



Invited Talk at Enterprise Modeling Workshop (CAiSE 2016), June 2016, Ljubljana

CPS, IoT, Industry 4.0 & Co. :

What are the implications for Enterprise Architecture Modeling?

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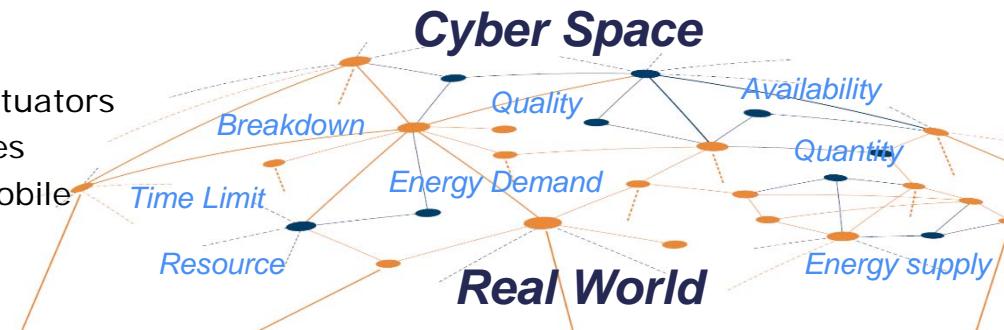
Overview

- Motivation:
Why discuss Internet-ofThings, Cyber-Physical Systems, Industry 4.0
in the context of Enterprise (Architecture) Management?
- Implications for Enterprise (Architecture) Modeling – 3 Cases
 - IoT in Smart Garden (Husqvarna)
 - CPS in Logistics (DataChassi)
 - Digitization in Utility Industry (Stadtwerke Rostock)
- Conclusions

Cyber-Physical Systems

Technologies:

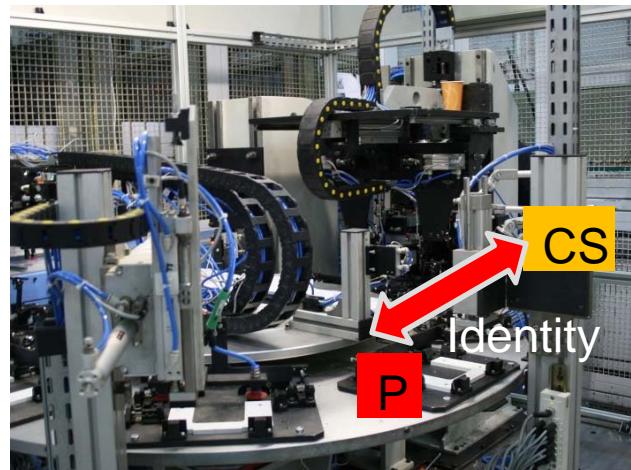
- Sensors & Actuators
- Cloud Services
- Wireless & Mobile Com.
- Self-X
- (Standards)



Functions:

- Communicating & Negotiating
- Interpreting & Deciding
- Configuration & Adjusting
- Analyzing & Optimizing

