Industrie 4.0 – Between Vision and Reality

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Scientist and Entrepreneur

1787-1826

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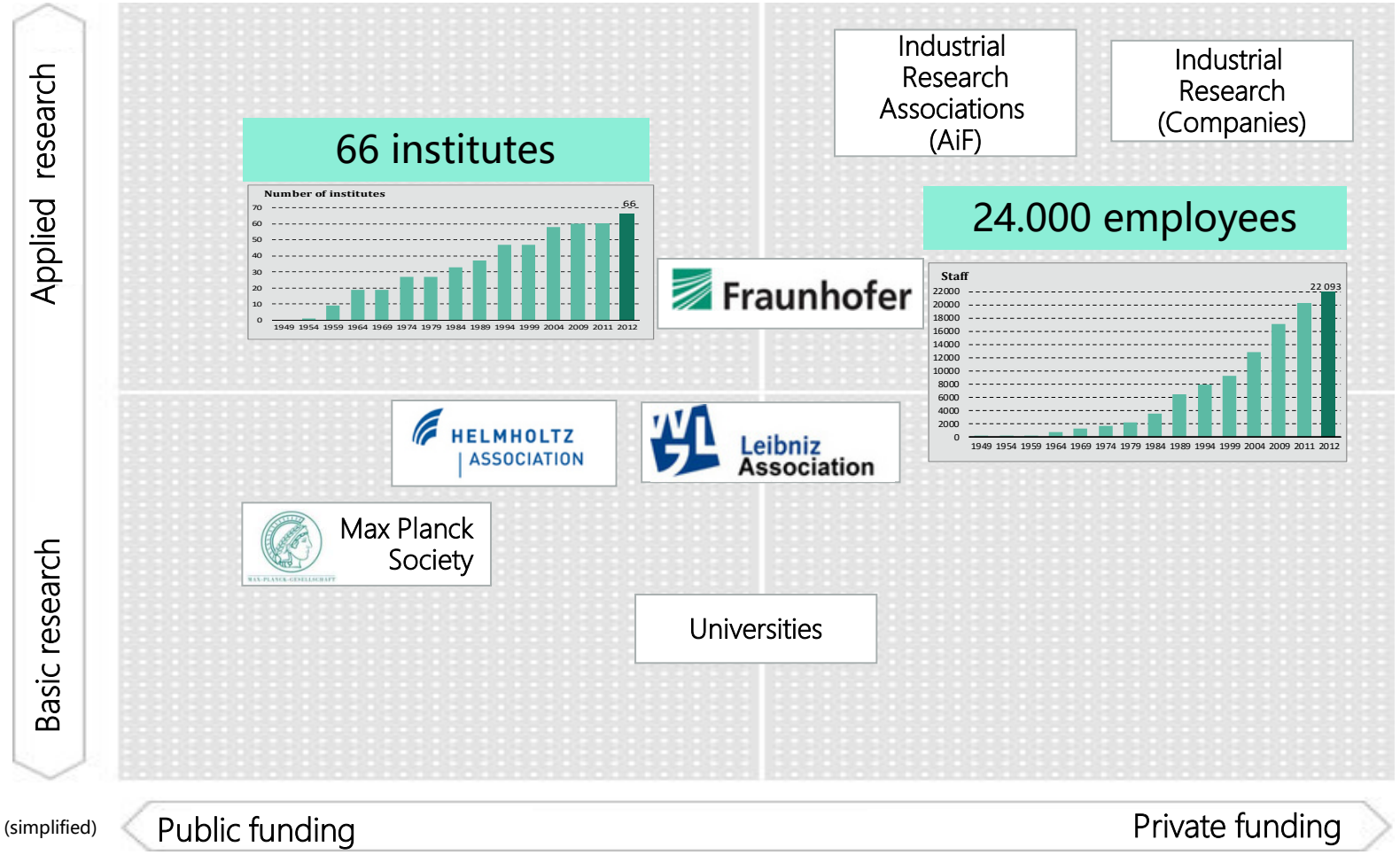
Fraunhofer IOSB
Head of Department
Information Management and Production Control
Spokesperson Business Unit Automation

Content

1. **Fraunhofer IOSB**
2. Critical look back
   - Where do we stand today after the proclamation of a long term vision of an Industry 4.0 five years ago ?
3. Critical look into the next 5 years:
   - What may be possible ?
   - What must have been achieved in order not to have lost momentum ?
4. Scope: national – European – global

Fraunhofer in the German Research Landscape



Source: BMBF (simplified)

Fraunhofer IOSB (Optronics, System Technologies and Image Exploitation)

Karlsruhe

Ettlingen

Managing Director:
Prof. Dr.-Ing.
Jürgen Beyerer

Operational costs 2015	53 Mio €
Permanent employees	449
of which scientists/ engineers	327

Lemgo

Ilmenau

Beijing

Competences

- Optronics
- System technologies
- Image exploitation

Business Units

- Automation
- Energy, Water and Environment
- Automated Visual Inspection
- Defense
- Security

Department of Computer Sciences, Institute for Anthropomatics, Vision and Fusion Laboratory

Engagement of Fraunhofer IOSB in the Industrial Internet

Industriegetriebes Konsortium,
CAEX (IEC 62424) als Dachformat

CIRP, Mitarbeit im STC-O

Mitarbeit in der
UMCM-Arbeitsgruppe

Leitung Fachbereich IT in der GPP
FA Digitale Fabrik
FA 5.15 „Agentensysteme“
FA 5.23 „XML in der Automation“
FA 6.12 „Durchgängiges Engineering von Leitsystemen“
FA 7.21 „Industrie 4.0“
FA 140 „MES“
FA 146 „MES-AG 2 Energiemanagement mit MES“
VDI-GPL - Fachbereich A5 „Modellierung und Simulation“

NA 060-30-05-04 (Normenausschuss Maschinenbau, NAM)

K941.0.2 AutomationML

OPC UA hat sich als *der* Kommunikationsstandard in der Industrie etabliert (IEC 62541)

Mitarbeit in Industrie 4.0-Arbeitsgruppen des VDI und der Plattform

Modellfabriken in Karlsruhe und Lemgo

Das IOSB zählt zu den 100 führenden Orten für Industrie 4.0 in BaWü

IIC Testbed mit
KETI (Südkorea);
Testbed +
Smart factory working groups

Working group 9 of SC
65E AutomationML

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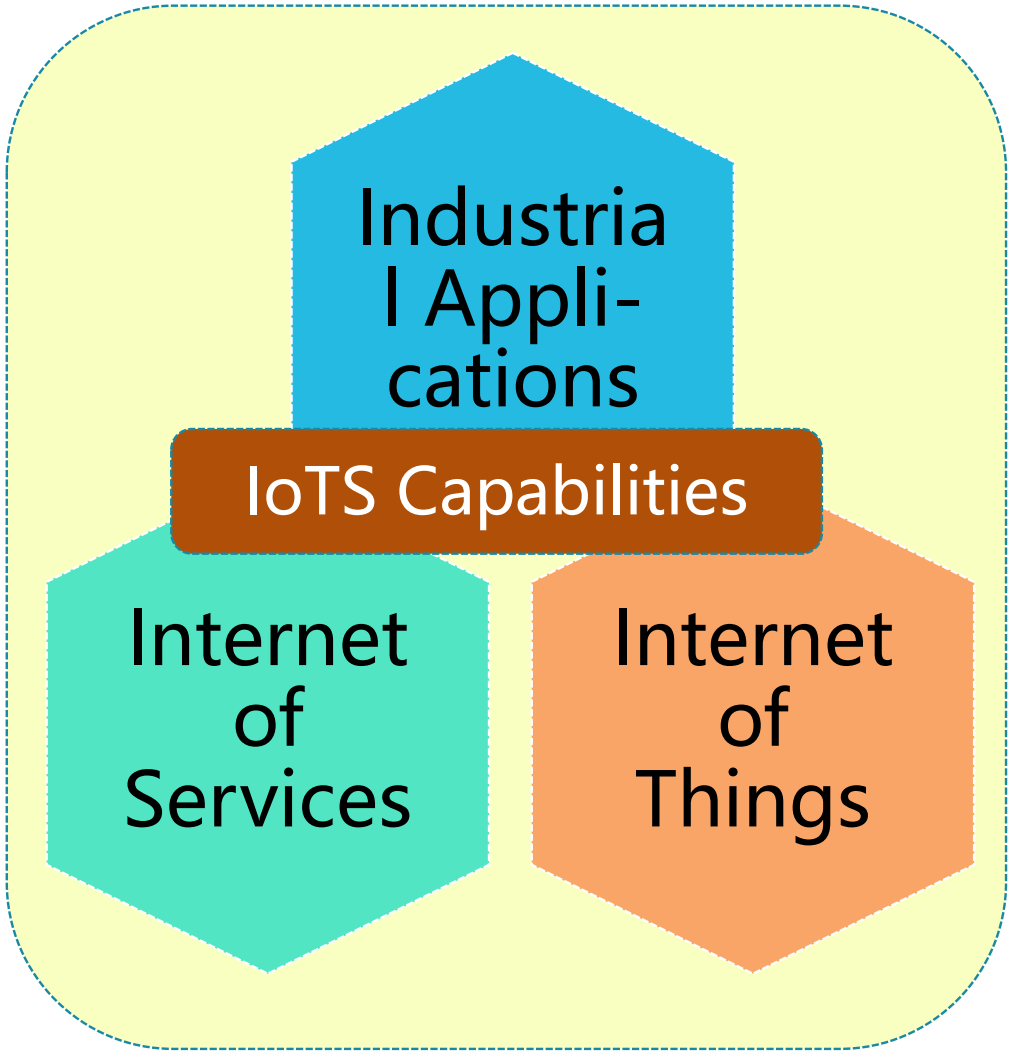
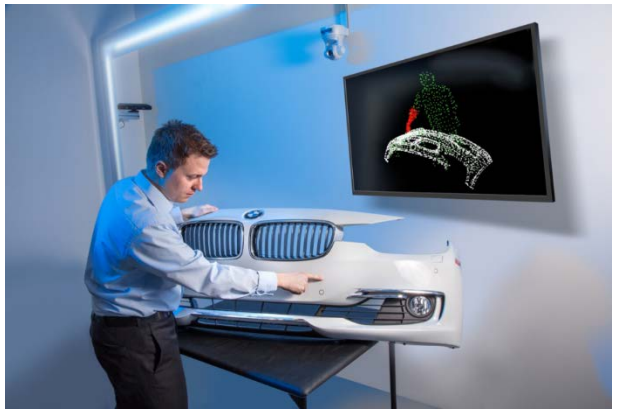
New dimension of Industrie 4.0

