Digital transformation and the need for Model-Based Systems Engineering

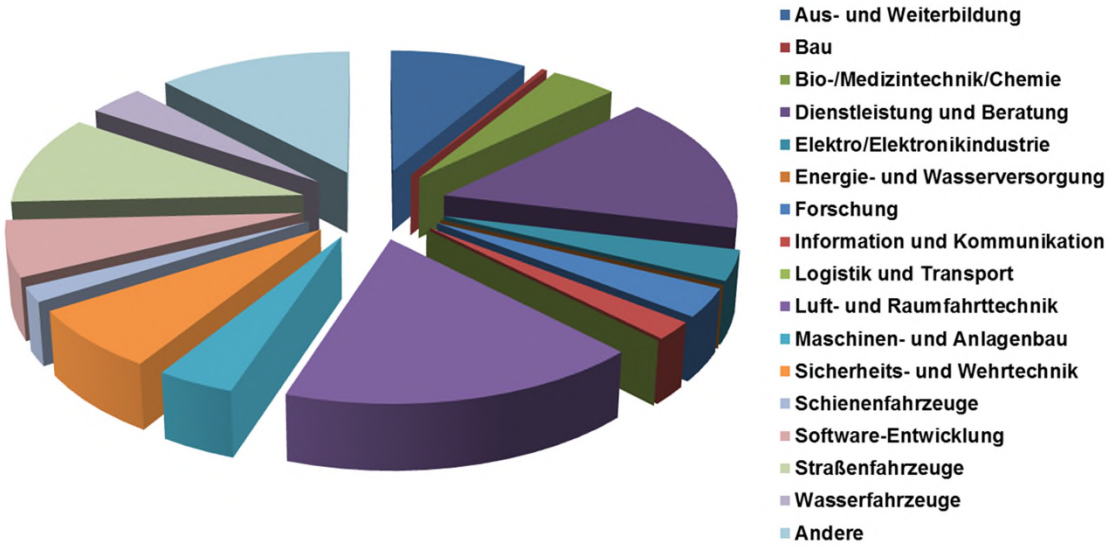
Model-Based Engineering, Automation and IoT in Smart Manufacturing

6th December 2017

The Network

GfSE
Gesellschaft für
Systems Engineering e.V.

- Founded 1997 as non-profit Organization
- Is INCOSE in Germany and Austria
- Members from different industries



INCOSE
International Council on Systems Engineering

- Founded 1990 as non-profit Organization
- Worldwide network of Systems Engineering competence

GfSE Portfolio

Systems Engineering competence in industrial practice

GfSE Gesellschaft für Systems Engineering e.V. GERMAN CHAPTER OF INCOSE

75% of companies see Systems Engineering as a management task for orchestrating interdisciplinary cooperation

Source: SE in industrial practice, 2013

80 %

of high-performance companies

consistently measure and optimize their engineering performance.

Source: The Mechatronics System Design Benchmark Report, 2006

The biggest **obstacles** for change to systems engineering:

31% difficulties to quantify business case

22% Lack of introduction methods

21% Missing own knowhow

Source: SE in industrial practice, 2013

57% of manufacturing companies today consider networking and intelligence as a driver of technical innovation.

Source: SE in industrial practice, 2013

Successful companies achieve their quality, cost, time-to-market and sales targets in

84%

of their development projects.