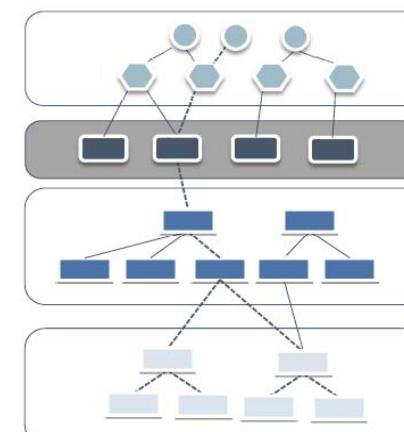
Physical World / Control Systems



CS
Identity
P

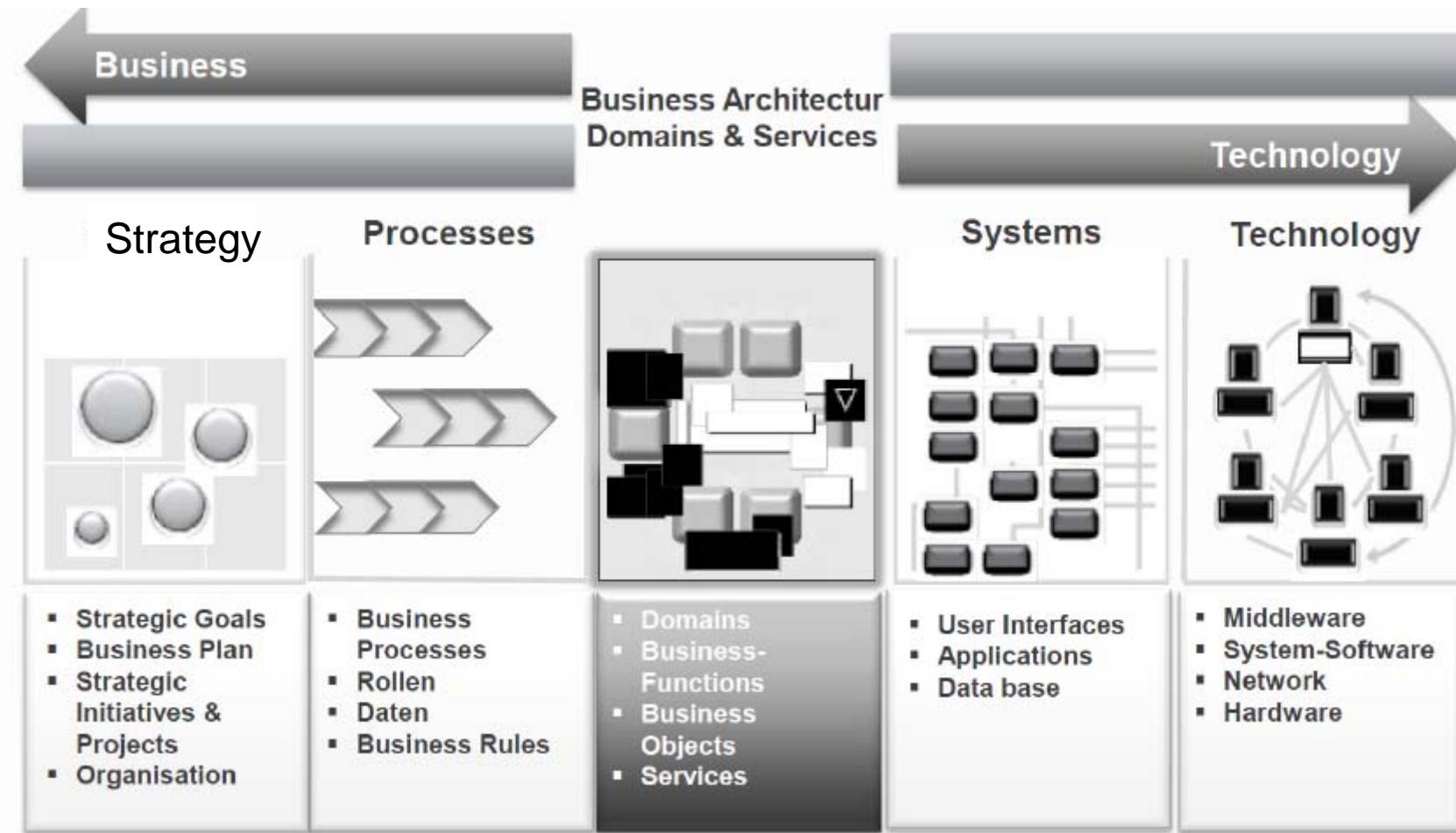
Manufacturing Order
Realtime Update & Control