Up to now, optimization in industrial production has mainly targeted matter, energy and cost.

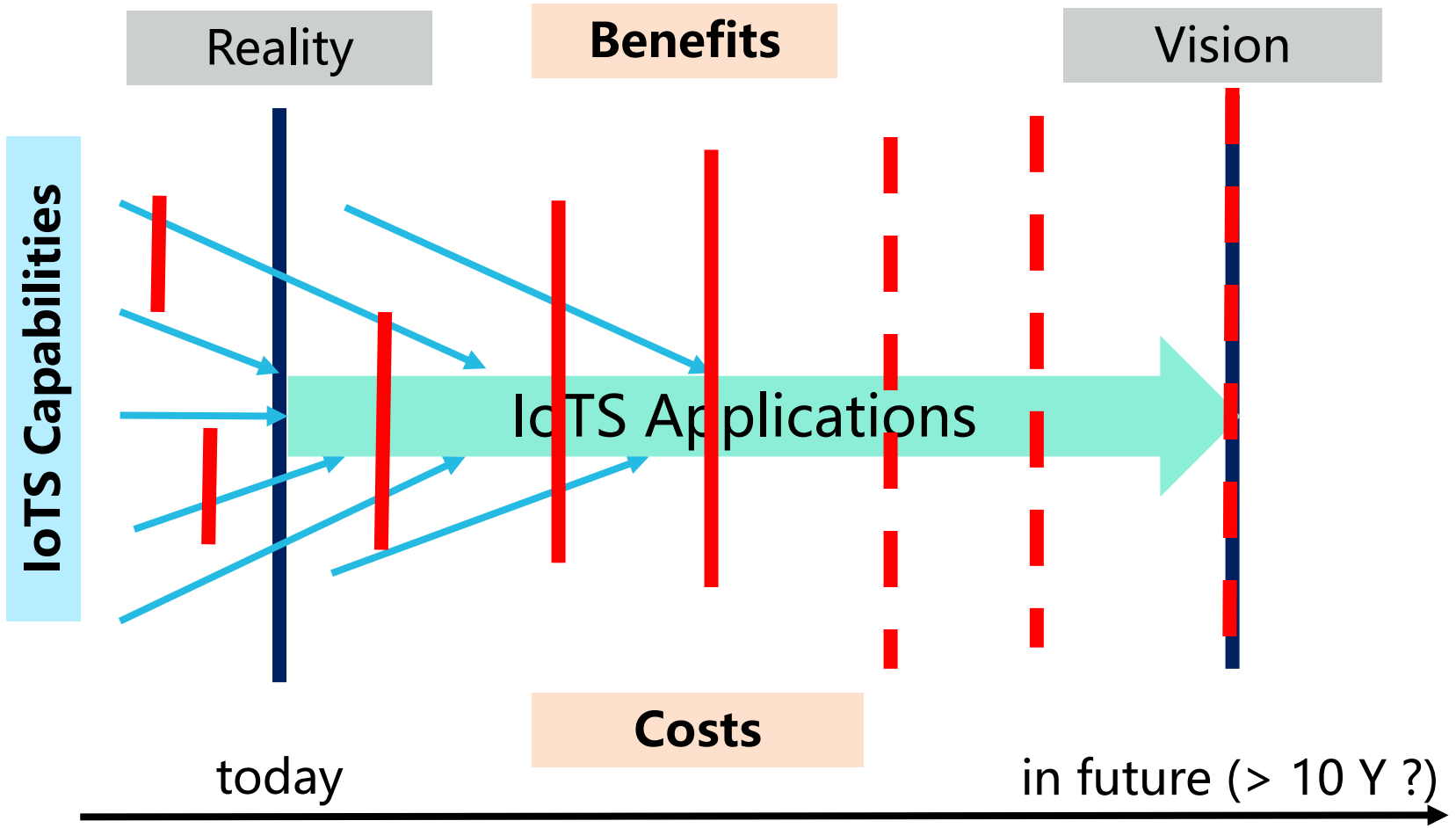
However, the potential of data, information and knowledge in industrial production is still widely unexploited.

Industrie 4.0 – IoT Application on Industrial Production





IoTS Applications - Between Vision and Reality



New „Platform Industrie 4.0“ (since 14.04.2015)

Ministry of Economic Affairs

Ministry of Research

Leitung
BM Gabriel, BM‘in Wanka
Vertreter Wirtschaft, Gewerkschaft, Wissenschaft
Politische Flankierung

Technisch-praktische Kompetenz, Entscheidung	Politische Steuerung, Gesellschaft, Multiplikatoren	Aktivitäten am Markt

Lenkungskreis
(Unternehmen)

- Leitung durch Unternehmer unter Beteiligung BMWi, BMBF
- AG-Leitungen und weitere Gäste/ Promotoren

Industrielle Strategieentwicklung, technische Koordinierung, Entscheidung und Umsetzung

Strategiekreis
(Politik, Verbände, Gewerkschaft, Wissenschaft)

- Leitung StS Machnig, StS Schütte
- Vertreter Lenkungskreis
- Vertreter Bundeskanzleramt, BMI
- Vertreter Arbeitskreis Bundesländer
- Vertreter Verbände (VDMA, ZVEI, BITKOM, BDI, VDA, BDEW)
- Vertreter Gewerkschaft (IG Metall)
- Vertreter Wissenschaft (FhG)

Agenda-Setting, politische Steuerung, Multiplikatoren

Industriekonsortien und Initiativen

Realisierung am Markt: Prüfstände, Anwendungsfälle

Arbeitsgruppen

- Referenzarchitektur, Standardisierung und Normung
- Forschung und Innovation
- Sicherheit vernetzter Systeme
- Rechtliche Rahmenbedingungen
- Arbeit, Aus-/Weiterbildung
- Weitere nach Bedarf

Arbeitseinheiten mit technisch-praktischer Kompetenz; Beteiligte Ressorts BMWi, BMBF, BMI, BMJ, BMAS

Internationale Standardisierung

Konsortien, Standardisierungs-gremien, DKE u. ä.

Wissenschaftlicher Beirat

Geschäftsstelle als Dienstleister
Netzwerkkoordination, Organisation, Projektmanagement, interne und externe Kommunikation

Stand: 13. März 2015

Reference Architecture Model Industrie 4.0 (RAMI4.0) … in a nutshell (YouTube)

