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
Let’s revisit the Industrial revolutions of the past!

**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

1784 1870 1969
Productivity Growth Across Major Countries
Has been falling since the 1970s

A change is inevitable!
New business models in the digital age disrupting complete markets...
Similarly, technological drivers are disrupting the industries to embrace the next level of innovation in production. Electrification, automation, and digitalization serve as levers to increase productivity.
The Fourth Industrial Revolution
To drive the next level of productivity

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?
Industry trends

**Efficiency**
- Resource and energy efficiency
- Demanded product/quantity
- ...

**Flexibility**
- Individualized mass production
- Volatile markets
- ...

**Quality**
- Closed-loop quality
- Traceability
- ...

**Time-to-market**
- 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

1 Pre-Feed
2 Process and plant design
3 Engineering & Commissioning
4 Operations
5 Services
What is needed?
A holistic integrated approach across the value chain
What is needed?
A holistic integrated approach across the value chain

Holistic approach

1. Pre-Feed
2. Process and plant design
3. Engineering & Commissioning
4. Operations
5. Services
Create the Digital Twin

Holistic approach

1 Pre-Feed
2 Process and Plant Design
3 Engineering & Commissioning
4 Operations
5 Services

Digital Twin of the entire value chain

Suppliers
Why do companies fail?
Silo approach not ideal

- 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
Answering Industry 4.0
Digital Enterprise With Integrated Engineering and Integrated Operations

Pre-/Feed

Design and Engineering

Fabrications and Commissioning

Operations and Maintenance

Lifecycle Solutions

Conceptual and Tender

Process Design and Simulation

Plant Design and Engineering

Product Design and Engineering

Fabrication and Commissioning

Production and Maintenance

Asset Management

Project Management

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

Source: McKinsey
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**
Introducing MindSphere 3.0

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
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

CMMS

MindConnect / APIs

MindConnect Hardware

Open gateway

S7

OPC UA

Field device

Field device

Field device

Field device

Field device

Field device

PLM

SCADA

CMMS

SCADA

PLM

MindSphere

MindConnect Hardware Open gateway
Wide Protocol Support and Enterprise Integration

Protocols
- S7
- OPC UA
- HTTP
- MQTT
- AMQP
- LoRaWAN
- Modbus
- CoAP
- XMPP
- 6LowPAN

Gateways & Devices

Infrastructure as a Service (IaaS)

Public Regions

Private
### Connecting to MindSphere

#### Hardware
- **MindConnect Hardware** - Connects to PLC or Industrial Network
- **Manage My Machines** - Connects to NC Machines
- **MindConnect 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
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
• **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
MindSphere 3.0
Roles match offerings

Developer
Operator
User
Launch Pad

Connect
MindSphere Open Partner Ecosystem

Exemplary Partners

Partner Roles

Consulting/Strategy Partners
Connectivity Developer
Application Developer
Technology Provider
System Integrator
IaaS Provider
What can partners do?

**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
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
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

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 asset & 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

**Unit & Currency**
Use Unit & Currency Services to convert between different units & currencies

**Advanced Internationalization Service**
Request general Information about regions, e.g. language, currency...
Manage your regional content, e.g. contracts, documentation, help,...
# Analytics APIs

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Trend Prediction</strong>&lt;br&gt;Provides linear &amp; polynomial regression of time series data for predicting future data points, trends and range violations</td>
</tr>
<tr>
<td><strong>Event Analytics</strong>&lt;br&gt;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</td>
</tr>
<tr>
<td><strong>Data Flow Engine</strong>&lt;br&gt;Provides workflow orchestration. Create custom rules based on incoming data, apply them on the fly &amp; define actions based on this information.</td>
</tr>
<tr>
<td><strong>Aggregate Service</strong>&lt;br&gt;Read aggregated values with three durations: 2 minutes, 1 hour, and 1 day</td>
</tr>
<tr>
<td><strong>Anomaly Detection</strong>&lt;br&gt;Density based detection of anomalies trained with a golden batch data set for up to 10 dimensions</td>
</tr>
<tr>
<td><strong>Signal Validation</strong>&lt;br&gt;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</td>
</tr>
<tr>
<td><strong>Signal Calculation</strong>&lt;br&gt;Provides signal mathematics such as filling dead bands, transformation, phase calculation and basic math, e.g. as step after Signal Validation</td>
</tr>
<tr>
<td><strong>KPI Calculation</strong>&lt;br&gt;Statistical data on operating KPIs of a machine given a state variable as input that indicates the machine operating status</td>
</tr>
</tbody>
</table>
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

- 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

The Siemens offering for the Digital Enterprise in process industries

MindSphere

COMOS SIMATIC PCS 7 SIMIT Walkinside XHQ Energy Suite

Industrial Ethernet Profinet / Profibus

SIMATIC NET

SITOP SITRANS/SIPART/SIWAREX/ MAXUM

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

- 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

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!

siemens.com