Manufacturing data



IT-World / Enterprise Computing

Enterprise Architecture Management

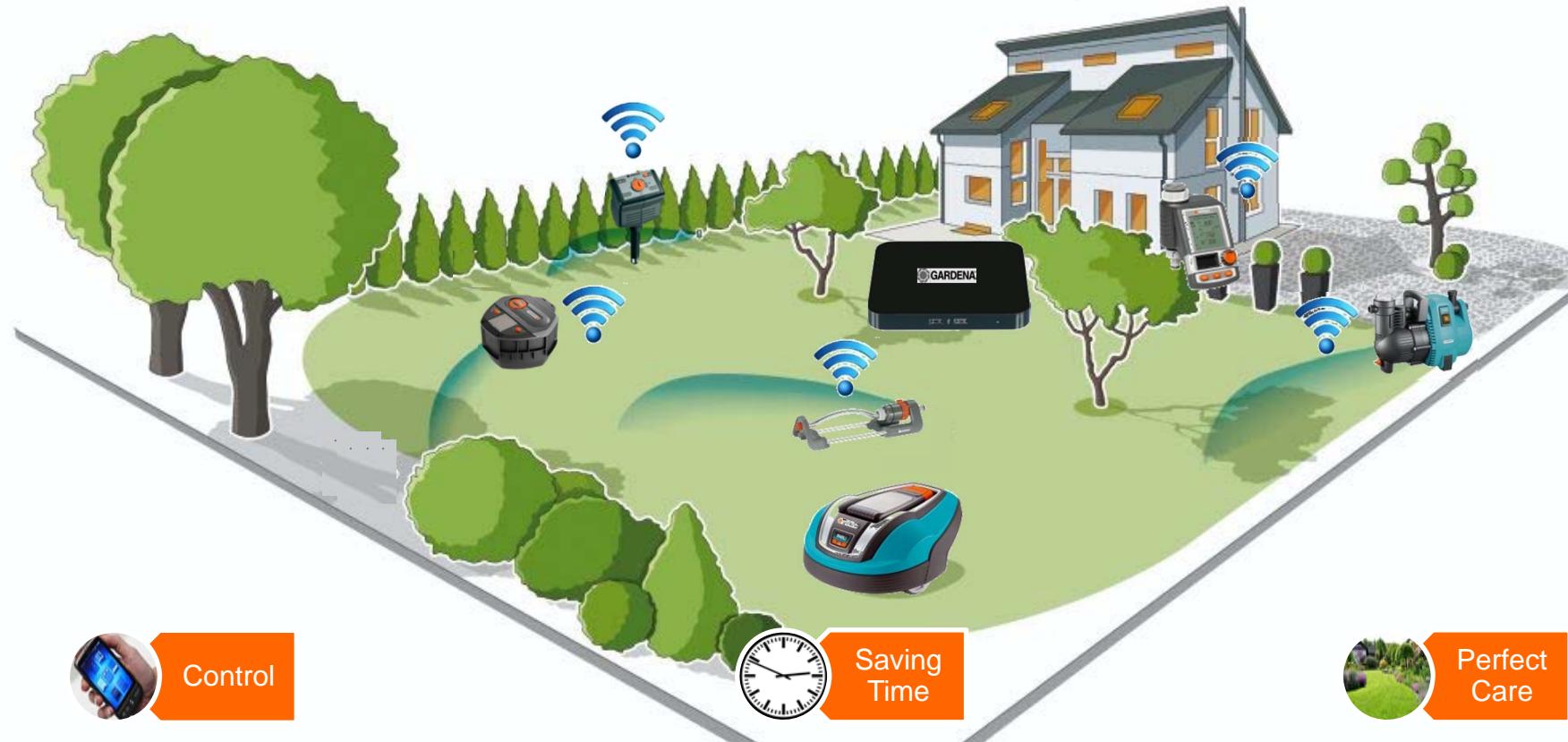


Impact of IoT: The Husqvarna Case

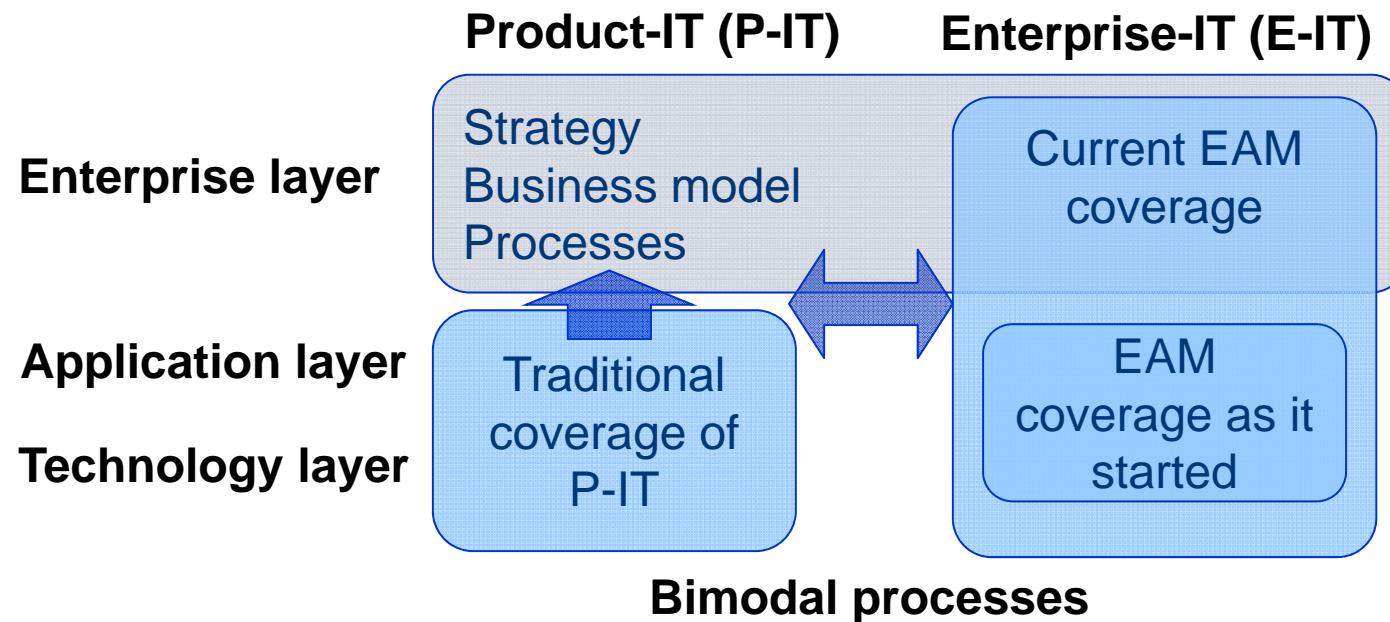
Smart Garden System

System structure...

All products are connected to the hub and the user can simply interact with all devices thru apps.



Product driven EAM



Mode 2, requires:

- fast turnaround
- frequent update
- rapid path

Mode 1, designed for:

- stability
- efficiency
- low cost
- traditional EAM



Implications of IoT for Enterprise Architecture Modeling

- IoT is becoming part of product IT
- We have to integrate Product IT into Enterprise Architecture Models
 - The process, roles and principles for synchronizing Product-IT and Enterprise IT need to be redefined
- Different „paces“ in Product-IT and Enterprise-IT development will lead to different granularities and update cycles in enterprise models
- Highly dynamic situation in the field
 - What has to be part of the model, what should be excluded?
 - Potentially incomplete and quickly changing models

