Industrial Internet & Smart Manufacturing

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IIC-Plattform Industrie 4.0 World Tours, Burlingame, December 08, 2017
Part I

Architecture Alignment & Interoperability

An IIC & Plattform Industrie 4.0 Joint Whitepaper
Jointly Publish a Whitepaper on Architecture Mapping & Alignment between IIRA & RAMI 4.0

http://www.iiconsortium.org/iic-i40-joint-work.htm
Architecture Alignment & Interoperability

- Contributed by members of from both organizations
  - Shi-Wan Lin (Thingswise)
  - Erich Clauer (SAP)
  - Ralf Neubert (Schneider Electric)
  - Madhusudan Pai (Wipro)
  - Heinrich Munz (KUKA)
  - Stephen Mellor (IIC)
  - Brett Murphy (RTI)
  - Ulrich Loewen (Siemens)
  - Gerd Bachmann (VDI)
  - Martin Hankel (Bosch Rexroth)
  - Erich Barnstedt (Microsoft)

- 60+ draft revisions over 10+ month with several rounds of internal reviews in each organization

- Independently approved by each organization
Architecture Alignment & Interoperability

- Highly complementary
  - IIRA: broad applicability and interoperability across industries
  - RAMI 4.0: in-depth focus on manufacturing & value-chain lifecycles
- The concepts, methods and models map to each other well
- Different emphasis in scope & depth from different perspectives
  - together strengthen the digitalization of manufacturing and beyond
  - IIRA: analytics capability; RAMI 4.0: I4.0 Components
- Important to enable interoperability among IIoT systems that are based on IIRA & RAMI 4.0
- Common ground to enable connectivity/communication/connectivity/semantic interoperability
Industrial Internet, the Core Idea

Transformational Business Outcomes
Intelligent Industrial Operations
Analytics Driving Optimal Decision-Making
IIoT - a simple idea, widely applicable

Digitalization-driven optimization from assets to processes, through the value chains, across enterprises & industries, end-to-end
Collaboration Between IIC and I4.0

Driving the digitalization of industries:

advances the adoption of the industrial internet on a global scale that transcends industry boundaries

coordinates the Industrie 4.0-driven digital transformation of the German industry

ENERGY
IIC
HEALTHCARE
MANUFACTURING
PUBLIC DOMAIN
TRANSPORTATION

Cross-domain & Interoperability in IIoT

Detailed model for next-gen Manufacturing value chain

1. Domain focus areas are complimentary
2. A clear mapping between both architectures will enable cross-domain interoperability
3. Collaboration on testbeds, test facilities and test methodologies will ensure interoperability on the technical level

Zurich, Nov 2015
Heidelberg, Sept 2016
Chicago, June 2016
Collaboration Between IIC and I4.0

- JTG1: Lifecycle Perspectives
- JTG2: Architectures Alignment
- JTG3: Collaboration on Testbeds
- JTG4: Interoperability & Standards
- JTG5: Security
- JTG6: Coordination & Roadmap...
addresses concerns about IIoT, emphasizing its broad applicability and interoperability across industries

takes an in-depth focus on manufacturing and related value-chain lifecycles.
IIRA – Business Value Driven Methodology

Identify & classify important system architecture concerns into related categories – viewpoints - for their analysis and resolution.

Business vision & value driven, concern-resolution centric, iterative design methodology
IIRA - Architectural Templates and Models
IIRA – Comprehensive Architecture Considerations

Identify major common functional domains & their relation and interaction.

Identify major cross-cutting functions

Identify major system characteristics as emerging system properties
RAMI4.0 – A Comprehensive Model for Manufacturing

- Identify standards requirements
- Assess applicability of relevant standards
- Recommend best-fitting standards

Full Interoperability
Industrie 4.0 Component

- The connection is made via the Industrie 4.0 communication
- The Administration Shell is the digital content
- The Thing is the real content

Common Model & Interface → Broad Interoperability
Industrial Internet Connectivity Framework

- a new IIoT stack model for mapping the rich connectivity landscape
- an open connectivity reference architecture for interoperability
- an assessment template for selecting suitable technologies and frameworks
RAMI Communication Stack

- I4.0-compliant access to information and functions of a networked asset
- a uniform I4.0 data format and a unified I4.0 communication
- communication across multiple axes – described separately in each partition
A Mapping of IIAR & RAMI 4.0

Similarities & Differences
A Functional Alignment between IIRA & RAMI 4.0
System Interoperability

Manufacturing

Maintenance Services

Predictive Maintenance

Asset Usage Data For Engineering Processes

...
IIRA & RAMI 4.0 share strong correspondence with many similar concepts. When differ, they are commentary in nature enhancing each other from the different prospects they offer in responding to the IIoT challenges.

We need interoperability between systems built based on them.

The better understanding of complementary nature of IIRA & RAMI 4.0 enables cooperation across industries, interoperability among systems across industries...
Part II

Applying Industrial Internet in Smart Manufacturing

An Architectural Approach

IIoT for Smart Manufacturing (ARC - Industrial IoT/Industrie 4.0 Viewpoints)

Manufacturing Challenge & Response

- Consumerization of the Internet
- Personalization of Products
- Globalization of Market

Change

- Dynamic responses to changes

- More Variety
- Cost
- Quality
- Efficiency
- Sustainability
- Shorter Cycle
- Smaller Batch

- Demand
- Competition
- Ecosystem
- Labor
- Business Model
- Technology
- Products
- Supply Chain
- Processes
- Material Equipment
Digitalization of manufacturing

optimized manufacturing processes driven by information to dynamically respond to changes

Information comes from analytics of data, lots of data...

Industrial Internet of Things
The Digitalization of Manufacturing Environment

The introduction of more diverse, more sophisticated products in a shorter innovation cycle

High performance and quality at low cost by dynamic optimization of the deployment of production resources

Multi-product small-batch customized mass production, Rapid response to market demand

Create value-added services and enable business transformation

Cyber Physical Systems (CPS)
Digital Thread & Digital Twin

**Digital Thread:**
- Integrate manufacturing functions
- Integrate product data for digital models

**Digital Twin:** A digital model for a product
- assessing capabilities & discovering deficiencies,
- optimizing manufacturing & operational processes,
- improving product designs,
- precise product recall scope
IloT & Analytics in Manufacturing

Streaming Data Analytics:
Responsive to events in the physical world
Batch Big Data Analytics: 
To identify performance bottlenecks and inefficiency
To build models for runtime analytics and engineering simulations
To understand product usage patterns and customer preferences
Distributed Industrial Analytics

Processes Data Lakes

Data Integration

Batch Analytics

Big Data Storage

Streaming Analytics

Data Collection & Process

Dynamic Machine & Process Data

Cloud

Enterprise/ecosystem

Factories

Plants

Responsiveness, reliability & security to production needs

Thingswise delivers a scalable distributed streaming analytics stack that are easy to deploy and maintain.
Digital Manufacturing – An Overlaying Architecture
Overlaying Architecture Mapping to IIRA
Overlaying Architecture Mapping to RAMI 4.0
IIoT – the Vision of Optimization

Supply are replenished in time and surplus production minimized

Downtime is predicted and prevented

Waste and defects are eliminated

Worker safety is ensured and sustainability is maintained

Full visibility to operation status providing access to real time, actionable information – operation management to mission control
Thank You!

http://thingswise.com