Digitale Transformation in der Landwirtschaft - Landtechnik im Wandel des 21. Jahrhunderts

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Dresden, 19. Oktober 2016 | simul+ Forum Landwirtschaft 4.0 in Sachsen

Today high performance agricultural machines establish productivity by

- growing working width,
- higher operational speed,
- larger storage volumes,

which expands engine power, weight & size.

→ weight and dimension now are becoming a major limitation (NA, EU)

Machines become smarter by

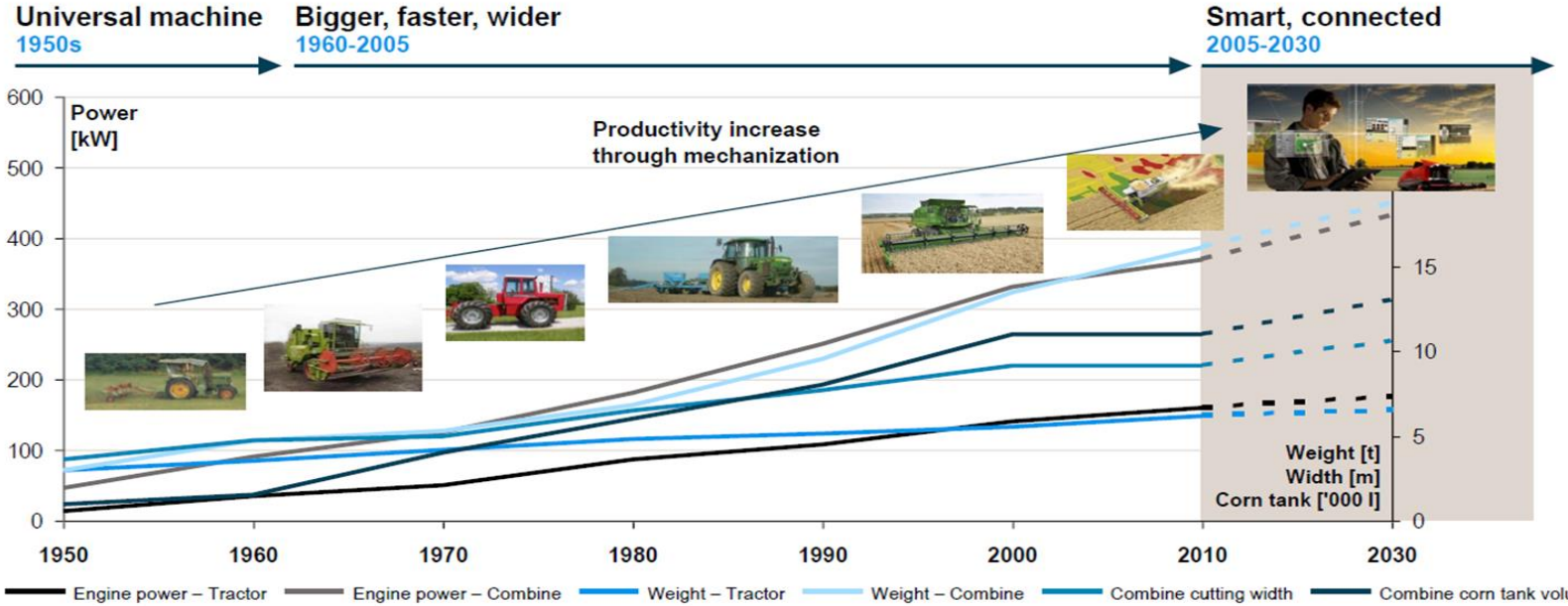
- Process Automation
  - Internal System-and Process Control
  - Machine Fleet Management
  - Process Chain Control
  - Autonomous Machine Control

yet immature

Evolution to Smart & Connected

After a steady increase in machinery parameters in the past, agricultural machinery is becoming smarter and more connected

