

Service Systems Forum

Venice, May 2015

# Maintenance as a Service System in the Context of the Internet of Things

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## **The Internet of Things**

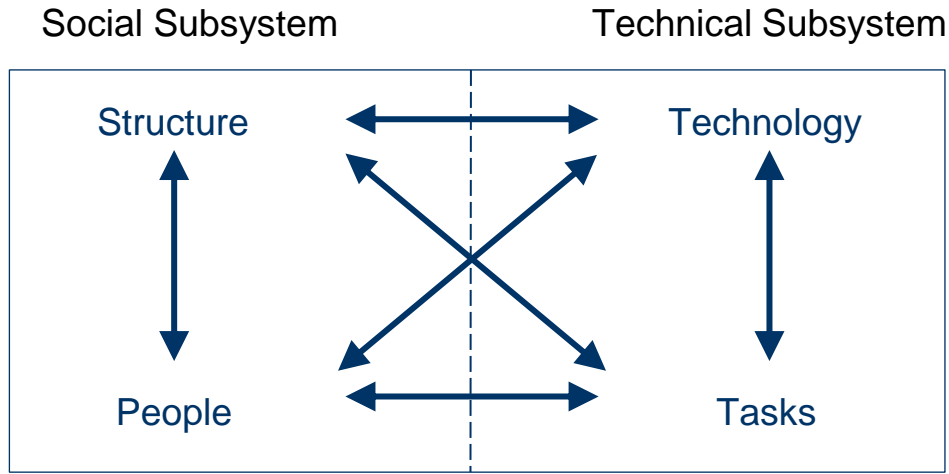
Sensor-based integration of physical objects in the operative logic of the internet

## **“Advanced Manufacturing” / “Industry 4.0”**

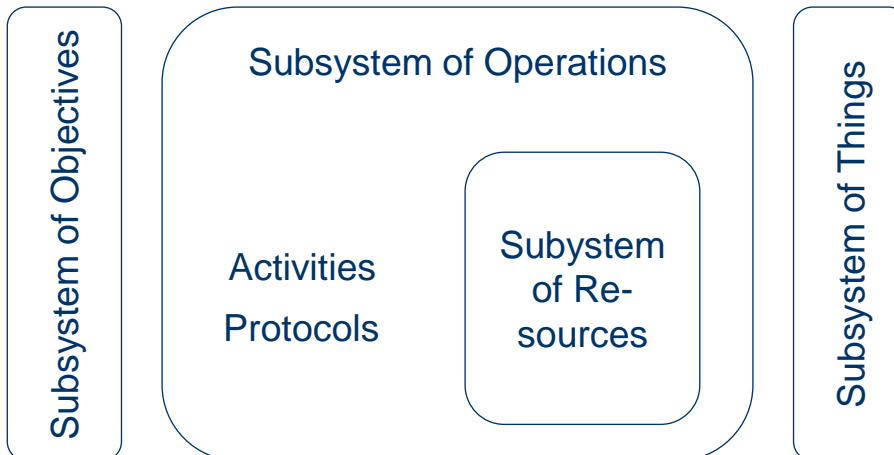
Initiatives to implement these solutions in manufacturing and related processes

## **Cyber-Physical Systems**

Formal concept to capture this approach in a scientific way



cf. Bostrom, R. P., & Heinen, J. S. (1977). MIS Problems and Failures: A Socio- Technical Perspective. Part I: The Causes. *MIS Quarterly*, 1(3), 17–32.



cf Albers, A. & Braun A. (2011) A generalised framework to compass and to support complex product engineering processes. *International Journal of Product Development* 15 (1-3): 6-25..

