Applying Enterprise Interoperability methods and tools to Manufacturing Service Ecosystems

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Is Enterprise Interoperability still relevant in the FI era?

- What we learned from the Past
  - A conceptual framework for interoperability is of fundamental importance
  - Even in Technical terms, Interoperability levels & vertical/horizontal are key
  - Interoperability is an ability, Interoperability by Design, Lossless interoperability

- What we are experiencing in the Present
  - [Enterprise] Interoperability is first priority for EU 2020 DAE Flagship Initiative
  - FI needs an interoperability framework: things, data, information, knowledge…
  - Synonyms? Interoperability, Integration, Seamless Access, Porting, Migration

- What we are going to expect in the Future
  - The evolution of interoperability to osmotic interconnection
  - The evolution of data exchange to symbiotic sharing [& protecting]
The Origin: INTEROP NoE Framework

Three basic dimensions => SOLUTION Space

INTEROP Framework
Enterprise Interoperability for Manufacturing Service Ecosystems

The **Service Innovation** challenge for the Manufacturing Industry
- Collaborative service innovation for Manufacturing Industry (WMF 2014 [www.worldmanufacturingforum.org](http://www.worldmanufacturingforum.org))
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The **Future Internet** challenge for the Manufacturing Industry
- FIWARE for Industry, components, platforms, trials (FITMAN [www.fitman-fi.eu](http://www.fitman-fi.eu))
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- CPPS and the 4th Industrial Revolution: regional pilots (BEinCPPS)
... this is why Manufacturing is such a pivotal sector for Europe

Importance of Manufacturing sector in the EU (% on the total economy)

- Value Added (2013): 15.0%
- Employment (2013): 14.3%
- Export (2013): 74.7%
- Business R&D Expenditures (2011): 63.8%
- Contribution to productivity growth (2010-2012): 60.0%

Source: The European House - Ambrosetti re-elaboration on Eurostat, AMECO and OECD data, 2014
Where to focus in Manufacturing?

The “SMILE” challenge: European businesses must focus on high value added activities

- Value creation in Manufacturing is progressively shifting towards pre-production (R&D and Design) and post production (marketing and Pre-or-After sales service) activities

Source: The European House - Ambrosetti re-elaboration on Bruegel data, 2014
Where to focus in Manufacturing?

But European Manufacturing is also affected by a long-term structural decline ...

Value Added (% of total) and employment (2010=100) of Manufacturing in the EU-28, 2000Q1-2013Q3

Source: The European House - Ambrosetti re-elaboration on Eurostat and AMECO data, 2014
Where to focus in Manufacturing?

... as the boundaries between Manufacturing and Services are blurring

- Producing goods is becoming a smaller part of manufacturing firms’ activities
- Manufacturing now provides a wide spectrum of services: from pre- and after-sales services, to design, R&D and marketing services
- Ultimately, the boundaries between Manufacturing and Services are blurring

Source: The European House - Ambrosetti re-elaboration on OECD data, 2013
Manufacturing drives production and service jobs

US manufacturing employment, 2010
(Million)

- Total manufacturing-related employment: 17.2
- Service and other jobs linked to manufacturing: 5.7
- Manufacturing employment: 11.5
- Service-type jobs in manufacturing: 4.2
- Assembly jobs: 7.3
**VISION:** By 2020, manufacturing value chains will be organised in symbiotic collaboration forms which, thanks to the full availability and adoption of advanced manufacturing intelligence technologies, will dramatically reduce the barriers which currently prevent EU Manufacturing Industries to take the lead of next generation STEEP sustainable product-service solutions.