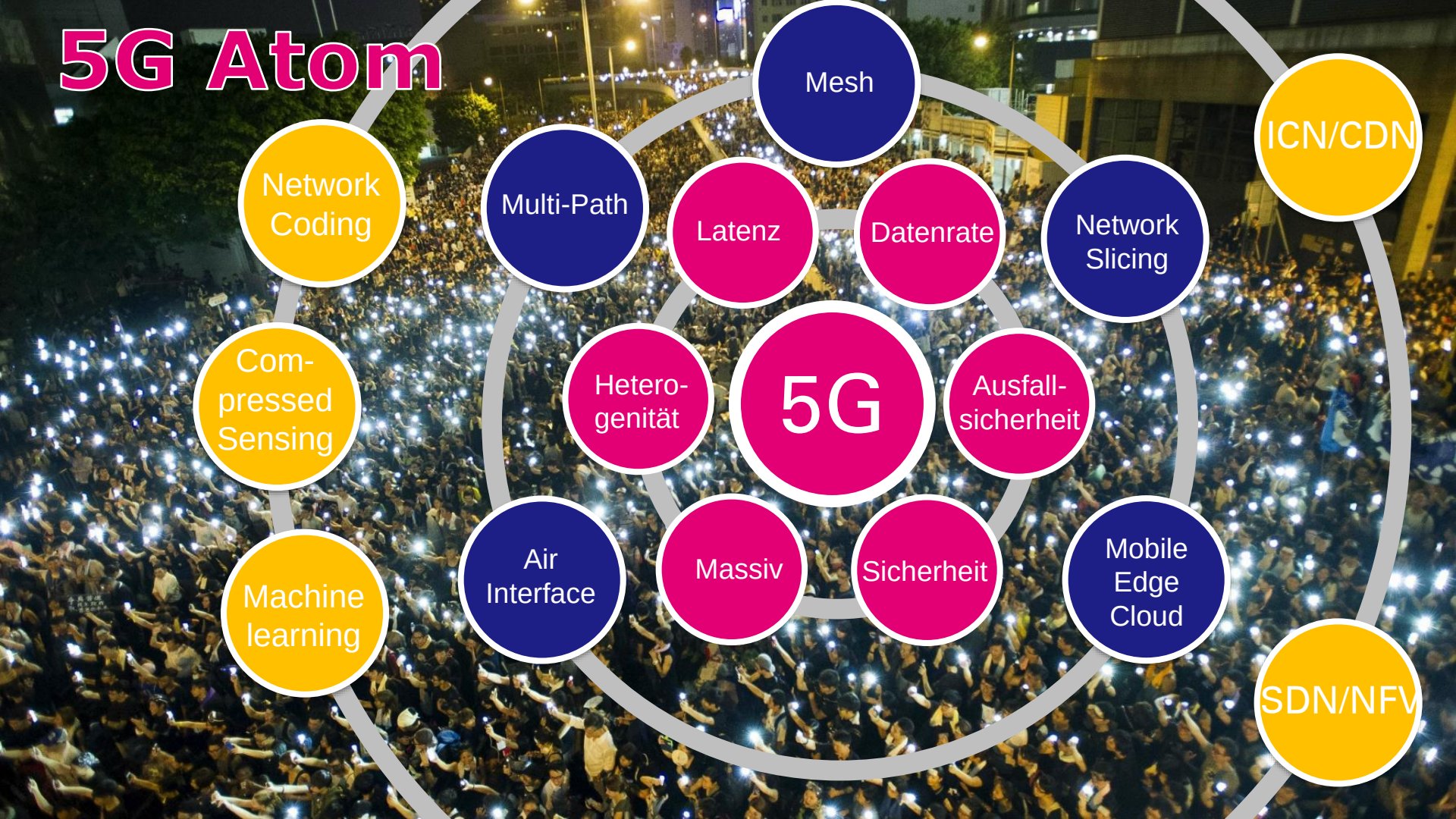
Evolution of agricultural machinery, past and future (Europe)



Source: Roland Berger Consultants

Future information and communication technology **could** change agricultural production processes in a unprecedented way

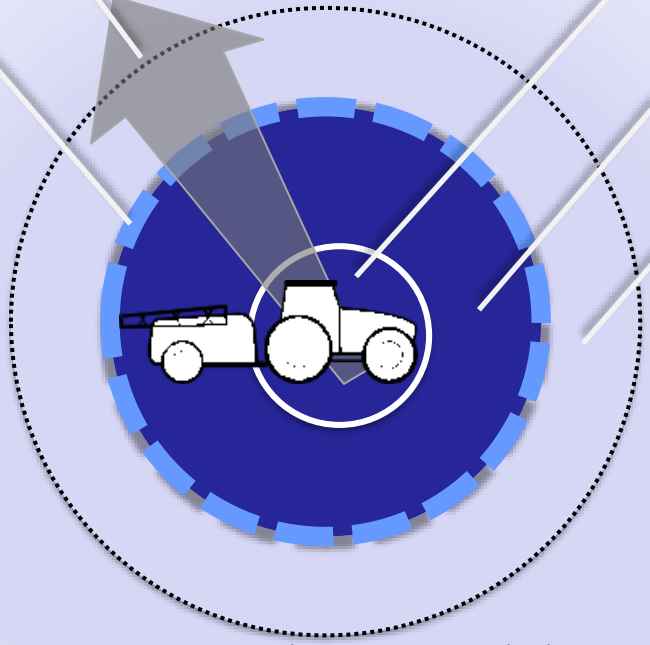
- 5G mobile communication
- Mobile/Cloud Computing – Smart Phones, Tablets
- Internet of Things – automated data exchange between devices
- location based monitoring – GIS information, UAS
- Big Data – Linked Open Data


