Prospects for Intralogistics through Industry 4.0

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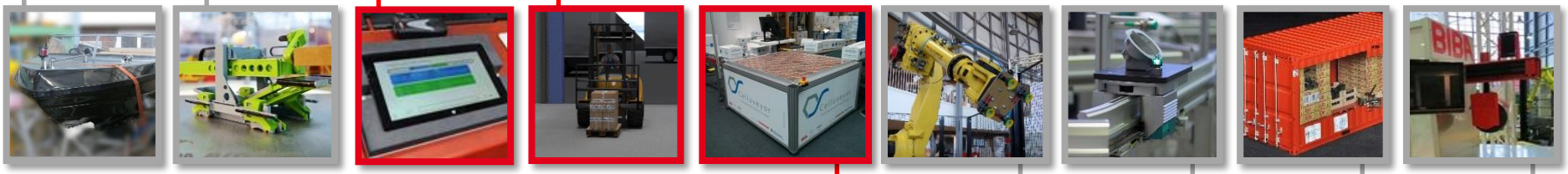
Usage of CPS data for product design

Robotics in logistics

Optimization of lean material flows

Increasing safety of intralogistics

business models



education / corporate training

Highly flexible conveying technology

Safe human-robot-interaction

Autonomous control of logistics processes

Quality-driven distribution

Pro-active maintenance

Further Information: http://www.biba.uni-bremen.de/industrie4.html?&L=1

Objectives of Intralogistics 4.0

Increasing efficiency

Increasing safety

Improving flexibility

OPTIMIZATION OF LEAN MATERIAL FLOWS

Optimization of Lean Material Flows

- Combination of Lean Production and Industry 4.0

- Lean Production
  - well known methods
  - in practice proved and established methods
  - but changed requirements
- Efficient material flow

- Industry 4.0
  - new methods
  - still in research and development
  - new opportunities through new technologies
- Efficient information flow

- Industry 4.0 can enhance lean methods in complex production processes, e. g. in manufacturing of a high number of different product variants in job shops or flexible flow shops.