https://youtu.be/NO4qWRVvMiU

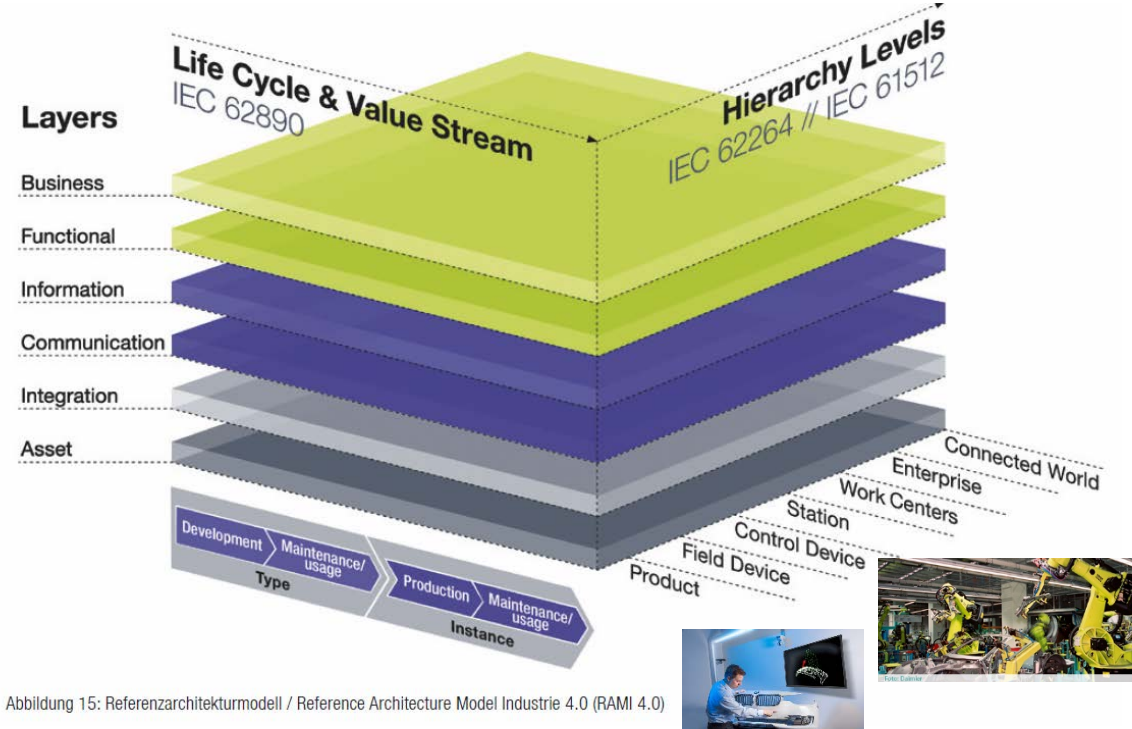
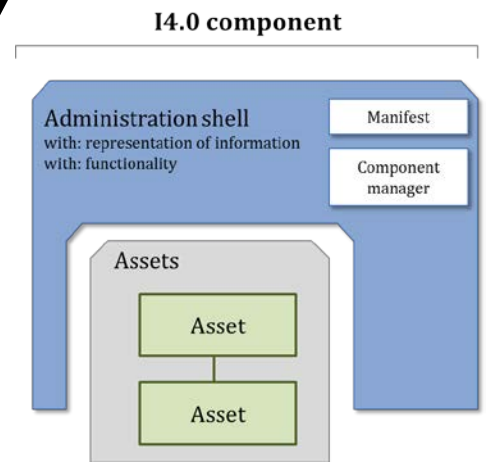


Abbildung 15: Referenzarchitekturmodell / Reference Architecture Model Industrie 4.0 (RAMI 4.0)



Plattform Industrie 4.0/Hrsg. BITKOM, VDMA, ZVEI:
Umsetzungsstrategie Industrie 4.0 – Ergebnisbericht, Berlin, April 2015

Achievements

- Vision broadly discussed in Germany, Europe and world-wide
- Reference Architecture Model Industrie 4.0 (RAMI4.0) as DIN SPEC 91345 published
  - new work item procedure in the relevant Technical Committee of the IEC Strategic Group 8, I 4.0, Smart Manufacturing.
  - RAMI4.0 proposed as Public Available Specification - PAS within IEC
- RAMI4.0 refinement specification ongoing in professional associations below the German Platform Industrie 4.0
  - application scenarios
  - security
  - Industrie 4.0 glossary
  - DIN SPECS
    - Reference Model for Industrie 4.0 Service Architecture
    - Universal Interfaces – Mapping of AutomationML to OPC UA
- many I4.0 testbeds registered in Labs Network Industrie 4.0 (see http://lni40.de/en/)
- open source implementations started on github
  - OPC UA → opc62541
  - Asset Administration Shell: openAAS

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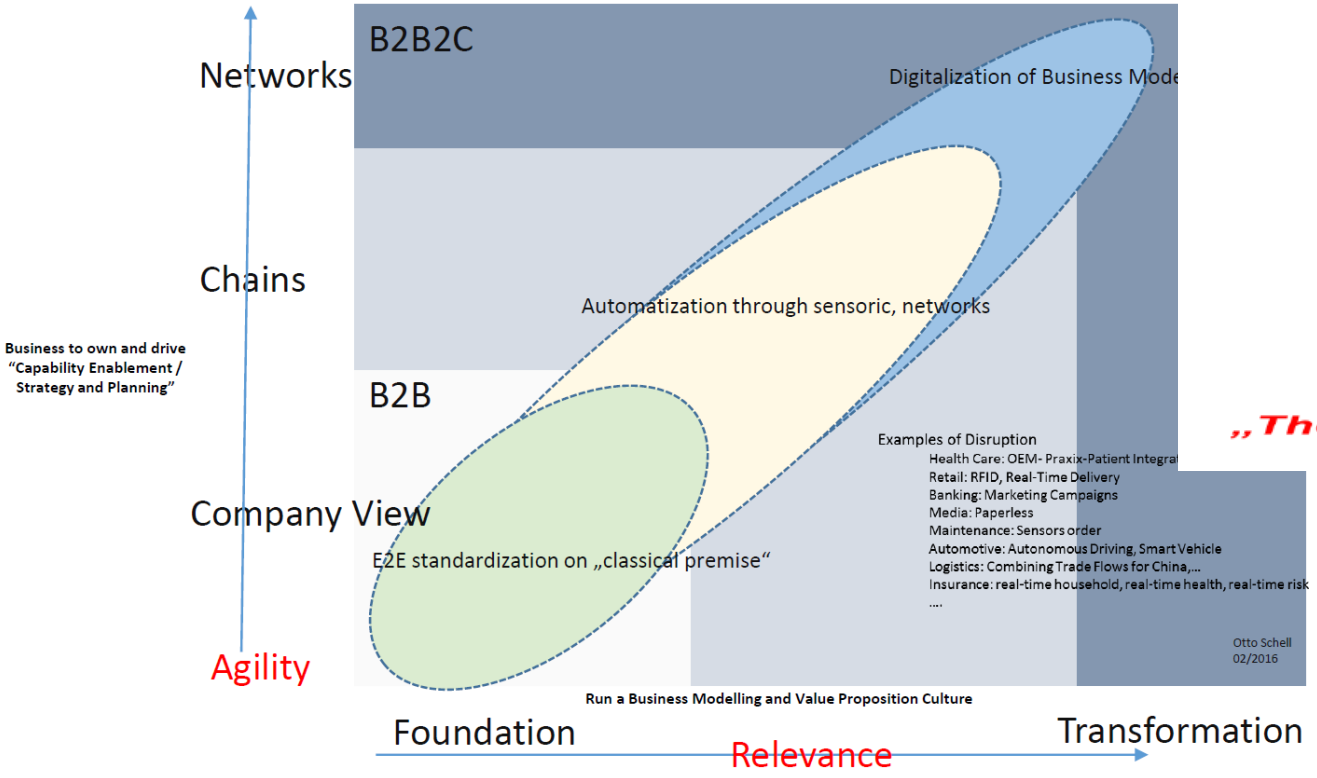
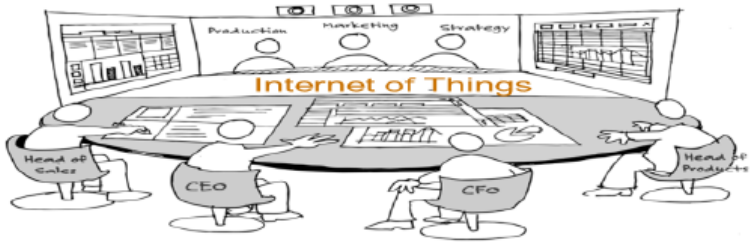
Trend: Inclusion of the Customer in B2B Value Chains (→ B2B2C)

