Das Technologie-Netzwerk:
Intelligente Technische Systeme OstWestfalenLippe

it's owl

Development of Intelligent Technical Systems

Bremen, Germany
July, 3rd 2014

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

INVENTED IN GERMANY

BETREUT VOM
PTKA Projektträger Karlsruhe
Karlsruher Institut für Technologie

OstWestfalenLippe

DAS CLUSTERMANAGEMENT WIRD GEFÖRDERT DURCH:
Ministerium für Wirtschaft, Energie, Industrie, Mittelstand und Handwerk des Landes Nordrhein-Westfalen

Ministerium für Innovation, Wissenschaft und Forschung des Landes Nordrhein-Westfalen

The Technology-Network:
Intelligent Technical Systems
OstWestfalenLippe . Germany

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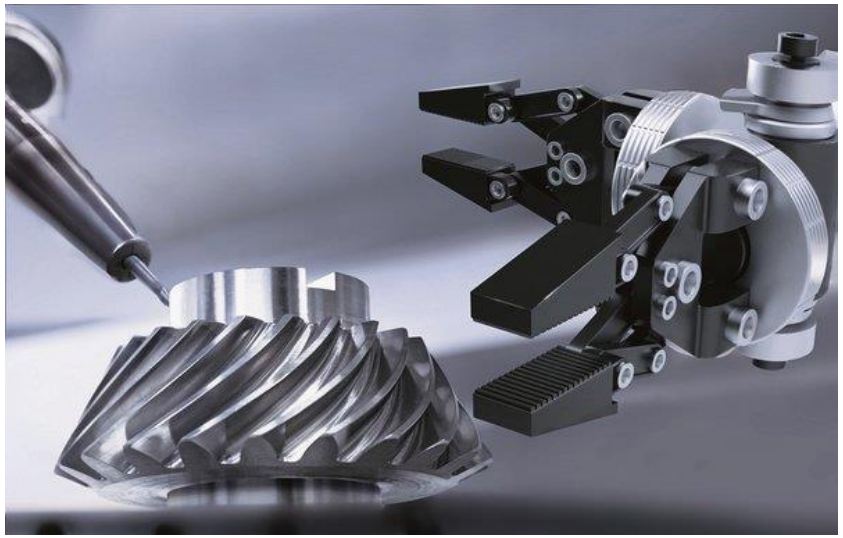
Development of Intelligent Technical Systems



Mareen Vaßholz

Heinz Nixdorf Institute,
University of Paderborn, Germany

SysInt 2014, Bremen, Germany

July, 3rd 2014

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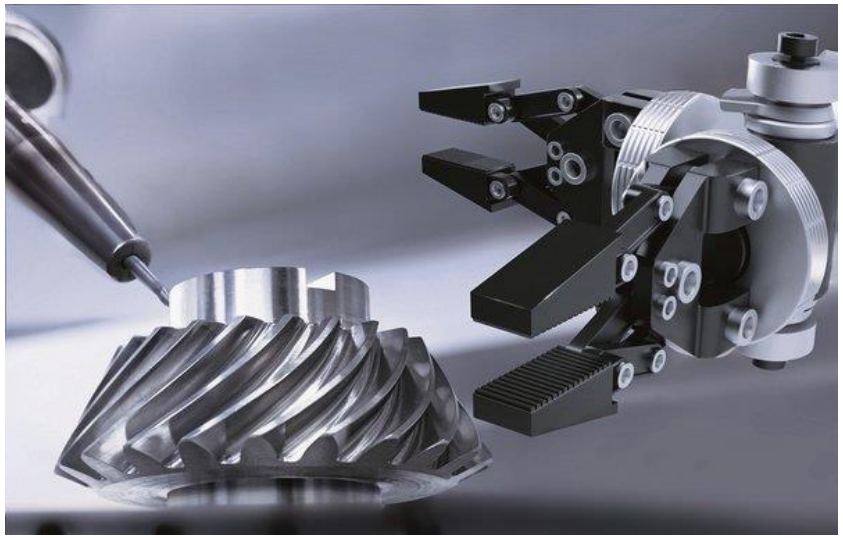

Leading-Edge Cluster it´s OWL

Intelligent Technical Systems

Systems Engineering

Leading-Edge Cluster Competition initiated by the Federal Ministry of Education and Research (BMBF)

SPONSORED BY THE

Federal Ministry
of Education
and Research

- BMBF wants to support strong regions in Germany to increase their global positions
- Leading-Edge Cluster competition were initiated
- Close Alliance between top-level science and leading industry
- 3 rounds of competition (2007 to 2012)
- 15 leading-edge clusters represent high-tech competence ensuring growth and employment
- Funding: €40m over 5 years for each cluster
- In total about €100m for each cluster (€60m from enterprises)

OWL – Outstanding Region for Innovation, Added Value and Employment (1/2)

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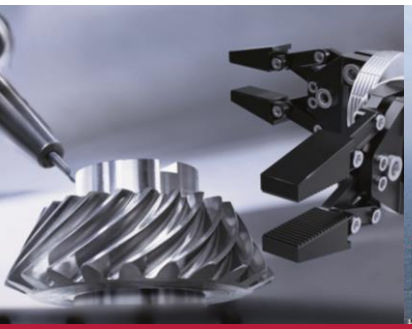
Vibrant Industries

Mechanical engineering, electrical/ electronic and automotive supply industries

Strong brands, hidden champions, independent family-owned companies

AEG POWER SOLUTIONS · BECKHOFF · BENTELER · GEA · CLAAS · DELTA · DENIOS · DMG MORI SEIKI COMPANY LIMITED · GOLDBECK · HARTING · HAVER & BOECKER · HELLA · HESSE MECHATRONICS · Hettich · Kannegiesser · KEB · Kemper Baker's friend · Lenze · Miele · PHOENIX CONTACT · WAGO INNOVATIVE CONNECTIONS · Weidmüller · WINCOR NIXDORF · WITTENSTEIN motion control





OWL – Outstanding Region for Innovation, Added Value and Employment (2/2)

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High-Performance Research

Strength: symbiosis of informatics and engineering sciences

Universität Bielefeld
UNIVERSITÄT PADERBORN
Die Universität der Informationsgesellschaft
Hochschule Ostwestfalen-Lippe
University of Applied Sciences
FH Bielefeld
University of
Applied Sciences
UNIVERSITY OF APPLIED SCIENCES
FHDW
FACHHOCHSCHULE DER WIRTSCHAFT
STAATLICH ANERKANNT
HOCHSCHULE
HAMM-LIPPSTADT
CORE Lab
Research Institute
for Cognition and Robotics
CITEC
Cognitive Interaction Technology
Excellenzcluster
Universität Bielefeld
HEINZ NIXDORF INSTITUT
Universität Paderborn
inIT
Institut
Industrial IT
www.init-owl.de
c-lab
DMRC
DIRECT MANUFACTURING RESEARCH CENTER
LAB
LIGHT | HUMAN | MACHINE
Fraunhofer
ENAS
Fraunhofer
IOSB-INA
Fraunhofer
IPT
mieletec
FH Bielefeld
OWITA
OWL ViProSim
Virtual Prototyping
& Simulation
OstWestfalenLippe
in Kooperation mit OWL MASCHINENBAU
s-lab
Software Quality Lab



Vision it`s OWL 2017:
Top Position in Intelligent Technical Systems

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Mission Statement:

- Resource efficiency
- Usability
- Reliability

Vision it‘s OWL 2017

Intelligent Systems

Innovation Leap

Cluster it‘s OWL 2012

Mechatronics

Mechanics

Objectives:

- 80.000 jobs secured
- 10.000 new jobs
- 50 new companies
- 5 new research institutes
- 500 additional researchers
- 4 new courses of study / 500 enrollments (per year)