Optimization of Lean Material Flows

Intralogistics at Wittenstein bastian GmbH, Fellbach, Germany

Source: Wittenstein AG

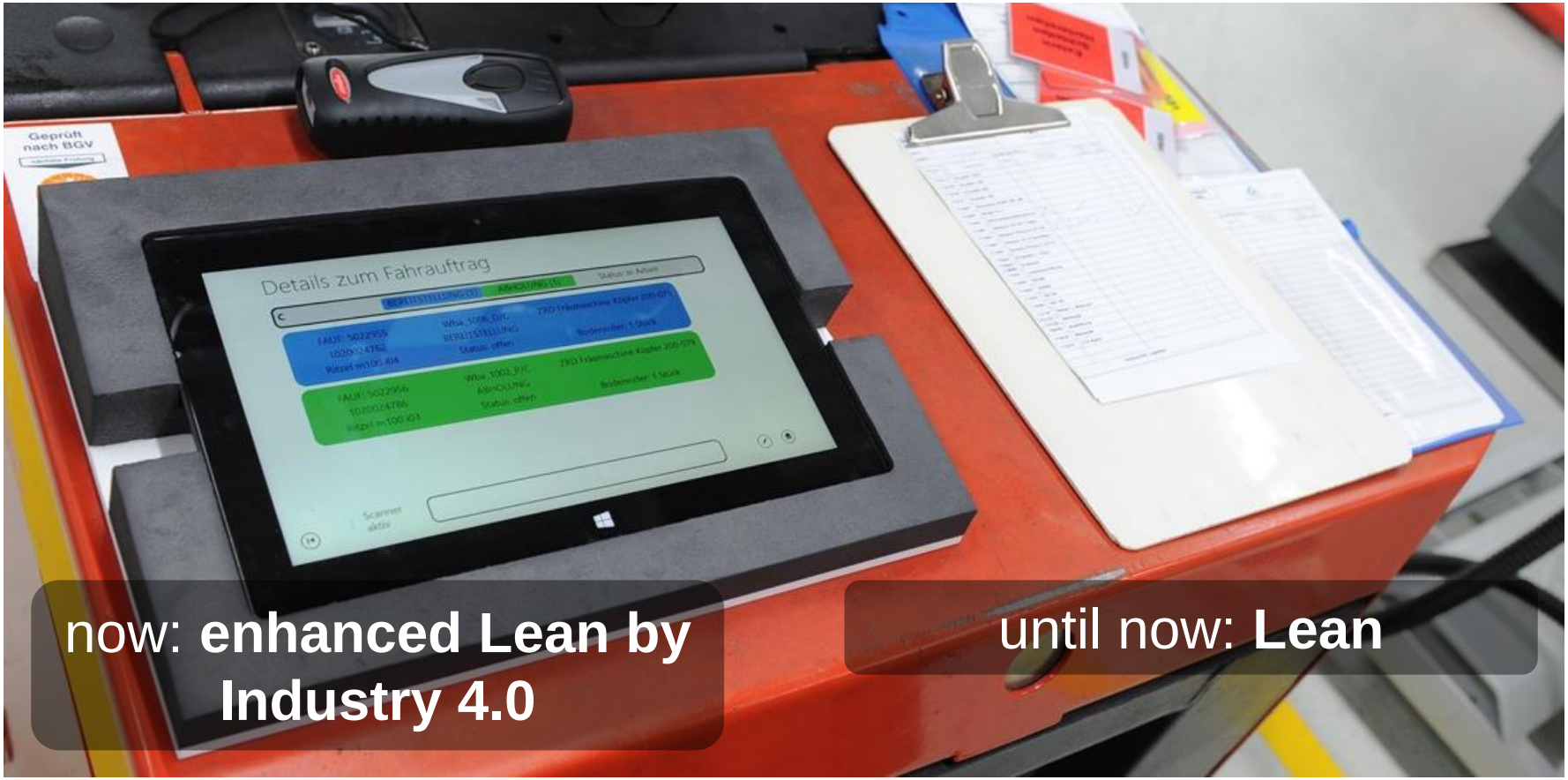
Factory for gear wheels

Source: Wittenstein AG

Tugger train for material supply (milk run method)

Optimization of Lean Material Flows

Tablet computer on the tugger train.



