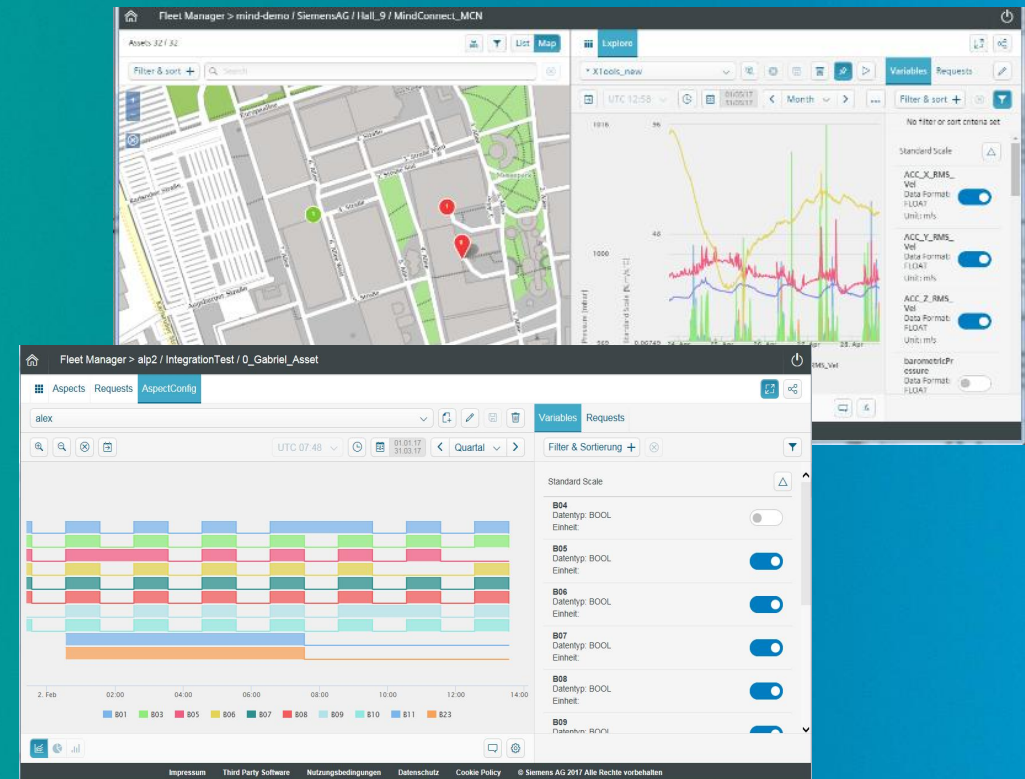
Data Visualization
Dashboarding and Data Exploration

- Enable MindSphere users to create customized Dashboards and Reports

- Integrated in Mindsphere with SSO

- Customized data adapters to import data from MindSphere via MindApp API

- Contains standardized visualization elements, direct access to data in MindSphere, preconfigured templates and an integrated path to publish dashboards and reports
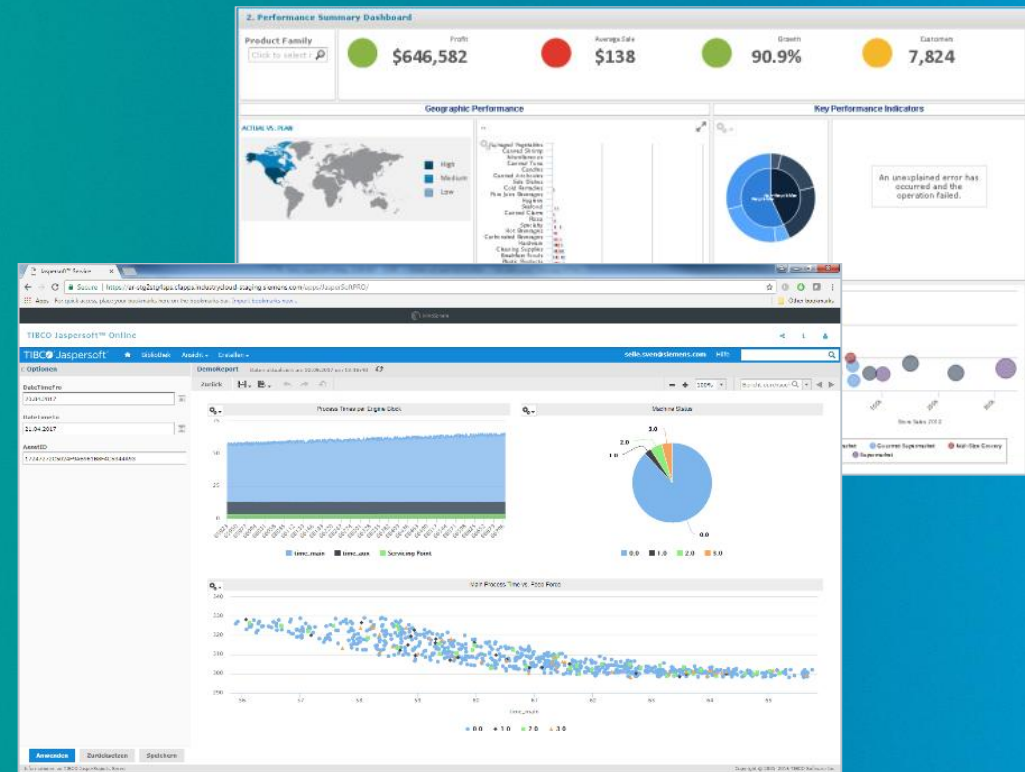
Visual Workflow Creator