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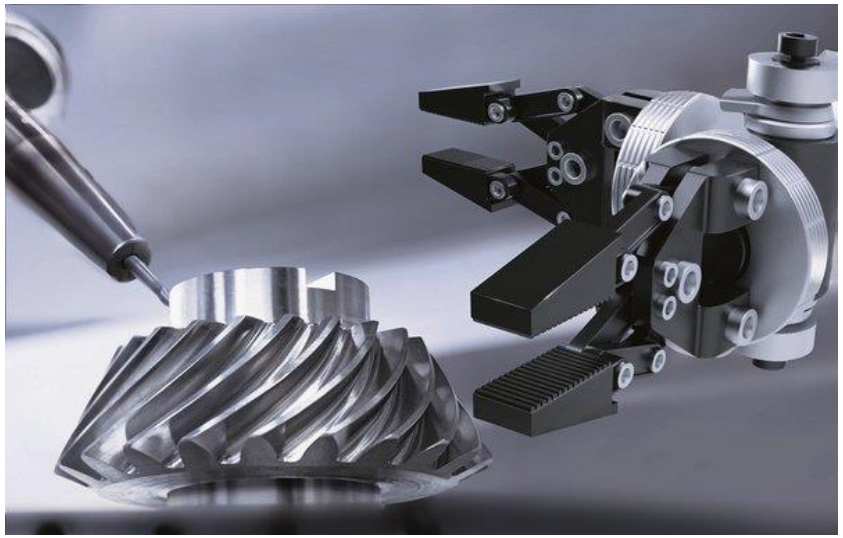
Development of Intelligent Technical Systems

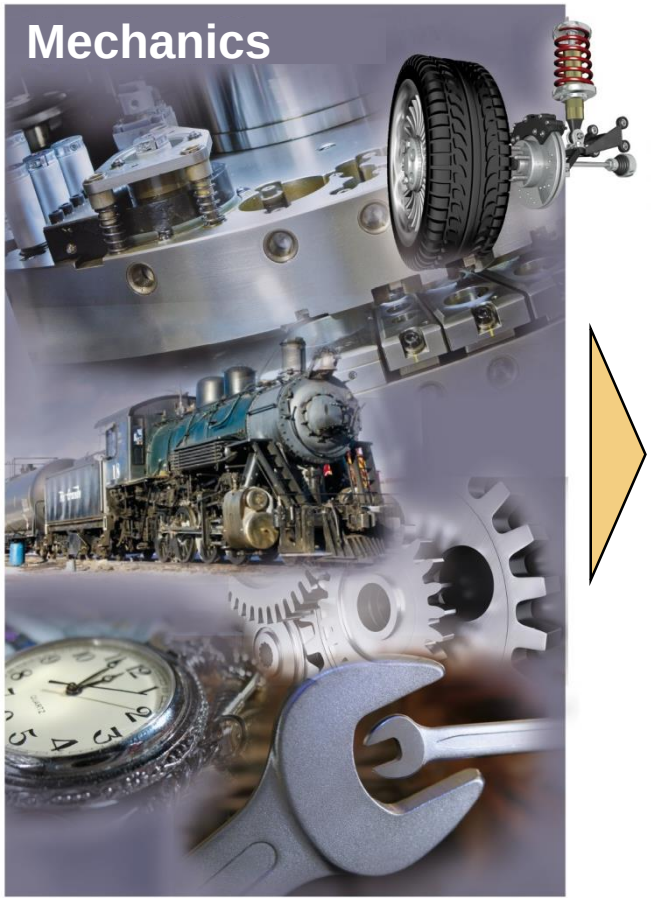


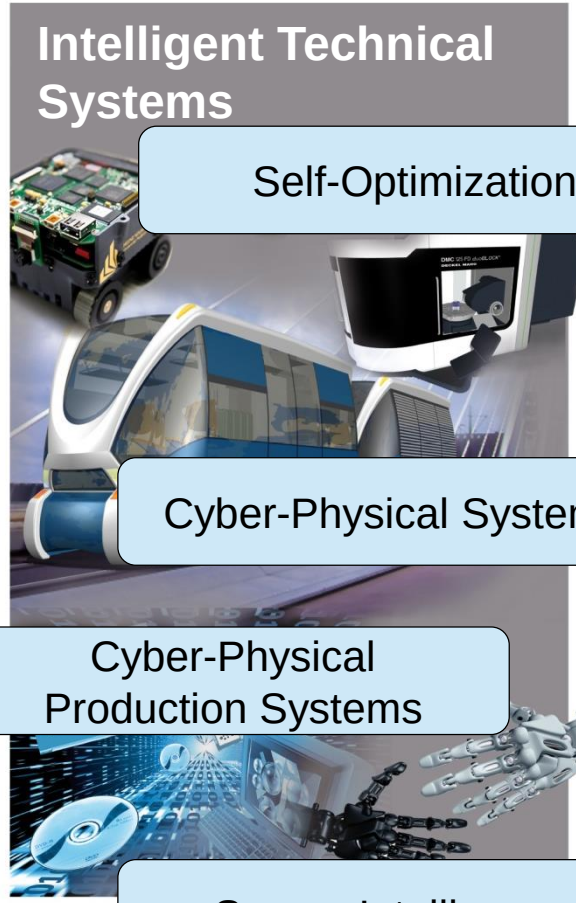
Leading-Edge Cluster it´s OWL

Intelligent Technical Systems

Systems Engineering

Innovation Leap Towards Technical Systems with Inherent Partial Intelligence





GAUSEMEIER, J.; TSCHIRNER, C.; DUMITRESCU, R.: Der Weg zu Intelligenten Technischen Systemen. In: Industrie Management, 29, 2013

Characteristics of Intelligent Technical Systems

… interact with the environment and adapting to it autonomously (**adaptive**).

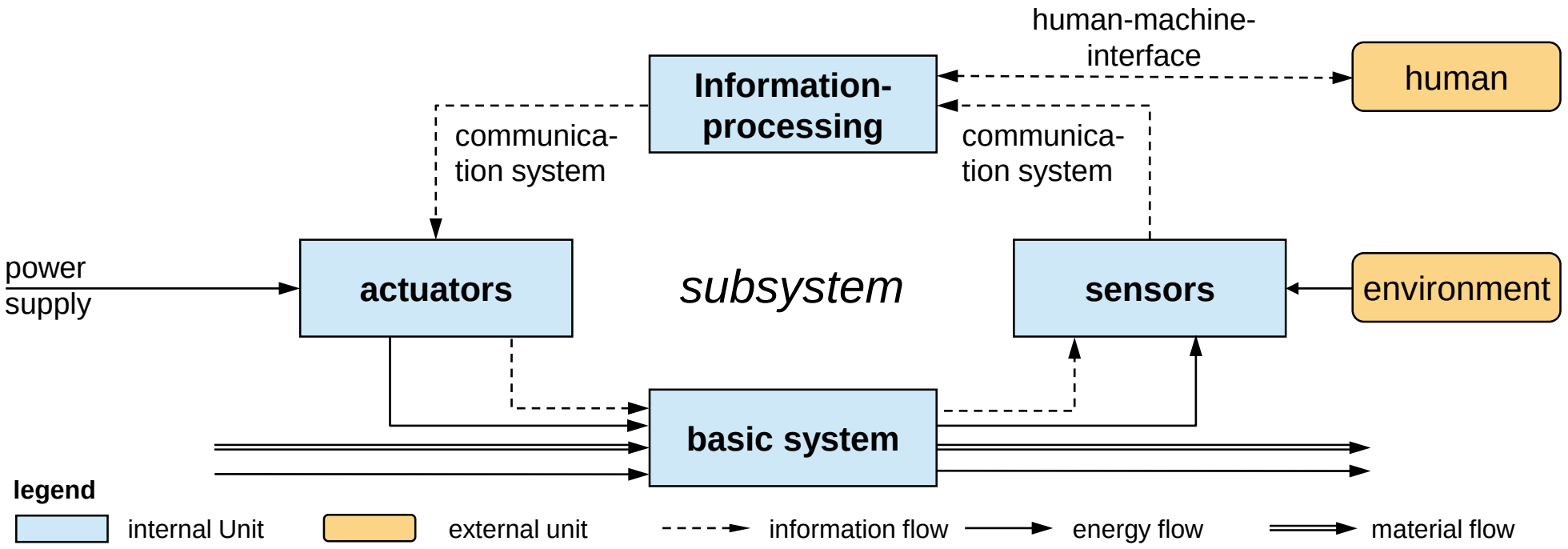
… even manage unexpected situations not taken into account by the developer in the development process (**robust**).