Source: Wittenstein AG

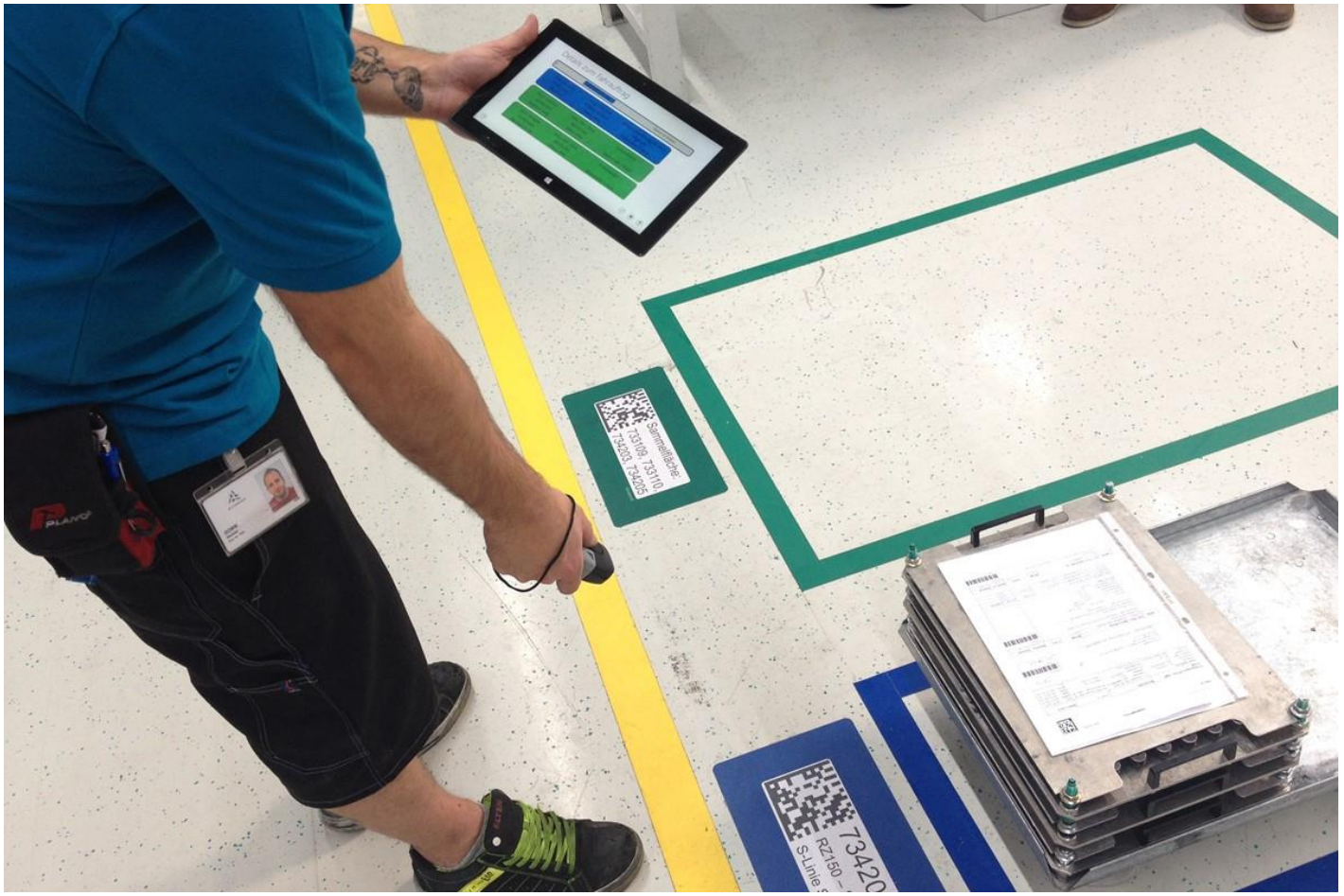
Optimization of Lean Material Flows

Tugger train driver receives transportation orders via a tablet computer.

Source: Wittenstein AG

Optimization of Lean Material Flows

Tugger train driver scans material buffers.



Source: Wittenstein AG

Optimization of Lean Material Flows

- Enhanced Lean by Industry 4.0

- Lean Production
  - efficient material flow
  - low work-in-process
  - low waste (muda)
  - IT independent

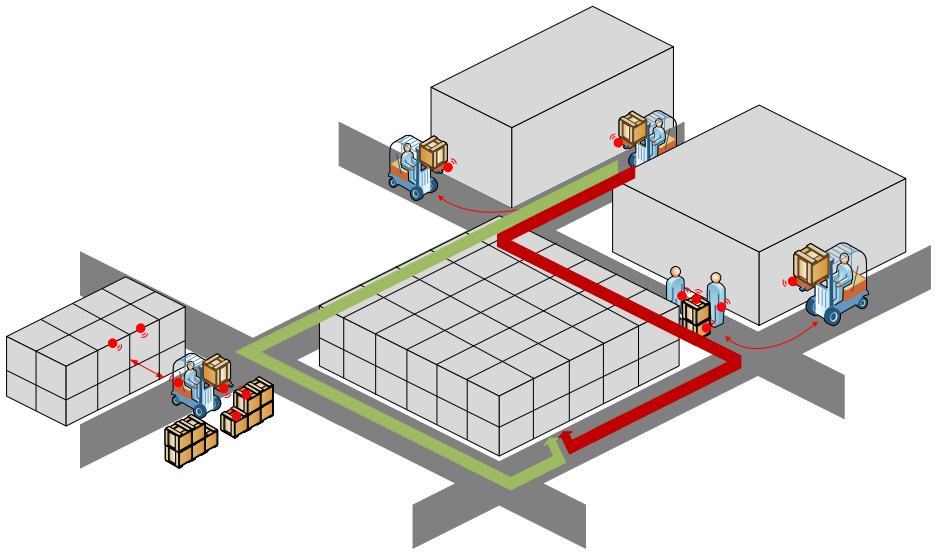
- Enhanced Lean by Industry 4.0
  - efficient material flow
  - low work-in-process
  - efficient information flow
  - lower waste (muda)
  - quick reaction on disturbances and rush orders

- Industry 4.0 can still decrease waste, however the IT-dependence will increase.

