Activities on Product Service Platforms Interoperability in Europe

A view on projects and initiatives
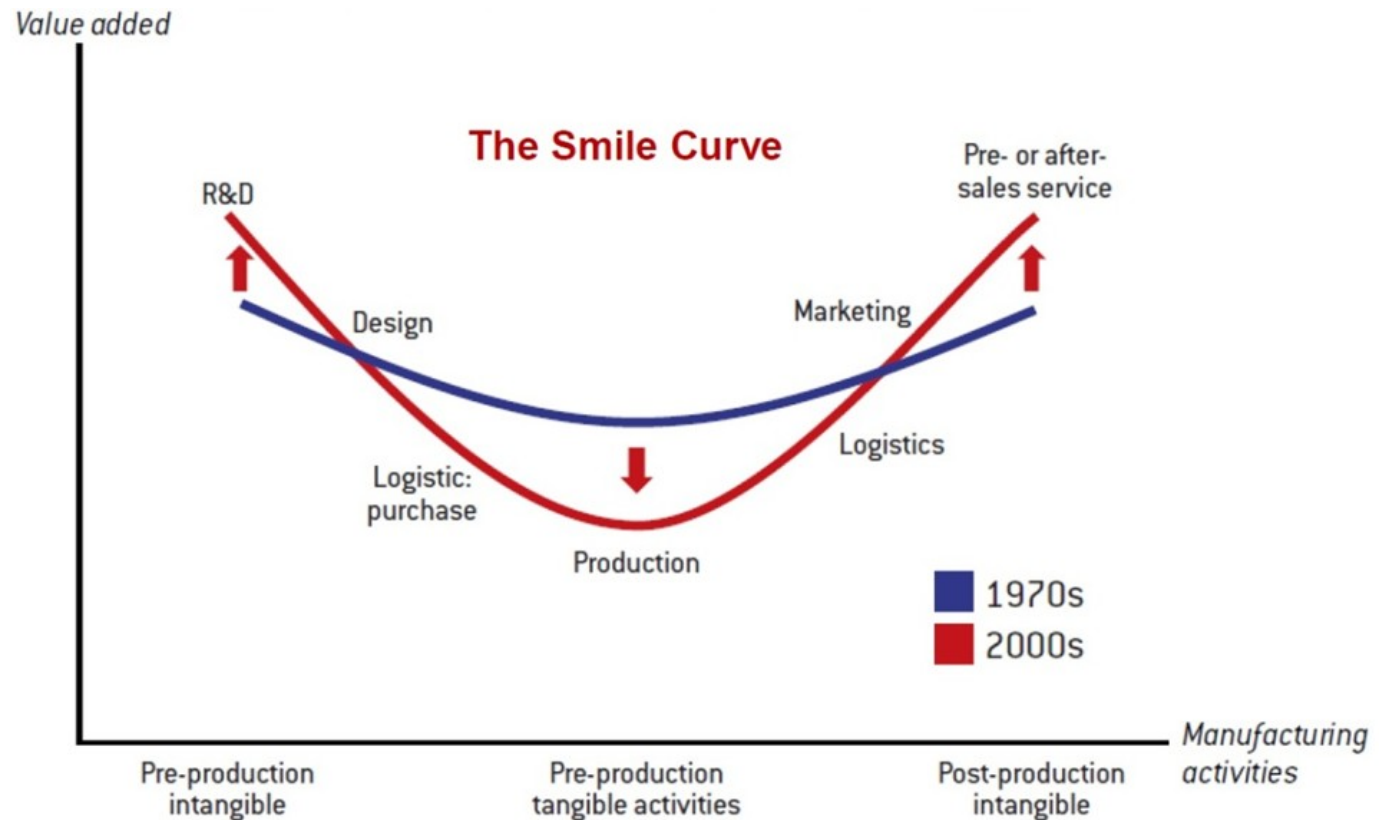
Dr.-Ing. Dipl.-Kfm. Christoph Runde

Project Development Coach for European Union

Intelligent Manufacturing Systems (IMS)

Increasing Meaning of Product Service Systems (PSS)

- blurring between manufacturing and services: the Smile Curve

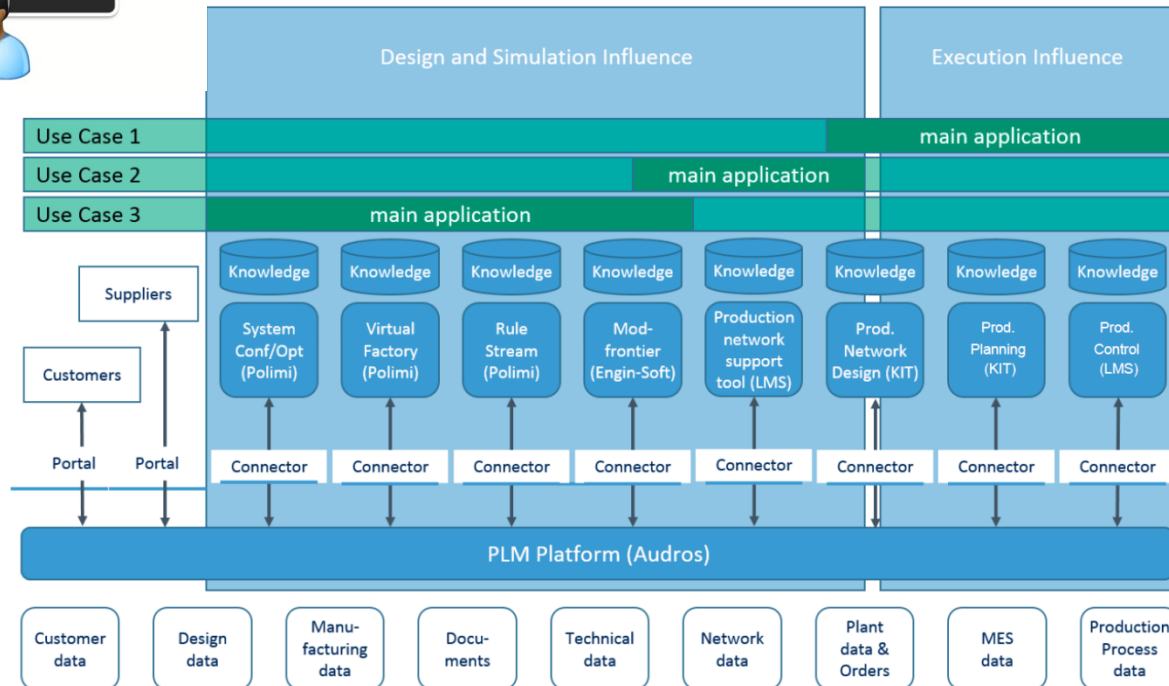- indicating the need for PSS design platforms

The Smile Curve

Value added — Manufacturing activities

R&D — Design — Logistic: purchase — Production — Marketing — Logistics — Pre- or after-sales service

Pre-production intangible — Pre-production tangible activities — Post-production intangible