- Configure own workflows

- Standard calculations

- Prepare data for further analysis and visualization

- Aggregate data together

- Define and calculate KPIs

- Trigger more complex actions
  (e.g. send email, if threshold rule is
  breached under a certain condition etc.)
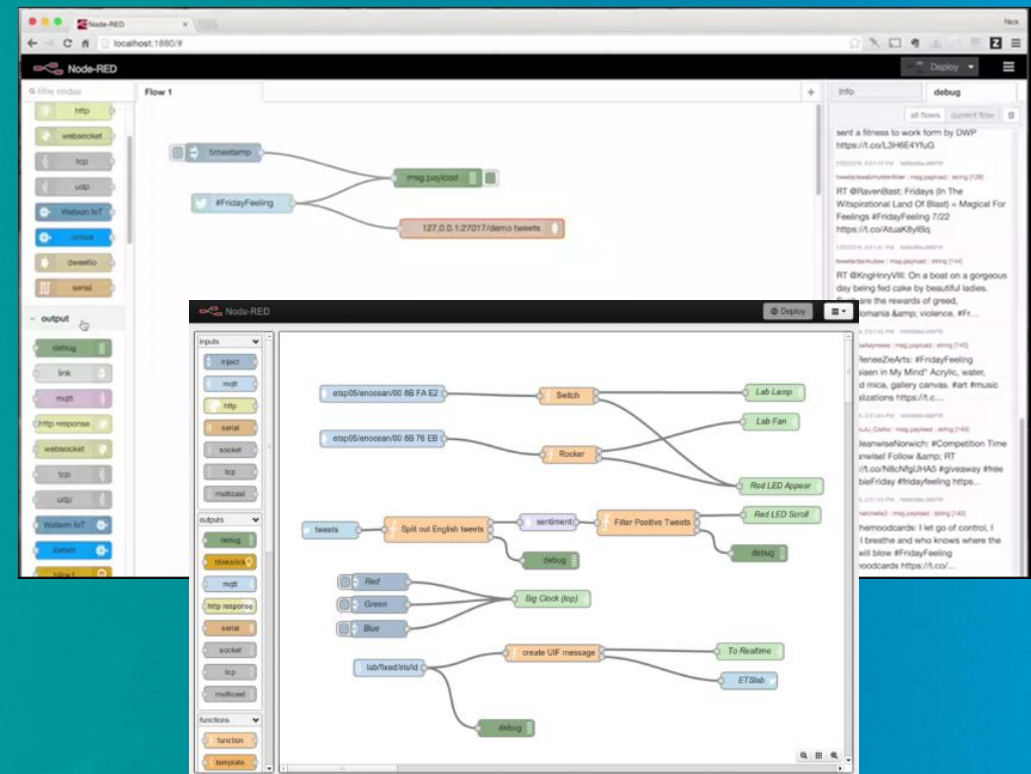
MindSphere – Advanced APIs / Offerings & Content

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Ingenuity for life

Description

Asset / Aspect / Model Management

Use Asset Management APIs to represent physical assets from your site in MindSphere.