5G Atom
Mesh
ICN/CDN
Network Coding
Multi-Path
Latenz
Datenrate
Network Slicing
Com-pressed Sensing
Hetero-genität
5G
Ausfall-sicherheit
Air Interface
Massiv
Sicherheit
Mobile Edge Cloud
Machine learning
SDN/NFV

Evolution of Machines
from embedded to cyber – physical systems

increasing complexity

communication wall between machine system and the world



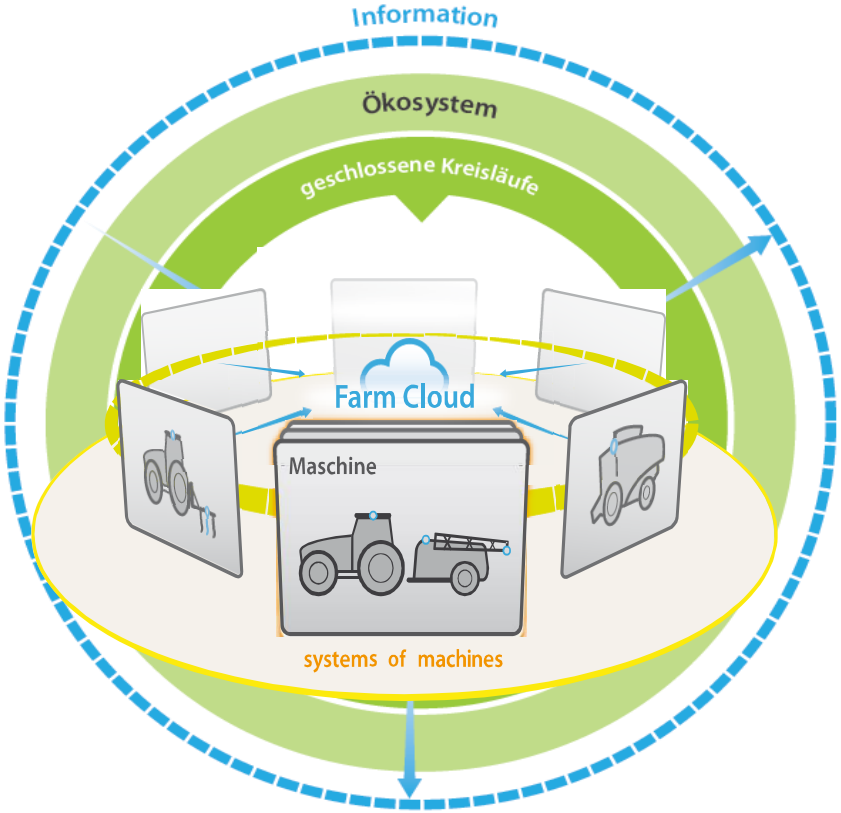
Embedded System
e.g. hitch controller

Controllernetzwerk
e.g.traktor-implement - ISO-Bus

Cyber-Physical System
e.g. M2M, Telematics

Vision:
Internet of Things
Data & Services

Challenges in Agri-Business



- productivity
- peak performance
- process quality
- cost of ownership

↕

- connectivity

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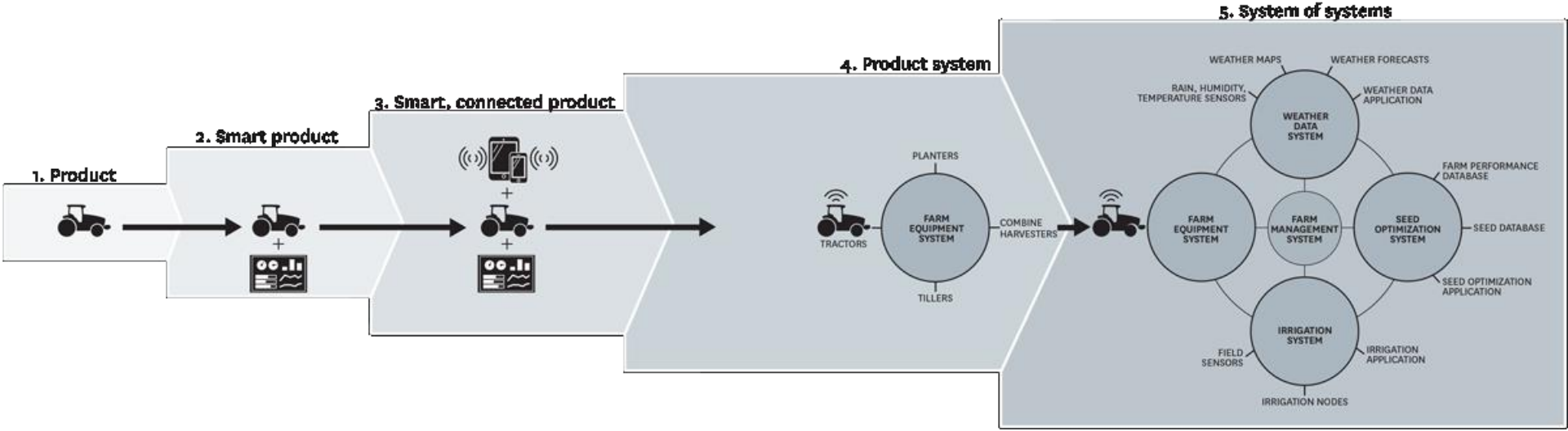
- sustainability
- resource recirculation
- biodiversity