1970s
2000s

Interoperability Challenges in PSS development

relevant Stakeholders

source: ICP4Life

source: ProRegio

relevant data sources

Interoperability Challenges in PSS development

Syntactic

Sources of PUI (Product Usage Information)
- PEIDs
- operation logfiles
- maintenance logfiles
- social media networks
- helpdesks
- ERP systems
- …

from MOL (middle of life) need to be integrated with target IT systems in PSS (re-)design and development
- Cax
- simulation
- forecasting
- data analytics
- …

Semantic
- Information and knowledge from different lifecycle phases, processes and domains need to be integrated into product/service development processes and systems
- Semantic representation of item-level PUI
- Semantic interoperability required to address general PSS and sector-specific requirements

Organisational
- multiple stakeholders
- 3rd parties such as social media networks
- collaborative PSS design and improvement tools are necessary, involving
- actors from different processes and knowledge domains
  - PSS design,
  - operation,
  - maintenance
  - …
  - Customers and end-users from in both B2B and consumer contexts

source: FALCON

Where to get to

Taken from the „*Factories of the Future 2020 Roadmap*", created by the „*European Factories of the Future Research Association (EFFRA)*", Domain 6: Customer-focused manufacturing

Collaborative product service systems design environments for SME involvement

- increased reactivity to demand
- rapidly deliver new products leveraging business relationships and local expertise with focus on SME participation
- ICT research need to leverage the cloud-computing paradigm as the basis for communication amongst human stakeholders
- interoperable and open interfaces to connect to systems across geographically dispersed competence centres
- digital rights management (DRM) to protect intellectual property (especially for jointly created product designs with SMEs)
- agile UIs and mobile apps for seamless collaboration by designers and customer

Where to get to

Taken from the „*Factories of the Future 2020 Roadmap*", created by the „*European Factories of the Future Research Association (EFFRA)*", Domain 6: Customer-focused manufacturing

Product service simulation for sustainability impact

- simulation tools and digital mock-ups for product servitisation and recycling, assessing its value and impact for stakeholders
- framework for life cycle simulation
  - choice of specifications
  - design
  - materials
  - 'make or buy' and suppliers
  - manufacturing strategy (produce to order or make to stock)
  - product usage (profiles of customers)
  - product servitisation (type of maintenance services proposed)
  - product recycling/reuse
- framework for digital mock-ups of product and services in their environment
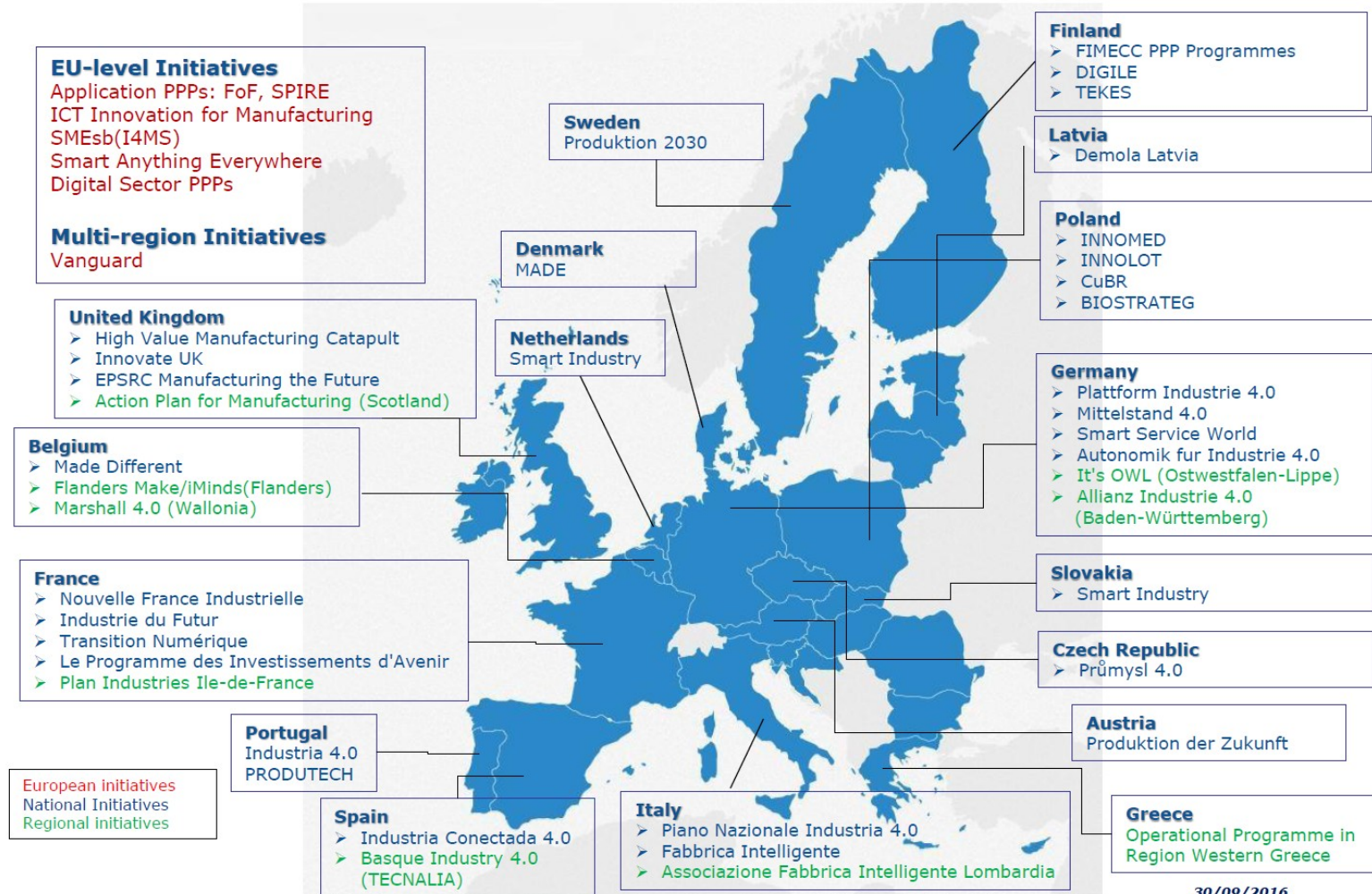
Where to get to

Taken from the "*Factories of the Future 2020 Roadmap*", created by the "*European Factories of the Future Research Association (EFFRA)*", Domain 6: Customer-focused manufacturing

Data collection, analysis and anonymisation during product usage

- use advanced sensors and the IoT to transfer product-specific data to monitor logic hosted in cloud infrastructure
- use mark-up language to easily decipher and consume usage patterns of products and of data anonymisation techniques
  - o obfuscation
  - o randomisation
  - o reduction
  - o perturbation

  to disassociate customer information from collected data

Ensuring impact: setting up a pan-European Network of Digital Innovation Hubs

EU-level Initiatives
Application PPPs: FoF, SPIRE
ICT Innovation for Manufacturing SMEsb(I4MS)
Smart Anything Everywhere
Digital Sector PPPs

Multi-region Initiatives
Vanguard

United Kingdom
➢ High Value Manufacturing Catapult
➢ Innovate UK
➢ EPSRC Manufacturing the Future
➢ Action Plan for Manufacturing (Scotland)

Belgium
➢ Made Different
➢ Flanders Make/iMinds(Flanders)
➢ Marshall 4.0 (Wallonia)