The Business Value path from Standardization to Digitalization

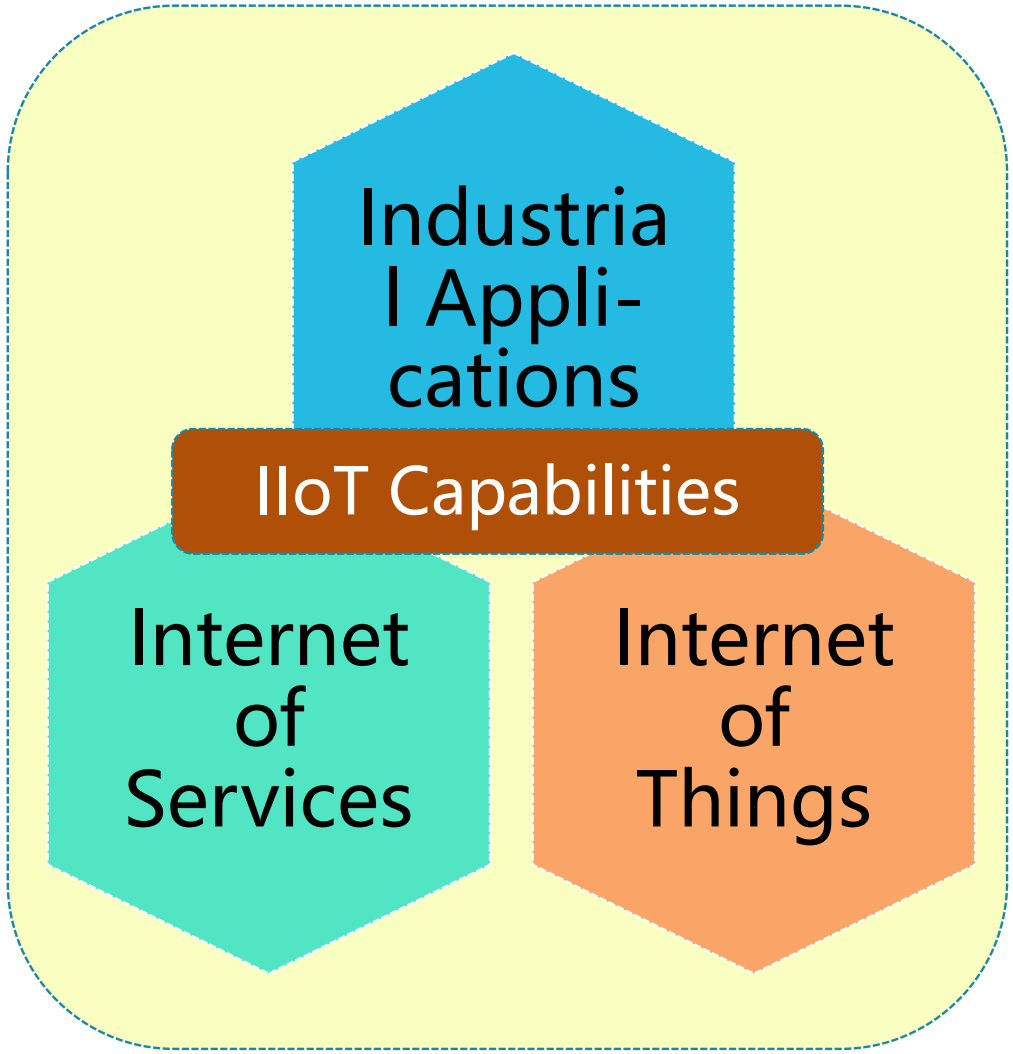


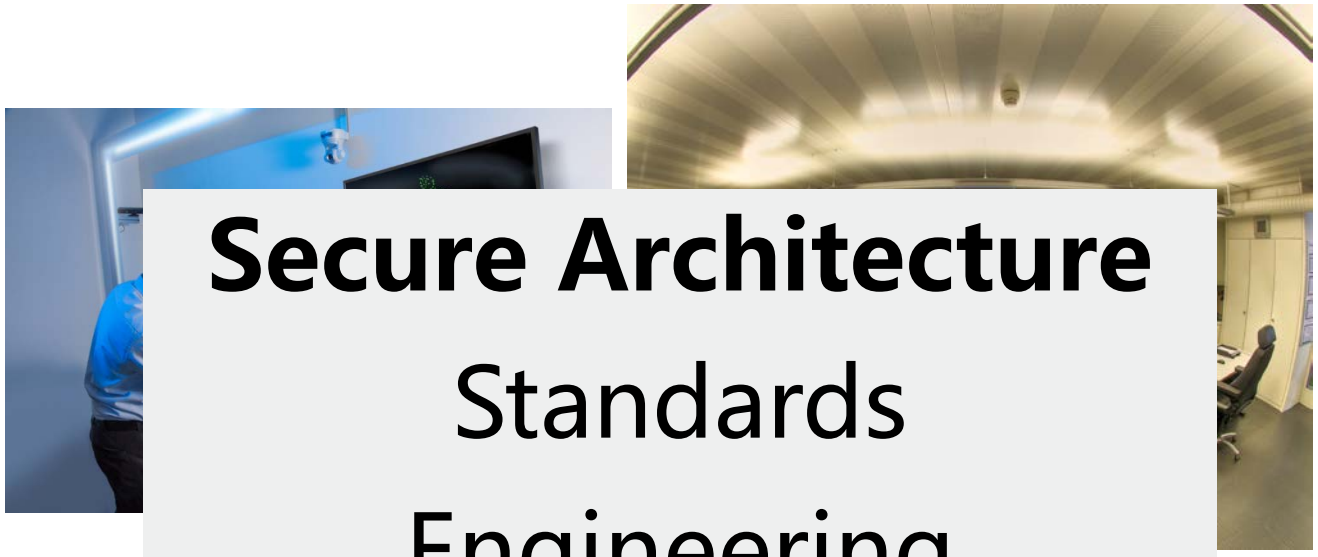
- **Processes & Technology**
  - .....



„The Generation Y" does not want to own products, they are in a shared environment!"

IIoT– Next Challenges



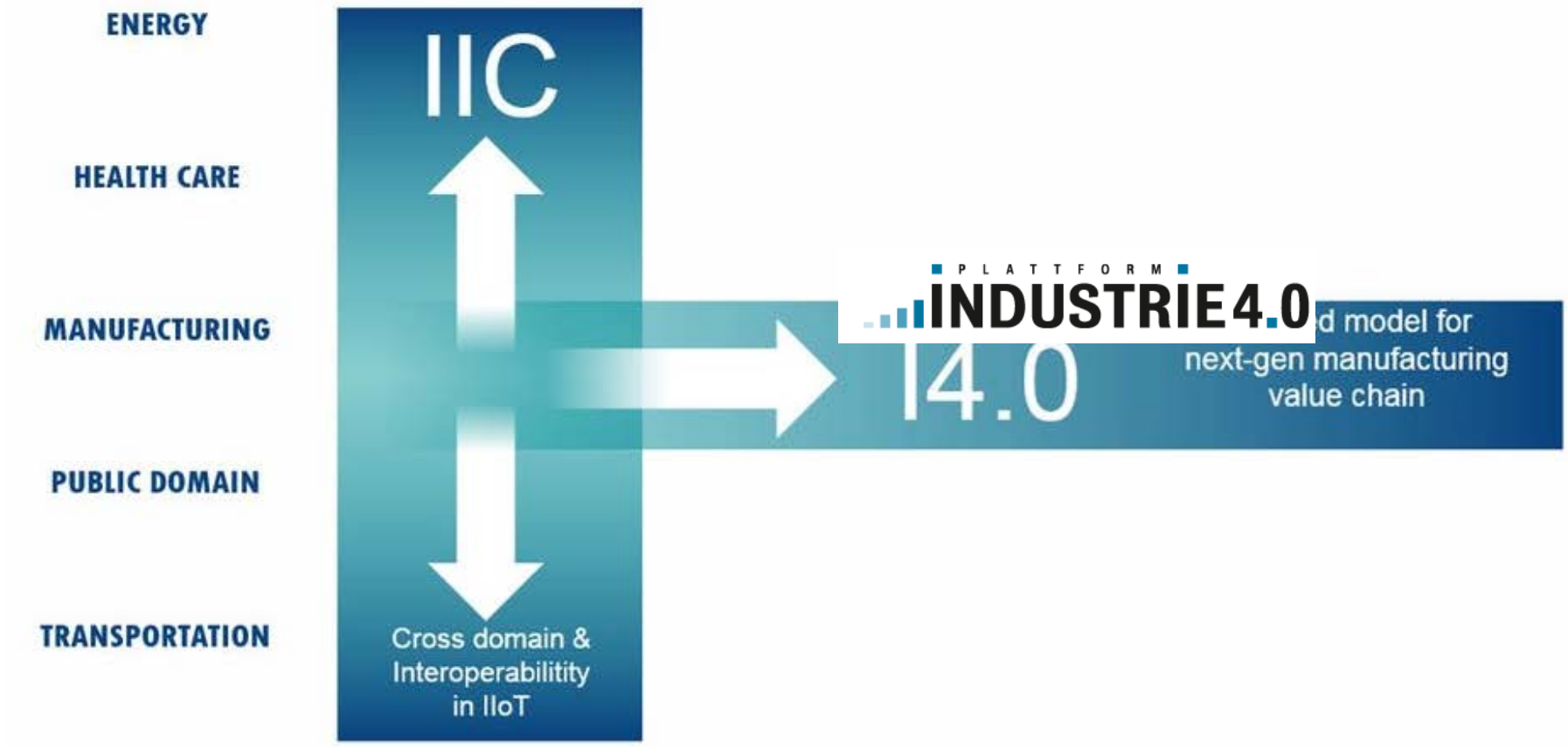


Secure Architecture

Standards

Engineering

Industrie 4.0 and IIC (Quelle: Plattform Industrie 4.0)



Reference Architecture Models

PLATTFORM INDUSTRIE 4.0

industrial internet CONSORTIUM

Reference Architecture Model Industrie 4.0 (RAMI)

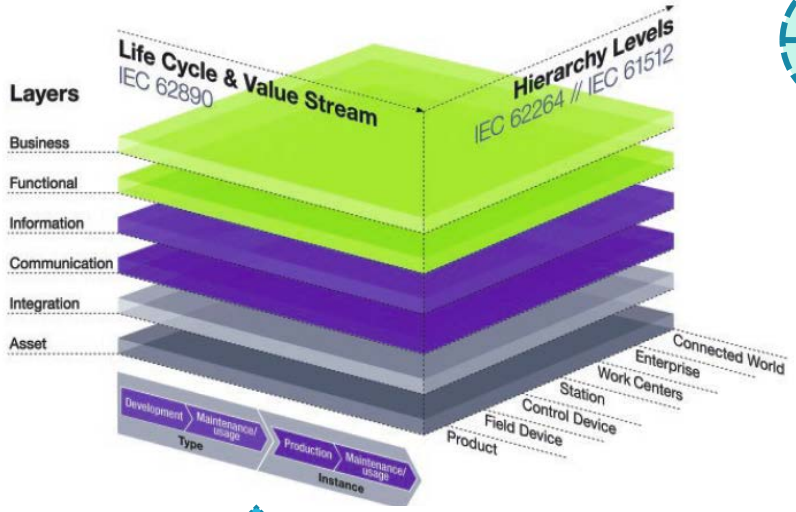
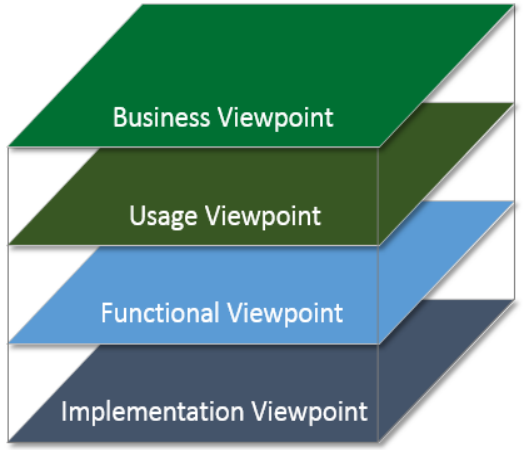