… anticipate on the basis of experimental knowledge future effects of influences and possible states (**anticipative**).

… take into account individual user behavior (**user-friendly**).

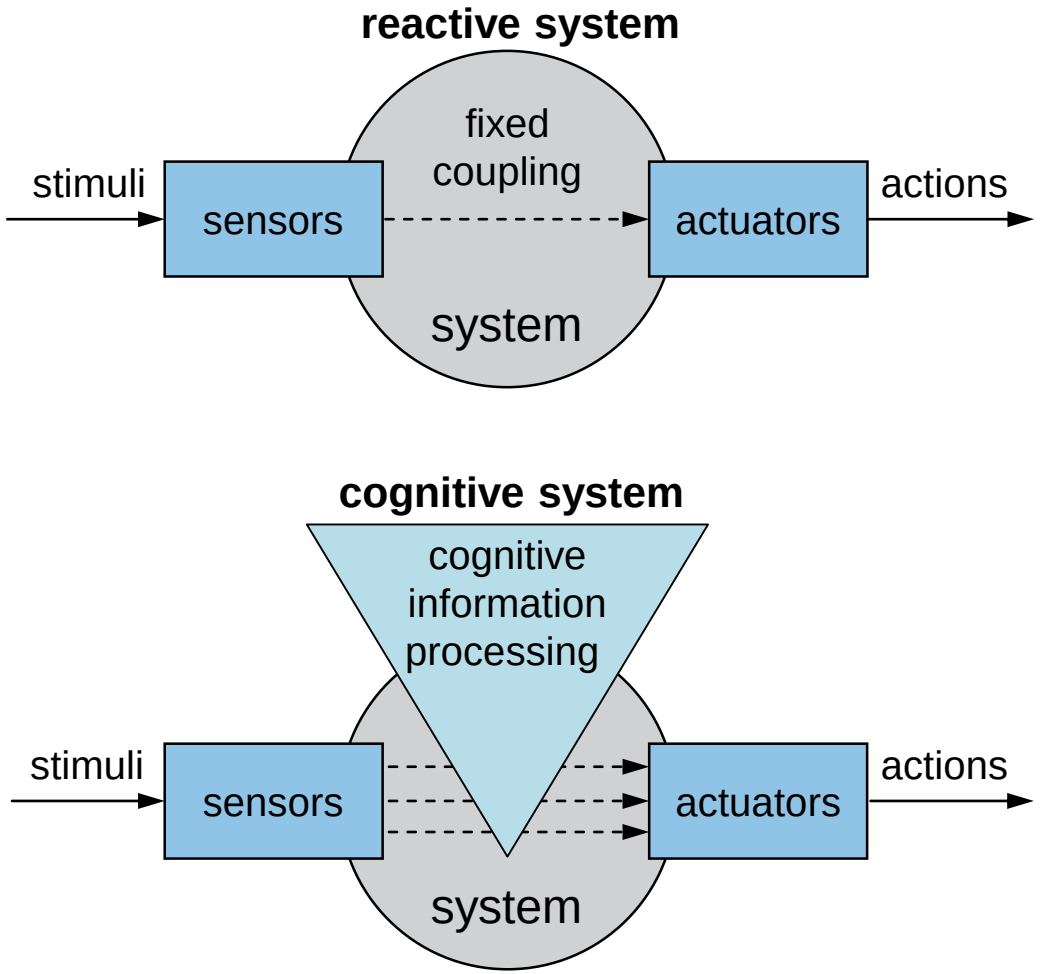
System-integrated Intelligence – it's owl' point of view

Basic structure of a mechatronic system



System-integrated Intelligence – it's owl' point of view

Information Processing of Intelligent Technical Systems



non cognitive regulation
model-based control, e.g. by using PLC-logic or control algorithms

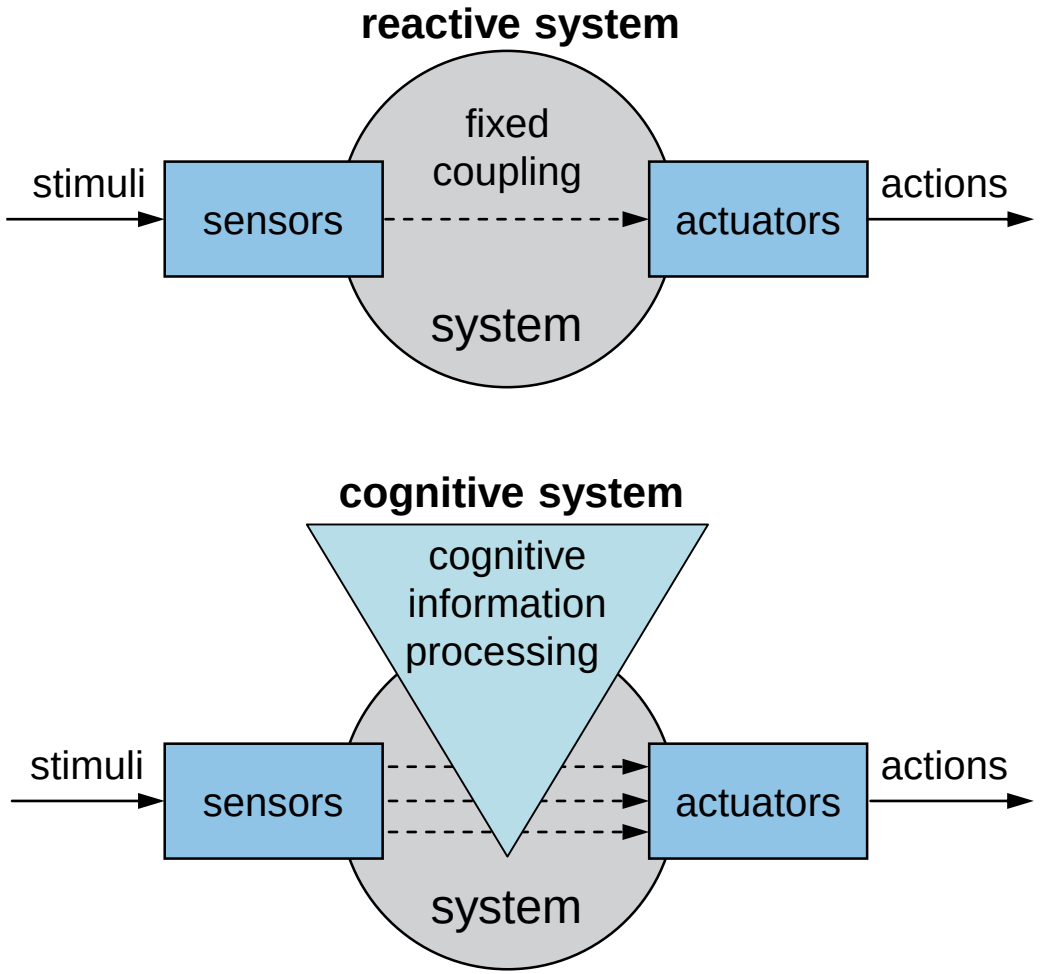
associative regulation
learning complex dependacies (off-/ online), which are hard to describe by physics

cognitive regulation
objective mangament,
like e.g. maximizing productivity or minimizing energy consumption

