INDUSTRY 4.0

Overview

The Fourth Industrial Revolution: Industry 4.0

Industry 1.0 "Mechanization"	Industry 2.0 "Electrification"	Industry 3.0 "Automation"	Industry 4.0 "Autonomization"
Mechanical production equipment with water and steam power	Mass production with division of labor and electrical energy	Automation of production with electronics and IT	Cyber physical production based on the internet of things & services

1784 first mechanical loom	1870 first conveyor belt	1969 first programmable logic controller (PLC)	…
1800	1900	1970	today

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Definition of Key Terms

Internet of Things

A global infrastructure enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies. [ITU 2012]

Industrial Internet

An internet of things, machines, computers, and people, enabling intelligent industrial operations using advanced data analytics for transformational business outcomes. [IIC 2015]

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Definition of Key Terms

Cyber Physical Systems

Embedded Systems with a range of multi-modal and interconnected human-machine interfaces that collect and process data through sensors and manipulate physical operations through actors. [acatech 2011]

Embedded Systems

A microprocessor-based system that is built to control a (range of) function and is not designed to be programmed by the end user. [Heath 2003]

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# Definition of Key Terms

Industry 4.0

The technical integration of CPS in production and logistics as well as the application of the internet of things and services in industrial processes – including the resulting consequences for the value creation, busines models, and the subsequent services and industrial engineering. [AKI 2013]