Figure 1. Reference architectu
Copyright „Umsetzungsstrategie

PLATTFORM INDUSTRIE 4.0

Industrial Internet Reference Architecture (IIRA)



R&D Projects + I4.0 Labs

IIC Testbeds

IT Security Lab – Check the Vulnerabiliyt of Your Production Network

- Hybrid Test Environment
- Real Components
- Simulated Process

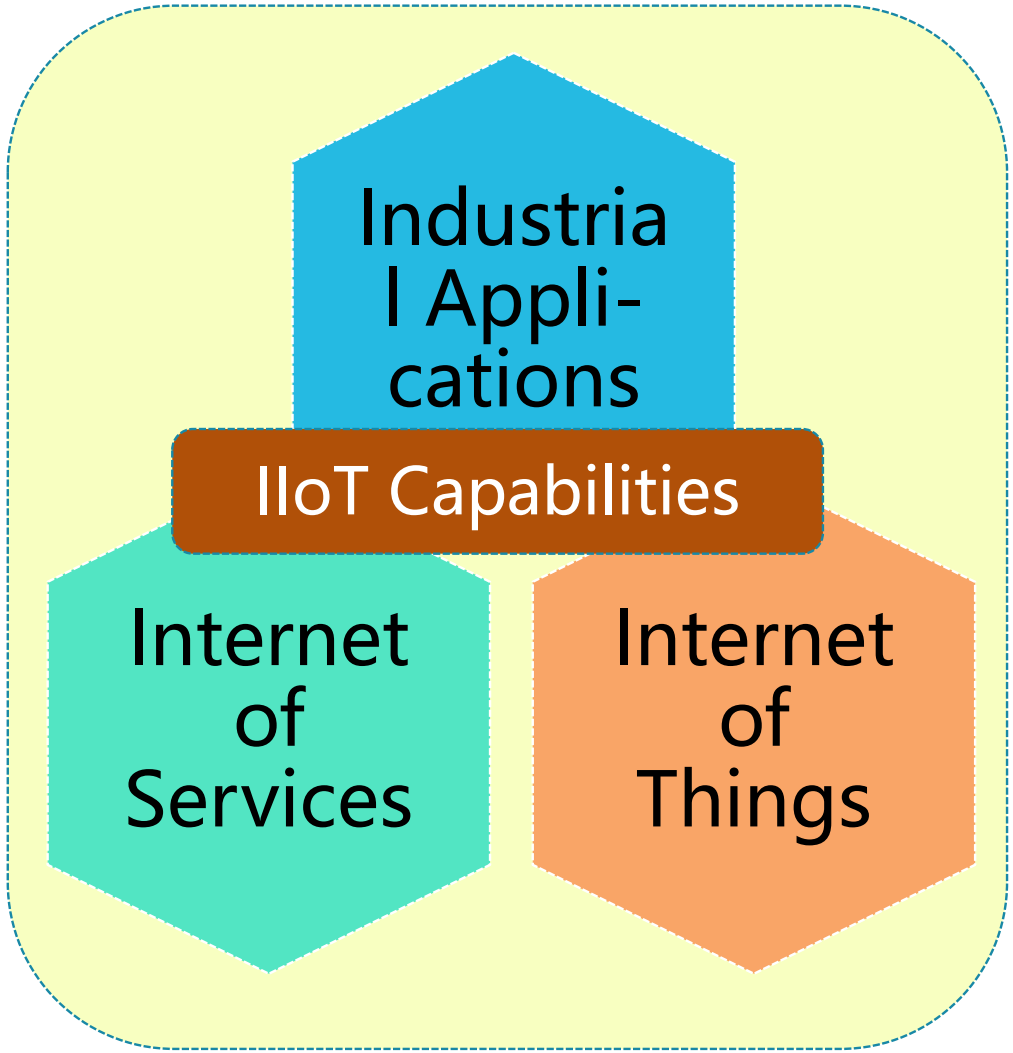
- Software-Defined Netzwerk
- Intrusion detection

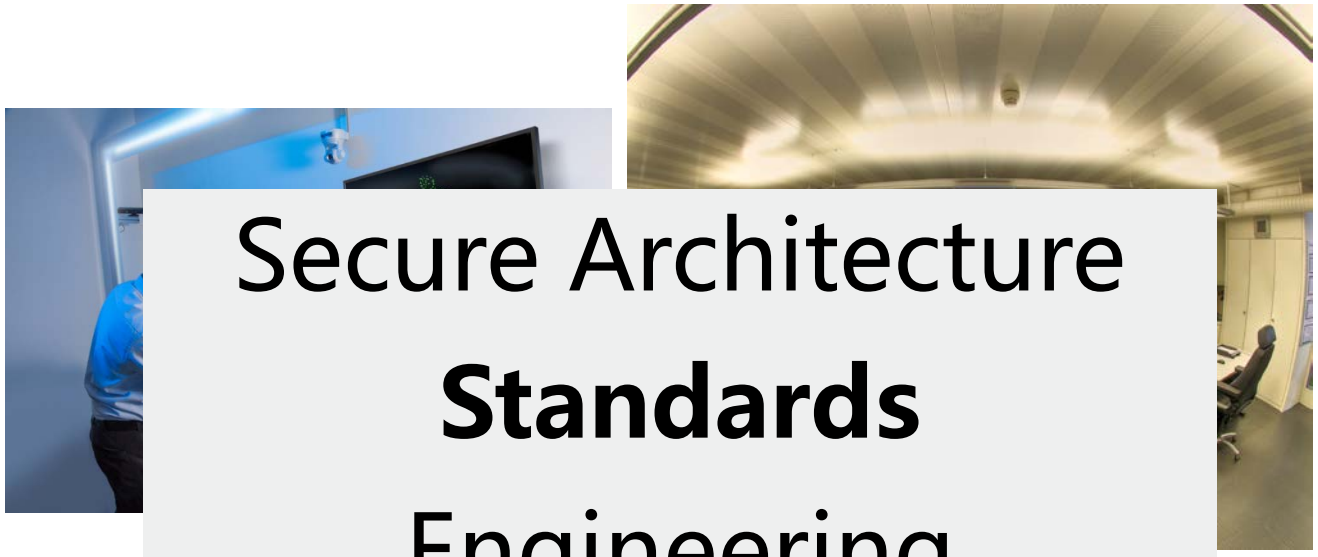
- Run Cyber-Attacks in a controlled way
- Ex.: man-in-the-middle