France
➢ Nouvelle France Industrielle
➢ Industrie du Futur
➢ Transition Numérique
➢ Le Programme des Investissements d'Avenir
➢ Plan Industries Ile-de-France

Portugal
Industria 4.0
PRODUTECH

European initiatives
National Initiatives
Regional initiatives

Spain
➢ Industria Conectada 4.0
➢ Basque Industry 4.0 (TECNALIA)

Sweden
Produktion 2030

Denmark
MADE

Netherlands
Smart Industry

Italy
➢ Piano Nazionale Industria 4.0
➢ Fabbrica Intelligente
➢ Associazione Fabbrica Intelligente Lombardia

Finland
➢ FIMECC PPP Programmes
➢ DIGILE
➢ TEKES

Latvia
➢ Demola Latvia

Poland
➢ INNOMED
➢ INNOLOT
➢ CuBR
➢ BIOSTRATEG

Germany
➢ Plattform Industrie 4.0
➢ Mittelstand 4.0
➢ Smart Service World
➢ Autonomik fur Industrie 4.0
➢ It's OWL (Ostwestfalen-Lippe)
➢ Allianz Industrie 4.0 (Baden-Württemberg)

Slovakia
➢ Smart Industry

Czech Republic
➢ Průmysl 4.0

Austria
Produktion der Zukunft

Greece
Operational Programme in Region Western Greece

30/09/2016
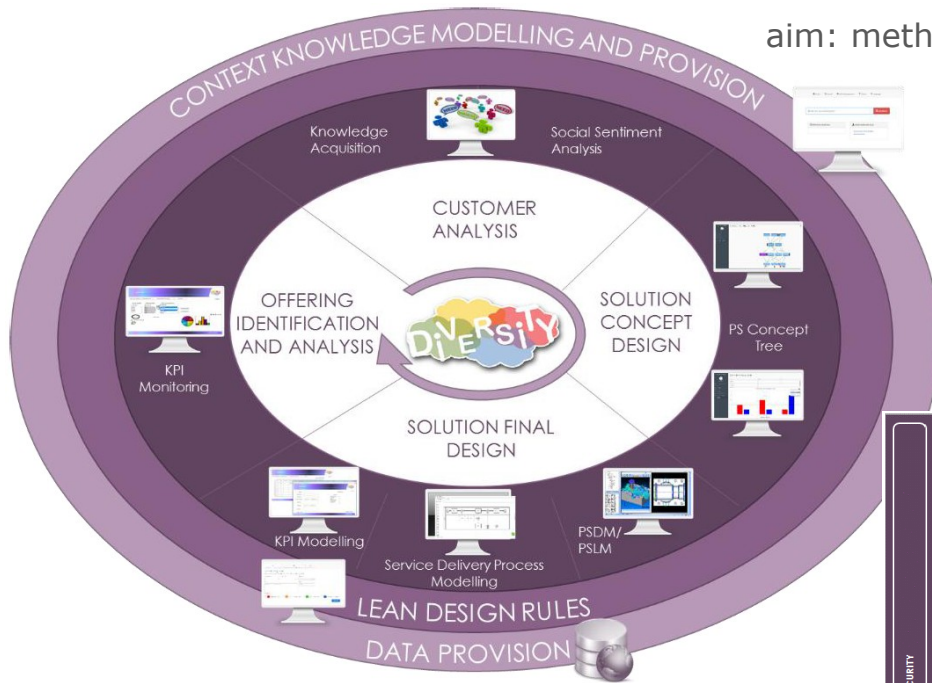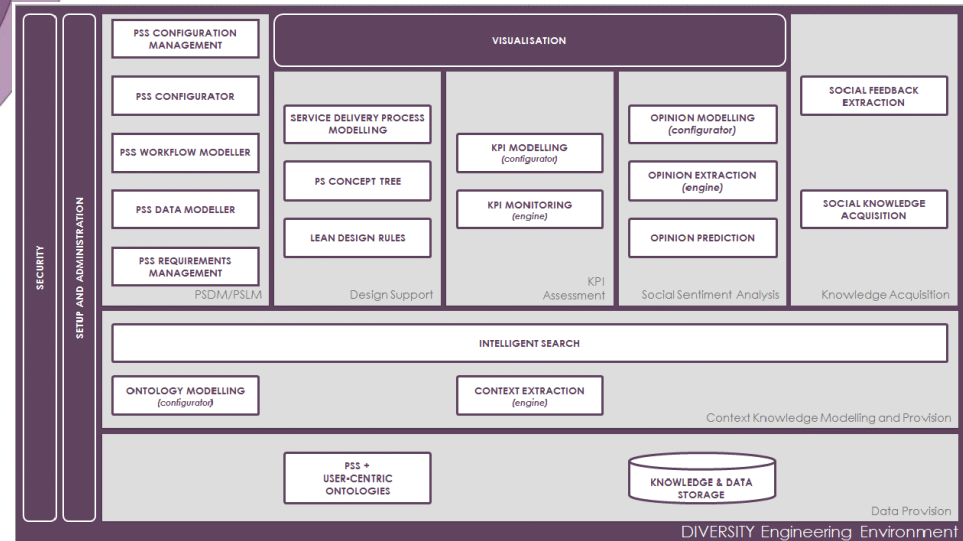
Factories of the Future (FoF) projects
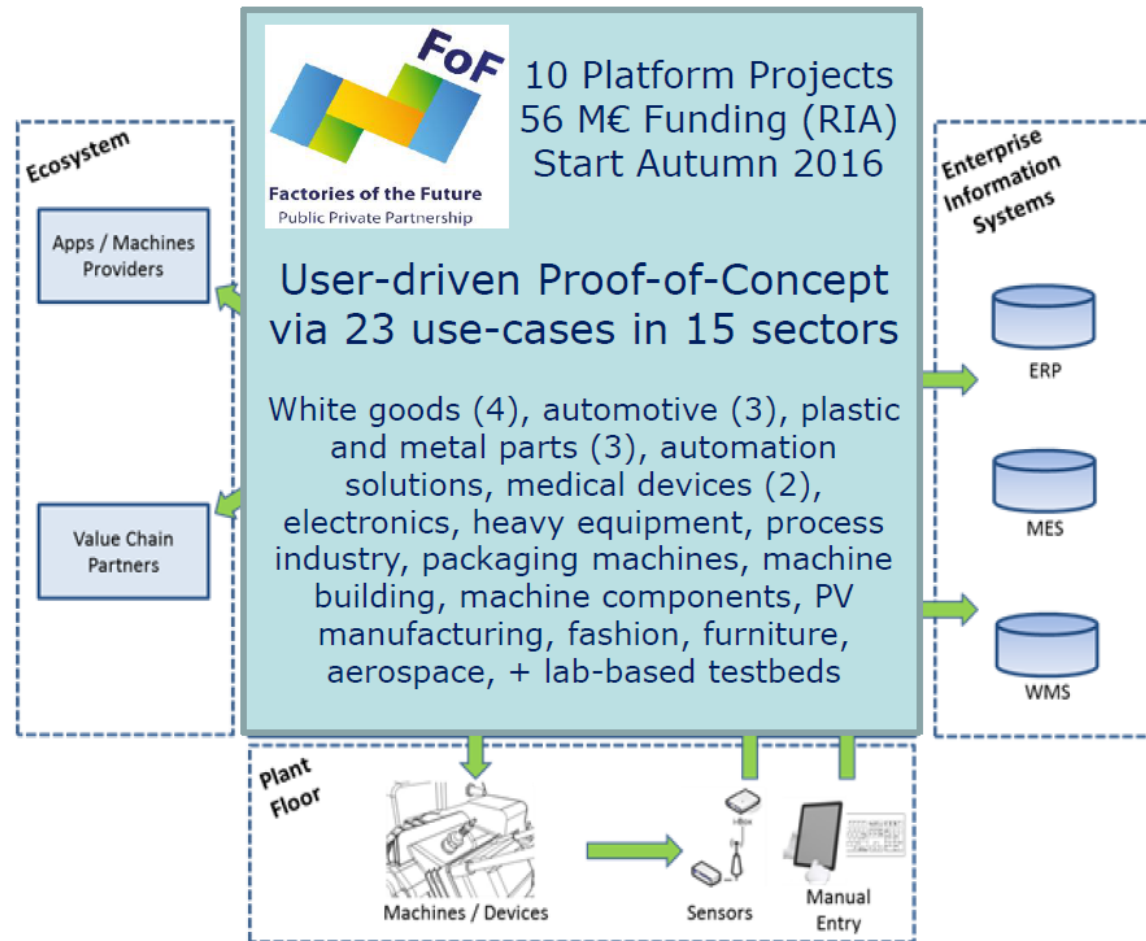
Single FoF projects and their interoperability approaches