How Smart, Connected Products Are Transforming Competition



Harvard Business Review
Michael E. Porter is a University Professor at Harvard, based at Harvard Business School in Boston
James E. Heppelmann is the president and CEO of PTC

Definition Cyber–Physical System

Definition Edward A. Lee, 2008 [1]:

„Cyber-Physical Systems (CPS) are integrations of computation with physical processes.

Embedded computers and networks monitor and control the physical processes, usually with feedback loops where physical processes affect computations and vice versa."

Acatech research agenda, 2012 [2]:

Connection of physical system with information technology utilizing open global networks (e.g. Internet)

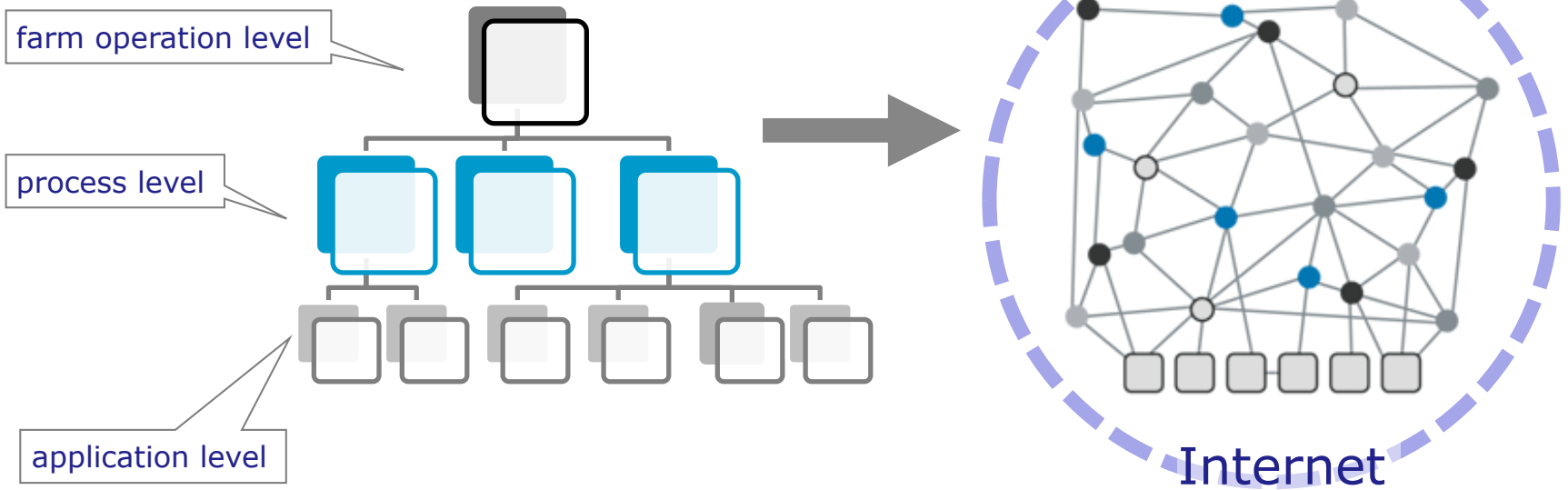
Typical examples "Smart Grids", „Car-to-X"

[1] Cyber Physical Systems: Design Challenges", E. A. Lee, Technical Report No. UCB/EECS-2008-8; http://www.eecs.berkeley.edu/Pubs/TechRpts/2008/EECS-2008-8.html