- Create, edit and delete elements
- Reuse types for an easy & quick connection
- n:m between assent & connectivity elements
- Use Aspect Management APIs to define your data model, add standardized meanings for a better understanding and usage of your data
- Store, retrieve, replace and delete

Event Management

Use Event Management APIs to manage standardized and customized events.

Events, alarms, warnings can be acquired from the field, sent to MindSphere and used to inform the operator using the notification services.

Weather Service

Use Weather Information Services to request historical and forecast for localized weather information including weather alerts

Data Flow Engine

Use Data Flow Engine to create custom rules based on events like & define your action based on this information.

- Inspect incoming data, compute KPI & distribute using the event mgmt.
- Change detector / hysteresis filtering

Notification Services

Use Notification Service APIs to send information to your users & customers

- Create/Manage templates
- User Interface
- Recipient lists
- Email channel

Advanced Internationalization Service

Request general Information about regions, e.g. language, currency…

Manage your regional content, e.g. contracts, documentation, help,…

Unit & Currency

Use Unit & Currency Services to convert between different units & currencies
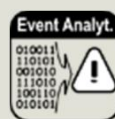
Analytics APIs

Description

Trend Prediction

Provides linear & polynomial regression of time series data for predicting future data points, trends and range violations

Event Analytics
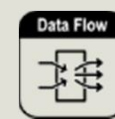
Provides the top ten error events of a given set of error messages, can be trained for detecting error patterns in event logs in a later stage

Imp

Data Flow Engine

Provides workflow orchestration. Create custom rules based on incoming data, apply them on the fly & define actions based on this information.

Aggregate Service

Read aggregated values

with three durations: 2 minutes, 1 hour, and 1 day

Anomaly Detection

Density based detection of anomalies trained with a golden batch data set for up to 10 dimensions
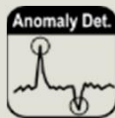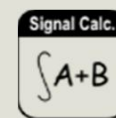
Signal Validation

Finds range violations, spikes, sudden signal steps, extremely large signal variations (aka noise), bias deviation, dead bands and signal gaps for later processing, e.g. alerting
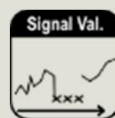
Signal Calculation

Provides signal mathematics such as filling dead bands, transformation, phase calculation and basic math, e.g. as step after Signal Validation

KPI Calculation

Statistical data on operating KPIs of a machine given a state variable as input that indicates the machine operating status

