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Robotics & Industrie 4.0

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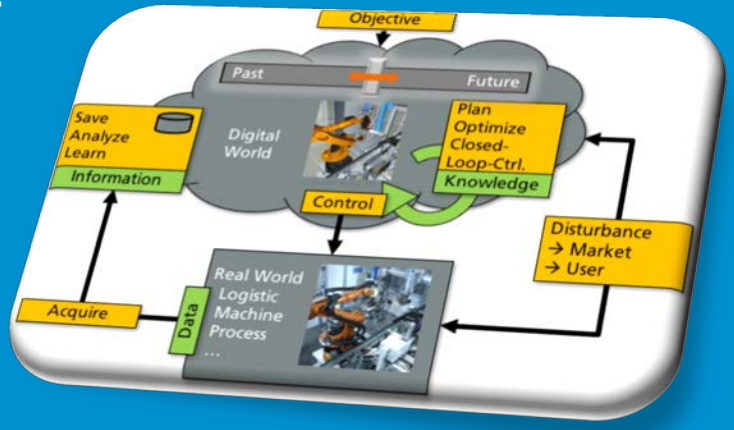
University of Stuttgart

Universität Stuttgart ISW



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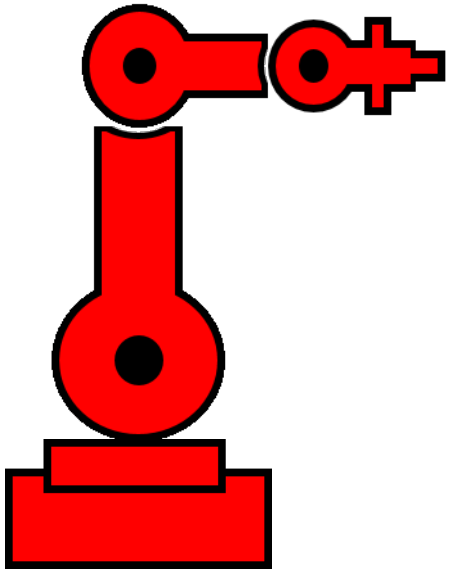

- Introduction
- i4.0 in Manufacturing Automation
- Examples on i4.0 & Robotics
- Lessons learned

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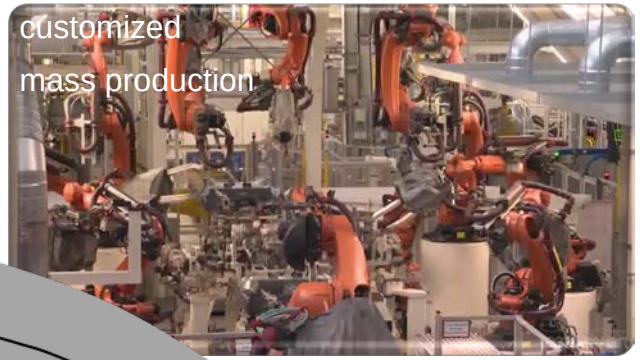
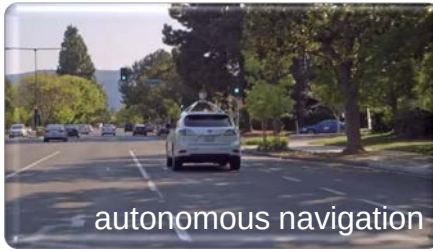
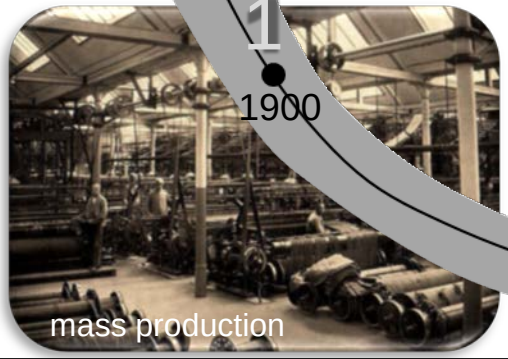
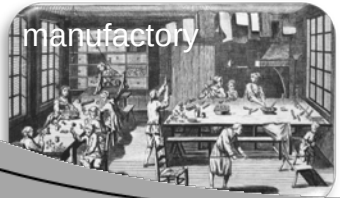
Industrial Revolutions









