“Architectural Blueprint Solution for Migrating towards FAR-EDGE”

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Characteristics of CPPS:

► ADAPTABILITY to changing production environment

► OPENESS to new features and functions

► FLEXIBILITY to different processing tasks

► MODULARITY to enable quick and economical changes

Source: Digital Factory: Smart manufacturing in the U.S. (siemens.com)
The FAR-EDGE Platform will lower the barriers for manufacturers (including SMEs) to move towards the Industry 4.0

- Flexible and fast integration of new technologies and devices
- Reconfiguration and optimal production scheduling
- Implementation of highly scalable solutions
- Validation and testing of alternative strategies for migration
Challenges for Migration

The digital transformation is not only a technological journey.

- The digital transformation has a big impact on different dimensions of the factory
- Holistic migration approaches are needed but have been neglected within research until now
The FAR-EDGE Migration approach

Stepwise migration approach to support continuous improvement, adaptation to changes and incremental innovation towards digitalization by means of FAR-EDGE solution.

- **Assessment of the AS-IS**
- **Identification of the TO-BE**
- **Definition of migration scenarios**
  - Gap analysis AS-IS → TO-BE
- **Evaluation of business goals and KPIs**
- **Definition of optimal migration strategies and architectural blueprints**
The Assessment Questionnaire supports context analysis and goal definition.

Goal of the interview:

- Assess the current production system
- Identify potential of digital improvements according to the business strategy

Technical dimension

Operational dimension

Human dimension
The Migration Matrix supports the identification and evaluation of migration alternatives towards a higher level of digital maturity by means of FAR-EDGE solution.
The Gap Analysis

Definition of migration scenarios:
- Analyze the gap between AS-IS and TO-BE
- Identify and evaluate possible migration scenarios
Example of implementation roadmap of the FAR-EDGE Automation for plug-and-produce equipment reconfigurability.

<table>
<thead>
<tr>
<th>Field Abstraction</th>
<th>1 Virtual machine installation on the equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edge Automation</td>
<td>2 EAS for Edge Adapter development</td>
</tr>
<tr>
<td>Service</td>
<td>3 Implementation of the maintenance plan for Edge Infrastr.</td>
</tr>
<tr>
<td></td>
<td>4 Edge Training for technical and maintenance staff</td>
</tr>
<tr>
<td></td>
<td>5 Edge Training for operational staff</td>
</tr>
<tr>
<td></td>
<td>6 VM installation on the work cell (Edge Gateway)</td>
</tr>
<tr>
<td>Edge Gateway</td>
<td>7 Pull- and event-based SCADA, DCS and PLC functionalities</td>
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<tr>
<td></td>
<td>8 Edge Training to platform manager</td>
</tr>
<tr>
<td></td>
<td>9 Ensure LAN connectivity to the Field</td>
</tr>
<tr>
<td></td>
<td>10 Connect Edge Adapter to equipment</td>
</tr>
<tr>
<td>Connectivity</td>
<td>11 Connect Edge Adapter to Edge Gateway</td>
</tr>
<tr>
<td></td>
<td>12 Ledger integration in the factory network</td>
</tr>
<tr>
<td>Ledger</td>
<td>13 Connect Ledger with Edge Nodes / Edge Adapters</td>
</tr>
<tr>
<td></td>
<td>14 Implementation of the maintenance plan for Ledger Infrastr.</td>
</tr>
<tr>
<td></td>
<td>15 Ledger training / new specific role</td>
</tr>
<tr>
<td></td>
<td>16 Cloud installation on a computer</td>
</tr>
<tr>
<td></td>
<td>17 Migrate ERP/PLM services to the Cloud server</td>
</tr>
<tr>
<td></td>
<td>18 Define cloud identity manager for Ledger</td>
</tr>
<tr>
<td></td>
<td>19 Implementation of the maintenance plan for the Cloud</td>
</tr>
<tr>
<td></td>
<td>20 Further training for Cloud maintenance and management</td>
</tr>
</tbody>
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Dr. Ambra Calà  
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### Business goal: versatile production in a mass-customization scenario

- **Example:** PnP Reconfigurability

<table>
<thead>
<tr>
<th>MP 1 Automation</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Equipment/Machinery connectivity and communication protocols</strong></td>
<td>Not available</td>
<td>Basic connectivity (RS232-RS485)</td>
<td>Local network through LAN/WAN</td>
<td>Networked with vendor specific API, integrable with other systems</td>
<td>Networked with standardized mechanisms and standard API</td>
</tr>
<tr>
<td><strong>Physical production process control</strong></td>
<td>Not available</td>
<td>Locally per station / equipment</td>
<td>Centrally available through SCADA</td>
<td>Available and analyzed through MES at factory level</td>
<td>Available and analyzed through the Cloud</td>
</tr>
<tr>
<td><strong>Cyber-Physical System characteristics of the product</strong></td>
<td>No identification or serialization available</td>
<td>Simple identification (e.g. Barcodes or RFID tags)</td>
<td>Sensors and actuators attached to the product</td>
<td>Sensors readings are processed by the product</td>
<td>The product exhibits CPS functionality</td>
</tr>
<tr>
<td><strong>Reconfiguration of shop-floor equipment</strong></td>
<td>Only manual reconfiguration</td>
<td>Supported by HMI at machine level</td>
<td>Configuration managed through central supervisor system</td>
<td>Configuration centrally managed by MES or MOM</td>
<td>Centrally managed according to ERP through the Cloud</td>
</tr>
<tr>
<td><strong>Production IT department</strong></td>
<td>Not available</td>
<td>External service provider for traditional IT systems</td>
<td>Internal for traditional IT systems</td>
<td>External service provider for all digital systems from field to cloud</td>
<td>Internal for all digital systems from field to cloud</td>
</tr>
<tr>
<td><strong>Production employees' skills</strong></td>
<td>No experience with digital technologies</td>
<td>Little experience with digital technologies</td>
<td>Digital skills in some technology focused areas</td>
<td>Digital and data analysis skills in most areas of the business</td>
<td>Cutting edge digital and analytical skills are prevalent all across the factory</td>
</tr>
</tbody>
</table>
Example: PnP Reconfigurability

Expected impact at each dimension:

- Increased flexibility
- Decreased configuring costs and effort
- Increased factory automation level
- Increased production data monitoring
- Improved operation quality
- Reduced human error
- Better instructions
- Fewer skills needed
The **migration blueprints** are based on the use cases developed within the project with reference to FAR-EDGE domains:

- Automation
- Analytics
- Simulation

The aim is to provide a reference for deployment configuration variants of the FAR-EDGE architecture

“**TO-BE**” Scenarios:
- Plug-and-produce equipment automatic reconfiguration
- Operator support for smart sequencing
- Analytics for improved accuracy of assembly times
- Predictive maintenance
- Secure order execution system
- Analysis and certification of KPIs for production modules
- …
The proposed migration approach leads to the definition of migration strategies towards the digital manufacturing automation.

**Benefits for manufacturers**

- Understand the value of digital transformation
- Shape targeted strategies
- Improvement in innovation
- Prioritization of value-reach opportunities
THANK YOU!

For more information:
https://www.edge4industry.eu/product/migration-services/

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