**MISSION:** PSYMBIOSYS aims at improving the competitiveness of European Manufacturing industries by developing an innovative product-service engineering environment, symbolized by a five-pointed symbiosis star – **design-production, product-service, knowledge-sentiment, EDA-SOA, business-innovation** – and able to dramatically reduce the time-to-market of more attractive and sustainable product-service solutions.
German initiative „Industry 4.0“

Framework of Life Cycles of
- Product
- Order
- Technology
- Factory

…making Integrated Production

Management: Project Office supported by Industry Associations ZVEI, VDMA and BITKOM, the Scientific Advisory Board and Government functions
Challenges for standardisations in PSS

Framework of Life Cycles of
- Product
- Order
- Technology
- Factory
- SERVICE

…making the Product-Service System
MSEE Servitisation Framework

M = Manufacturing Extended Products

IV Service is the Product. Product is a Service Platform

III Service differentiates the Product

II Service added to the Product

I Product

E = Ecosystem Collaborative Innovation

S = Service Driven Engineering

Innovation Ecosystem

Value Network

Supply chain

Single Enterprise

Process Oriented

Portfolio Oriented

Customer Oriented

Knowledge Oriented
MSEE Assets for Service Ecosystems

1. MSE Management & Governance

2. Service Ideation in Service Ecosystems

3. Assets Virtualisation in Service Ecosystems

4. Business Processes & Indicators in MSE
MSEE Assets in Servitisation projects

1. Virtual Enterprise Servitisation Strategy

2. Servitisation Framework for Virtual Enterprises

3. VR Service Engineer and Testing Theatres

4. VME Service Modelling & Execution

- Identification
- Concept
- Design
- Requirements
- Implementation
- Operation
Service Innovation: Use Cases

**USE CASE 1: INDESIT**
Web/mobile service to support customers

**USE CASE 2: BIVOLINO**
Customizable product configurator

**USE CASE 3: IBARMIA**
Intelligent Maintenance Service

**USE CASE 4: TPVISION**
Application Ecosystem for smart TVs
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Enterprise Interoperability for Manufacturing Service Ecosystems

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What’s FIWARE?

FIWARE: Future Internet Open Platform
IoT Community Building Event
Brussels, 7th November 2014

Nuria de Lama
Representative of Atos Research & Innovation to the EC
FIWARE Collaboration Officer
nuria.delama@atos.net

http://fiware.org
http://lab.fiware.org
A FIWARE Generic Enabler (GE):
- set of general-purpose platform functions available through APIs
- Building with other GEs a FIWARE Reference Architecture

FIWARE GE Specifications are open (public and royalty-free)

FIWARE GE implementation (FIWARE GEi):
- Platform product that implements a given GE Open Spec
- There might be multiple compliant GEis of each GE Open Spec

One open source reference implementation of each FIWARE GE (FIWARE GEri):
- Well-known open source license
- Publicly available Technical Roadmap updated in every release

Available FIWARE GEis, GEris and incubated enablers are published on the FIWARE Catalogue http://catalogue.fiware.org
Real-time data collection & processing for Shop-floor operations

Connecting people to information, advanced data visualization

Cross-enterprise collaboration, tangible/intangible asset management
FITMAN Results

One FITMAN Generic Platform for Manufacturing Industries, as a collection of several Generic Enablers

Three FITMAN Specific Platforms as a collection of several Specific Enablers Implementations

- Smart Factory Platform
- Digital Factory Platform
- Virtual Factory Platform

Ten FITMAN Trials Platforms as instantiation of the selected Generic and Specific Enablers for 10 industry-driven multi-sectorial Trials

One generic and flexible Trials Verification and Validation Framework, encompassing concepts, methods and tools for Manufacturing Trials
## FITMAN Reference Platforms: 14+15 Enablers

### Smart Platform
- **GE1**
  - IoT.Backend.IoTBroker
  - Reference Impl. by NEC
- **GE2**
  - IoT.Backend.ConfMan
  - Orion Context Broker by Telefonica I+D
- **GE3**
  - IoT.Backend.DeviceManagement
  - IDAS by Telefonica I+D
- **GE4**
  - IoT.Gateway.ProtocolAdapter
  - ZPA by Telecom Italia
- **GE5**
  - IoT.Gateway.DataHandling
  - Esper4FastData by Orange
- **SE1**
  - Shopfloor Data Collection
  - SDC by Uninova & ATOS
- **SE2**
  - Secure Event Management
  - SEM by TXT
- **SE3**
  - Dynamic CEP
  - DyCEP by FZI & NISSEATECH
- **SE4**
  - Dynamic Visualization & Interaction
  - DyVisual by DFKI