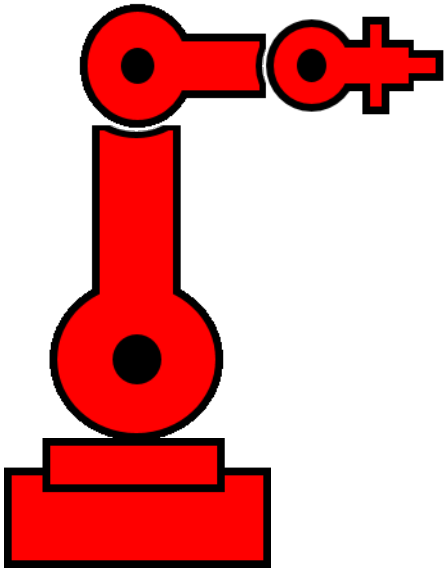
1960
2
1980
3
2000
4
1
1900
1800

product volume

product diversity

according to Yoram Koren:
The Global Manufacturing Revolution

Agenda



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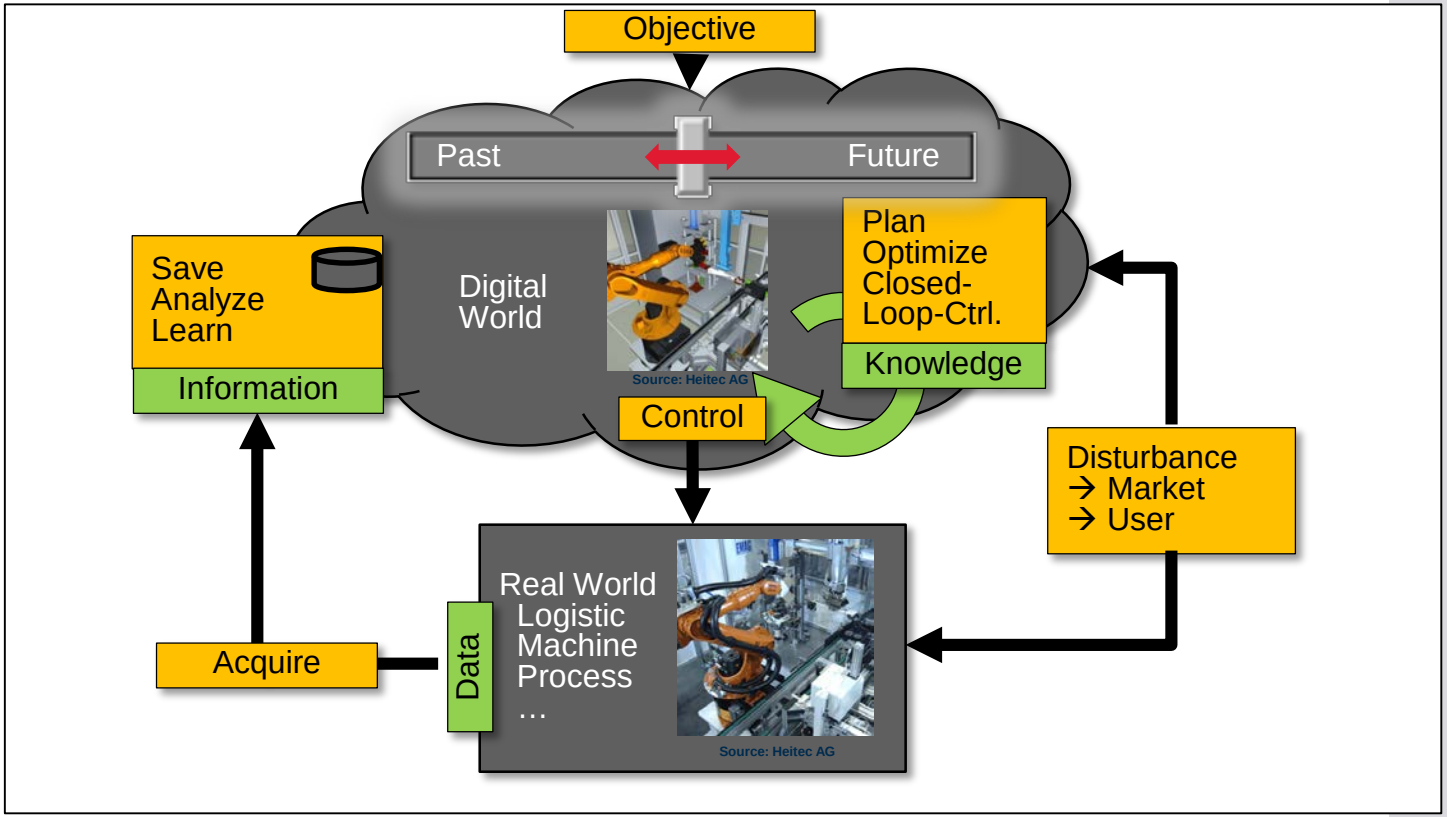