Quelle: STRUBE, G.: Modelling Motivation and Action Control in Cognitive Systems. In: Mind Modelling. Pabst, 1998

System-integrated Intelligence – it's owl' point of view

Information Processing of Intelligent Technical Systems



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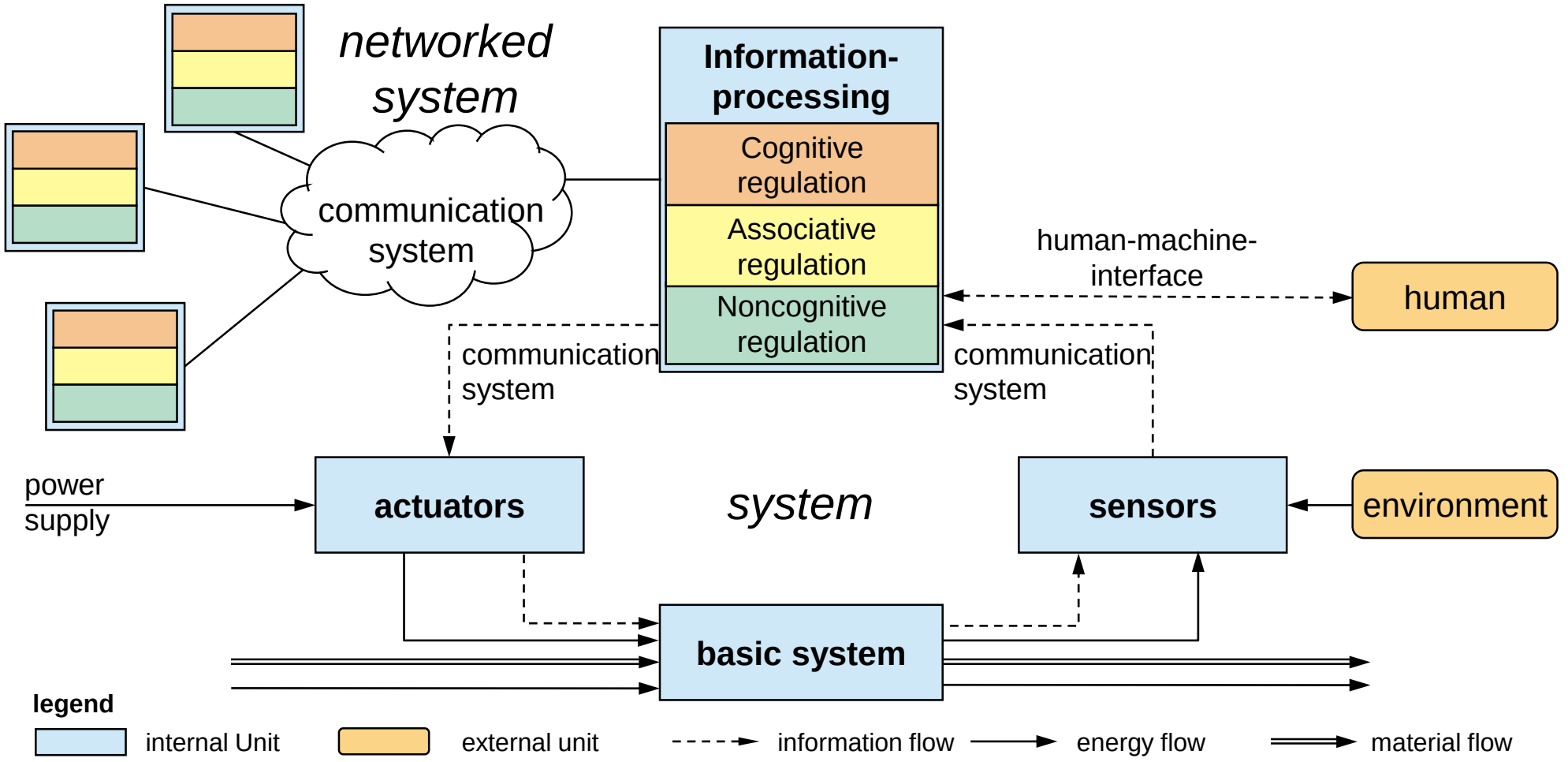
Technology Concept

From mechatronics to intelligent subsystems up to networked intelligent systems (Cyber-physical Systems)



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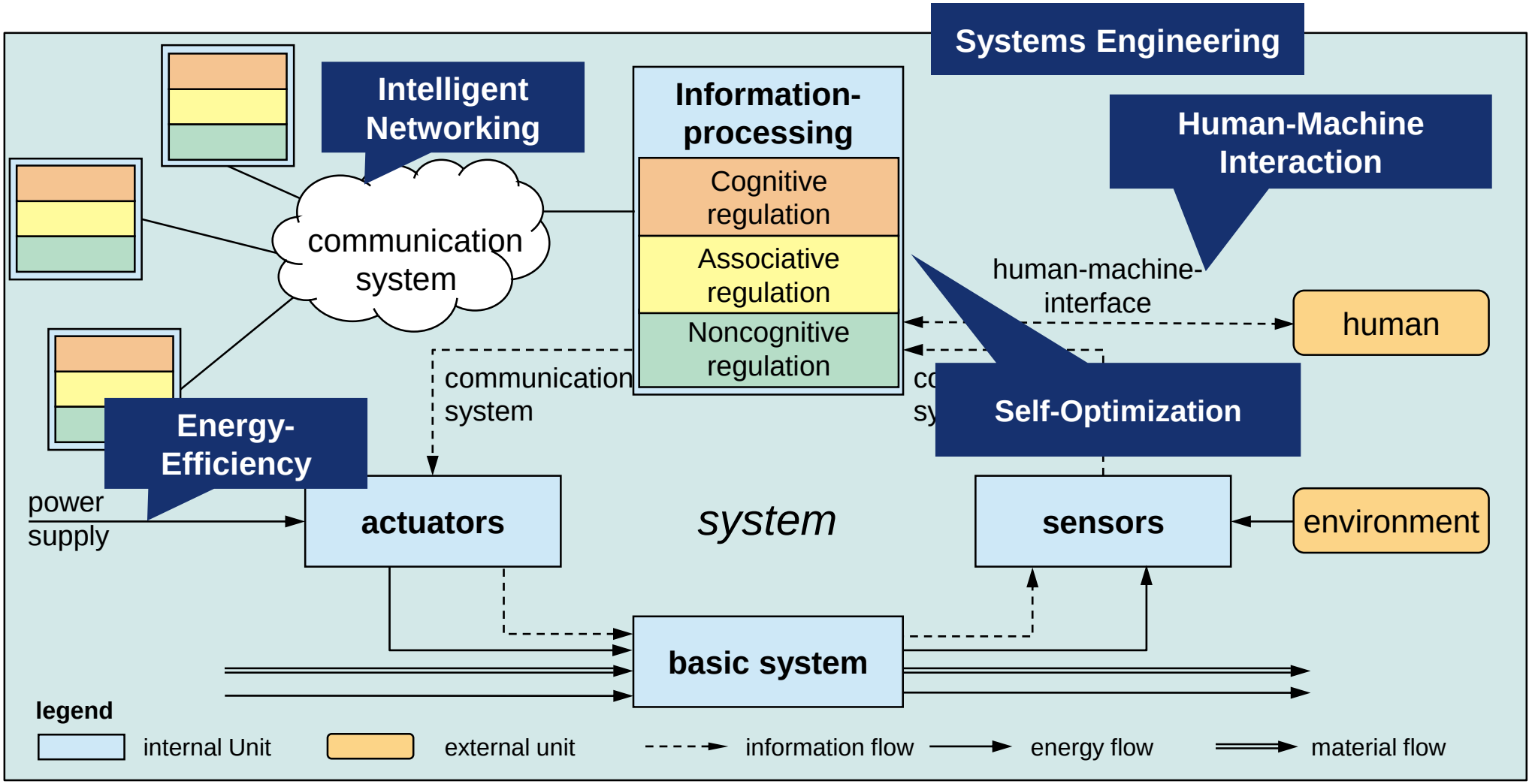