New

MindSphere App Store

- Applications built by Siemens and Partners
  - **Partners:** Accenture, Atos, Omnetric, Evosoft, others.
  - **Siemens:** Product Intelligence, Manage My Machines, others.
  - **Industries:** Oil & Gas, Machinery & Plant Construction, Chemicals, and more
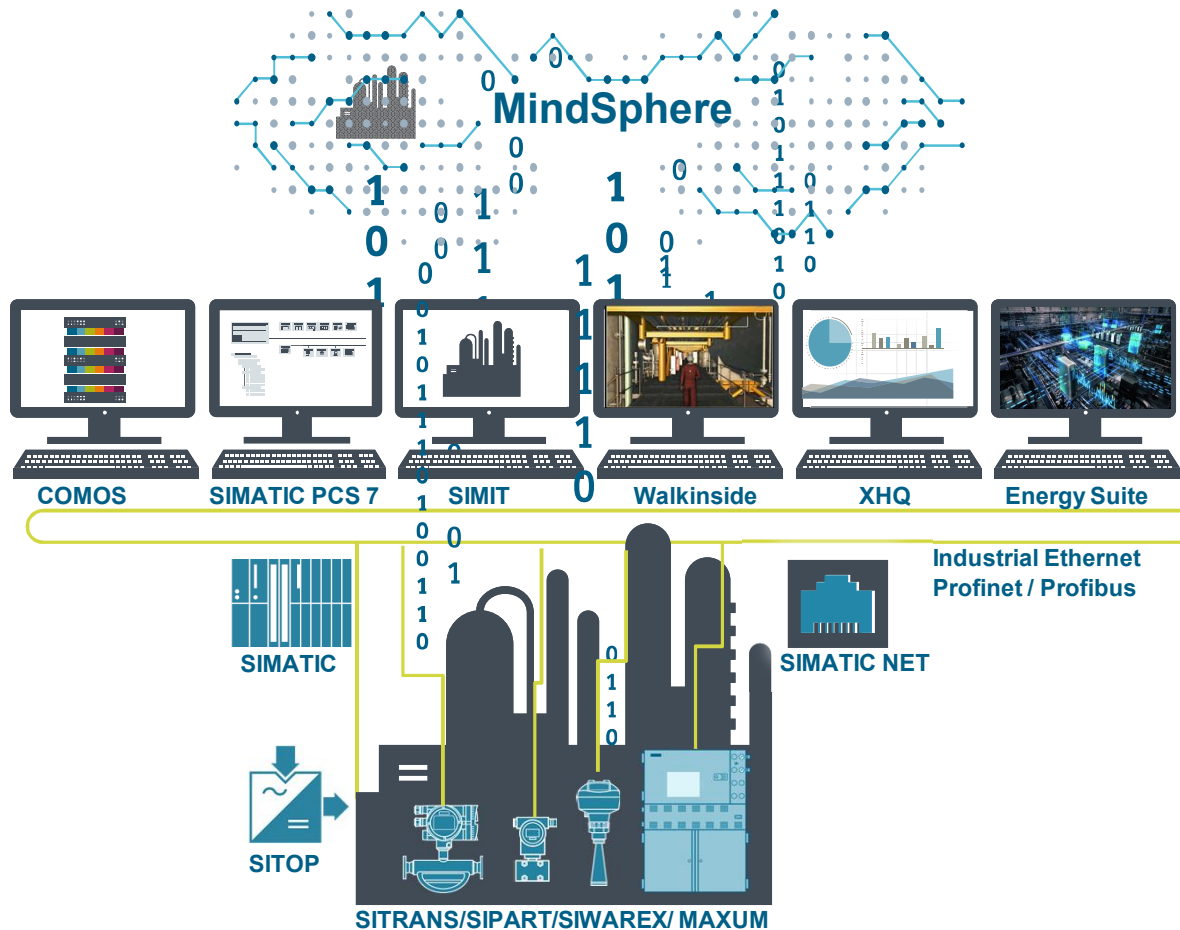 - **Use Cases:** Analytics, Maintenance, PLM, Quality, and more

And once you are ready!

Implement your Digital Enterprise with MindSphere!

Siemens offers a comprehensive and seamless Digital Enterprise portfolio for process plants

SIEMENS
Ingenuity for life

MindSphere

COMOS   SIMATIC PCS 7   SIMIT   Walkinside   XHQ   Energy Suite

SIMATIC

SITOP

SITRANS/SIPART/SIWAREX/ MAXUM

SIMATIC NET

Industrial Ethernet
Profinet / Profibus

The Siemens offering for the Digital Enterprise in process industries

✓ **Field data turn smart**

✓ **Consistent and always up-to-date data and documentation across the entire plant lifecycle**

✓ **Comprehensive connectivity**

✓ **Optimal interplay with all levels**

✓ **Operation transparency**

Visit our booth
MindSphere Use Case & Benefits for Oil & Gas

MindSphere increases business value:

