Workshop "Platforms for connected Factories of the Future"

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Content

Reference Architecture for CPS-Platforms

IT – Platforms (Engineering & Simulation)

CPS – App Platforms (Convergence of physical world and IT-world)

Cross-domain/cross-value-chains platforms (Manufacturing Platform)
Increase productivity and flexibility through networked intelligent systems at the factory

Are there guidelines and templates to model a CPS-based factory?

**Reference Architecture**

- **Information model**: Architectural elements - Entities and their relationships
- **Methodology**: Sum of the languages and methods for the description of the architectural elements
- **Procedural model**: How to use the architectural elements and methods
INFORMATION MODEL: ARCHITECTURAL ELEMENTS TO DESCRIBE THE CPS-BASED FACTORY

- Describes the **structure of the CPS-based factory** and the relation of elements to one another
- Provides a **framework for developer** to model a CPS-based factory
- Smallest unit: CPS
  1) **Self-contained CPS**
  2) **Distributed CPS**
- Other elements: CPT, CPP, CPI,…
**METHODOLOGY:**
MODELING OF THE CPS-BASED PRODUCTION FROM DIFFERENT PERSPECTIVES

- **Collection of methods** for modelling the CPS-based factory
- Matches the architecture elements and procedural model
- **Different views** for the purposes of analysis

**BPNM, UML, Tree Diagramms, etc.**

**METHODOLOGY:**
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Source: Scheer Management Consulting
PROCEDURAL MODEL: HOW TO USE THE ARCHITECTURAL ELEMENTS AND METHODS

- **Structured approach (top-down)** that supports the development of CPS-based solutions
- **Iterative approach** with up to 14 steps
- Uses the **methodology and architectural elements**
- Suitable for modelling the **actual and target stage** from **strategy and business model layer to technology - and infrastructure level**
IT-SYSTEM INTEGRATION – PLATFORM
EU-FP7-CLOUDFLOW (I4MS)

"flexible platform enabling a low-effort, user-friendly integration of multi-vendor engineering services in the cloud."

Cloudification Modularisation

Set of modular engineering services with defined interfaces

Orchestration of multi-vendor services

Individual Workflows

ISV 1 ISV ...

Individual Competencies and Services

User 1 User ...

Individual Needs /Tasks

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CPS – APP PLATFORMS: SYSTEM & CONCEPT DESCRIPTION

Mobile User Interface

• Mobile, universal user interface
• Platform independence
• Touch&connect-metaphor

Device Registry

• Administration of CPS
  • Login & logout
  • Provision of information
• Communication initiation
• Factory internal application

Industrial App Store

• Distribution platform for Apps
  • Market Place for users & developers
  • Provision of information
  • Novel business models
  • Cloud-based applications

Cyber-Physical Systems

• Central system component
• Runtime environment for Apps
• Administration of Apps & driver
• Internal & external communication

Industrial App Store

TCP/IP, HTTP

• Administration of CPS
  • Login & logout
  • Provision of information
• Communication initiation
• Factory internal application
CPS – APP PLATFORMS: DEVELOPER BOARD & SOFTWARE ARCHITECTURE

- Analog I/O
- Digital I/O
- Ethernet
- Serial port RS-232
- Serial port RS-422/485
- USB
- Electricity

“Aria G25”

- “Plug & Play”
- Easy Parameterization
- Modular functional extension of field devices

System service layer
Middleware
Functional layer

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“Adidas wants to produce shoes right in the store”

→ Local Micro-Factories
From smart objects to smart factories
First-time access to production processes

Clients

IT-Infrastructure / Platform

Order / Product/Process Knowledge

Process Knowledge

Feedback

Domain Experts

e.g. Laser-based manufacturing, additive manufacturing

Logistics

Production Infrastructure:
Local, modular, universal, networked, smart

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Multi-sided platforms: From the internet of people over the internet of things to the internet of services

What is key?

- Open and flexible platform infrastructure
- Modular products/services encapsulated according to the respective platform—“standards”
- Business model — including its technical implementation as part of the platform infrastructure (billing mechanism, etc.)

It can’t be anticipated who will make up the ecosystem:

- **Big, established companies** (such as SAP, IBM, HP, SIEMENS, etc.) might fail to adopt new and disruptive business models.
- **Small companies** could implement disruptive innovations in a smart way with relatively low effort and resources.