Source: ISW – University of Stuttgart

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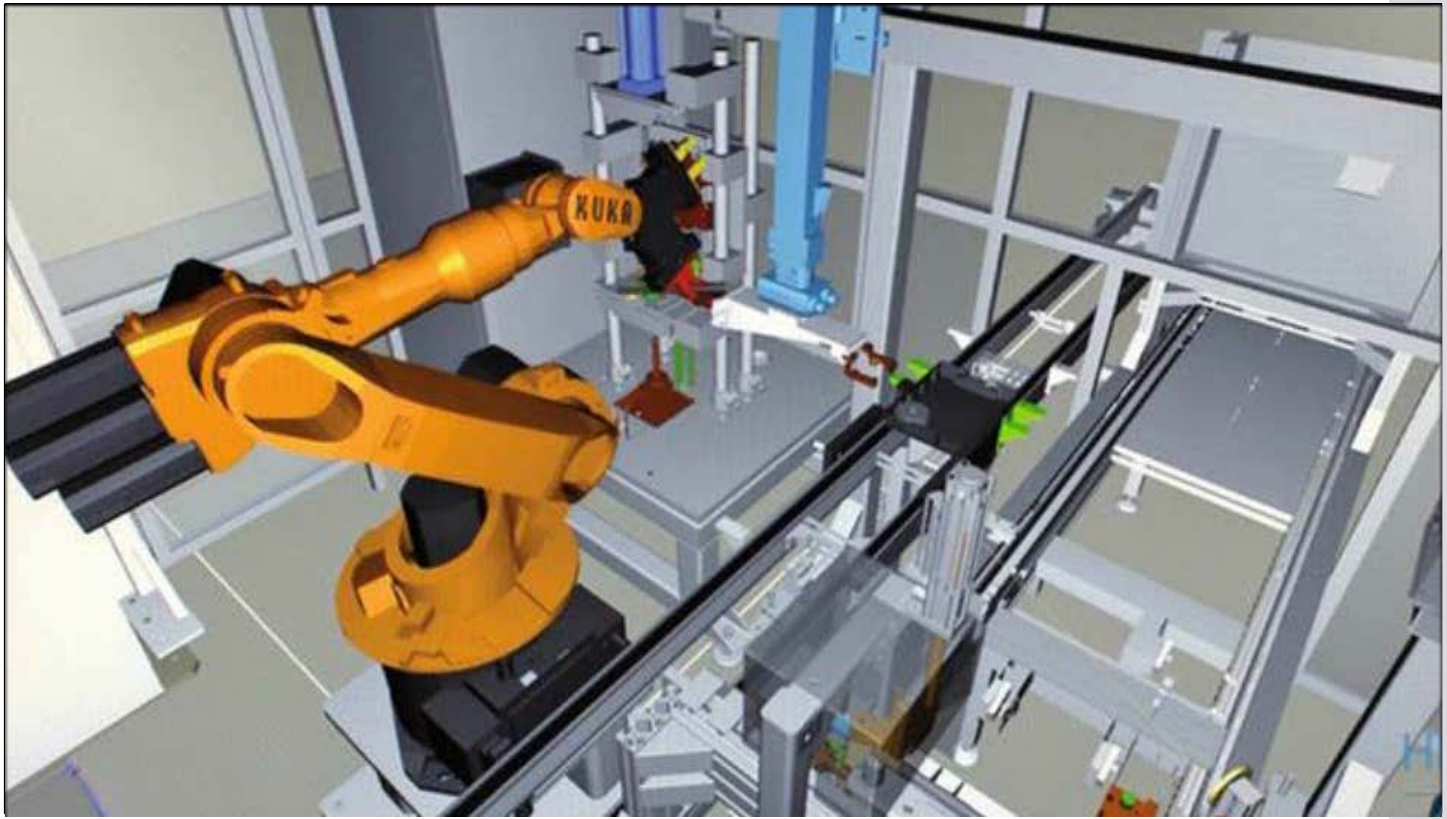
Cyberphysical Systems in i4.0-Robotics