[2] Integrierte Forschungsagenda Cyber-Physical Systems, Acatech 2012; http://www.acatech.de/?id=1405

current automation structures

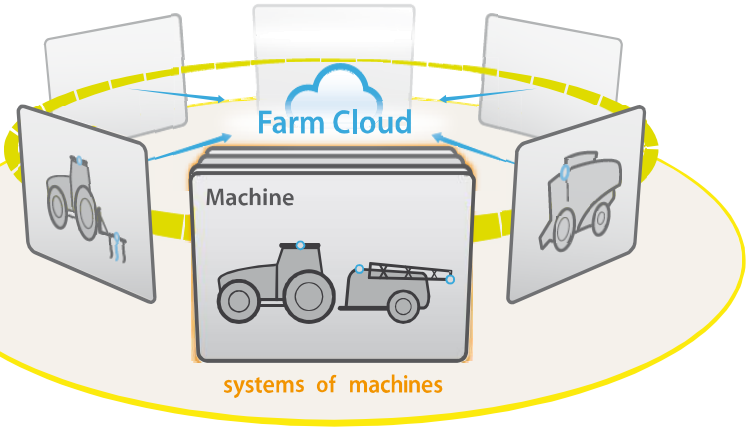
CPS based automation



Definition of mobile cyber physical systems

Connectivity
machine to machine
machine to human
machine to infrastructure

systems of machines
Systems of systems



Automation

Security and safety

New business models

Human centered

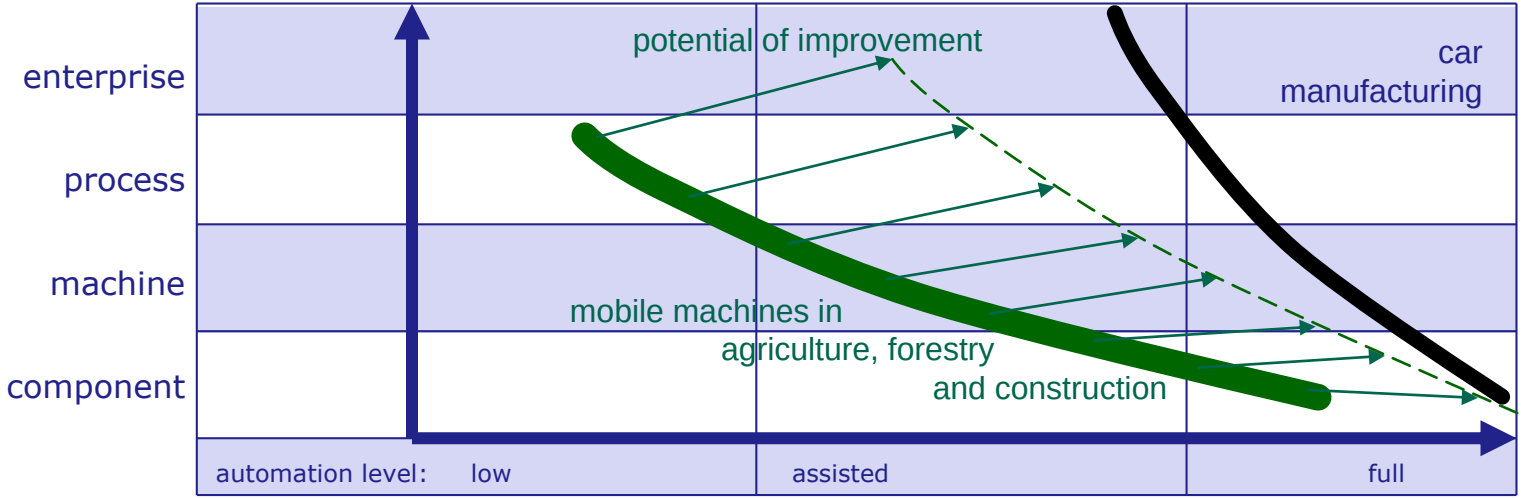
Future creation of added value takes place with many and in real time communicating players in closely connected networks .

Roland Berger Strategy Consultants / BDI, 2015
DIE DIGITALE TRANSFORMATION DER INDUSTRIE