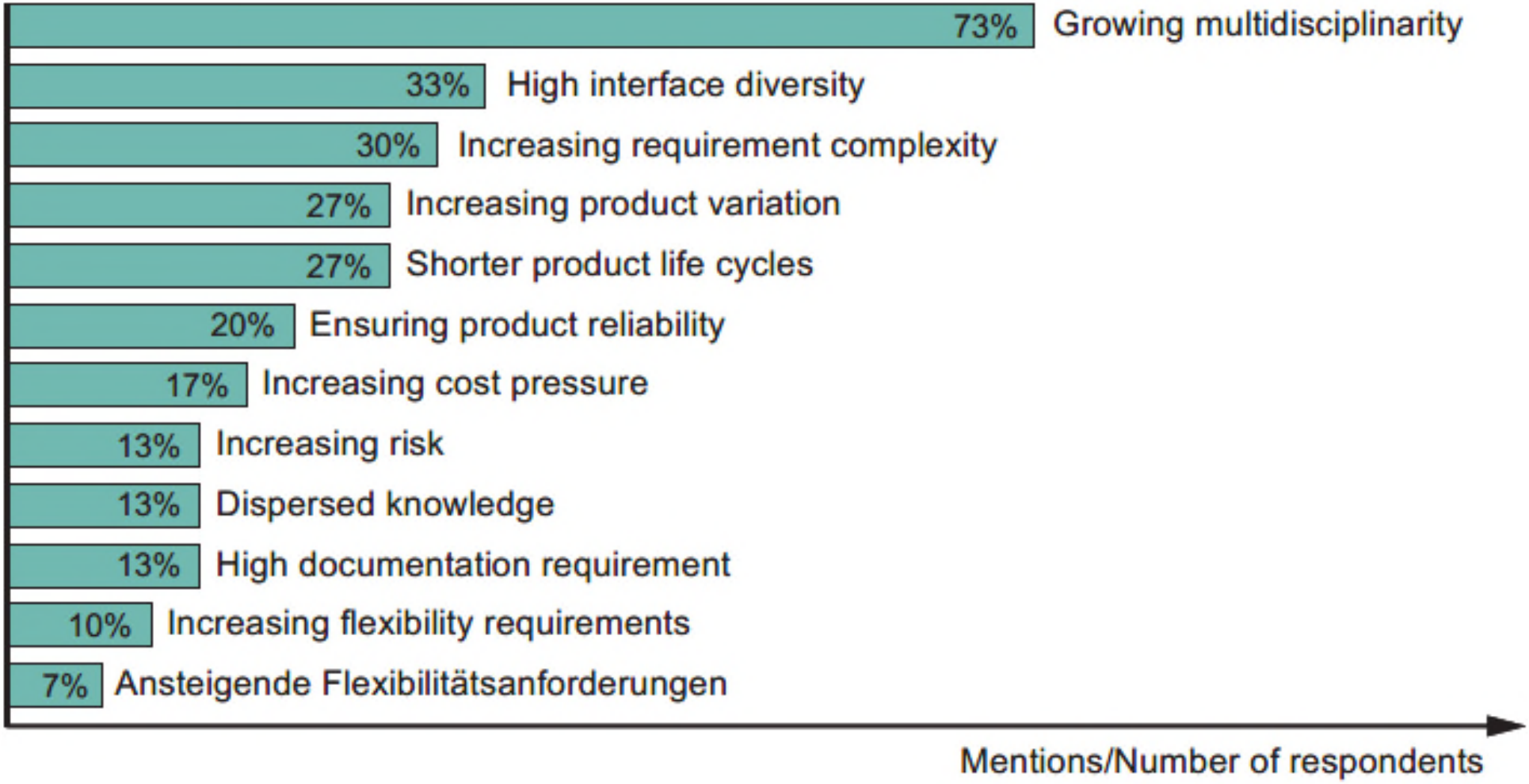
Source: The ROI of Systems Engineering: Some Quantitative Results, 2007

On average, every euro invested in the interdisciplinary concept phase generates a saving in later phases by