aim: methodology

source:

aim: engineering environment

Share data with existing PDM/PLM systems and business process modeller

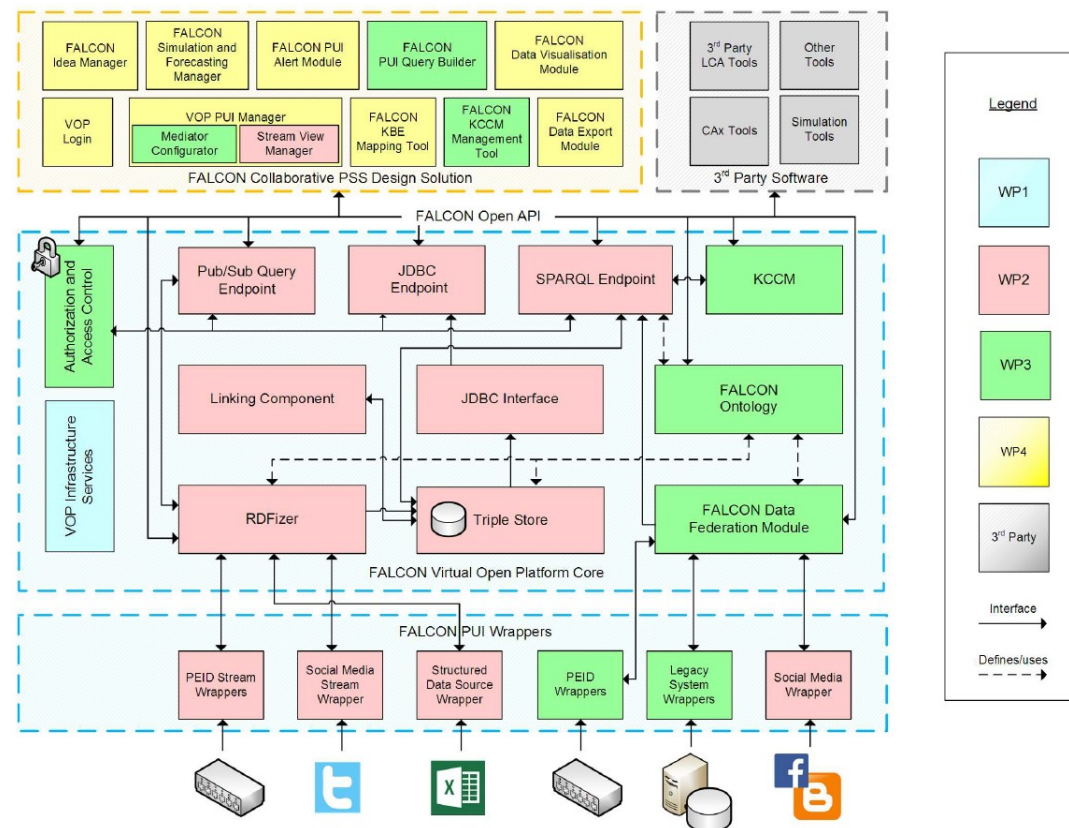# Single FoF projects and their interoperability approaches

- FALCON Ontology
  - Knowledge framework for PSS in general (GFO)
  - Semantic vocabularies for sectorspecific business scenarios
- FALCON VOP [Virtual Open Platform]
  - Uses the FALCON Ontology
  - Integrates streaming and consolidated data sources via semantic descriptions/wrapper mechanisms
  - Offers a common, open API for access from IT systems in PSS (re-)design and improvement
  - Offers a platform for collaborative PSS design and improvement tasks

source: FALCON

Single FoF projects and their interoperability approaches

- supports Product Service Lifecycle:
  - collaborative PS design
  - customer integrated PS customization
  - PS Planning including supply network
  - integrated PS use phase
  - dedicated product service framework
- modular
- service oriented
- cloud enabled
- scalable
- secure