Robust and economical viable automation is pre-condition for autonomous systems

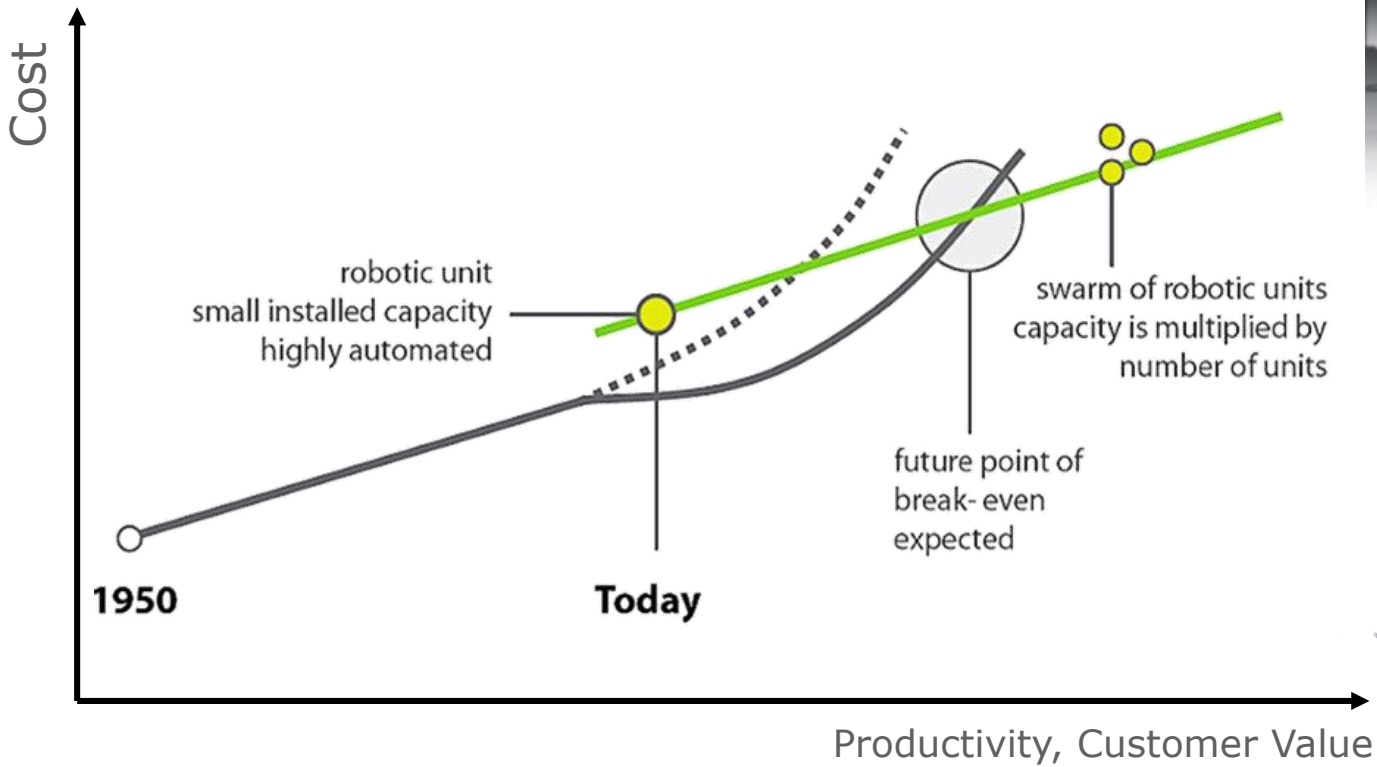
Problem of automation in biobased value chains:

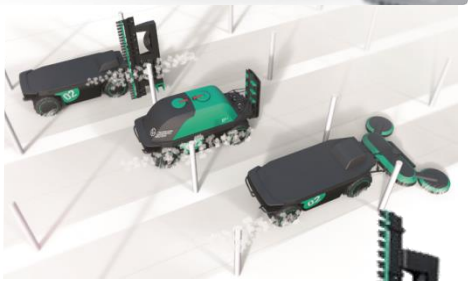
- many disturbances and strong variation of inputs
- lack of sensors and process knowledge
- huge diversity of machines and execution of processes