Operationalization by Projects

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Global Market for Intelligent Technical Systems

Subsystems	Systems	Networked Systems
Examples: • intelligent sensors • drives • automation components	**Examples:** • manufacturing equipment • household appliances • ATMs	**Examples:** • smart grids • production plants • cash management systems
founding the basis for systems	**founding the basis for partlially geographically dispersed networked systems**	**adjustable during run time**

33 Innovation Projects
of industry partners lead to superior market performance

5 Platform Projects
creating technology platform for innovation projects and transfer

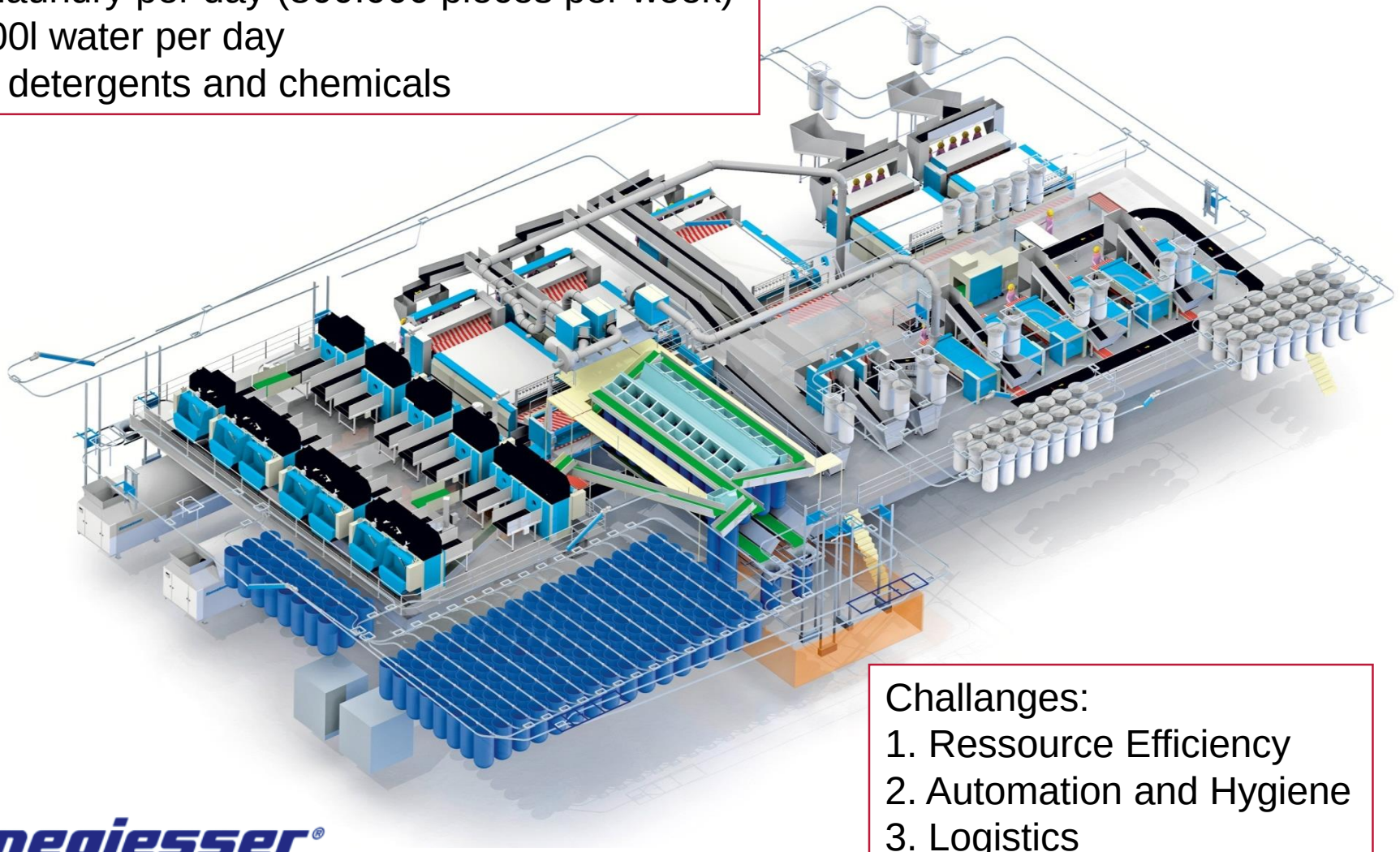
- **Self-Optimization**
- **Human-Machine Interaction**
- **Intelligent Networking**
- **Energy-Efficiency**
- **Systems Engineering**

7 Measures for Sustainability
creating development dynamics beyond funding period

Strategic Foresight	Technology Transfer		Acceptance
Prevention of Product Piracy	Education and Training	Market Orientation	Business Start-Ups

Self-Optimizing Resource-Efficient Industrial Laundry

50t of laundry per day (800.000 pieces per week)
900 000l water per day
1.5t of detergents and chemicals



Challanges:
1. Ressource Efficiency
2. Automation and Hygiene
3. Logistics

Kannegiesser®

Quelle: Spitzencluster Intelligente Technische Systeme Ostwestfalen Lippe (it´s OWL)

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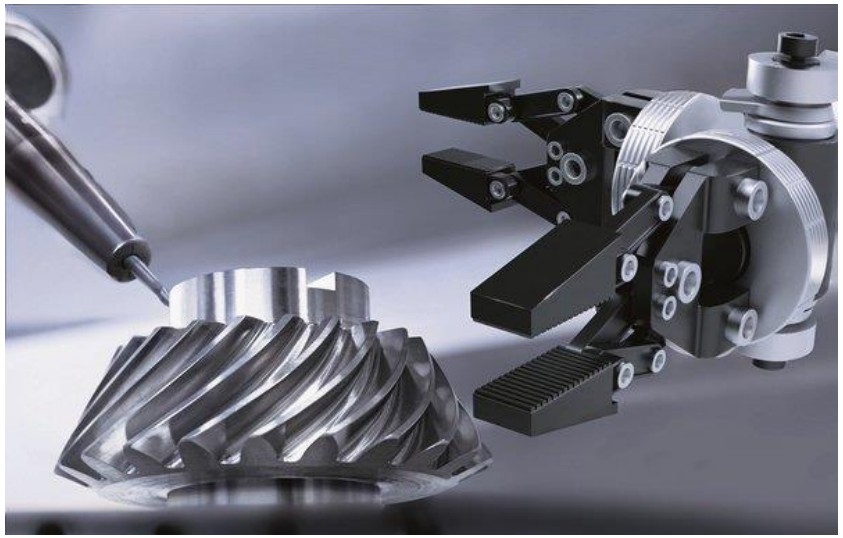
Development of Intelligent Technical Systems