### Virtual Platform
- **GE1**
  - Apps.Marketplace
  - Reference Impl. by SAP
- **GE2**
  - Apps.Repository
  - Reference Impl. by SAP
- **GE3**
  - Apps.Mediator
  - Reference Impl. by Telecom Italia / Thales
- **GE4**
  - Apps.Registry
  - Reference Impl. by SAP
- **GE5**
  - Apps.LightSemanticComposition
  - COMPEL by ATOS
- **GE6**
  - Data.SemanticSupport
  - Semantic Application Support by ATOS
- **SE1**
  - Collaborative Asset Management
  - CAM by ENG
- **SE2**
  - Collaborative Business Process Management
  - BPM by ENG
- **SE3**
  - Supply Chain & Business Ecosystem Apps
  - SCApp by TXT
- **SE4**
  - Data Interoperability Platform Services
  - DIPS by TXT
- **SE5**
  - Metadata and Ontologies Semantic Matching
  - SeMa by NTUA
- **SE6**
  - Management of Virtualized Assets
  - MoVA by DITF
- **SE7**
  - Generation and Transformation of Virtualized Assets
  - GeToVA by UIBK

### Digital Platform
- **GE1**
  - Data.PubSub
  - Context Awareness Platform by Telecom Italia
- **GE2**
  - Apps.ApplicationMashup
  - Wirecloud by UPM
- **GE3**
  - Data.UnstructuredDataAnalysis
  - UDA by ATOS
- **SE1**
  - Unstructured & Social Data Analytics
  - Anizer by NTUA
- **SE2**
  - Semantic Mediator front-end & back-end
  - SEMed by BIBA
- **SE3**
  - 3D Scanning Storage and Visualisation
  - 3Dscan by DATAPIXEL
- **SE4**
  - Collaborative 3D Web Viewer
  - c3DWW by DFKI
50 FI-based business process
Large Industries and
10 manufacturing sectors
SME Management
Ten FITMAN Trials in Six Countries

**LARGE ENTERPRISES:**
- #1 VW (Automotive OEM - DE)
- #2 TRW (Automotive Supplier - ES)
- #3 AW (Aeronautics - IT)
- #4 Whirlpool (White Goods - IT)

**SMEs:**
- #5 Piacenza (Textile - IT)
- #6 APR (Plastic - FR)
- #7 Consulgal (Construction - PT)
- #8 TANet (Resource Mgmt. - UK)
- #9 COMPlus (LED Lighting - DE)
- #10 AIDIMA (Furniture - ES)
1. Different **Innovation** pace, speed, jargon, model between FI and Industry (Manufacturing in particular). IT/OT gap. E.g. Hackers

2. An **Industrial** (Manufacturing) **Trial** is not limited to software. Important roles are played by further intangibles (data, knowledge, models, human skills) and non-IT tangibles (production systems, engineering infrastructures). E.g. Phase III impact to FITMAN

3. Evolution of FIWARE Technologies (FiWare-FiCore GEs, GERi GEi) and integration of domain independent with domain dependent **Software Enablers**. E.g. Integrating FITMAN SEs into FIWARE

4. **Cloud Strategy**, Journey, Adoption methods and tools are needed for EU industry in order to fully trust the FIWARE Cloud Value Proposition and its SLAs (availability, scalability, performance, security). E.g. FIWARE-based Cloud commercial value propositions
“Software, itself, does nothing, it does not build anything, it does not save lives. The objective should be to **adapt it to industrial technologies**. Unify the software with the tools already available”.

The fundamental challenge is to start a business process digitalisation in sectors so far not **digitised**, which opens a world of opportunities for enterprises”.

*July 2014*
FIWARE for Industry Exploitation

FIRST FIWARE CALLS OPEN NOW!