source: ICP4Life
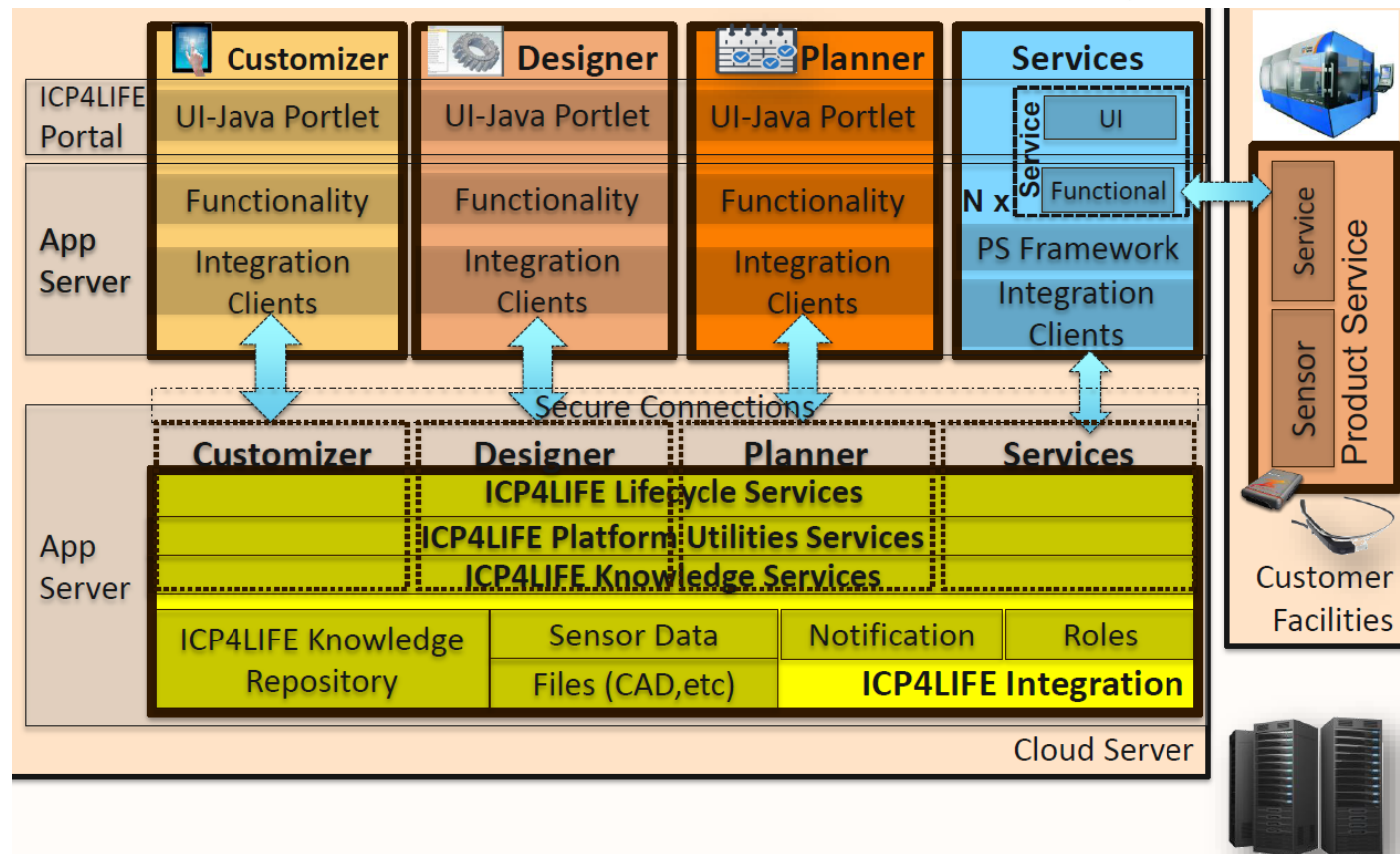
Single FoF projects and their interoperability approaches

- web services (e.g. for integration of sensors)
- development of data of data exchange between 3DExperience and Holonix I-Like to automatize the IoT data availability to designers

source:
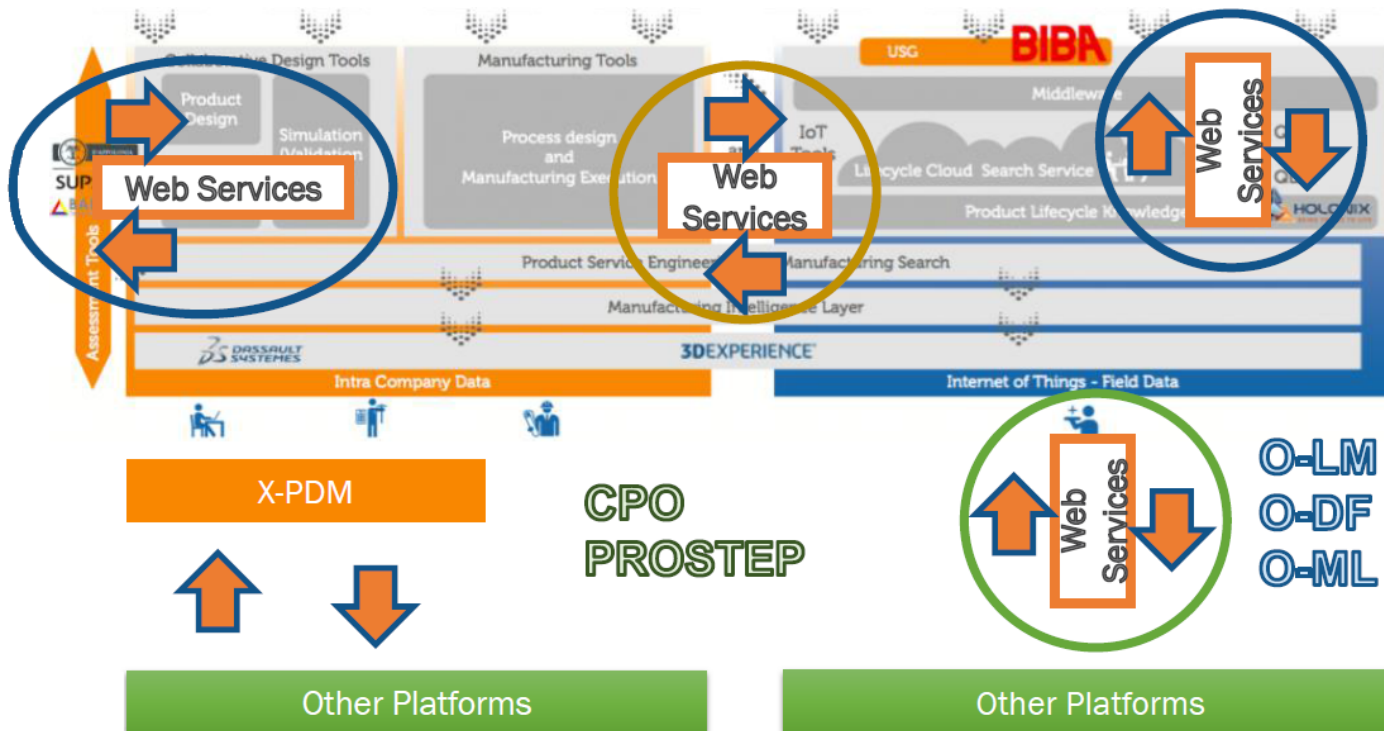
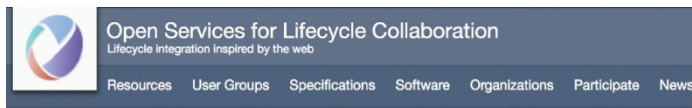# Single FoF projects and their interoperability approaches

tools/apps with different functionality and usability based on use case specific requirements need a modular and open platform