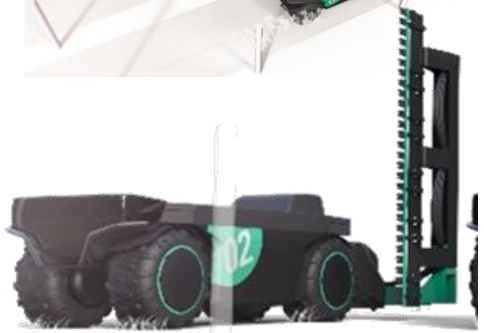


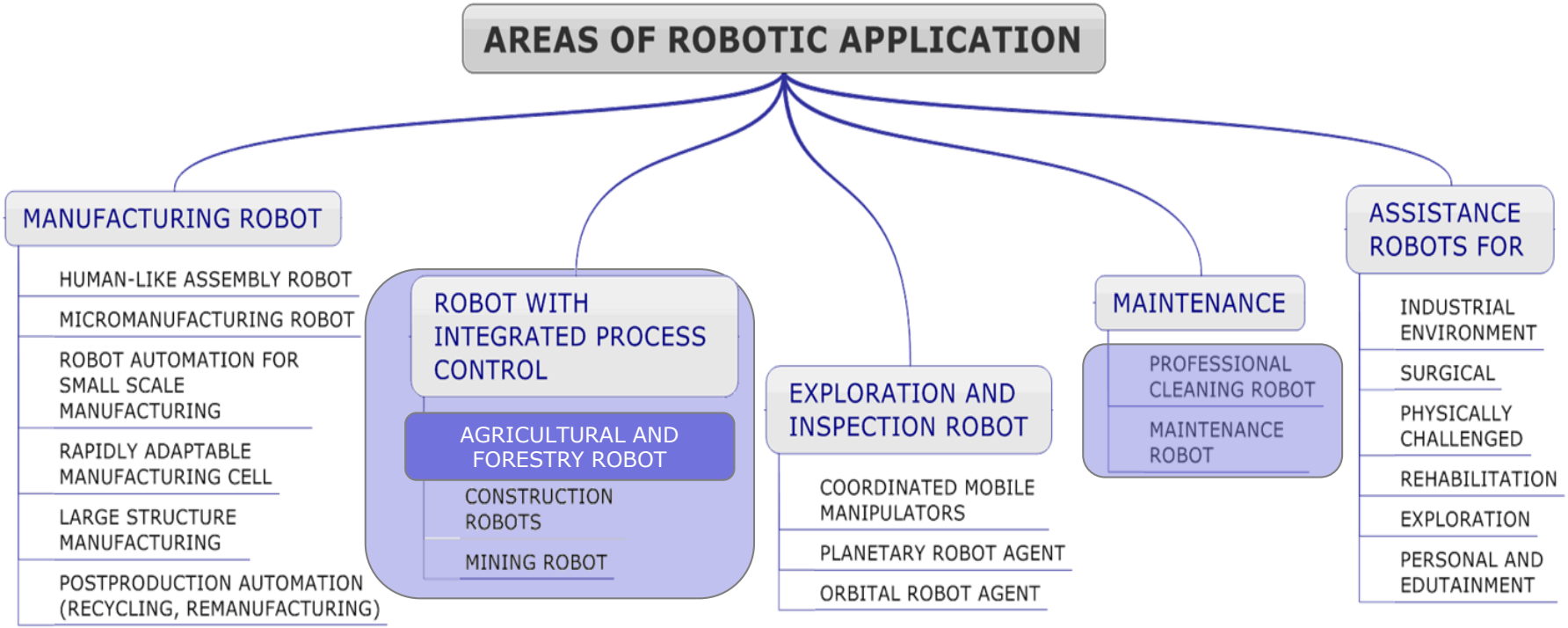
Griepentrog (2015), modified

Vision of systems of machines towards robotic swarms



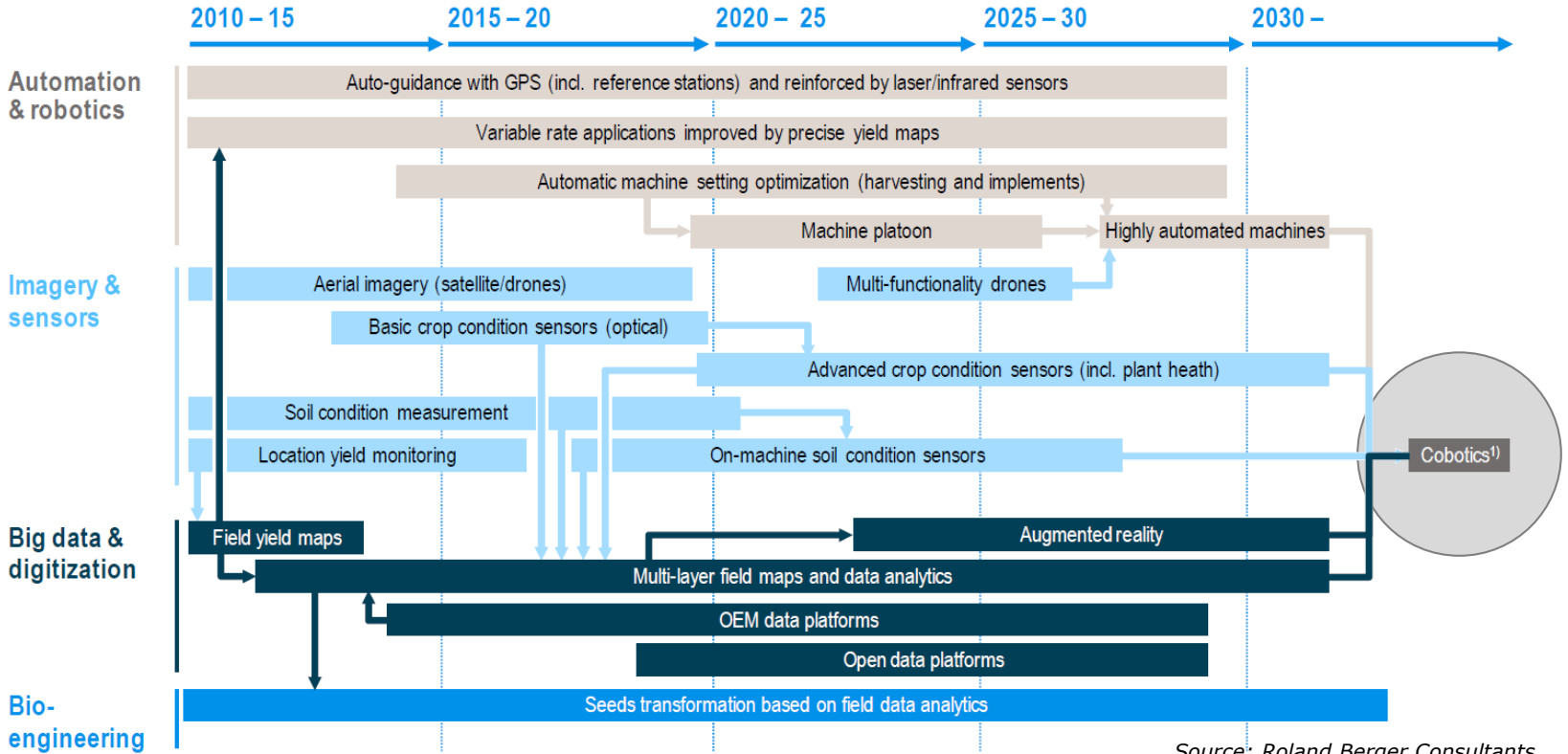






European Robotics Technology Platform: Robotic Visions to 2020 and beyond The Strategic Research Agenda for robotics in Europe, 07/2009 (second edition)

Technology roadmap for developments driven by enhanced connectivity



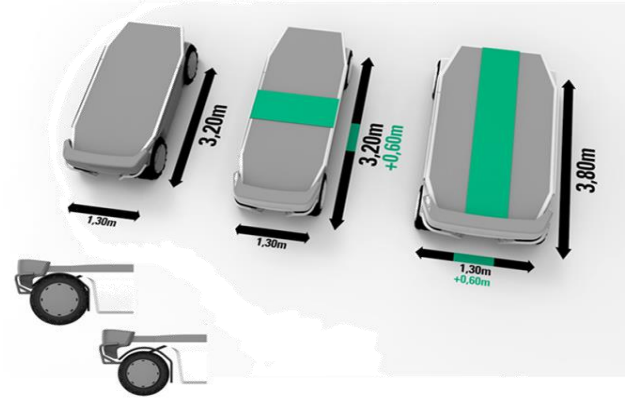
Source: Roland Berger Consultants

1) Collaboration of humans and machines

Model range of a robotic platform for vine and fruit with standardized tool interfaces

modularized components

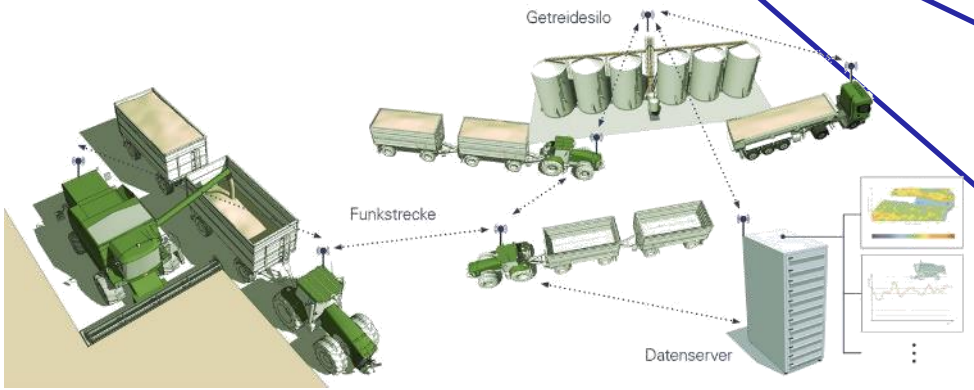
- chassis and drives
- application and tools
  1. spraying
  2. mulching
  3. cutting / pruning
  4. transporting
- sensors and navigation



(*) durch die BLE gefördertes Projekt
Partner: Hochschulen Osnabrück . Geisenheim, TU Dresden, Raussendorf, Obstland Sachsen, Weingut Schloss Proschwitz

Communication Technology as Enabler

Connectivity
machine – machine
human – machine
machine - infrastructure



Robotics & Automation
navigation
autonomy of machine fleets
Telematics

Digitalisierung/Big Data
analysis & forecast climate, soil
process optimization
remote operation and surveillance

Sensorik
characteristic process data
stationary In-Field-Sensors
image processing bird view images
UAV airborne sensors

Bio-Engineering
assistance systems Seed selection
Seeds transformation based on
field data analytics

Swarm vision for tillage and seeding
autonomous implement modules
virtually connected to leader

Swarm vision for grain harvest
autonomous combine modules
supervised from operator at site

Willkommen in der neuen Welt der Cyber-Physikalischen Systeme