factor of 3.5

Source: Study of Systems Engineering Effectiveness, 2011

Challenges in product engineering of tomorrow

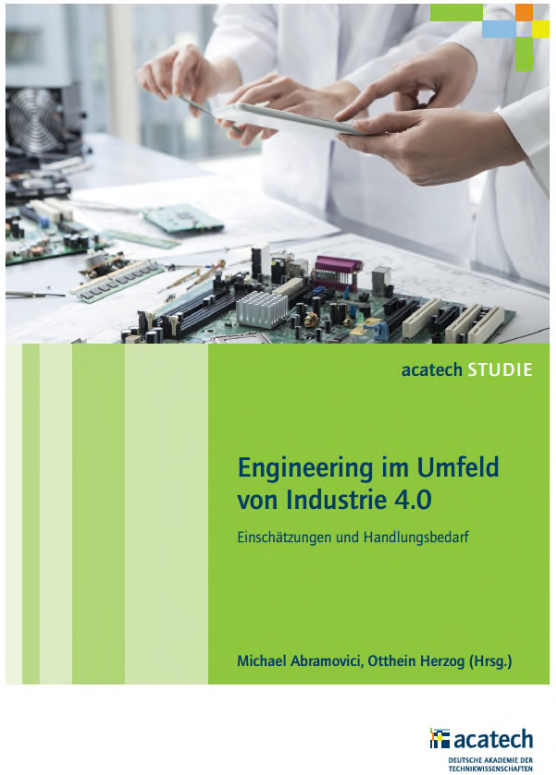


Referenz: Systems Engineering in der industriellen Praxis, Studie; Gausemeier, J.; Dumitrescu, R; Czaja, A.; Wiederkehr, O.; Tschirner, C.; Steffen, D.; Paderborn, 2013

Studies in Germany

- GfSE Industry Best Practice Circle
  - Position paper

- More studies…



Summary: The need for Systems Engineering and MBE/MBSE is strengthened

Industrial Revolution Overview

4. Industrial Revolution

Autonomous products and decision-making processes control value-added networks in near real-time

3. Industrial Revolution

Automation of production by electronics and IT

2. Industrial Revolution

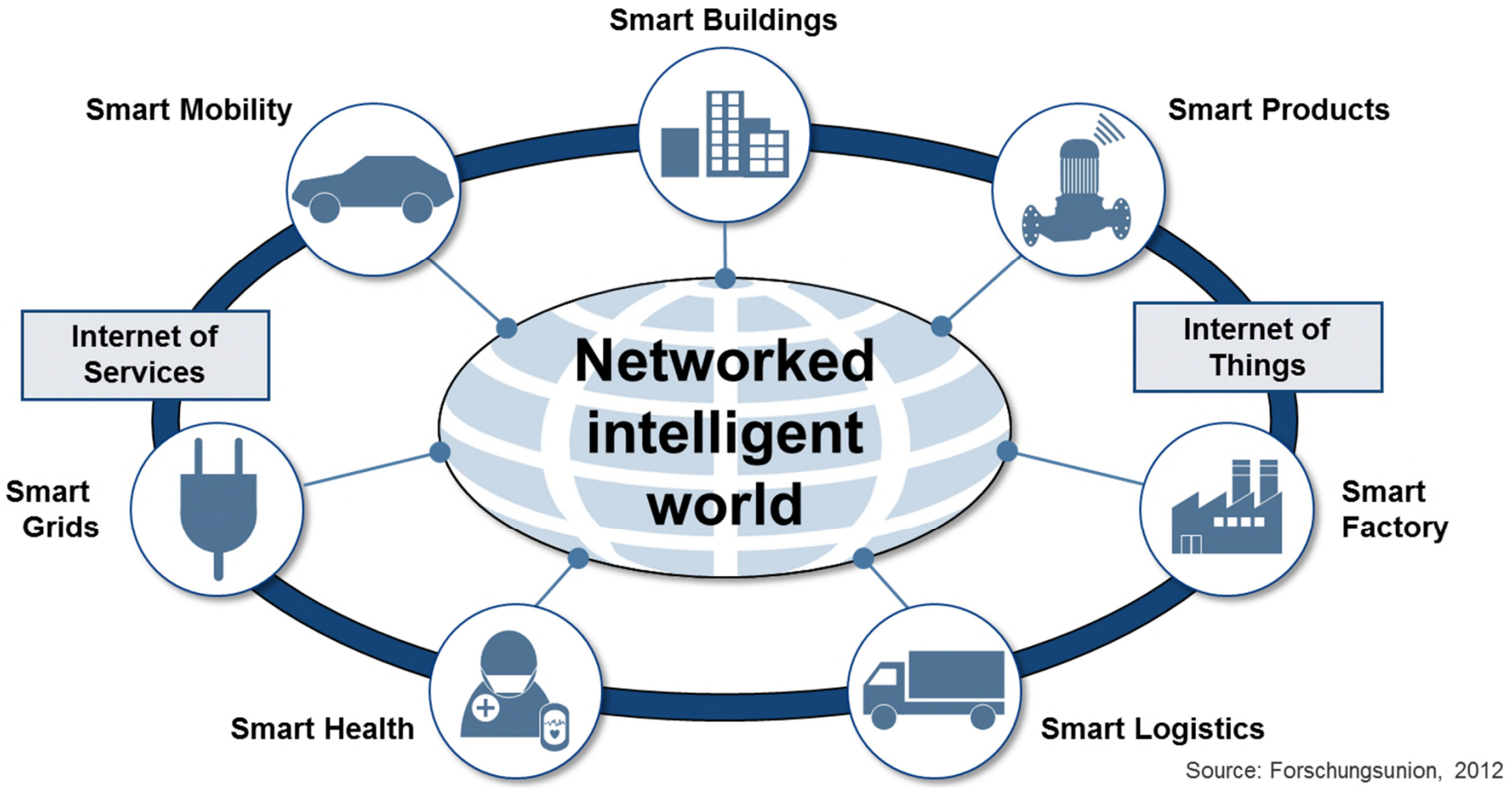
Technologies of mass production based on the division of labour by means of electronic energy