source: ProRegio
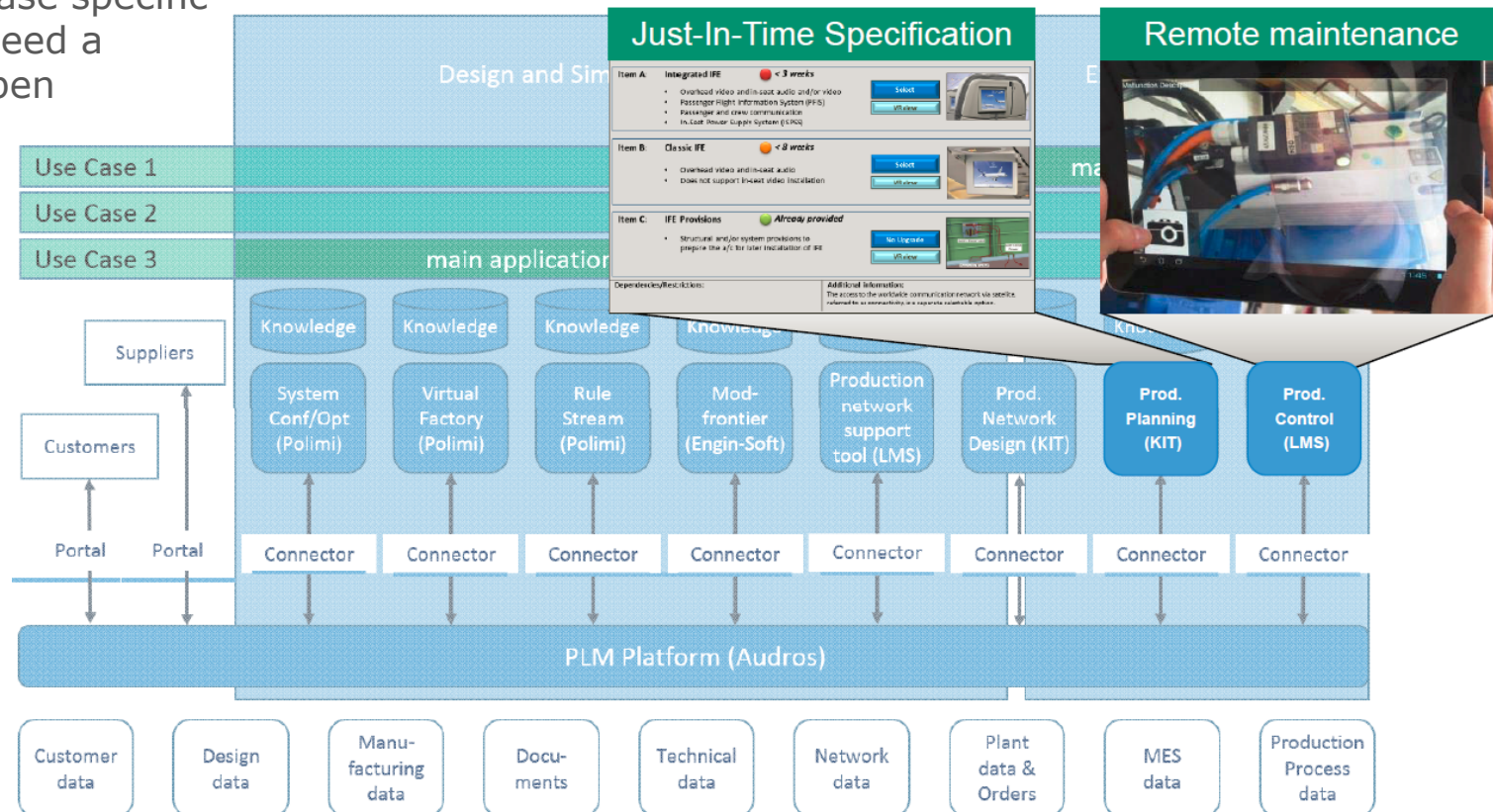
Single FoF projects and their interoperability approaches

- Open Services for Lifecycle Collaboration

source: Psymbiosys

Open Services for Lifecycle Collaboration
Lifecycle integration inspired by the web
Resources   User Groups   Specifications   Software   Organizations   Participate   News

- Home page: http://open-services.net
- Adopting Semantic Web technology
  - RDF – Resource Descriptive Framework
  - OWL – Web Ontology Language
  - RESTful – HTTP protocol for managing resources
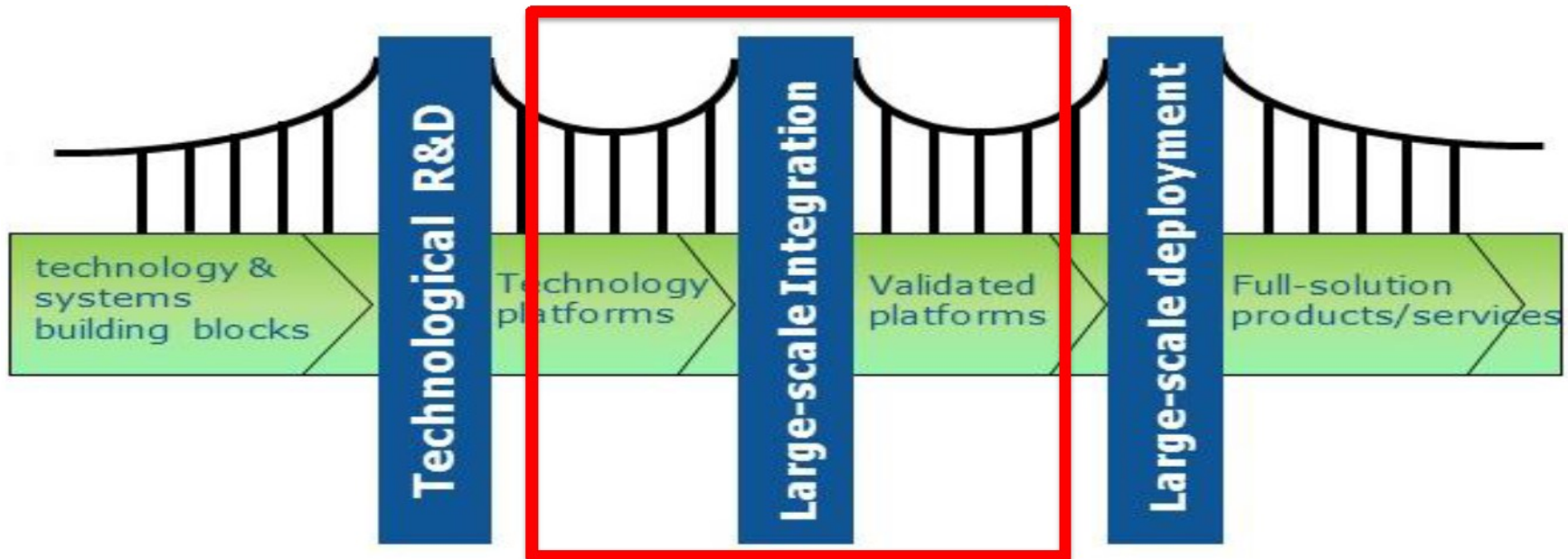 - Linked Data – as in W3C
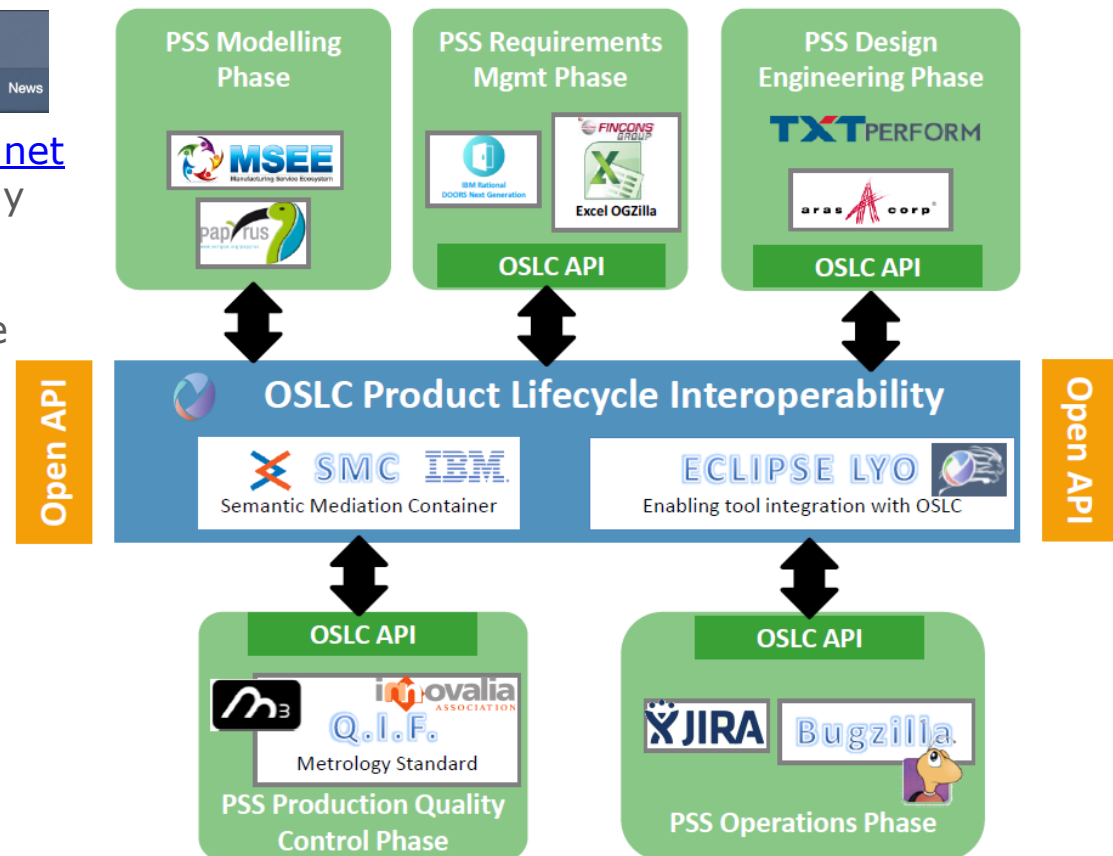
Contributions to Standardization