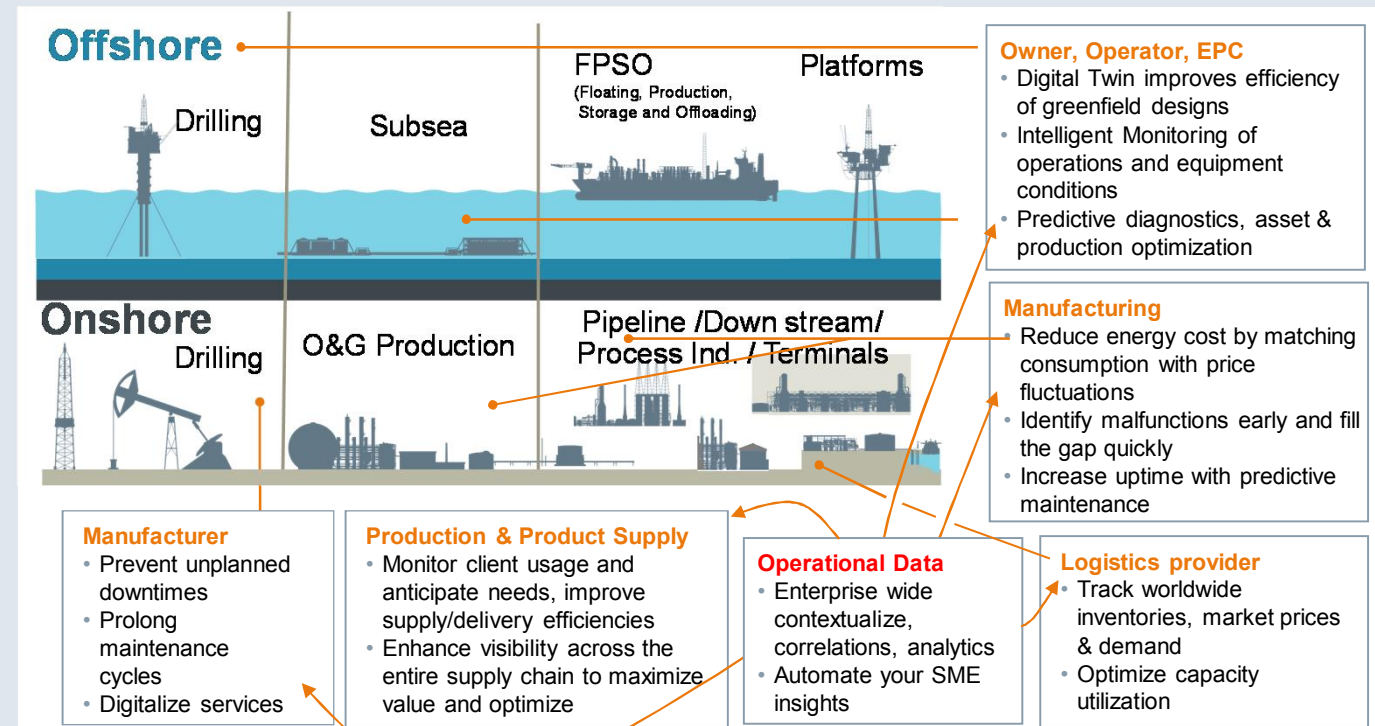**Digitalization to reach the next level of performance**

- **Integrated Engineering** and **Integrated Operations** enhances Communication, Computing Power, Virtualization with data availability/connectivity
- Offer **additional services** and enable **new business models**

Process & Machines Speak Out

- **Increase uptime / asset availability**
- **Gain new insights to optimize assets** across the enterprise
- **Increase maintenance efficiency**
- **Enhanced Learnings** shared
- **Expedite Critical Decisions**

**Example MindSphere use cases around Oil & Gas and the Process Industries**

Offshore

Drilling   Subsea   FPSO (Floating, Production, Storage and Offloading)   Platforms

Onshore

Drilling   O&G Production   Pipeline /Down stream/ Process Ind. / Terminals

Owner, Operator, EPC
- Digital Twin improves efficiency of greenfield designs
- Intelligent Monitoring of operations and equipment conditions
- Predictive diagnostics, asset & production optimization

Manufacturing
- Reduce energy cost by matching consumption with price fluctuations
- Identify malfunctions early and fill the gap quickly
- Increase uptime with predictive maintenance

Manufacturer
- Prevent unplanned downtimes
- Prolong maintenance cycles
- Digitalize services

Production & Product Supply
- Monitor client usage and anticipate needs, improve supply/delivery efficiencies
- Enhance visibility across the entire supply chain to maximize value and optimize

Operational Data
- Enterprise wide contextualize, correlations, analytics
- Automate your SME insights

Logistics provider
- Track worldwide inventories, market prices & demand
- Optimize capacity utilization