Leading-Edge Cluster it´s OWL

Intelligent Technical Systems

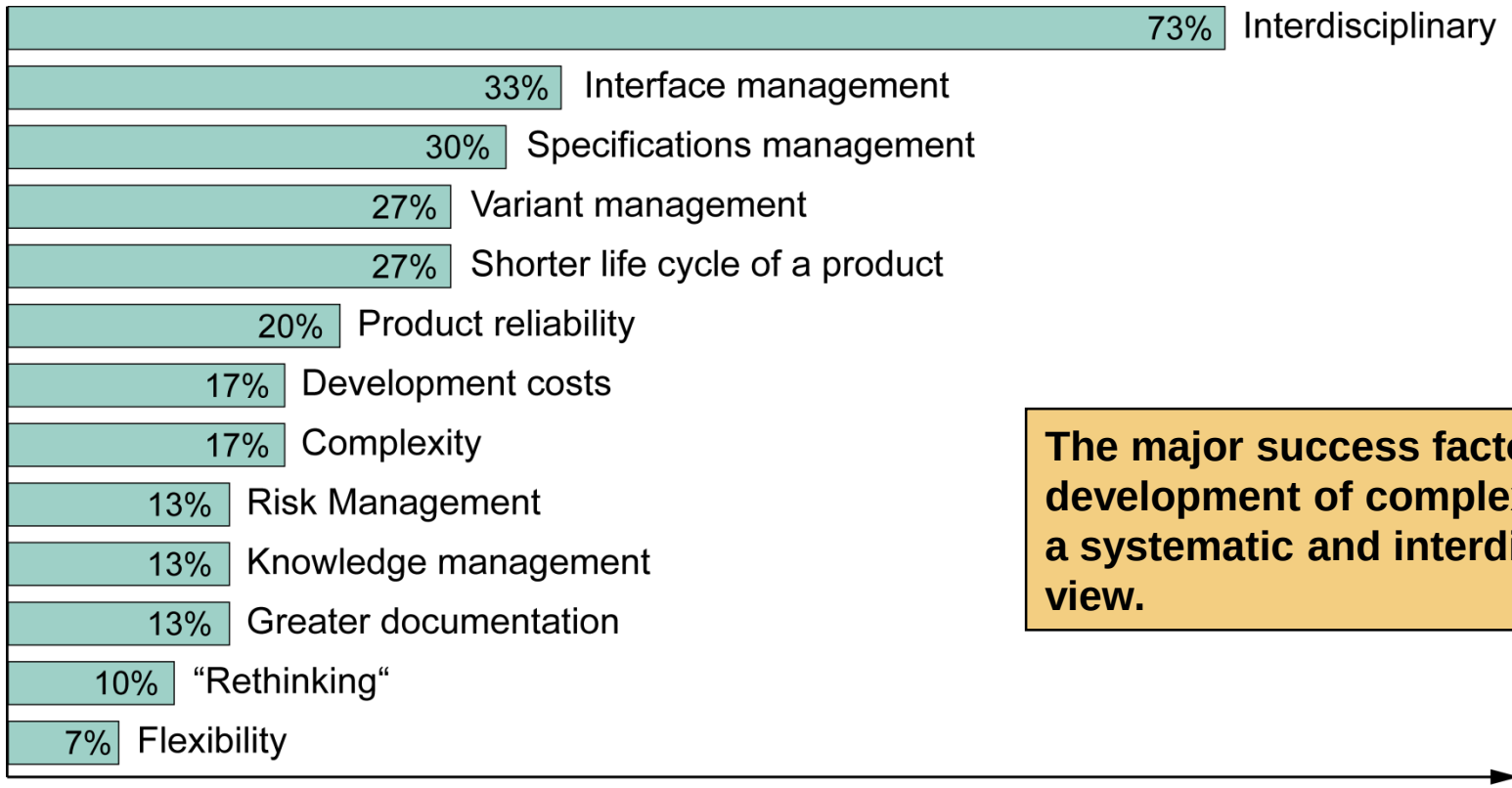
Systems Engineering

Survey Design

Expert interviews: personal talks with 32 companies in the D-A-CH region

Challenges in Developing the Products of Tomorrow

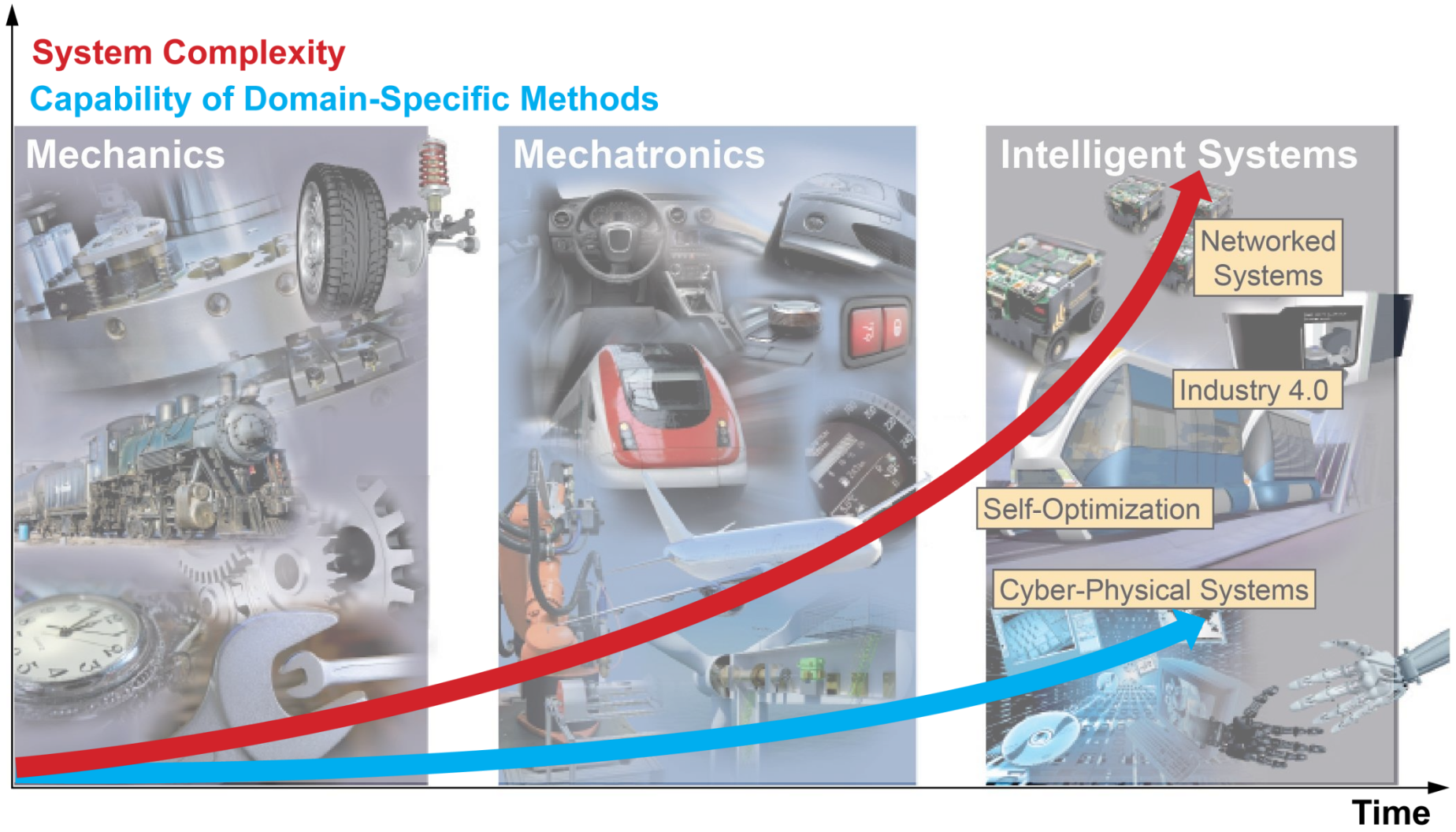
What are the challenges in future product development?



The major success factor for the development of complex systems is a systematic and interdisciplinary view.