INCREASING SAFETY IN INTRALOGISTICS

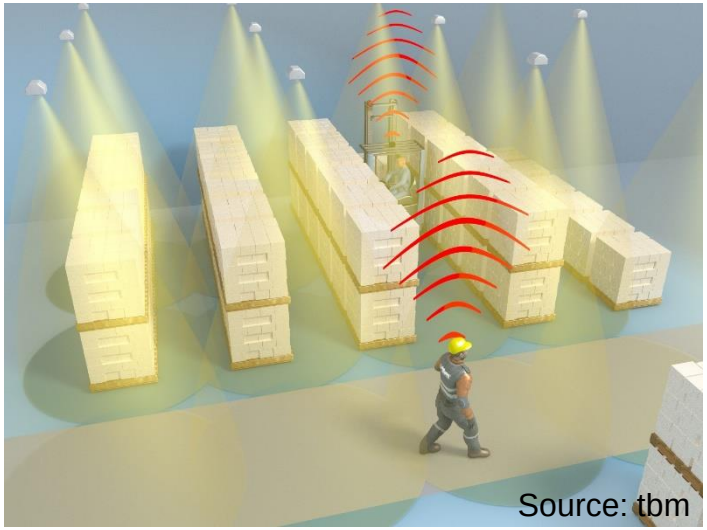
Improving Safety in Intralogistics

- High risk of accidents caused by the use of forklift trucks
  - 2010 in Germany: 10,000 heavy accidents, including 18 resulting in death and 337 resulting in accident pensions
  - Consequence of accidents: high direct and indirect costs
- Assistance systems to avoid collisions between forklift trucks and workers, goods, or infrastructure
  - Demographic change: support of cognitive abilities becomes more relevant
- Solutions
  - Intelligent infrastructure
  - Sensor system at the forklift truck



Improving Safety in Intralogistics

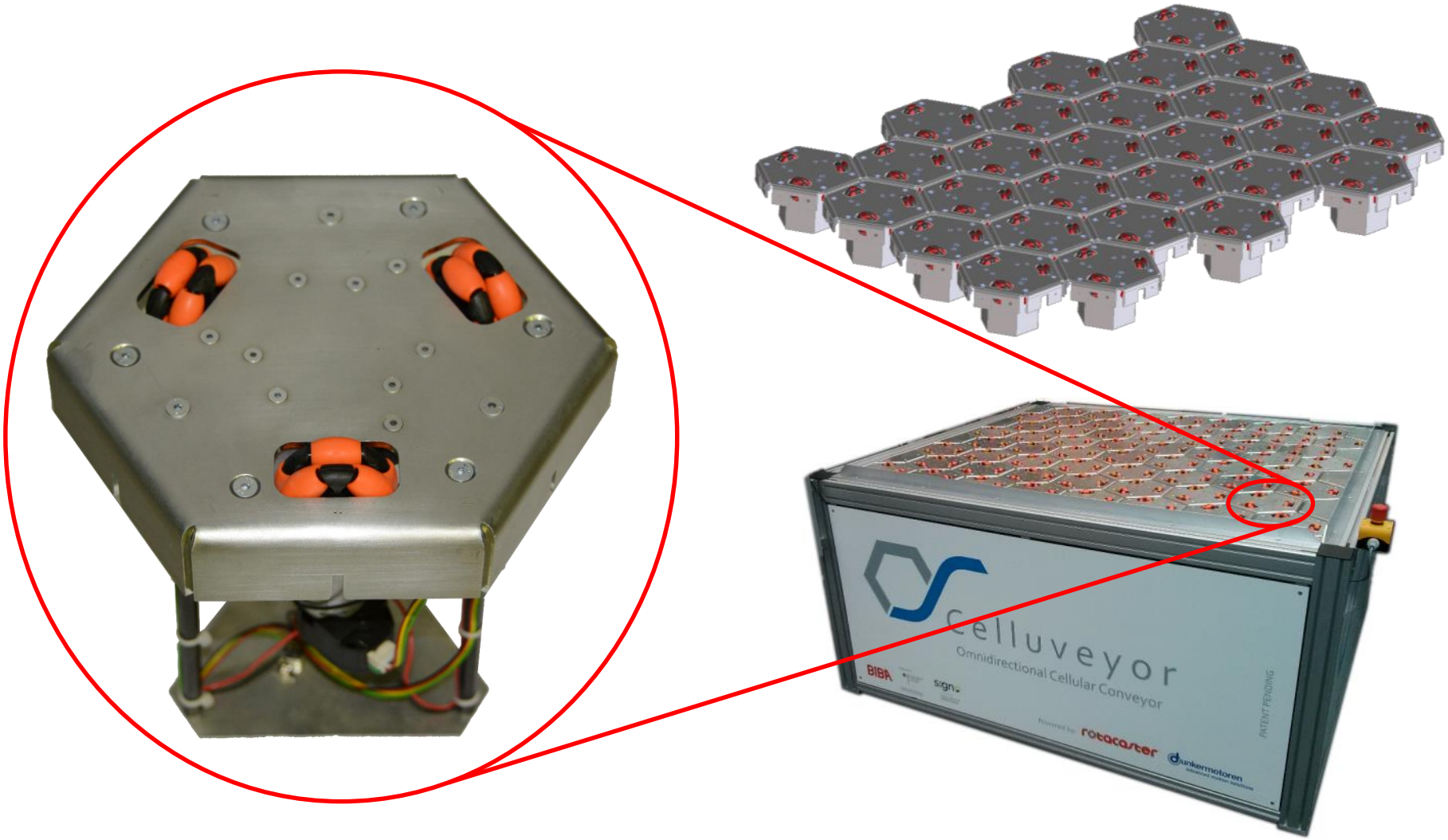
- Intelligent infrastructure (left figure)
  - Communication of forklift trucks, workers and infrastructure through infrared sensors
  - Combination of collision avoidance and intelligent routing
  - Retrofit system suitable for all types of fork lift trucks
- Sensor system at the forklift truck (right figure)
  - Development of a driver assistance system by using image processing methods
  - 2D and 3D sensors recognize objects and their moving path
  - Upgradeable and vendor-independent