- Detect
- Observe
- Act
- Improve

SECURE by design

IIoT– Next Challenges



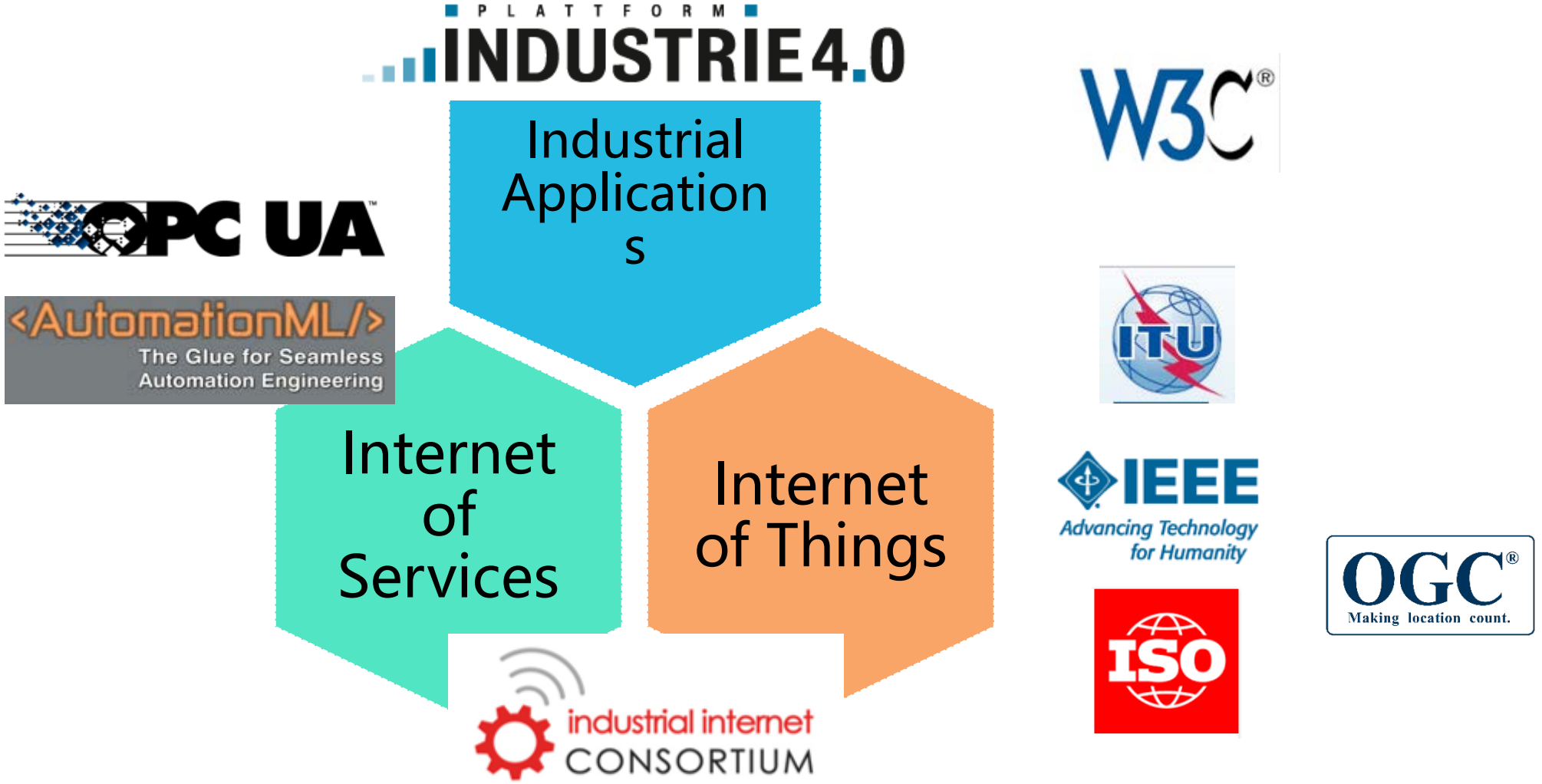


Secure Architecture

Standards

Engineering

Standardization Activities



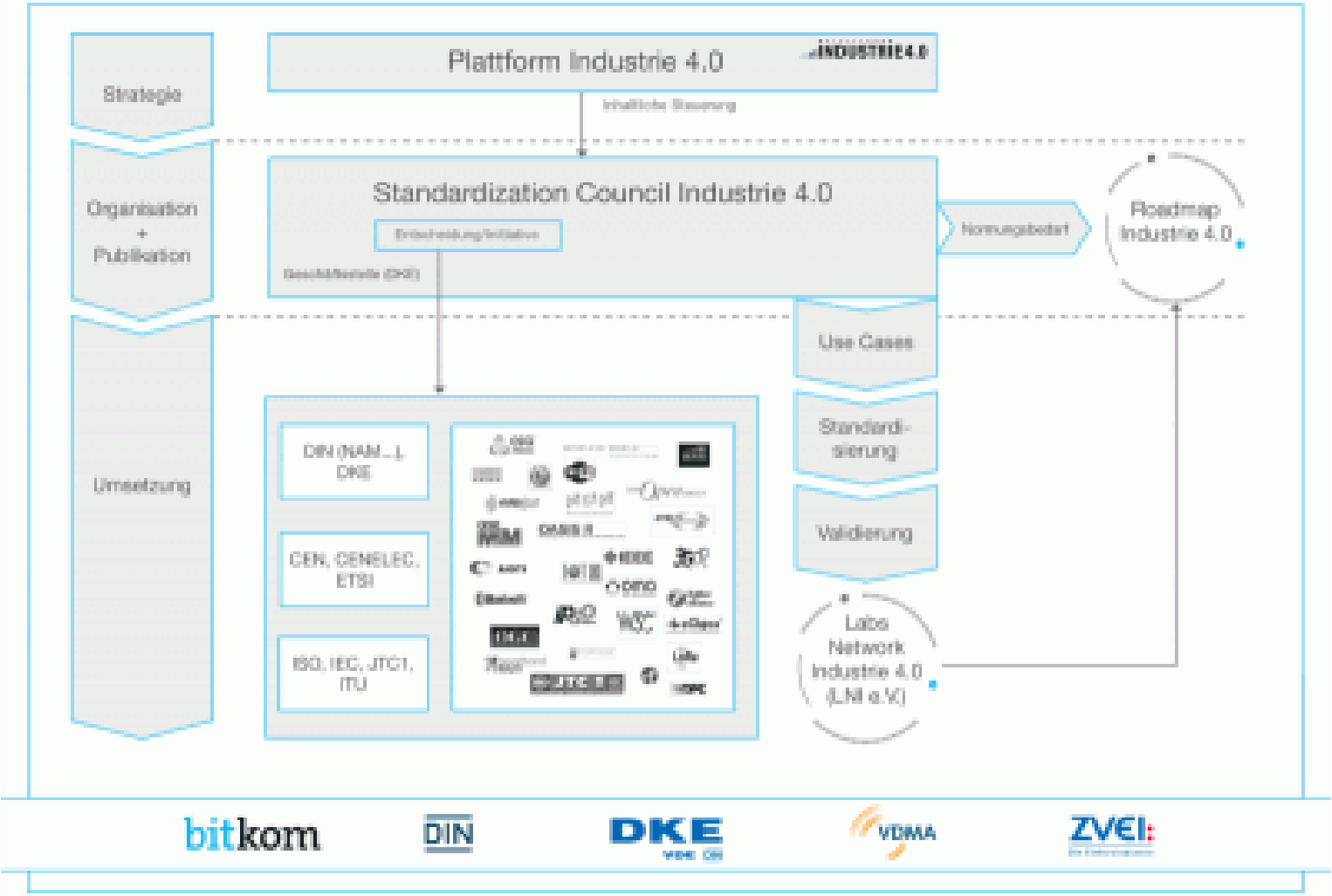
Two I4.0 Candidate Standards in combination (already IEC standards)

Description of the contents, stored and transferred as OPC-UA data model (WHAT)

