Opening Keynote Presentation

Industry 4.0 and Cyber Age: Preparing the downstream sector for Technological Revolution

Karthick Srinivasan
Director – Process Controls Engineering, Delek US Refining
Agenda

• Industrial Revolution – The Journey
• Industry 4.0 and the Cyber Age
  • Understanding Industry 4.0:
  • What it means for the automation industries
• what it means for the downstream world
  • Integrated Optimization
• Exploring technology and innovation
  • Evolutionary vs revolutionary
• Taking the next step in automation and digital transformation:
  • Cyber Physical Systems architecture
• Identifying and overcoming the challenges
• The Roadmap
Industrial Revolution – The Journey

Industry 1.0
Mechanical Energy generated by water and steam

Industry 2.0
Electric Energy drives mass production

Industry 3.0
IT and OT systems automate production lines

Industry 4.0
Cyber Physical systems and IoT to automate complex tasks

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Industry 4.0 and Cyber Age

• Next Step in digital transformation
  • Optimize assets, process, people using a common platform to empower employees
  • IoT – Internet of Things – everywhere, simple and efficient.
  • IIoT – Industrial Internet of Things

• Standardize and Connect resource, schedule, production, order, package and process in organization using common network and protocols.
• Cloud/Network/Automation/Digitalization + Standard Network (local network/intranet \(\rightarrow\) Internet) = Industry 4.0

<table>
<thead>
<tr>
<th>Business</th>
<th>Operations</th>
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<tr>
<td>- Value chain of the life cycle of products</td>
<td>- Connect smart device using common protocols</td>
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<td>- Horizontal Integration</td>
<td>- Cross boundaries between OT and IT network.</td>
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<td>- Vertical Integration</td>
<td>- Cybersecurity</td>
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<td>- System Engineering</td>
<td>- Digital twin</td>
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*Example: Autonomous Vehicle; Devices monitoring residential home; Monitoring behavior and whereabouts in a car; PIMS (Plant Information Management Systems)*
Industry 4.0 in downstream

- Real time tank levels with predictive inventory.
- Digitalization → Predictive Analytics using IIoT
- Material Management System
- Energy Management
- Abnormal Situation Management (ASM)
- Safety Management
- Environmental Management
- Process Control Management

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Integrated Optimization

- Process Simulation Management
  - Digital Twin
- Real time integrated Optimization
  - Advanced Process Control (APC) → real time optimization
  - Optimization of production plan
  - Optimization of blending
  - Optimization for scheduling
  - Optimization for dispatch system
- Quality Management

Source: Journal - Smart manufacturing for the oil refining and petrochemical industry : Zhihong Yuan, Weizhong Qin, Jinsong Zhao
Exploring Technology: Evolutionary Vs Revolutionary

Convergence of Diffusion of Innovation Models

Traditional Oil & Gas Industry adopters
Challenges

- **Perception**
  - Capital intensive
  - Labor intensive
  - Sensor-driven computing

- **Transmission**
  - Rip and replace application is not an option
  - Navigate different business units using common protocol.

- **Computation**
  - Cybersecurity
  - Cloud computing vs edge computing
  - Analytics

- **Application**
  - Transform the workforce
  - Mobility
Cyber physical systems

Reference Architecture for ICS based on ISA-95 (Source: Whitepaper: Protocols and Network security in ICS infrastructures)

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Biggest Challenge/Threat - Cybersecurity

2000, Australia: Maroochy Shire sewage spill – Released 1 million liters of sewage into river.

2003, USA: Davis – Besse power station – Disabled security monitoring system for five hours.

2008, Poland: Public tram system – Derailed four trams by manipulating signaling systems.

2010, Iran: Nuclear plant – Stuxnet cyber worm affected more than 1000 nuclear centrifuges and 60,000 computers.

2011, Iran: Nuclear plant – Duqu Trojan based on Stuxnet design to collect data to facilitate the launch of future attack.

2014, Germany: Steel mill – Damaged the foundry.


Source: Industry 4.0: Managing The Digital Transformation by Alp Ustundag; Emre Cevikcan
Road map

• Industry 2.0 /3.0 → Industry 4.0

• Transform operation to digital world

• Beyond valves, instruments and controllers

• IT support service for business strategy – A partnership

• Product and service innovation
  • Distribution
  • Enhanced corporate control

• Embrace change in automation, IT and OT systems.