EU goal: agreements on functions and interfaces between industry players that create
- markets and market opportunities
- Platforms (narrow interpretation)
- Reference architectures
- Interaction protocols
- Interoperability frameworks

leading to ecosystems and standards

Contributions to Standardization

Key objectives
- Future global standards and platforms for the Connected Smart Factory
- joining forces along common interests in the "platform economy"

Approach: Bottom-up standardisation and platform building:
- Reference architectures, platforms, interoperability frameworks
- Testbeds and large scale experimentation
- Piloting on manufacturing system level
- Standardisation and ecosystem building

Scope:
- Addressing the manufacturing challenges of the future
- Profiting from digital advances (AI, data analytics, CPS/IoT, …)
- Building on existing platforms and reference architectures
- Balancing the interest of industrial actors – large and small

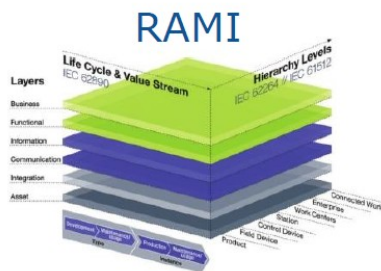**Basic concept:**
- "digital twin" of physical assets
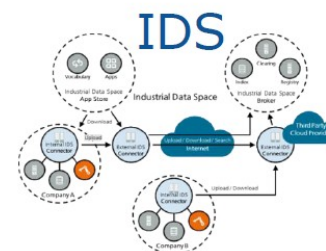- digital models of production, logistics, … facilities

Contributions to Standardization

starting point 1:
- industry-driven platforms

Contributions to Standardization

starting point 2:
- PPP FoF –
  Digital industrial platform projects

Examples of standards used and pushed by the above listed projects:

O-DF	Open Data Format
OWL	Web Ontology Language
RAMI 4.0	Industry 4.0, incl.
o IEC 62890	Life-cycle management for systems and products used in industrial-process measurement, control and automation
o IEC 62264	Enterprise-control system integration
o IEC 61512	batch control
ISO 15926	Industrial automation systems and integration

RESTful	HTTP protocol for managing resources
RDF	Resource Descriptive Framework
STEP	product data exchange
gfo	business process modelling
O-MI	Open Messaging Interface
KbeML	knowledge based engineering
CPO	Code of PLM Openness
O-LM	Open Lifecycle Management
O-SLM	Open Service Level Management
OSLC	Open Services for Lifecycle Collaboration

The EFFRA ConnectedFactories project

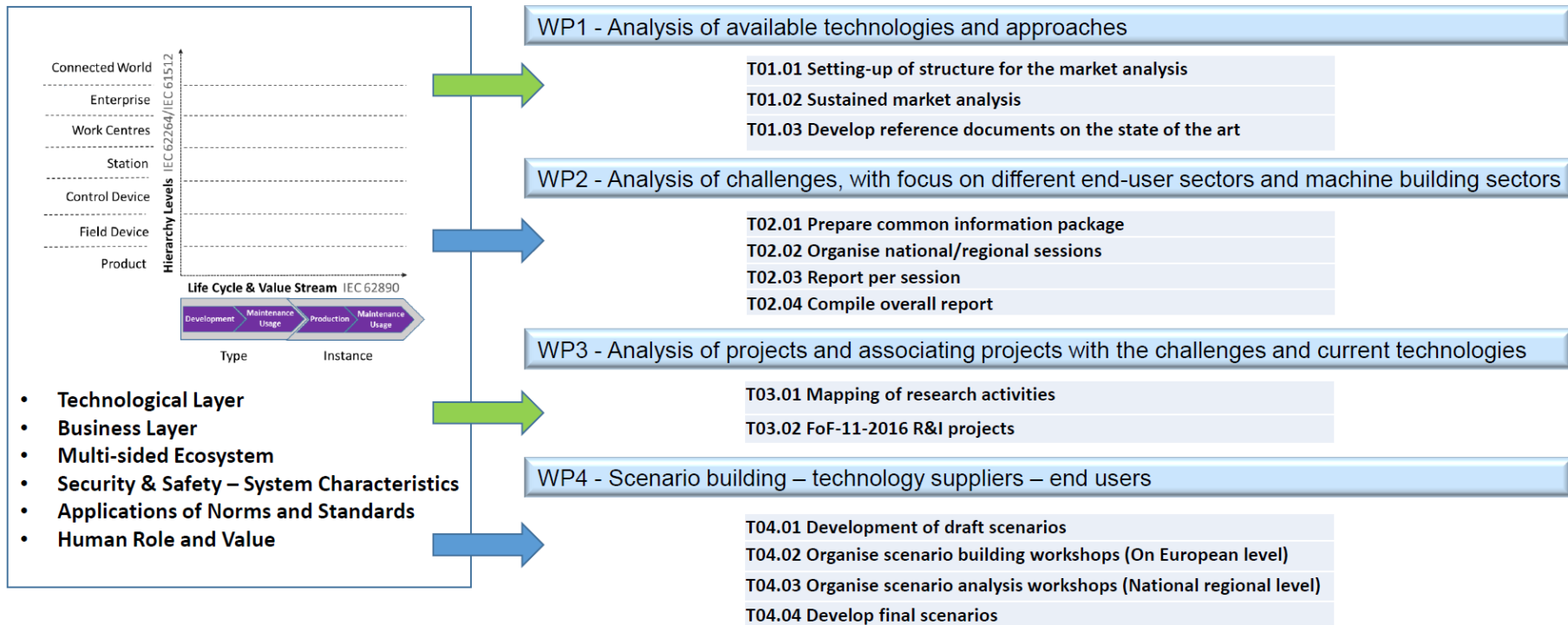Focussing the digitisation of manufacturing