FITMAN Academy
FITMAN Open Source Programme, Phase II, Package and Knowledge Repository
FITMAN Lab
FITMAN Platforms as a Service Programme, downloadable Enablers and Reference Platforms
FITMAN Hub
FITMAN Platforms, accessible and reliable Integrated Platforms
FITMAN Showcase
FITMAN Success Stories Programme, industrial showcases, interactive best practices

APPLICATIONS OPEN NOW
1. **ACADEMY:**
   a) Consultancy services, removing the barriers to the adoption by Manufacturing industry (SMEs) of FI Technologies (OSS Cloud)
   b) Educational initiatives, FI for Industry Summer Schools
   c) H2020 RIA and IA inspired by FITMAN (FoF and IOT, 1 success)

2. **LAB:**
3. **HUB:**
   a) FITMAN 15 SEs evolution programme, selection of the most promising ones to be inserted into FIWARE incubation program
   b) Intensive support to communities of developers, such as the Phase III OC winners (FI Impact estimate 15% in Manufacturing)
   c) Among the Phase III winners community, selection of a smaller set of champions to develop more integrated and advanced smart-digital-virtual factory solutions complementing FITMAN Trials and Platforms
4. SHOWCASE:
   a) Replication of successful FITMAN Trials to different sectors, domains, business processes.
      i. Large Enterprises: targeting the IT departments, low cost, open source, cloud-enabled Proof of Concept
      ii. SMEs: targeting SMEs Clusters, multi-source funding strategies: DG REGIO, CoR, DG GROW, DG CNECT I4MS

**Smart Specialisation** is a new innovation policy concept to boost regional innovation in order to achieve economic growth and prosperity, by enabling regions to focus on their strengths. The ‘**Vanguard Initiative (VI) for New Growth through Smart Specialisation**’ seeks to better position and embed the smart specialisation agenda within relevant EU policy frameworks.

[http://www.s3vanguardinitiative.eu/](http://www.s3vanguardinitiative.eu/)
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Internet of Things forecast (IDC)

IoT forecast 2013-2020 Installed Base and EU28 revenues

- The IDC IoT EU28 forecast is a subset drawn from the Worldwide IoT forecast published in May 2014. It is a top-down model.

- Installed base will grow from 1.8 billion in 2013 to almost 6 billion in 2020 (18.7% CAGR) driven by customer-pull and supply-push;

- Revenues in the EU will grow from €307 billion in 2013 to reach €1,181 billion in 2020 (CAGR 21.2%). Revenues will come from the complete lifecycle.

Internet of Things forecast: Manufacturing

Source: IDC 2014

Internet of Things forecast: Manufacturing

From Hype to Reality…. “Up and to the Right”

Forbes

“ It’s Official: The Internet of Things Takes Over Big Data As The Most Hyped Technology. ”

8/18/2014
Internet of Things Hype (Gartner)
IoT Hype: what to do (IoT 360)

IoT: mature technology, but...

1. Improve the technology

2. Limit the damage from the “fall” in the through of disillusionment
Developing the EU IoT Ecosystem

MAIN CHALLENGES

- Open Integrated Architectures
- End to End Connectivity
- Adaptive Networks
- Security and Privacy by Design
- Semantic Driven Analytics

DESIGN PRINCIPLES

- Manage Complexity
- Provide Scalability
- Guarantee Usability
- Preserve Privacy

RESEARCH

- Build EU industry competitiveness
- Ensure SMEs capability to enter the market
- Improve IoT readiness
- Develop the necessary skills and competencies
- Encourage international cooperation

INNOVATION

MARKETS

- Accelerate adoption through Lead Markets and Public Sector
- Develop the IoT-based Service Economy
- Build trust and remove unnecessary barriers

Provide Scalability

Guarantee Usability

Preserve Privacy

Semantic Driven Analytics

Build EU industry competitiveness

Ensure SMEs capability to enter the market

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The Sensing-Liquid Enterprise is a pot internally subdivided into three sectors by means of three membranes and forming the Real-Digital-Virtual sectors.

- A blue liquid is poured into the first sector → Real World population
- A red liquid into the second sector → Digital World population
- A green liquid into the third sector → Virtual World population

If the membranes are semi-permeable, by following the rules of osmosis which characterises each of the three membranes, the liquid particles could pass through them and influence the neighbouring world, so that in reality in the blue Real World we could also have red-green shadow ambassadors of the Digital/Virtual World and similarly for the other Worlds.
The Sensing Liquid Enterprise

- **Sensing Enterprise** evolution of the *Internet of Things*, when objects, equipment, and technological infrastructures will exhibit advanced networking and processing capabilities, actively cooperating to form a sort of 'nervous system' within the enterprise next generation.