Impact of CPS: The DataChassi Case

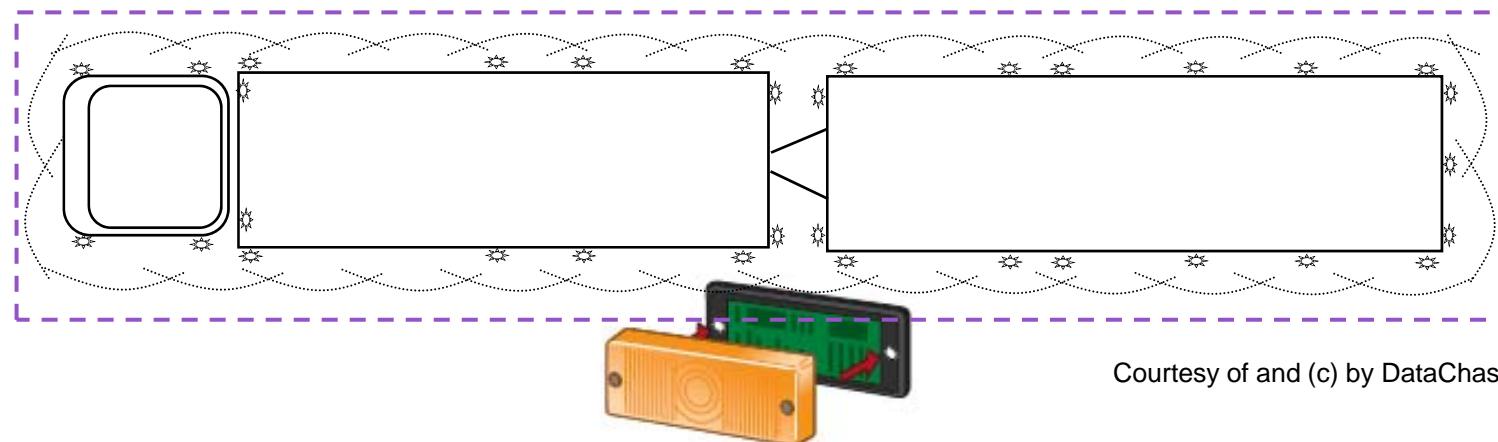
Industrial Case from Transportation



Courtesy of and (c) by DataChassi AB, Sweden



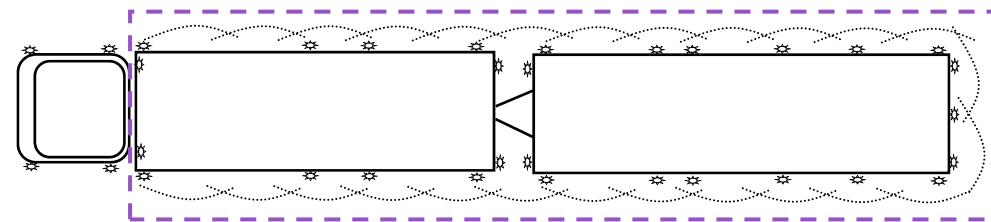
"Electronic Fence"



Courtesy of and (c) by DataChassi AB, Sweden

Modified sidemarking lights allow for an "electronic fence" around lorry and trailer

... flexibility to exclude the cabin to prevent insiders ...



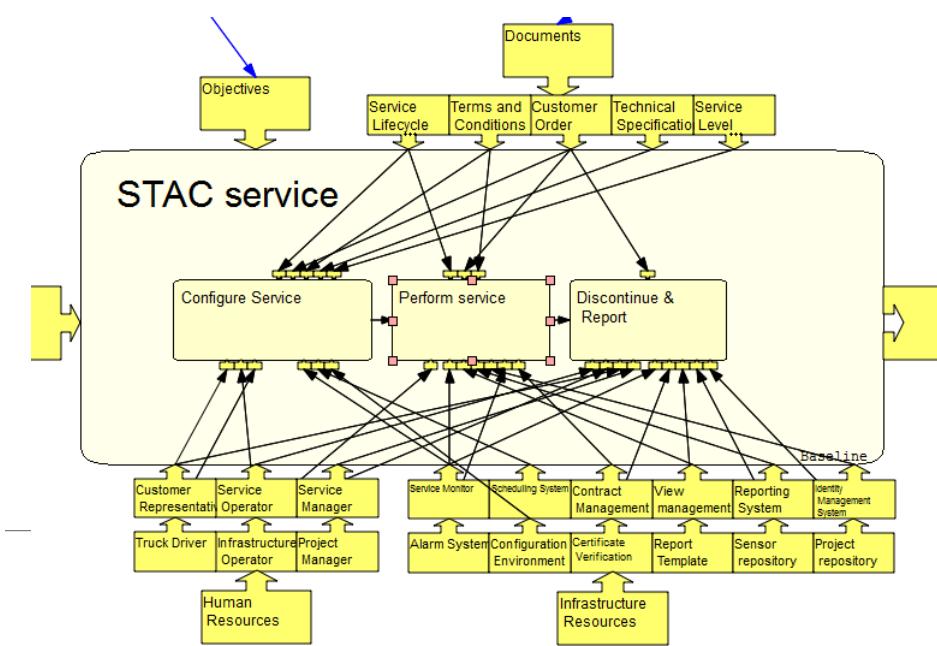
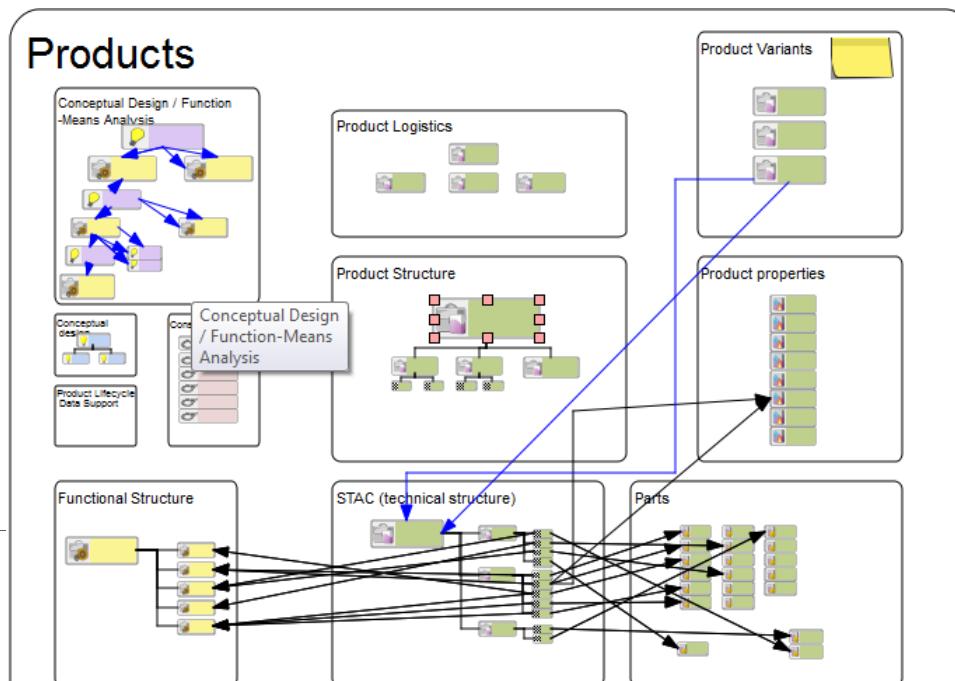
CPS development process