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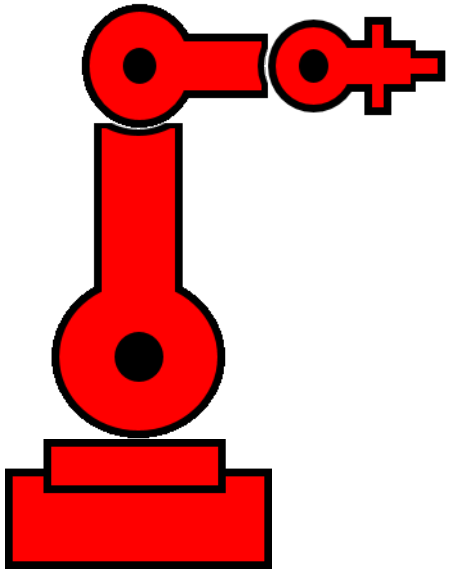

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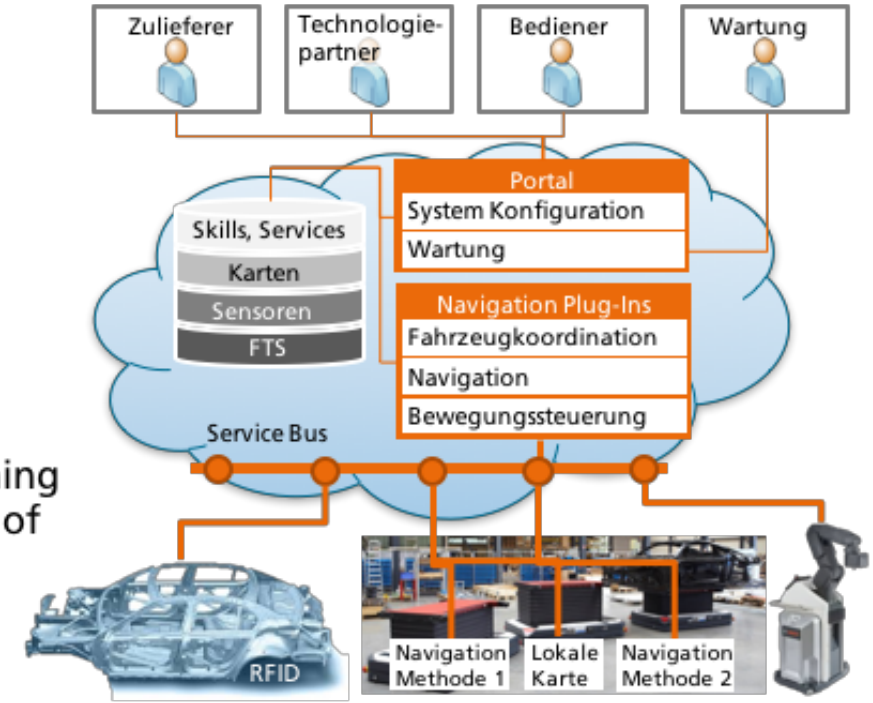
Cloud Navigation for Automated Guided Vehicles