Smart Factory

Factories with decentralized production logic based on intelligent products in horizontally and vertically embedded production systems for a consistent engineering along the value chain. [AKI 2013]
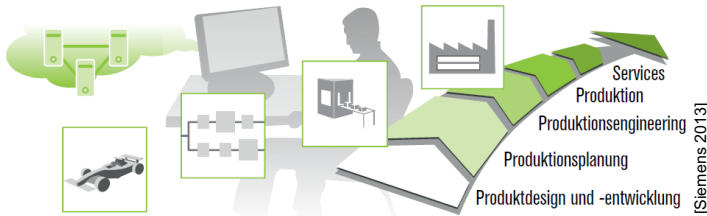
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Relationship Between Key Terms
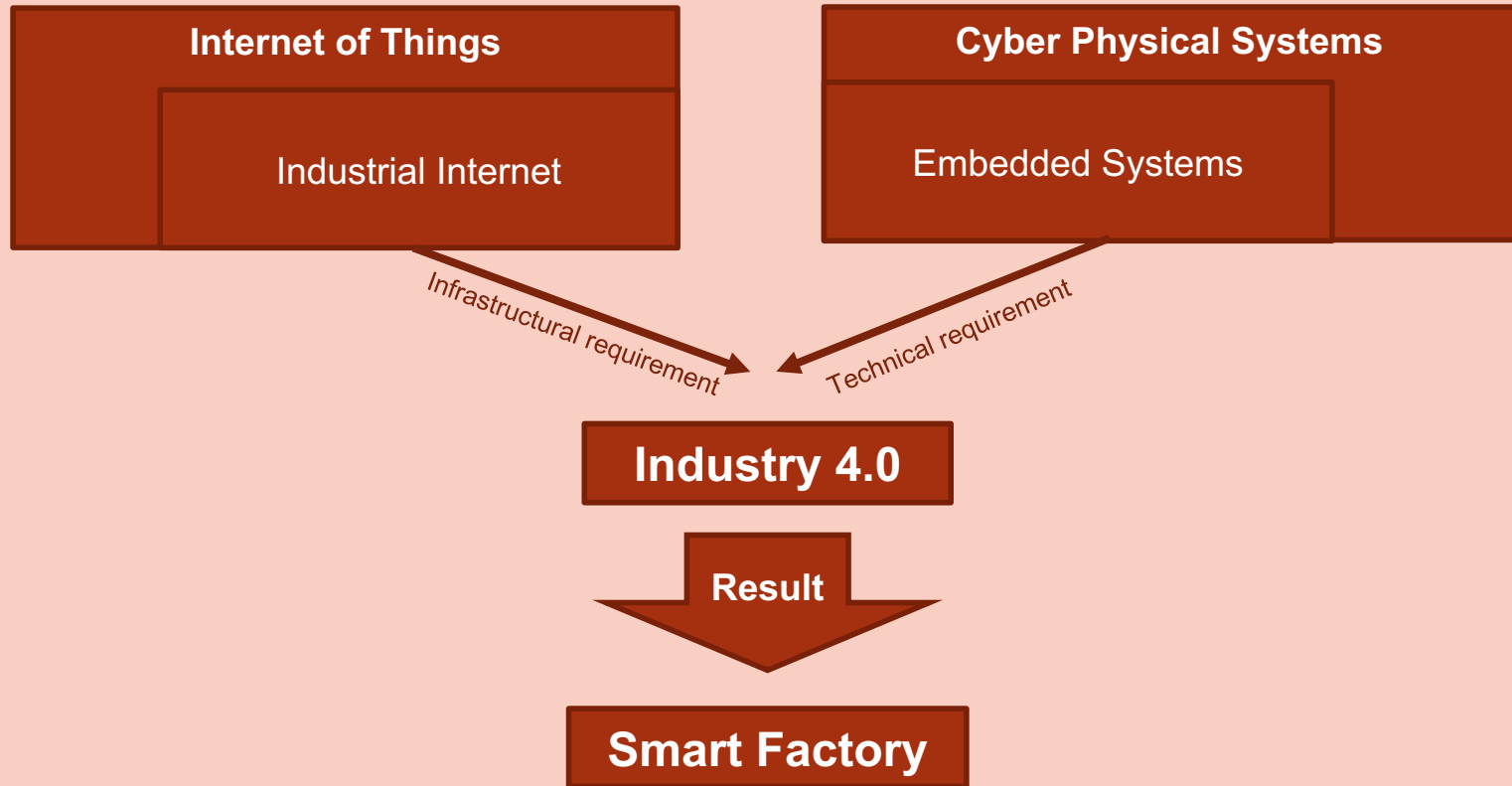
Types of Integration in Industry 4.0
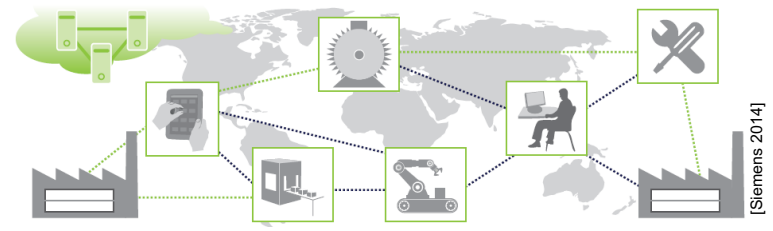
Vertical Integration

Integration of different IT systems on different hierarchy levels (e.g. actors and sensors level, control level, manufacturing management level, manufacturing execution level, corporate planning level) to a consistent solution. [AKI 2013]

Services
Produktion
Produktionsengineering
Produktionsplanung
Produktdesign und -entwicklung
[Siemens 2013]