- consolidate advanced manufacturing expert networks
- establish and maintain a structured overview of available and upcoming technological approaches and best practices
- identifying present and future needs and challenges of the manufacturing industries
- identify possible scenarios of how digital platforms will enable
  - the digital integration and
  - interoperability of manufacturing systems and processes
- industrial consensus building across Europe

The EFFRA ConnectedFactories project

The EFFRA ConnectedFactories project

Digital Platform Mapping Framework

- **Technological Layer**
- **Business Layer**
- **Multi-sided Ecosystem**
- **Security & Safety – System Characteristics**
- **Applications of Norms and Standards**
- **Human Role and Value**

WP1 - Analysis of available technologies and approaches

T01.01 Setting-up of structure for the market analysis

T01.02 Sustained market analysis

T01.03 Develop reference documents on the state of the art

WP2 - Analysis of challenges, with focus on different end-user sectors and machine building sectors

T02.01 Prepare common information package

T02.02 Organise national/regional sessions

T02.03 Report per session

T02.04 Compile overall report

WP3 - Analysis of projects and associating projects with the challenges and current technologies

T03.01 Mapping of research activities

T03.02 FoF-11-2016 R&I projects

WP4 - Scenario building – technology suppliers – end users

T04.01 Development of draft scenarios

T04.02 Organise scenario building workshops (On European level)

T04.03 Organise scenario analysis workshops (National regional level)

T04.04 Develop final scenarios

The EFFRA ConnectedFactories project

Example for platform mapping:

- IIC RA more business-oriented, RAMI 4.0 more technology-oriented
- System characteristics mentioned in IIC RA but not detailed
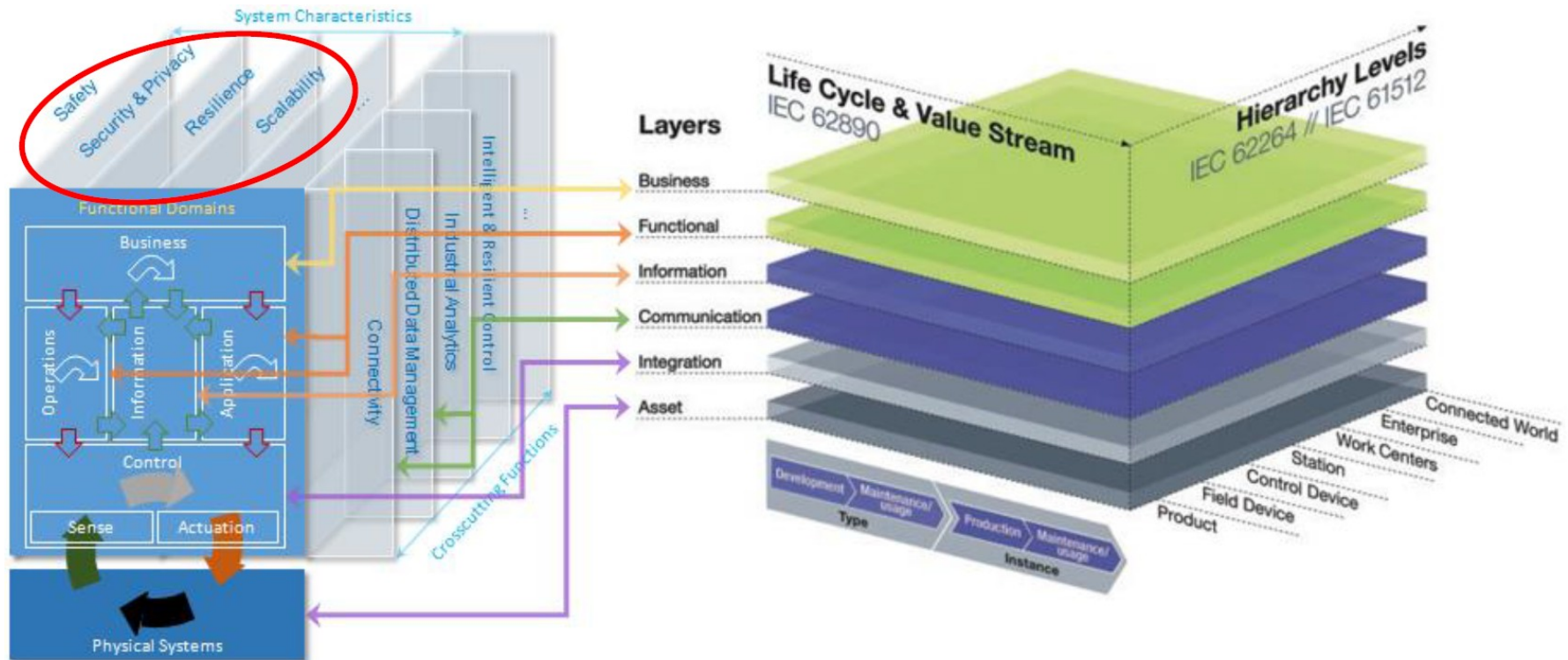
Outcomes Brussels Workshop on Nov. 21st, 2016

- best starting point to enable interoperability: existing reference architectures or CPO or larger conceptual framworks?
- definition of frameworks from sectors or as a generic vision?
- all-encompassing reference architecture vs. 1:1 exchange mechanisms (latter in much less time)
- RAMI4.0: strong automation background, not made for product-services
- approach: map existing EU projects to RAMI4.0 framework and draft extensions to RAMI4.0
- requirements definition by use case. But: future use cases cannot be entirely known now.
- also problematic: different life cycles of product services and factories
- transfer problem: many companies today don't know much about product-services.
- generalisation of PSS projects' outcomes
- further research fokus on pre-production and post-production aspects, search engines for lifecycle data of things, long-term availability and exploitability of data, data ownership, safety, security and privacy issues, PSS interoperability across sectors, digital twin use cases
- Follow-up workshop on PSS platforms in June 2017

Links to further activities

ConnectedFactories
http://www.effra.eu/index.php/research-a-innovation-65/connectedfactories

Diversity
https://www.diversity-project.eu/

Falcon
http://www.falcon-h2020.eu/

ICP4Life
http://www.icp4life.eu/

Manutelligence
http://www.manutelligence.eu/

ProRegio
http://www.h2020-proregio.eu/

Psymbiosys
http://www.psymbiosys.eu/

Activities on Product Service Platforms Interoperability in Europe

Thank you very much for your attention

Dr.-Ing. Dipl.-Kfm. Christoph Runde

Project Development Coach for European Union

Intelligent Manufacturing Systems (IMS)