(Example 1)

- State of the art
  - Central coordination of vehicles
- Under development:
  - AGV as „Lean Client“: navigation service on demand
  - Central data collection: optimization with learning algorithms (adaptation of skills, condition monitoring, …)



Source: Fraunhofer IPA

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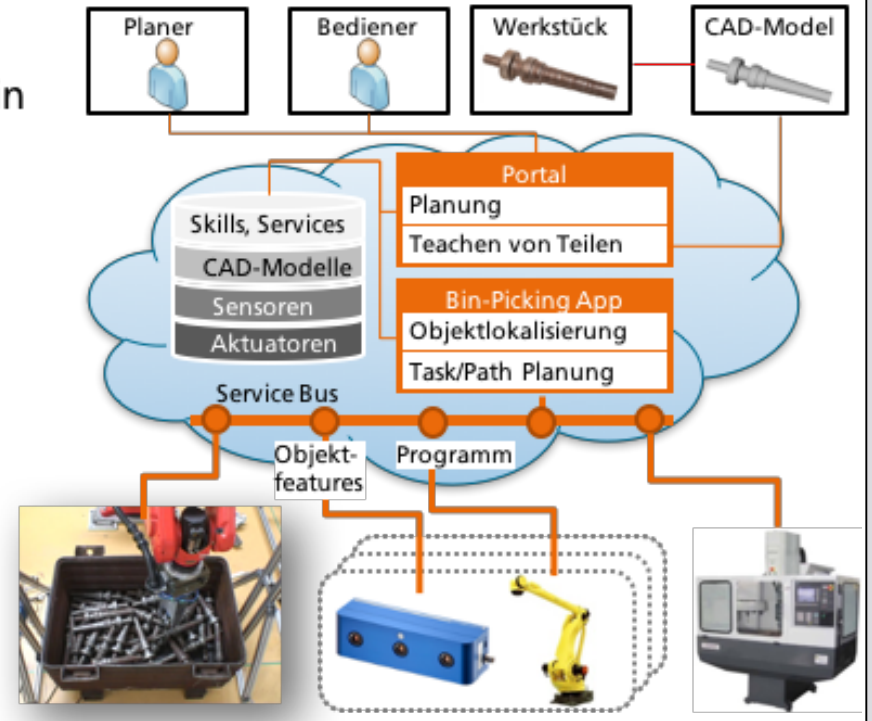
Part separation with cloud based bin picking

(Example 2)

Advantage

- Cloud based services of main functions, support, maintenance
- Very simple robotic cell („Lean Client")
- Central data collection: optimization with learning algorithms (adaptation of vision algorithms, quality assurance, statistics, …)