## Luhmann (Parsons): Functional differentiation

| <b>societal subsystem</b> | <b>functional code</b> |
|---------------------------|------------------------|
| <b>economy</b>            | possession             |
| <b>law</b>                | right                  |
| <b>science</b>            | truth                  |
| <b>education</b>          | ability                |
| <b>religion</b>           | transcendence          |

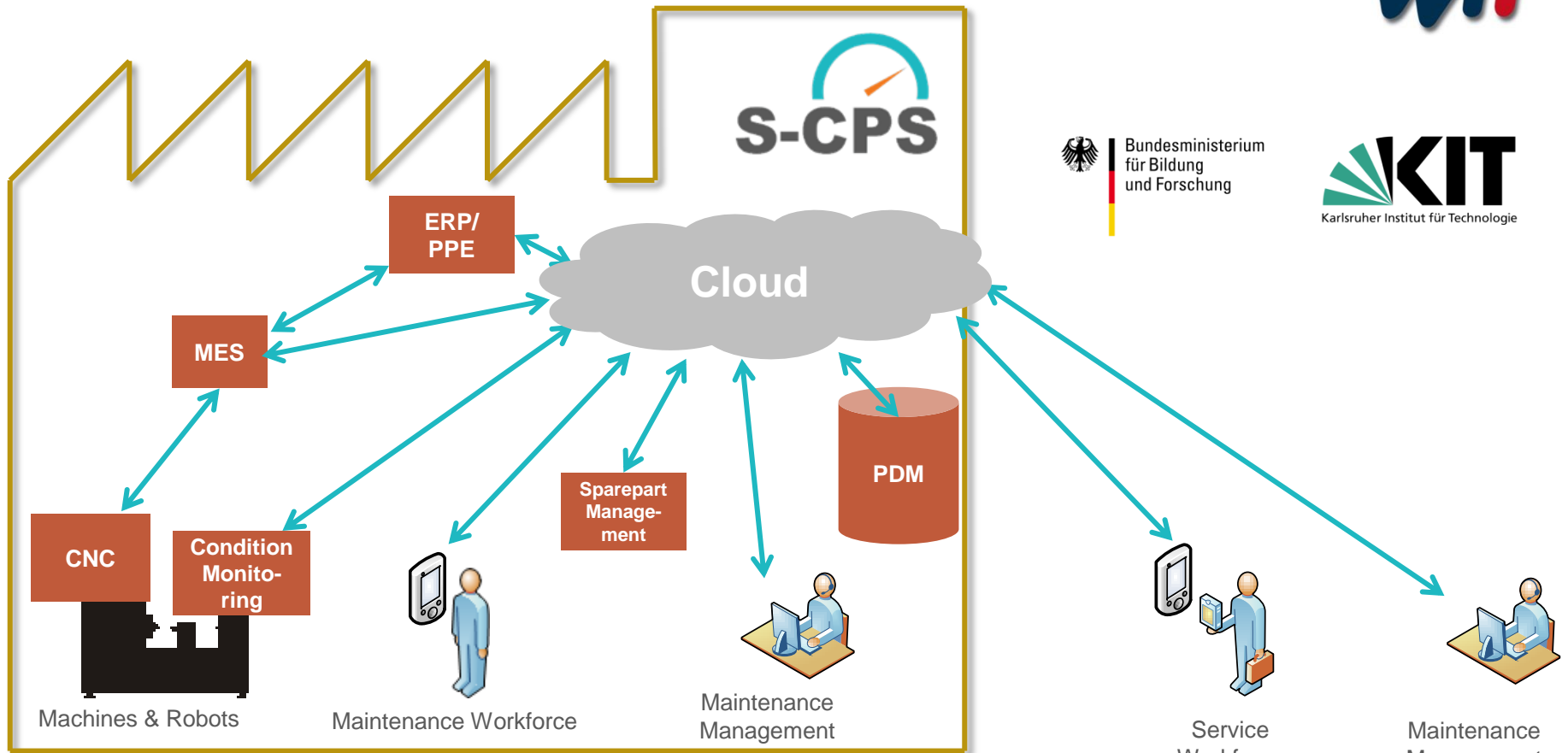
technology not as a system,  
but an operative principle

cf. Luhmann, Niklas (1989) Ecological communication,  
Cambridge: Polity Press

(Socio-) Cyber-Physical Systems:  
technology as a canvas for variable system structures

Questions:

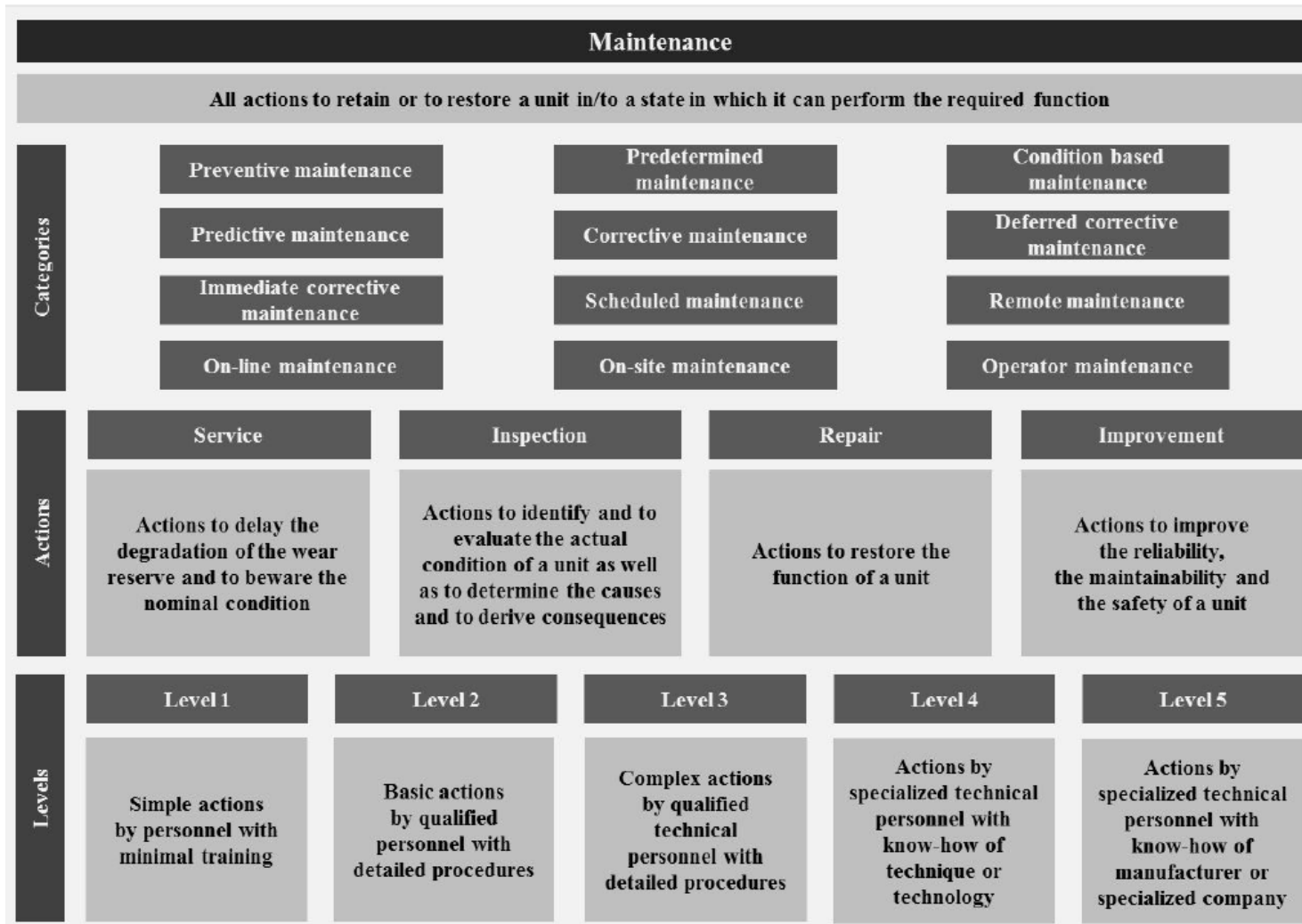
- how do boundaries/ functional differentiations shift?
- can, and, if so, how should this be managed?