company-wide
planning layers
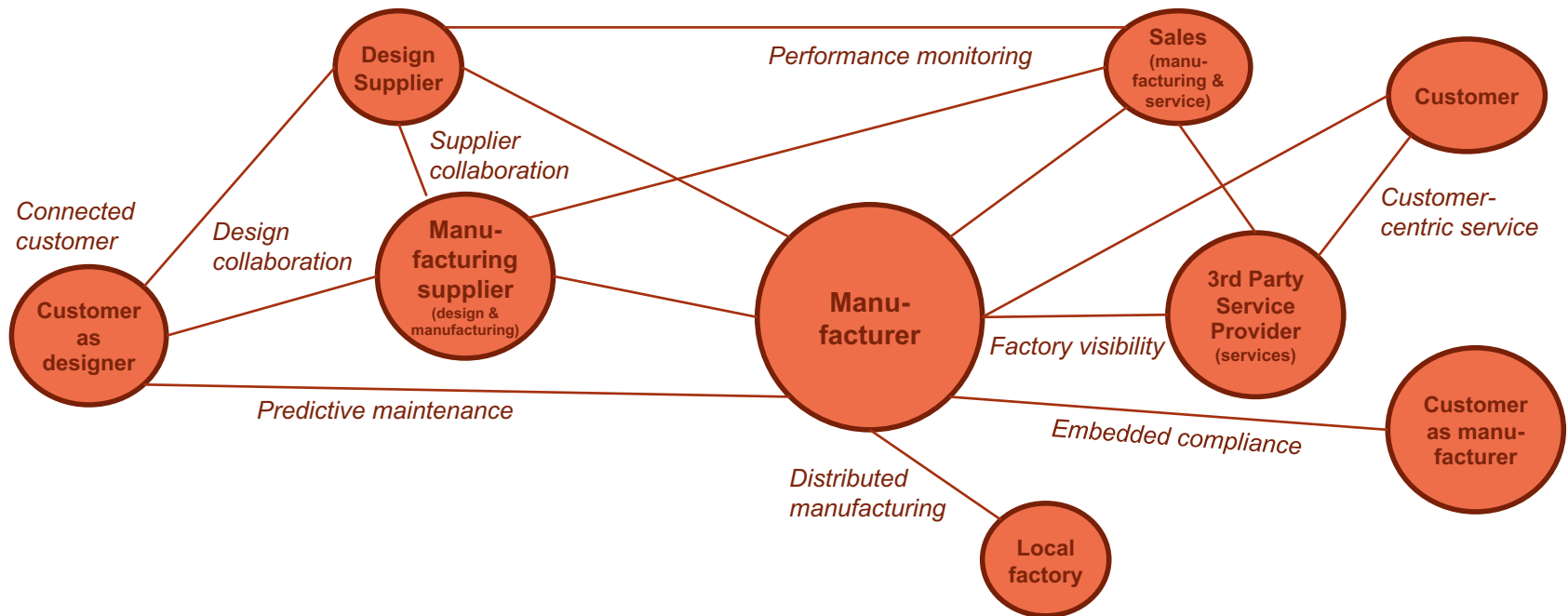
Horizontal Integration