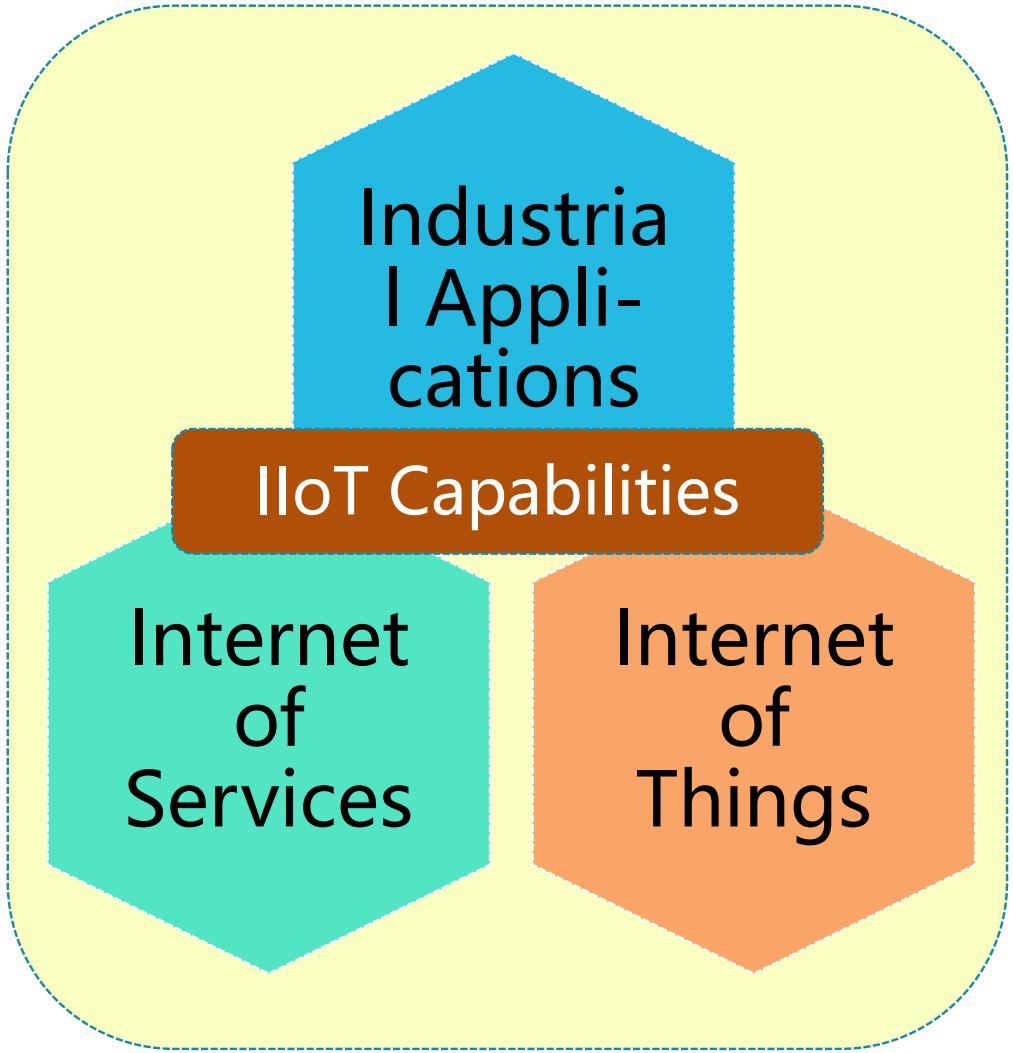
+

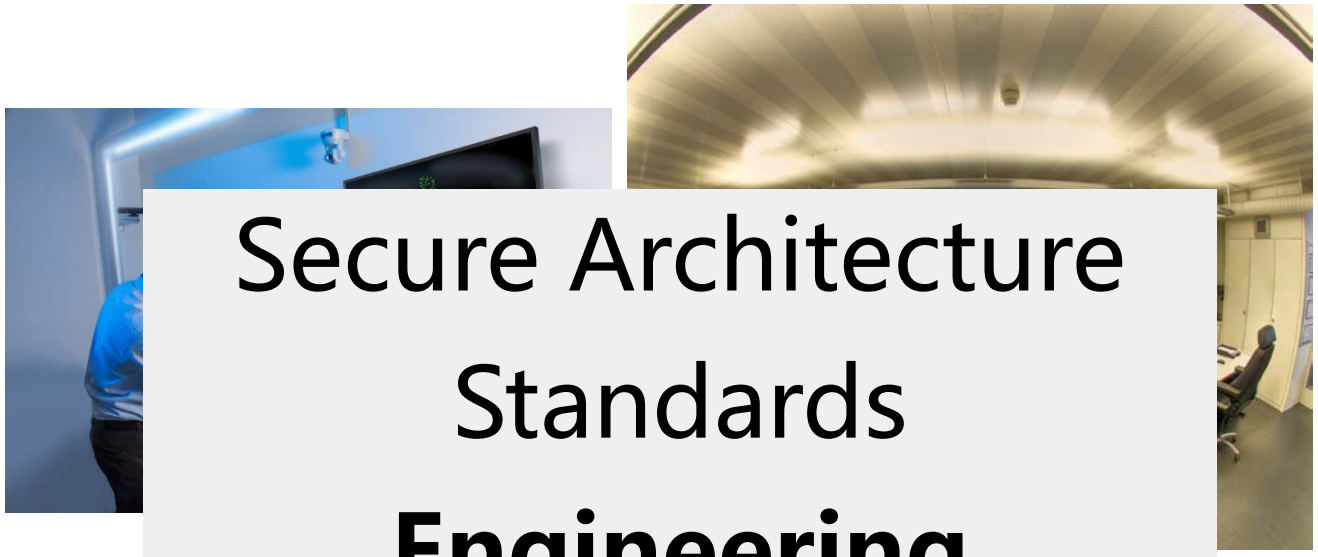
Communication services for the transmission of configuration and run-time data (HOW)

Foundation of the German Standardization Council Industrie 4.0 (SCI4.0)



IIoT– Next Challenges





Secure Architecture

Standards

Engineering

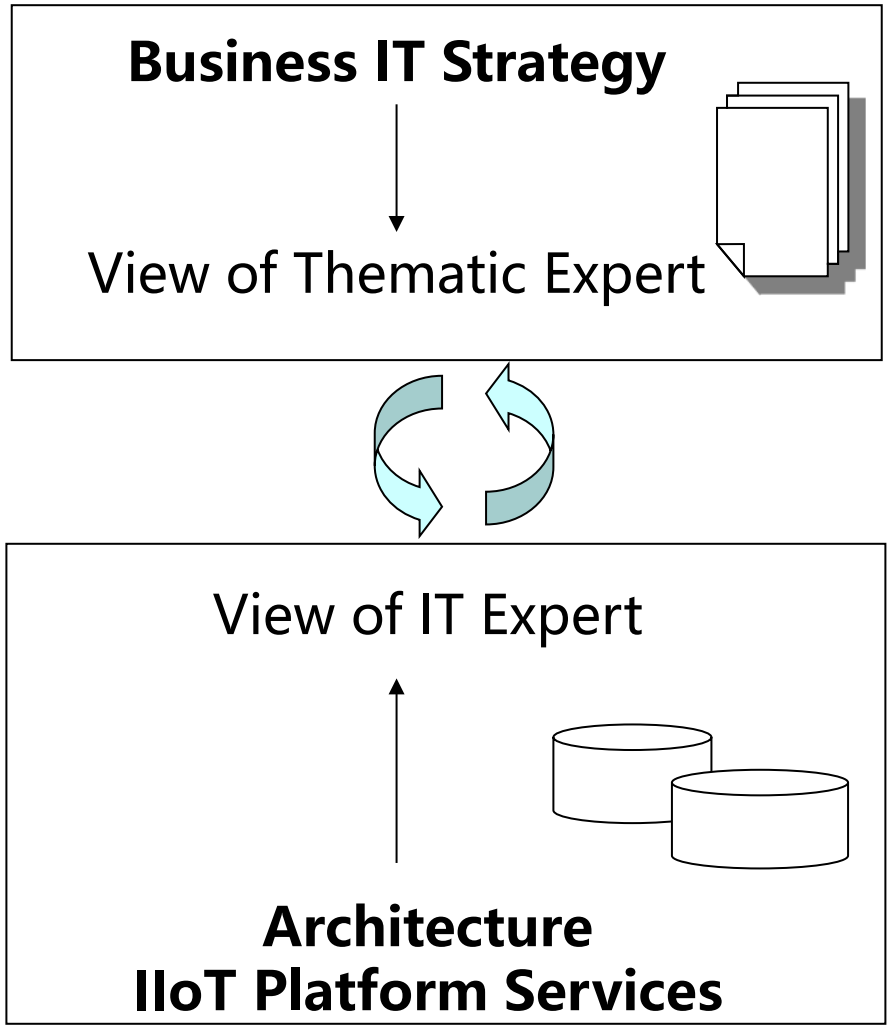
Problem: Agile Requirements Analysis

Service-Oriented Analysis and Design (SOAD)