1. Industrial Revolution

Introduction of mechanical production lines

Any industrial revolution caused an improvement in productivity and was accompanied by fundamental social changes.

Field of Applications – consider the big picture



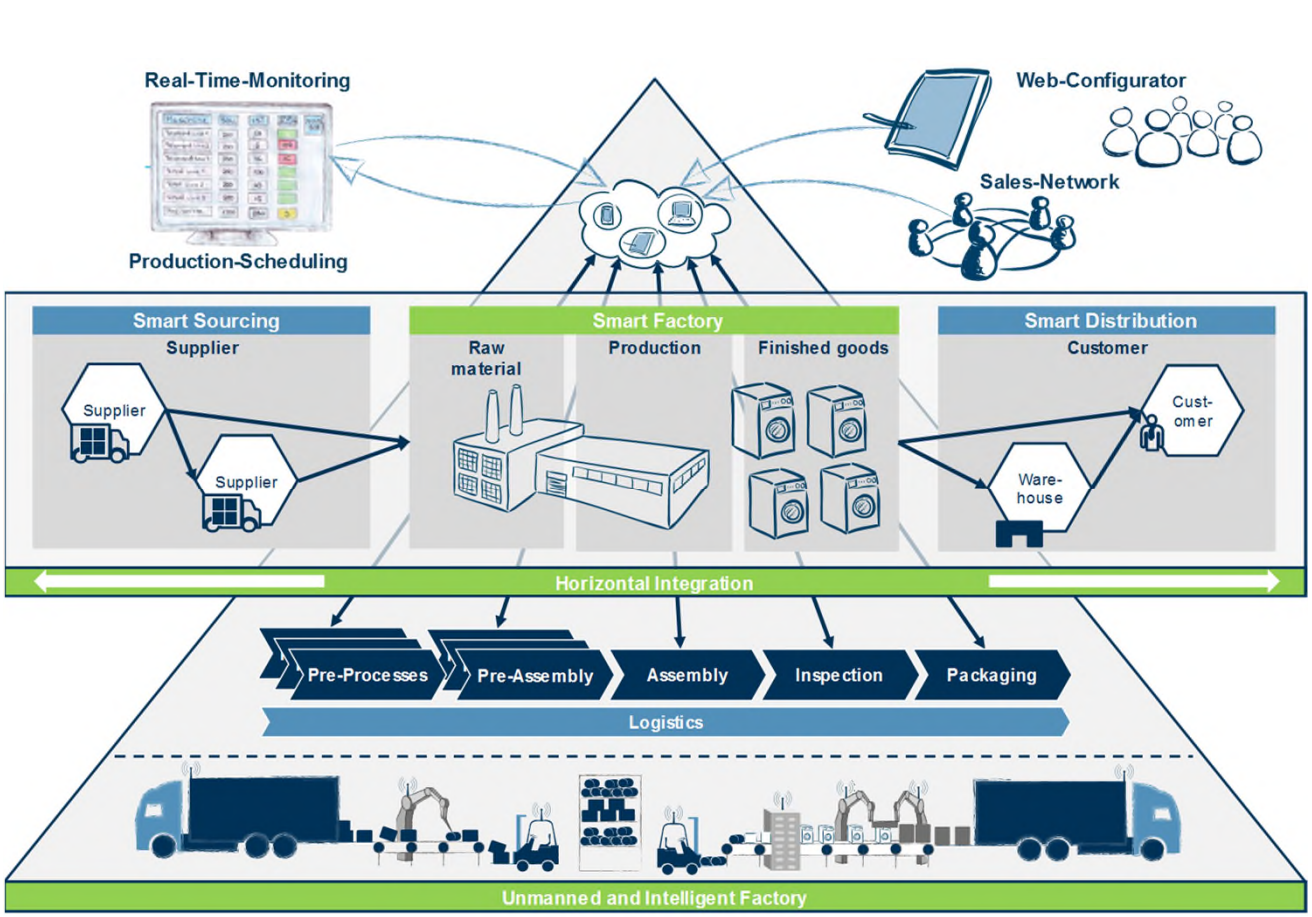
With the digitization and networking of all environments new requirements and dependencies arise.