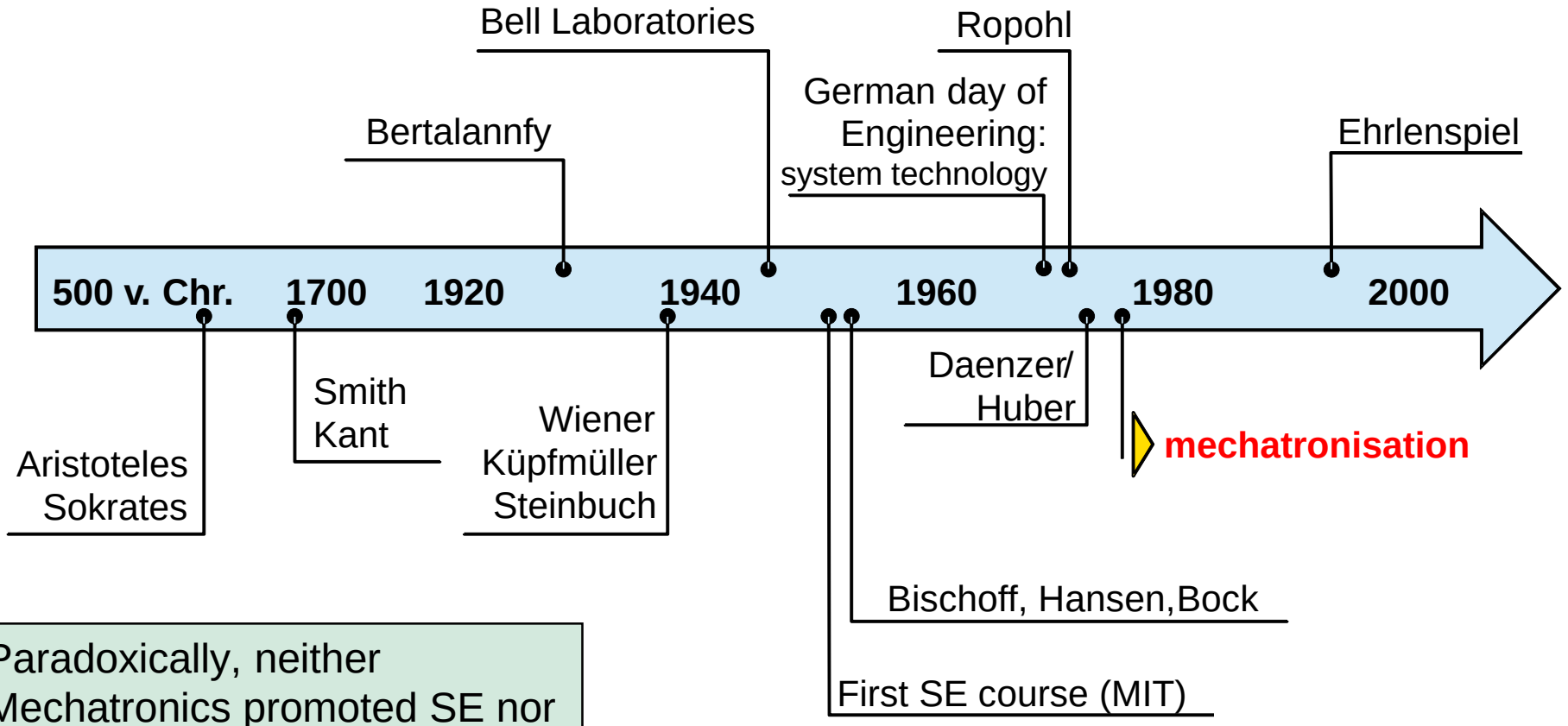
On the Way to Intelligent Technical Systems

Enabler: Systems Engineering



What is Systems Engineering?

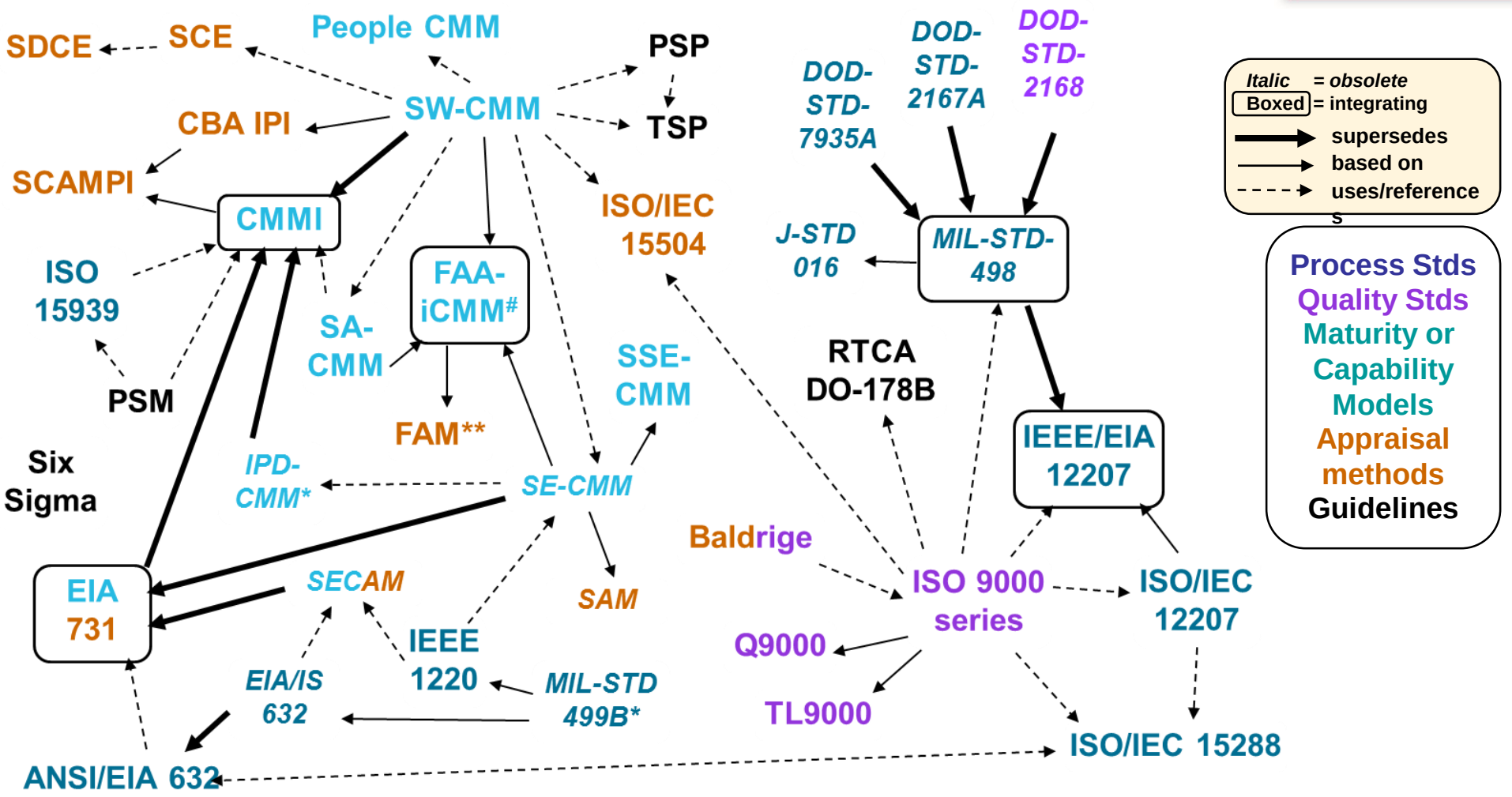
From Systems Thinking to Systems Engineering



Paradoxically, neither Mechatronics promoted SE nor SE promoted Mechatronics.