- a. Business objectives Enterprise Modelling
- b. Business model Enterprise Modelling
- c. CPS integration into the enterprise Enterprise Modelling
- d. Specification of CPS
 - d.1 architecture of the technical solution
 - d.2 services for operating the CPS Enterprise Modelling
- e. Support of operations Enterprise Modelling
- f. Monitoring, maintenance
- g. CPS revision

Example for use of Enterprise Modelling

c. CPS integration into the enterprise

- Development of an enterprise model
 - Processes: product-in-use and back-office
 - Organisation: roles involved
 - Product: general service product structure
 - System: technology required



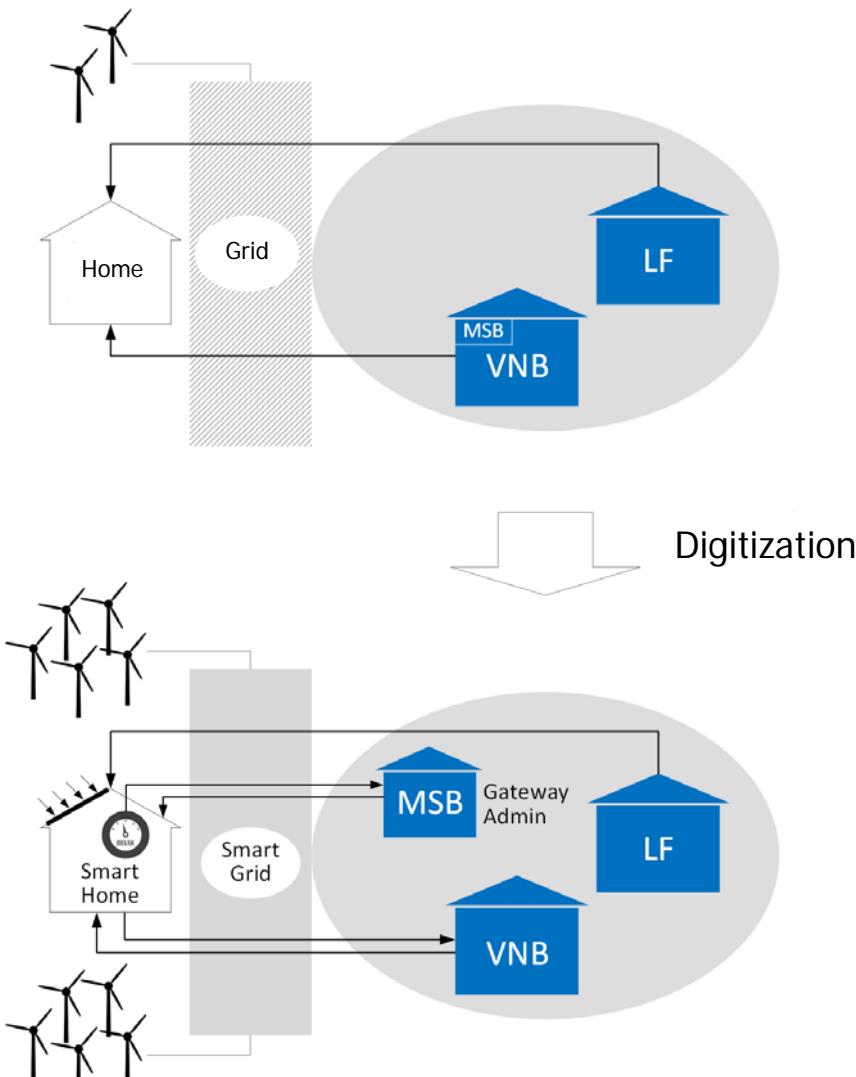
Implications of CPS for Enterprise Modeling