Impacts on the manufacturing industry

- Increasing digitization and connectivity (internet of things and services)
- Internationalization and increasing global competition
- Shifting demand towards emerging markets
- Individualization of products and services at a high level of productivity
- Shorter life cycles of products
- Demographic change and changing work environment
- Resource conservation and energy efficiency
- Managing complex systems and maintaining their reliability
- Protection of information (IT security) and intellectual property

"Industry 4.0" enables new ways of value creation and new kinds of business models. This requires new technical solutions with integrated IT systems.

Industry 4.0 for manufacturing
Horizontal and Vertical Integration



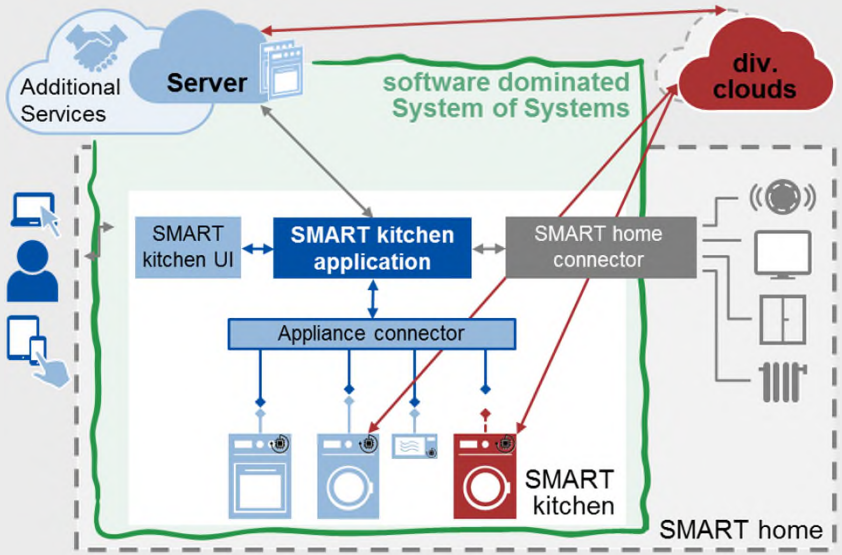
Reference: UNITY AG

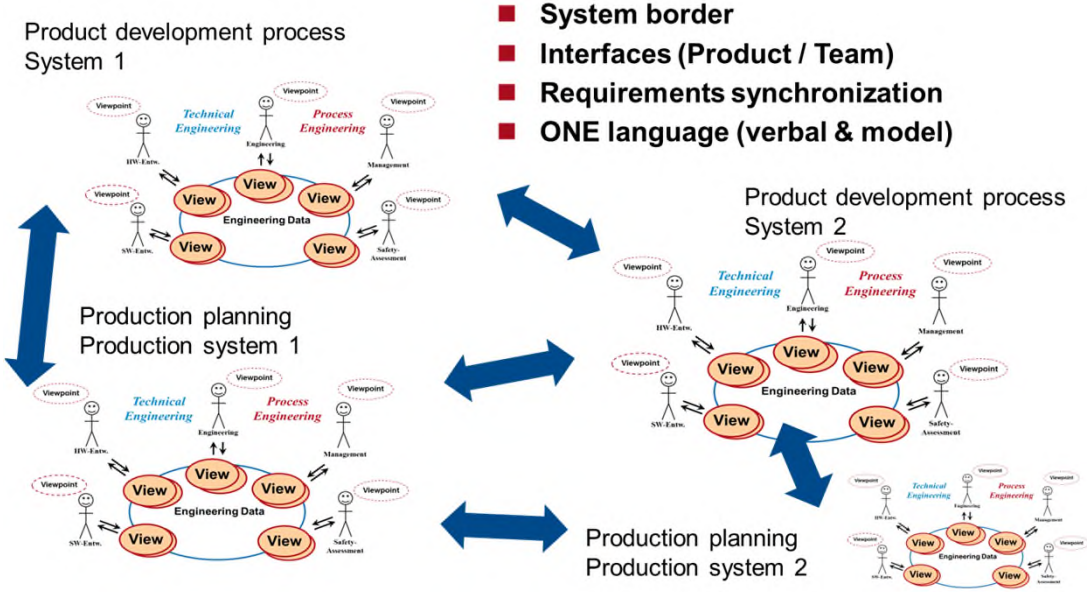
- **Vertical Integration**
  - Integrated product design and manufacturing system
  - Product configuration via internet by customer
  - Self-controlled production by intelligent und automatized equipment solutions
  - Smart product in its service environment
- **Horizontal Integration:**
  - Optimization of supplier network integration and scheduling
  - Real-Time-Monitoring of overall performance

Industry 4.0 will result in smart factories due to the networking of intelligent machines and products.