Take Advantage of the wealth of plant/asset data to increase uptime & lower operating costs
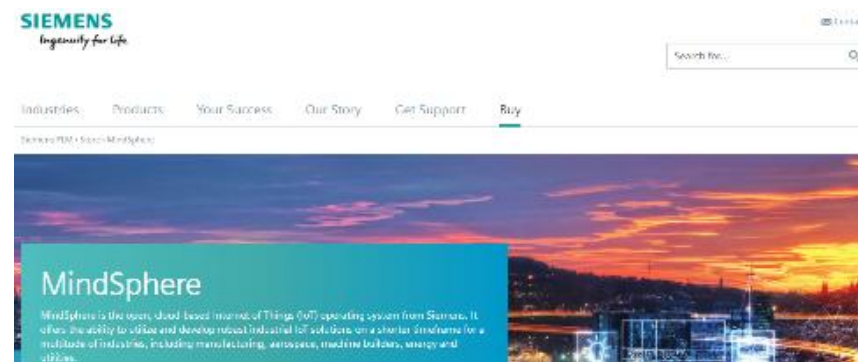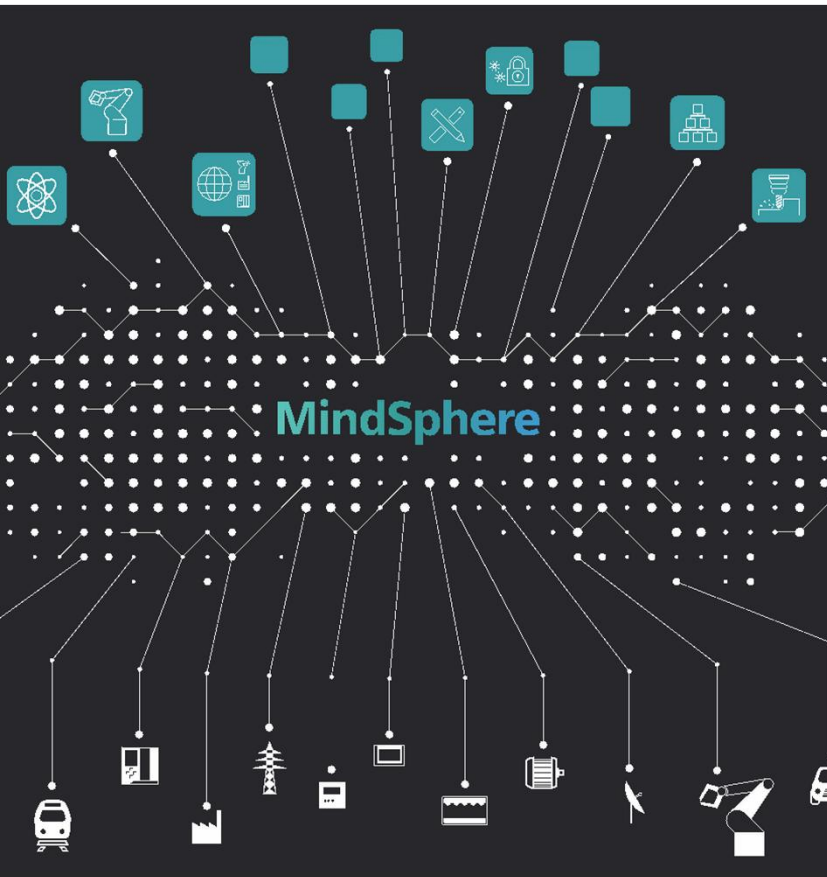
For more information

→ www.mindsphere.io
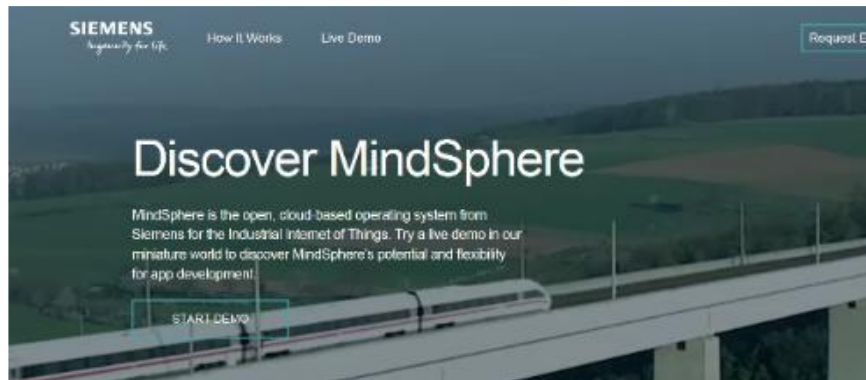
→ www.siemens.com/mindsphere

→ MindSphere Store

Thank You!