Source: Fraunhofer IPA

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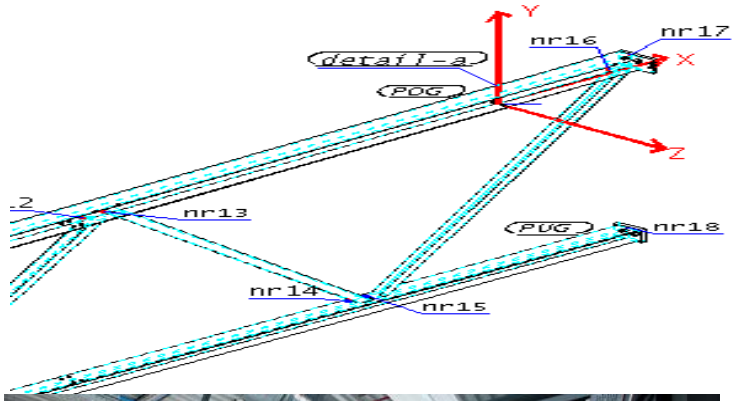
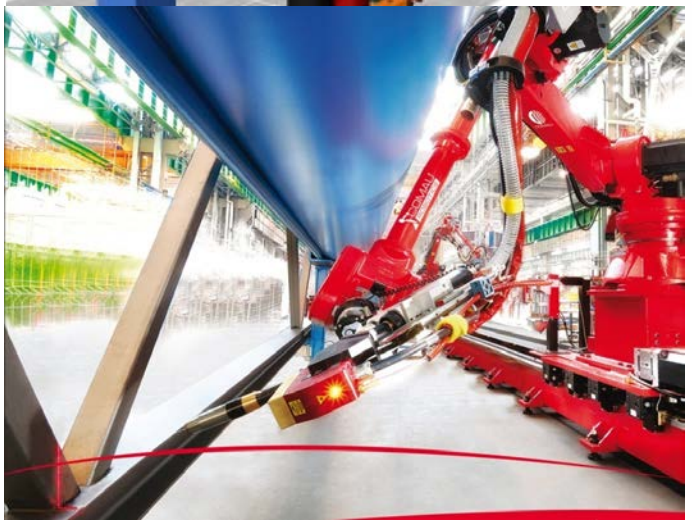
Automated welding of grid binders - lot size one

(Example 3)





Source: Fraunhofer IPA

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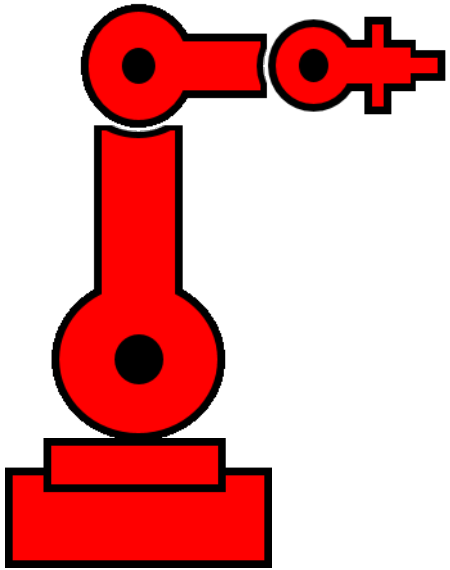

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Expectations regarding Industrie 4.0

More Flexibility and Adaptability

- Fixed structures will be replaced by adaptable networks
- Local Intelligence will help to handle complexity

More Modularity and Autonomy

- Cyber Physical Products will be introduced in all levels of Automation
- Granularity will adjust according to market needs

Highest Productivity

- Resource optimization will be done in the network based swarm optimization
- Plug & Produce features will bring down development cost significantly
- Management will do more optimization than fire fighting

New Business Models

- „app-store“ and “cloud” will provide the new knowledge management
- Prosumer-Models
- Lot size one should be feasible
- (Big Data) shall become a new driver
- Open Source Approaches shall provide new opportunities

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Human-robot collaboration

- Humans have skills which can not easily be copied by machines
- High degrees of automation often come at excessive cost
- Symbiotic human-robot collaboration enables new and economical solutions

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Summary

- Industrial robots are the prototype of a cyberphysical system in manufacturing
- Industrial robots are the key component in digital manufacturing
- IoT and i4.0 allow new business models with industrial robots
- Large-scale industry can benefit from more connectivity and cloud based optimization
- SMEs benefit from new services and new business modells

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Questions?

Thank you very much!

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