Is this Systems Engineering?

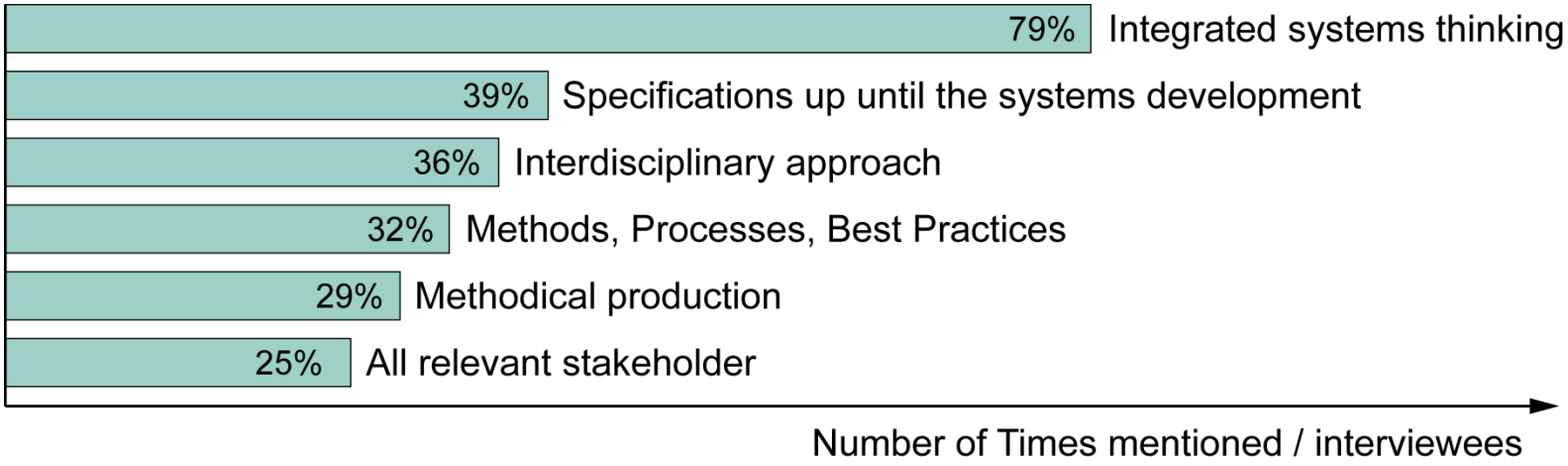
Some SE standards



Source: J. Armstrong, 2005 *not released **based on other Standards # V2 based on others

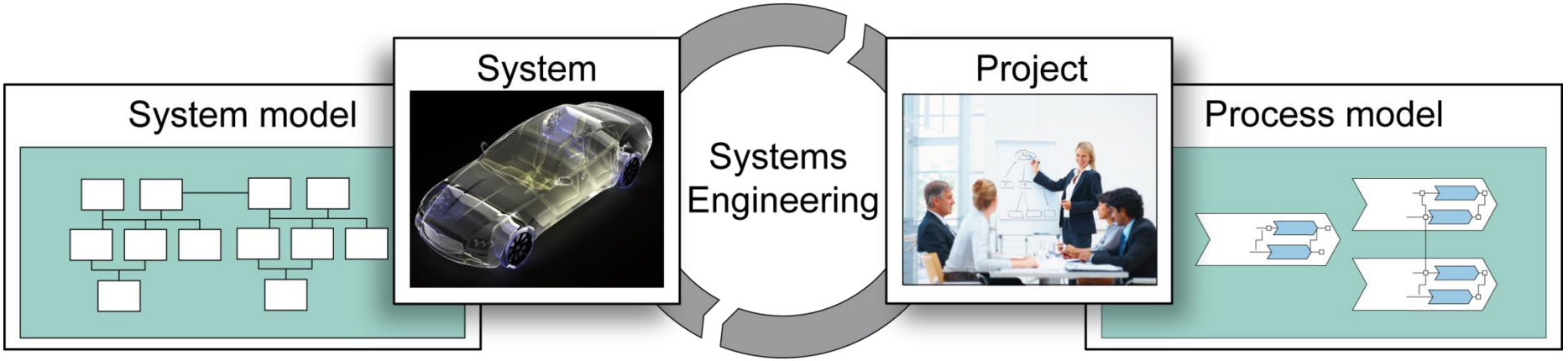
Systems Engineering in Practice:
The concept of Systems Engineering

Personally, what do you know about Systems Engineering?



There is no common acceptance of what SE is and what it is not.
The term lacks grip and clarity. SE is often seen as a “generic term”.

The concept of Systems Engineering (1/2)

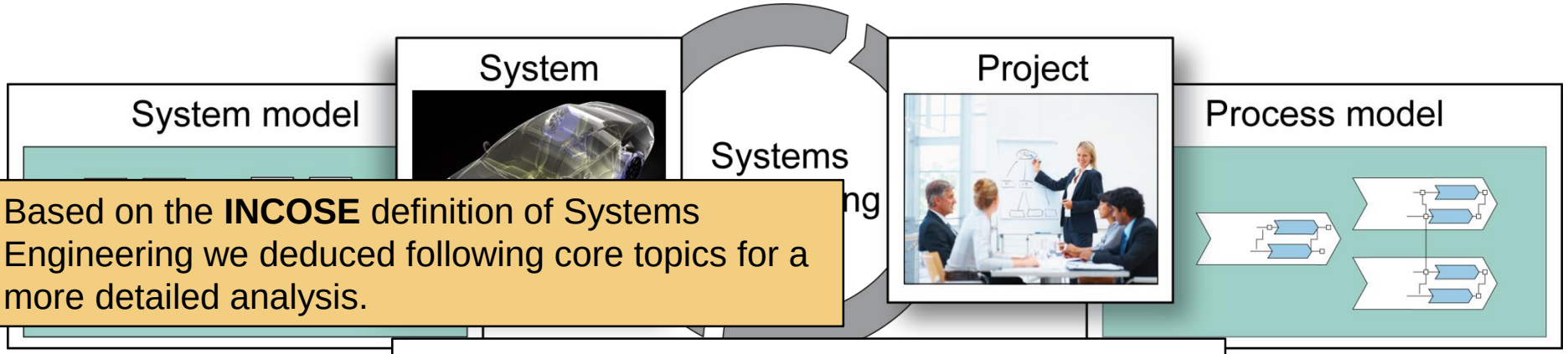


- requirements
- architecture
- analysis, simulation
- tests, validation
- optimization
- …

- resources
- stakeholders
- activities
- risks
- costs, time
- …

The System to develop and the related project need to be considered in collaboration.

The concept of Systems Engineering (2/2)



Based on the **INCOSE** definition of Systems Engineering we deduced following core topics for a more detailed analysis.

- requirements
- architecture
- analysis, simulatic
- tests, validation
- optimization
- …

ources
keholders
ivities
ks
sts, time

The System to deve **in collaboration.**

Core Topics of Systems Engineering:

- Requirements Management
- Domain-Spanning System Architecting
- Integrative Production System Development
- Model-Based Engineering
- Virtual Verification and Validation
- Product Lifecycle Assessment
- Process Tailoring

Conclusion

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- Tomorrows systems will be Intelligent Technical Systems
- Cooperation between technical (mechanical, electrical engineering etc.) and non technical disciplines (biology, cognitive science etc.) has to take place
- The Leading-Edge-Cluster it´s OWL enables the innovation leap towards Intelligent Technical Systemens for enterprises of the region OWL
- Common view in industry and academia:
  - Systems Engineering is indispensable to face tomorrow' s grand challenges
  - SE methods and tools need to be carried to a new advanced level to face the growing complexity along the product lifecycle
  - Research has to be done in close cooperation between academia and industry

Thank you for your attention!