MES ... Manufacturing Execution System  
 CNC ... Computerized Numerical Control  
 ERP ... Enterprise Resource Planning

PPS ... Production Planning & Execution  
 PDM ... Product Data Management

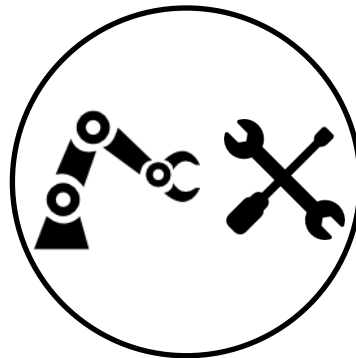
© S-CPS (2014)



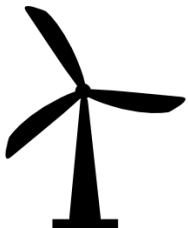
cf. Hopf, Hendrik et al. (2014) Improving Maintenance Processes with Socio-Cyber-Physical Systems



**Car manufacturer**



**Automotive parts & plant engineering**



**Wind energy**



## Identification of roles

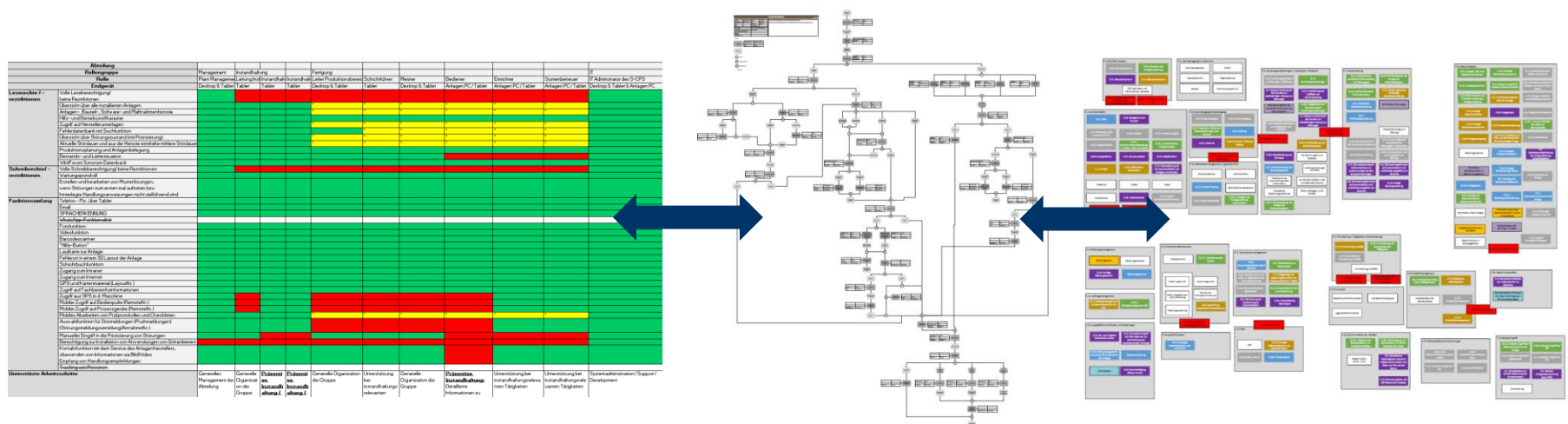
All involved stakeholders need to be identified

## Exploring responsibilities and dependencies

Gathering data about the tasks and need for information of each role

## Service System Engineering

Design of the service system based on processes and roles using a reference architecture



## Potentials for better value creation

- Maintenance workforce uses up to 35% of their time for information gathering
  - Situation-dependent and context based information provided by the service system in real time
- Tacit user knowledge needs to be captured by the system to be accessible for other system participants
  - For errors occurring for the first time solutions and guidelines will be recorded by the worker
- Upcoming errors can be identified via patterns of values noticed by sensors
  - Predictive maintenance tasks can be fitted in the schedules of the maintenance workforce









- Human machine interface
- Providing each role information and course of action for executing their tasks
- Scalable for different devices

To be solved:

- Data ownership
- Security and trust



## Questions, Remarks? Don't hesitate!

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