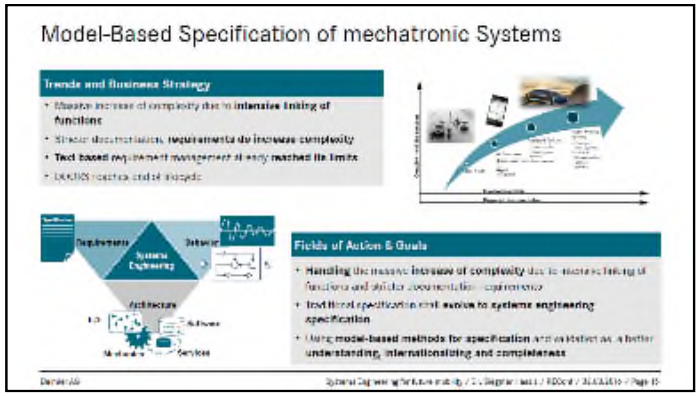
Activities and directions

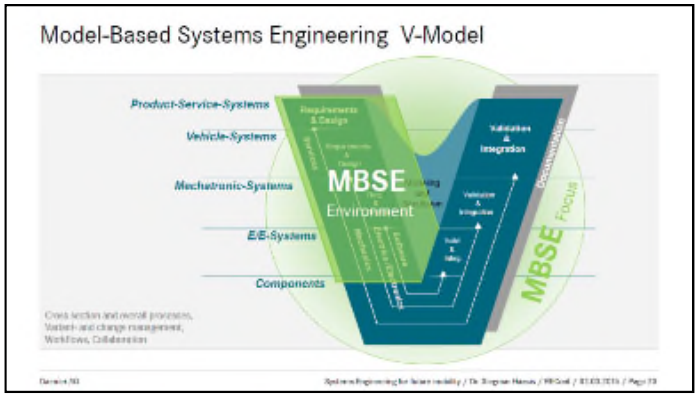
The challenge

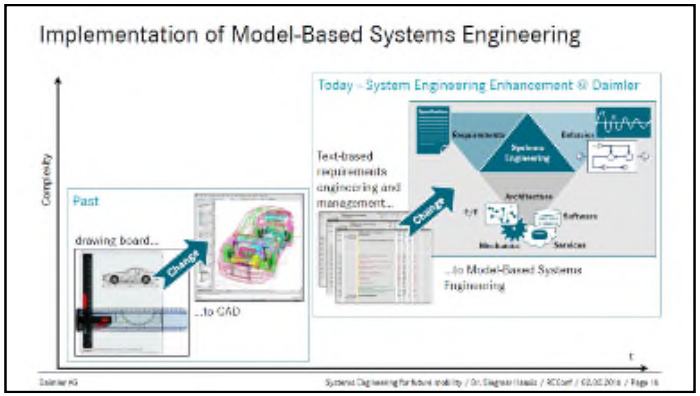




Example: From textual based specification to Model-Based Specification (SysML)