- **Liquid Enterprise**: enterprise having fuzzy boundaries, in terms of human resources, markets, products and processes. Its strategies and operational models will make it difficult to distinguish the 'inside' and the 'outside'.

- **Sensing-Liquid Enterprise** as a pot internally subdivided into three sectors by means of three membranes and forming the Real-Digital-Virtual sectors:
  - a blue liquid is poured into the first sector (**Real World RW**)
  - a red liquid into the second sector (**Digital World DW**)
  - a green liquid into the third sector (**Virtual World VW**).
The Osmiotic Metaphor

- Virtual World population
- Digital World population
- Real World population

Fuzzy Boundaries

Sensing Devices

OSMOSE
OSMOSE Metamodel

- **Real World KB**
- **Virtual World KB**
- **Common KB**
  - Entity KB
  - Process KB
  - Event KB
  - Service KB

Digitalization

Actuation

Enrichment

Simulation

Augmentation

Virtualization
Flight Simulation (@AW)

- Flight Simulators are intended as **training device** letting pilots to perform several types of training in different flight scenario. The most important feature of these devices is the **possibility to reproduce system malfunction and emergency scenario** that cannot be done on the real aircraft.

- Flight simulators are used by end-Customers with a contractual commitment that requires an **extremely high availability** (close to 24/7), which can be provided only if all the logistic chain and support personnel are correctly “synchronised”
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IoT and CPPS: Fourth industrial revolution
**Figure 1:**
Smart manufacturing services 2025

- New business models e.g. trading of production capacity and manufacturing data
- Crowdsourcing communities creates manufacturing innovations
- Cognitive abilities inform automated activities on site via remote access
- Fully automated marketplace for service providers
- Machines/service providers actively seek out new jobs
- Knowledge work: automatic generation of analyses, diagnoses and recommendations
- Optimisation: continues generation and automated feedback of empirical data
- Bundling of services, e.g. finance, insurance

**Digital Platforms**

- Export of smart services from Germany and Europe
- Leading platforms are operated by German and European companies
- Selected critical modules and enablers produced by German and European firms
- Opportunities for start-ups and SMEs through efficient market access and rapid scalability
- Smart talents: employees as creative bases and decision-makers

**Smart Machines**

- All machinery throughout the world connected to platforms
- Machines added and removed via “plug & use”

Source: Siemens 2014

**Figure 4:**
Layer model of digital infrastructures

**Innovation-oriented framework**

**Businesses, digital ecosystems**

- Service platforms: Smart services
- Software-defined platforms: Smart data
- Networked physical platforms: Smart products
- Technological infrastructure: Smart spaces

Source: ERP/IT/tech/Momentum
Interoperating CPPS with ESA

FoF9 I4MS Phase II Innovation Action

BEinCPPS, Business Experiments in Cyber Physical Production Systems.
Factories of the Future obj. 9: ICT Innovation for Manufacturing SMEs; Budget: EUR 8,000,000; Open Calls for SMEs: EUR 2,200,000; Start Date (provisional): October 1st 2015 – End Date: September 30th 2018

A Consortium of 23 partners performing CPPS experimentations in 5 regions (Lombardia, Euskadi, Baden Wuertemberg, Norte, Rhone Alpes) with Competence Centers, Industries, IT partners, SMEs Technology Transfer bodies)

- **Phase I**: 5 Big Industrial Champions involving their value chain SMEs
- **Phase II**: Open Call for additional platform / application providers (1M for IT SMEs)
- **Phase III**: pan-EU Open Call for replications of the champions in other sectors / domains / regions (1,2M for MAN. SMEs)
Conclusions

Enterprise Interoperability for Manufacturing Service Ecosystems

1. INTEROP NoE Framework for Enterprise Interoperability still valid

2. New Challenges are at the horizon for EI community:
   a. Product-Service Interoperability
   b. Real – Digital – Virtual Worlds Interoperability
   c. Cyber-Physical-Systems and Future Internet Interoperability
Applying Enterprise Interoperability methods and tools to Manufacturing Service Ecosystems

THANK YOU!!!

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