Reference Architectural Model Industrie 4.0 (RAMI 4.0)

An Introduction
Brave New World
The Internet of Things and Services

Health-care

Smartphone

Smart Meter

Smart Home
Smart Building

Smart Factory

Industrie 4.0

Smart Devices

Smart Mobility

Smart Grid

Graphics © Bosch Rexroth AG
What is Industrie 4.0

- I4.0 connects / merges production with information and communications technology
- I4.0 merges customer data with machine data
- Machines communicate with machines
- Components and machines autonomously manage production in a flexible, efficient, and resource-saving manner
The Potential of Industrie 4.0

EUR 78 Billion by 2025!

Graphics © Plattform Industrie 4.0, Study © BITKOM/Fraunhofer
The Benefits of Industrie 4.0

- Higher quality
- More flexibility
- Higher productivity
- Standardization in development
- Products can be launched earlier
- Continuous benchmarking and improvement
- Global competition among strong businesses
- New labor market opportunities
- Creation of appealing jobs at the intersection of mechanical engineering, automation, and IT
- New services and business models
Security as a Precondition and Enabler

- Security by design
- The basis of all Industrie 4.0 applications
Prerequisites

- Defining communication structures
- Development of a common language with its own signs, alphabet, vocabulary, syntax, grammar, semantics, pragmatics and culture
The Solution: RAMI 4.0 – The Reference Architectural Model for Industrie 4.0

**RAMI 4.0** is a three-dimensional map showing how to approach the issue of Industrie 4.0 in a structured manner.

**RAMI 4.0** ensures that all participants involved in Industrie 4.0 discussions understand each other.
RAMI 4.0 - Benefits

RAMI 4.0 is a SERVICE-ORIENTED ARCHITECTURE.

RAMI 4.0 combines all elements and IT components in a layer and life cycle model.

RAMI 4.0 breaks down complex processes into easy-to-grasp packages, including data privacy and IT security.
Axis 1 – Hierarchy: The Factory

The Old World: Industrie 3.0

- Hardware-based structure
- Functions are bound to hardware
- Hierarchy-based communication
- Product is isolated
The New World: Industrie 4.0

- Flexible systems and machines
- Functions are distributed throughout the network
- Participants interact across hierarchy levels
- Communication among all participants
- Product is part of the network
Axis 2 – Architecture

- **Business**: Organisation and Business Processes
- **Functional**: Functions of the Asset
- **Information**: Necessary Data
- **Communication**: Access to Information
- **Integration**: Transition from Real to Digital World
- **Asset**: Physical Things in the Real World
Axis 3 – Product Life Cycle

**The Product:** From the First Idea to the Scrapyard

- **Development**
  - Construction Plan:
    - Development
    - Construction
    - Computer Simulation
    - Prototype
    - ...
  - Construction Plan:
    - Software Updates
    - Instruction Manual
    - Maintenance Cycles
    - ...
- **Production**
  - Production:
    - Product
    - Data
    - Serial Number
    - ...
  - Facility Management:
    - Usage
    - Service
    - Maintenance
    - Recycling
    - Scrapping
    - ...

Graphics: Product Life Cycle, RAMI 4.0 © Plattform Industrie 4.0 and ZVEI, Additions by Dr. Peter Adolphs
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A Solution Space with a Coordinate System for Industrie 4.0

Development, Production / Sales, Service

Graphics RAMI 4.0 © Plattform Industrie 4.0 and ZVEI
What Do Communication Participants Need?

- Globally standardized communication
- Easy installation and operation ("plug and play")
- Standardized language for the exchange of information

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Who provides interpretation? The Administration Shell...

... is the interface connecting I4.0 to the physical Thing

... stores all data and information about the asset

... serves as the network’s standardized communication interface

... is also able to integrate passive assets
The Roles and Responsibilities of the Administration Shell

- Each physical thing has its own administration shell.
- Several assets can form a thematic unit with a common administration shell, several thematic units...
The Industrie 4.0 Component

Each object needs its own administration shell that allows its integration into Industrie 4.0

- The connection takes place over the I4.0 communication
- The administration shell forms the digital part
- The Thing forms the real part
Where do we need to go from here?

Next Steps

Architecture of Industrie 4.0
Semantics – Identification – Functions – Communication
Standards – Internationalization and Partnering

Concepts for the I4.0 Component

Submodels for Individual Aspects and Processes

Language of Industrie 4.0

Recommendations for Implementation

National and international standardization (DIN SPEC 91345)
Publications of Plattform Industrie 4.0

More information:

http://www.plattform-i40.de/I40/Navigation/EN/InPractice/Online-Library/online-library.html