- Enterprise Architecture is changed on several layers by CPS introduction
- Enterprise Models can serve as „glue“ between other model types

- Enterprise models as design time and runtime artefact?
- Business Model can be and should be captured in an enterprise model

Impact of Digitization: The Utility Sector Case

Developments in the Utility Sector

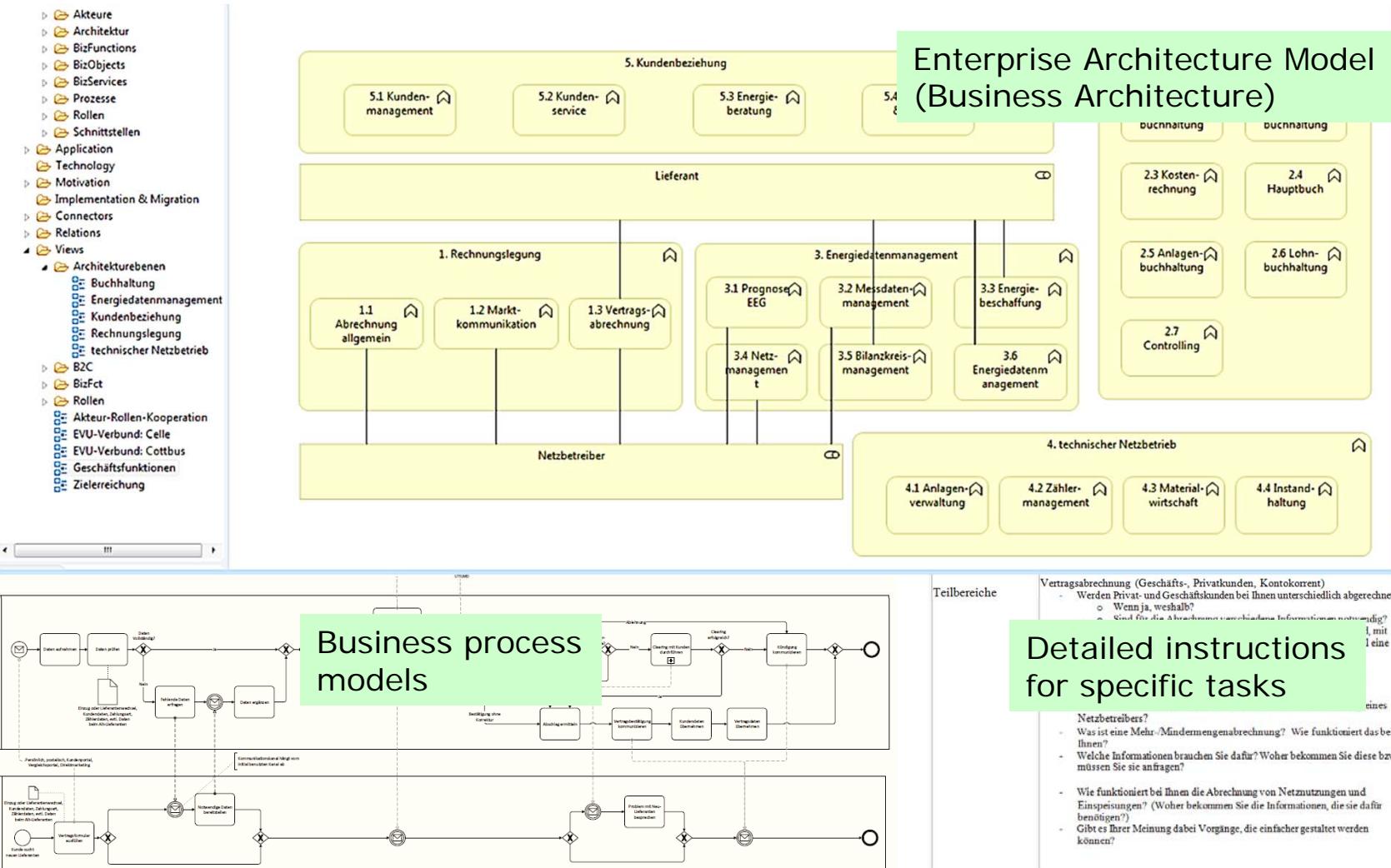


LF: Energi Supplier
VNB: Grid Operator
MSB: Metering Service Operator

Courtesy of and (c) by SIV.AG, Germany and ECLORA project

Reference Architecture

