Activities on Product Service Platforms Interoperability in Europe

A view on projects and initiatives

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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
Interoperability Challenges in PSS development

relevant Stakeholders

source: ICP4Life

relevant data sources

source: ProRegio
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

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

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
Where to get to

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

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
Where to get to

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
  - obfuscation
  - randomisation
  - reduction
  - perturbation

To disassociate customer information from collected data

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
Ensuring impact: setting up a pan-European Network of Digital Innovation Hubs
Factories of the Future (FoF) projects

10 Platform Projects
56 M€ Funding (RIA)
Start Autumn 2016

User-driven Proof-of-Concept
via 23 use-cases in 15 sectors

White goods (4), automotive (3), plastic and metal parts (3), automation solutions, medical devices (2), electronics, heavy equipment, process industry, packaging machines, machine building, machine components, PV manufacturing, fashion, furniture, aerospace, + lab-based testbeds
Single FoF projects and their interoperability approaches

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
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
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

Integration of the 3DExperience (Dassault), Holonix IoT tool and Sustainability tool (SUPSI & Balance) into the Manutelligence platform.

Potential Connectivity with other platforms
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
Single FoF projects and their interoperability approaches

- Open Services for Lifecycle Collaboration
  - 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

![Diagram of OSLC Product Lifecycle Interoperability]

- PSS Modelling Phase
- PSS Requirements Mgmt Phase
- PSS Design Engineering Phase

- OSLC API
- Open API
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

Community-led sector-specific (vertical)
- RAMI

Community-led cross-sector (horizontal)
- IDS

Commercial with open interfaces

Commercial platforms:
- FiWARE
- S3P
- CRYSTAL
- ARROWHEAD

SIEMENS

Predix
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.
  - **IEC 62890** Life-cycle management for systems and products used in industrial-process measurement, control and automation
  - **IEC 62264** Enterprise-control system integration
  - **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

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 frameworks?
- 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

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