Integration of different IT systems for different process steps of manufacturing and corporate planning which are connected through material, energy, or information flows both company-wide (e.g. inbound logistics, manufacturing, outbound logistics) and across several companies to get a consistent solution. [AKI 2013]
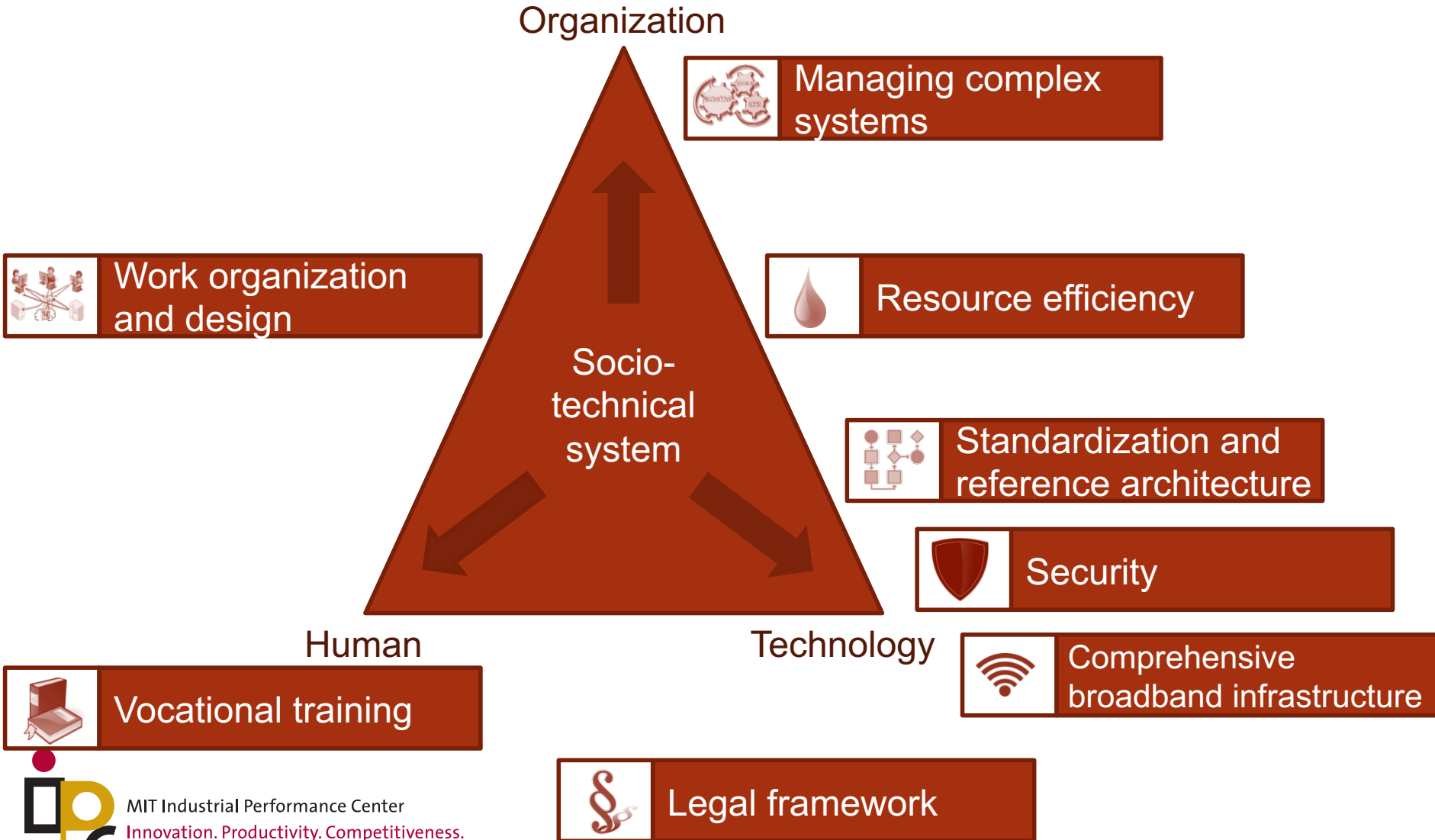

[Siemens 2014]

company-wide and cross-company
value chains

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Facets of horizontal Integration

Innovate — Design — Plan — Make — Service

Design Supplier

Sales (manu-facturing & service)

Customer

Performance monitoring

Supplier collaboration

Connected customer

Design collaboration

Manu-facturing supplier (design & manufacturing)

Manu-facturer

Customer-centric service

Customer as designer

3rd Party Service Provider (services)

Factory visibility

Predictive maintenance

Embedded compliance

Customer as manu-facturer

Distributed manufacturing

Local factory

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[SAP 2013a]

Challenges in Industry 4.0

Organization

Managing complex systems

Work organization and design

Resource efficiency

Socio-technical system

Standardization and reference architecture

Security

Human

Technology

Vocational training

Comprehensive broadband infrastructure

Legal framework

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based on [AKI 2013] [Spath et al. 2013]

What are the Opportunities in Industry 4.0?

Product	Process	After Sales Service
Digital product memory	One-piece flow	Fraud-secure warranty management
Integrated compliance	Asset information management	Targeted recall management
Service-enabled products	Predictive maintenance	Service cross-selling
	Adaptive & transparent logistics	
	Anticipatory quality management	

Smart Products

Smart Processes

Smart Services