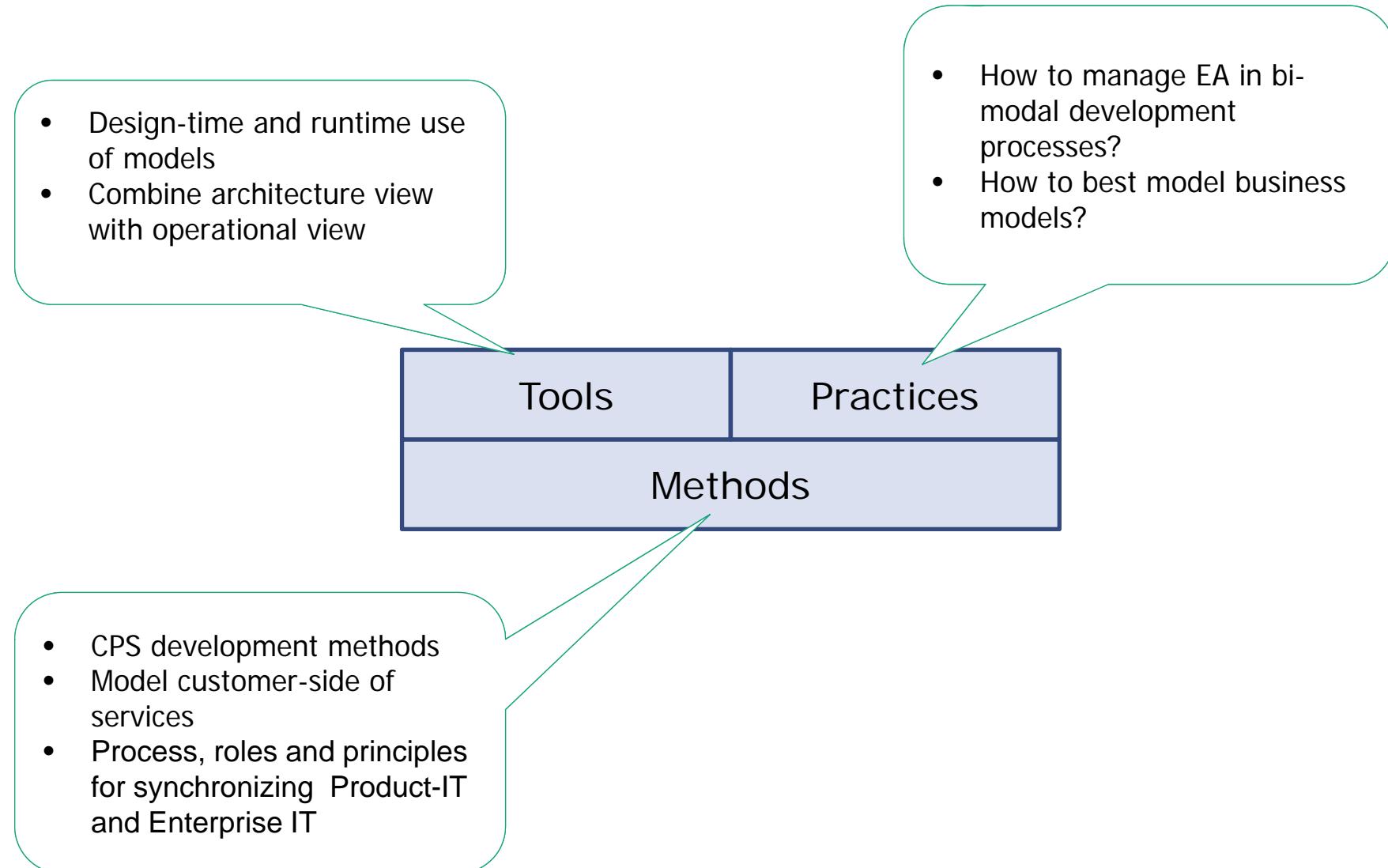
Business Architecture + Business Process Integration



Implications of Digitization for Enterprise Modeling

- Model the customer-side of services
- Integration of EAM and EM
 - Combine architecture view (higher abstraction level) with operational view (lower abstraction level)
 - Enterprise Model captures the value creation, Enterprise Architecture Model the context of this value creation

Summary: Implications for Enterprise (Architecture) Modeling



Thank you for your attention!

Time for questions!