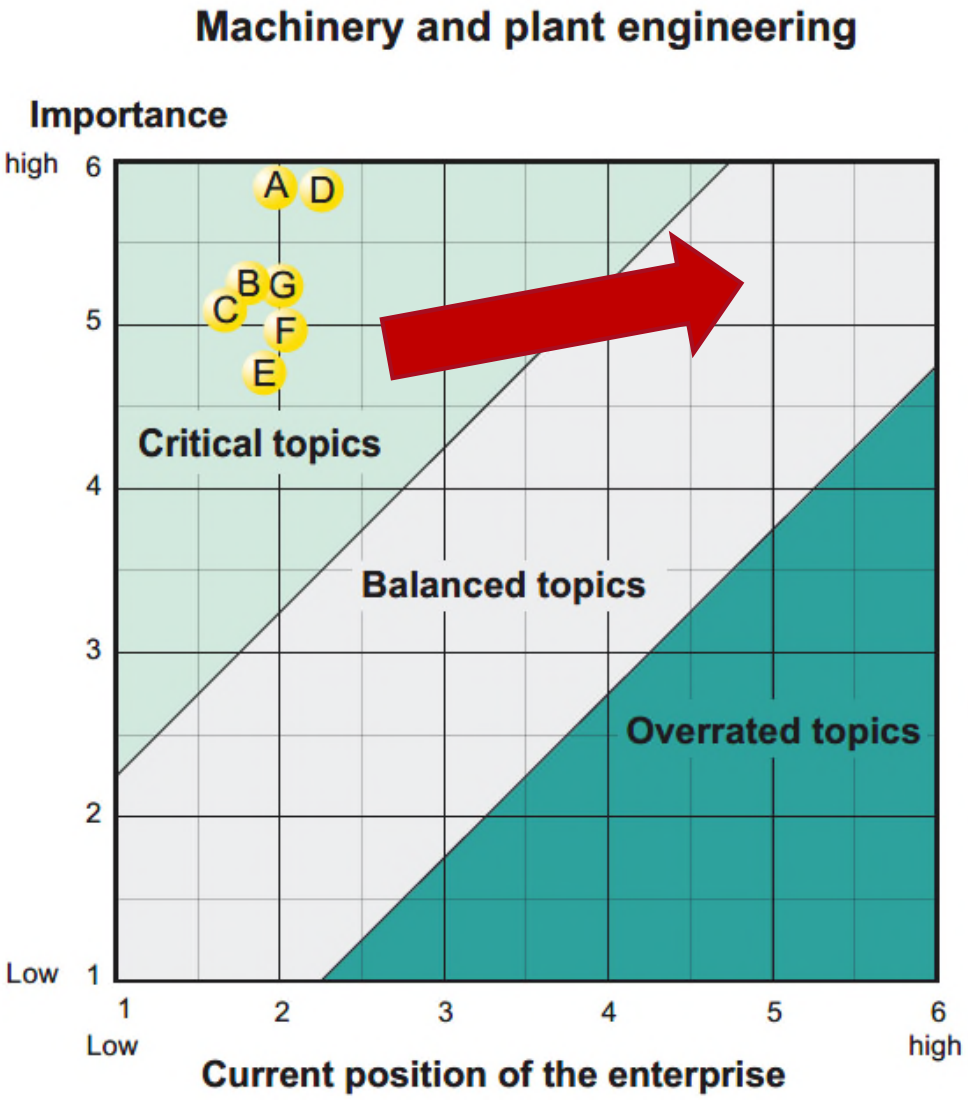






Reference: Daimler; ReConf Presentation

Industry-specific assessment of SE-related topics



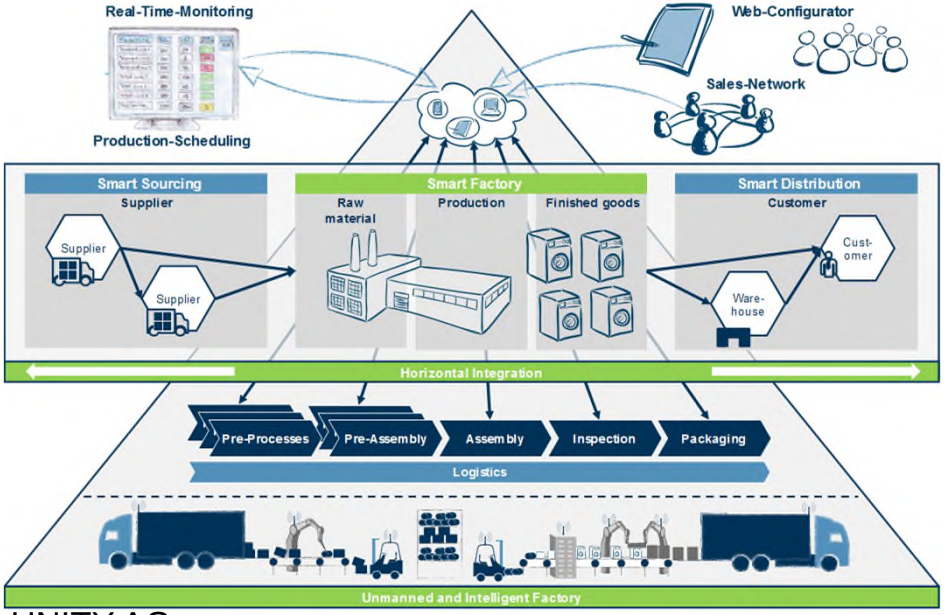
- A Requirements Management
- **B Model-based Systems Engineering**
- **C Model-based product development**
- D Virtual verification and validation
- E Integrative planning of the production system
- F Consideration of the whole product lifecycle
- G Project-specific adjustment of development processes

Reference: Systems Engineering in der industriellen Praxis; Paderborn, 2013

IoTS increasing the dynamic

New business models

- Product-Service combinations
- Shorter innovation cycles
- Design-to-Order capability
- Paradigma „Digital Twin“



Reference: UNITY AG

New producs / services

- System of Systems connectivity / M2M
- „local“ intelligence using new technologies
- Configuration capability (lot size 1)
- System thinking in intelligent and modular modules

New processes

- New relationships and work flow between Engineering, Production and Sales
- New competencies and partner
- New IT tools and methods

This requires an integrated MBSE approach, tailoring capability and IT scalability over the life-cycle and standardization.

Thank You

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