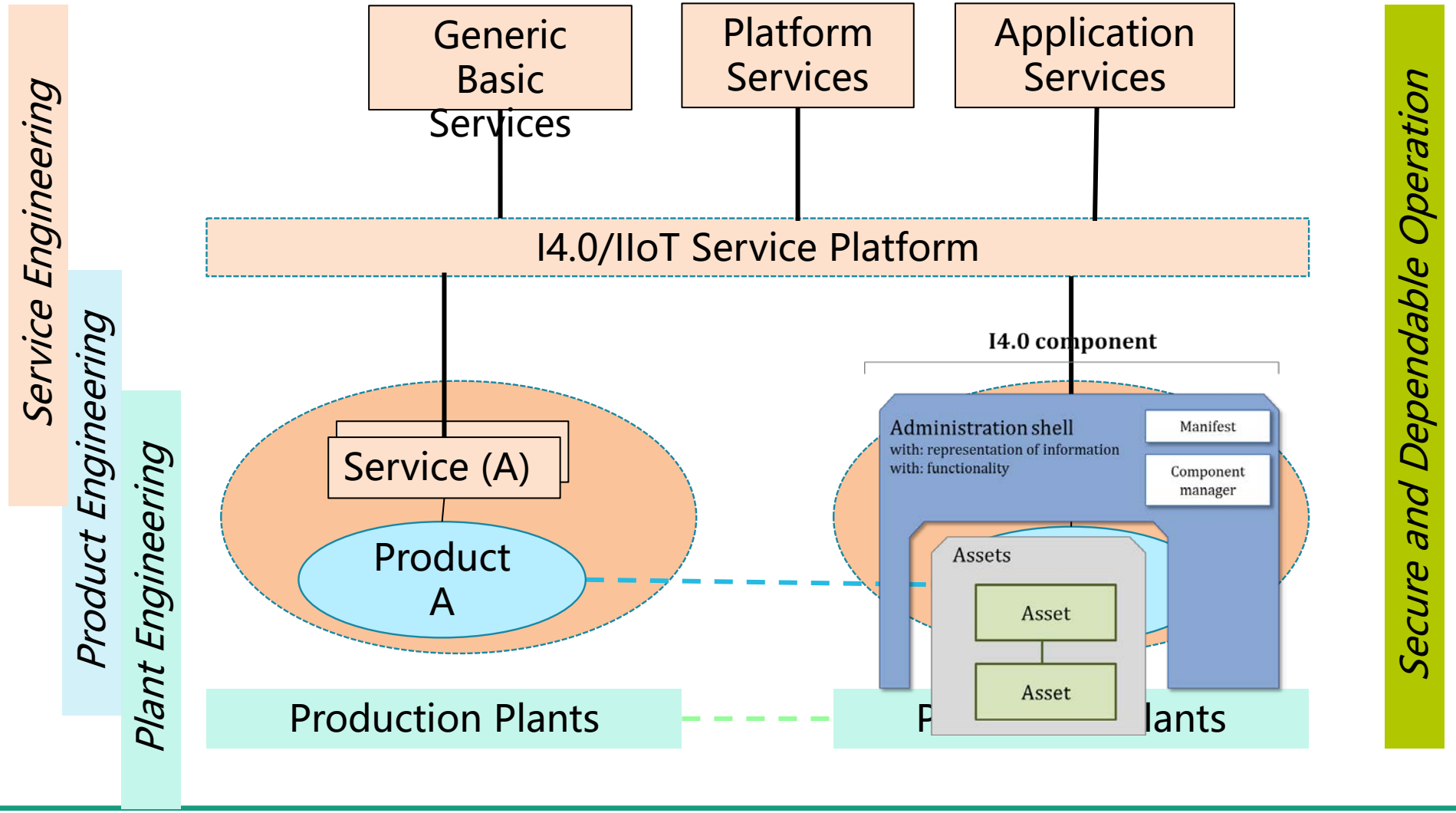
requirements

gap

capabilities / service registries



Engineering – Service Architecture Operation



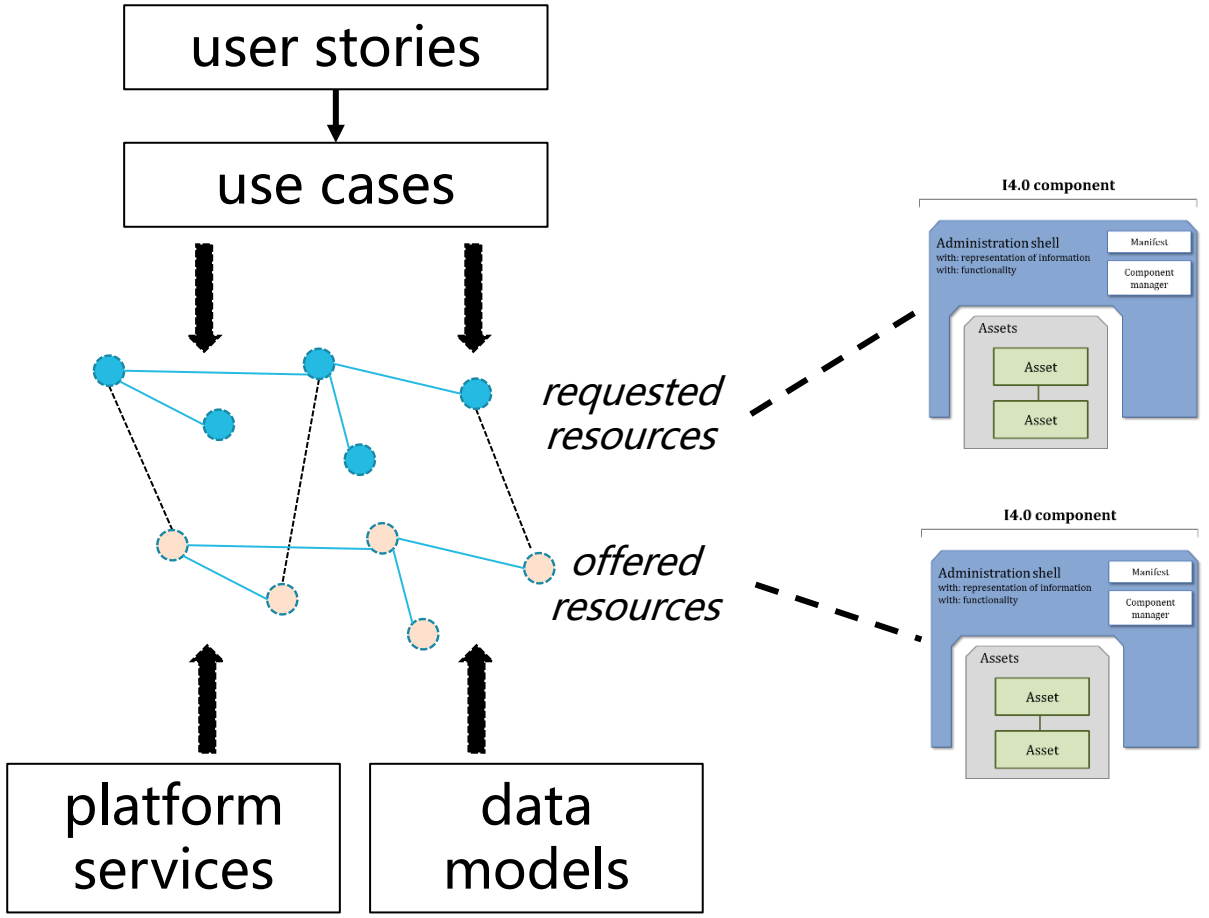
I4.0 System Engineering – based upon an I4.0 Component

Systematic Requirements Analysis

Requirements

Concepts Standards

IIoT Architecural Works



Statement 1 - extended

Up to now, optimization in industrial production has mainly targeted matter, energy and cost.

However, the potential of data, information and knowledge in industrial production is still widely unexploited.

Only if the strategic importance of IT Architectures and adequate System-Engineering-Methodologies is recognized by the given enterprises, this potential may be exploited.

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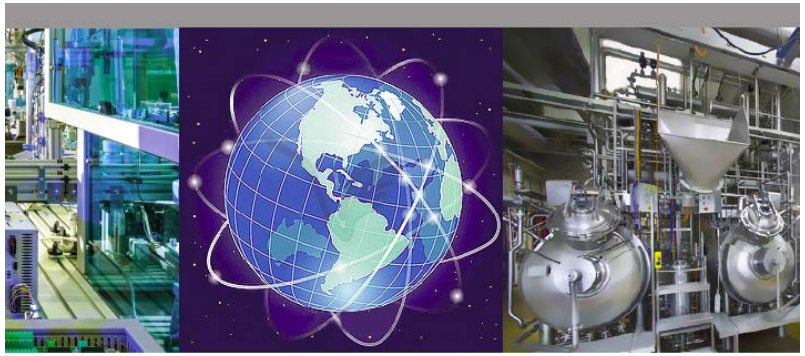
New IIC Testbed

http://www.smartfactoryweb.com

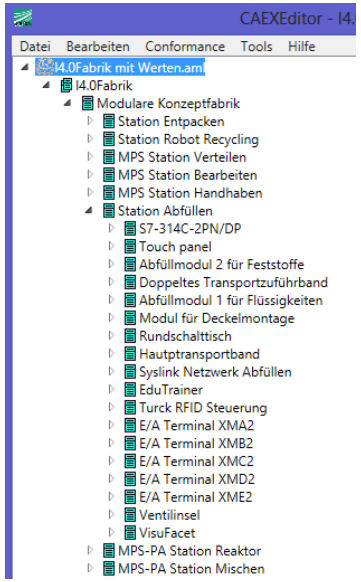
Smart Factory Web

Connect the smart factories of the world based upon international standards

How ? → OPC UA
What ? → AutomationML



SMART FACTORY WEB:
A TESTBED FOR IIC



Smart Factory Web

industrial internet CONSORTIUM

Fraunhofer IOSB

KETI 전자부품연구원

Smart Factory Web
www.smartfactoryweb.com

Goals

- Flexible adaptation of production capabilities and sharing of resources/assets in a web of Smart Factories to improve order fulfillment
- Provide the technical basis for new business models with flexible assignment of production resources across factory locations
- Factory-to-factory interoperability
- Enable cross-site usage scenarios with secure Plug & Work and data analytics

Sponsors / Roles

- Fraunhofer IOSB / Model Factories, Industrial Automation
- KETI / Model Factories, IIoT infrastructure

at Special Issue „Industrial Internet of Things supporting Factory Automation“ (Guest Editors: Beyerer/Usländer)

Industrial Internet of Things supporting Factory Automation

Beyerer, Jürgen / Usländer, Thomas

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Online veröffentlicht: 13/09/2016

Übersicht

IoT business models in an industrial context

Weinberger, Markus / Bilgeri, Dominik / Fleisch, Elgar

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The Open Geospatial Consortium and Industrie 4.0

Goldschmidt, Thomas / Simonis, Ingo

Seite 707
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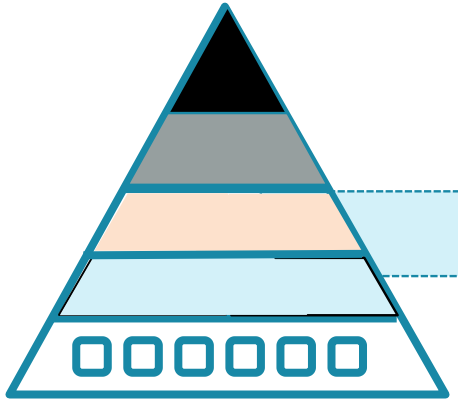
at – Automatisierungstechnik 2016 | Volume 64 | Issue 9

http://www.degruyter.com/view/j/auto.2016.64.issue-9/issue-files/auto.2016.64.issue-9.xml

http://www.degruyter.com/

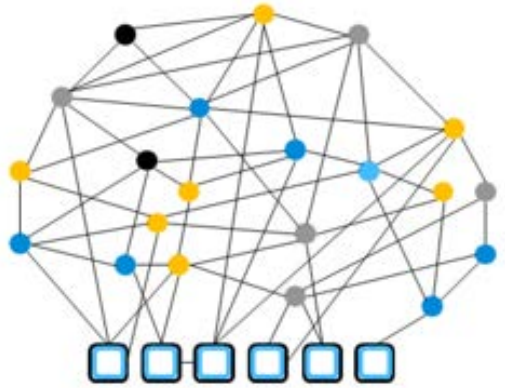
Evolution or Revolution ?

Revolution on Business Level



Automation Pyramid

Interoperability/Standards
IT-Security/Industrial Data Space®
Dependability and Latency
Machine Learning/Data Analytics
Human-Machine Collaboration



Service Network

Evolution on Technological Level

GRAZIE PER LA VOSTRA ATTENZIONE

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