Source: tbm

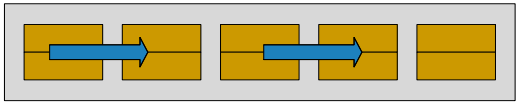
Source: BIBA

HIGHLY FLEXIBLE CONVEYING TECHNOLOGY

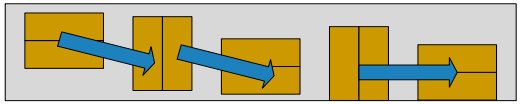
Celluveyor - Omnidirectional Cellular Conveyor



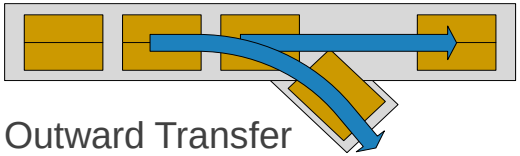
Celluveyor - Omnidirectional Cellular Conveyor



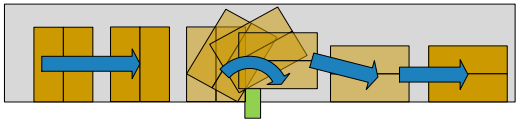
Conveyor



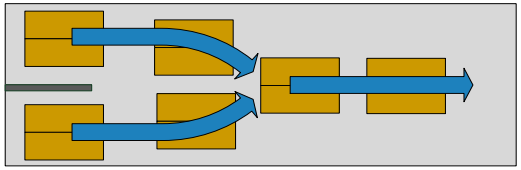
Aligner



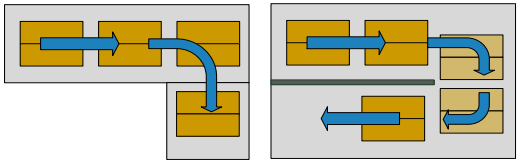
Outward Transfer



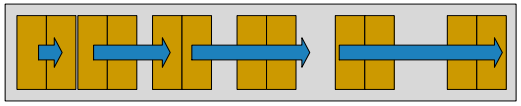
Turner



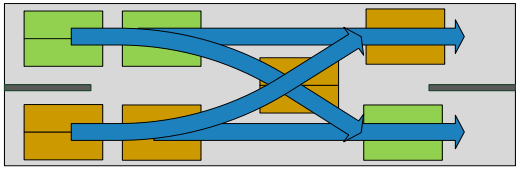
Merger



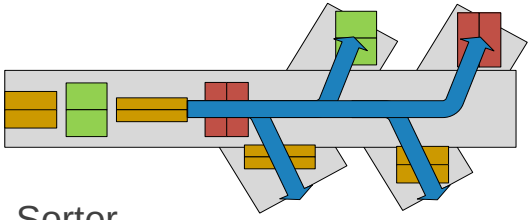
90° or 180° Transfer



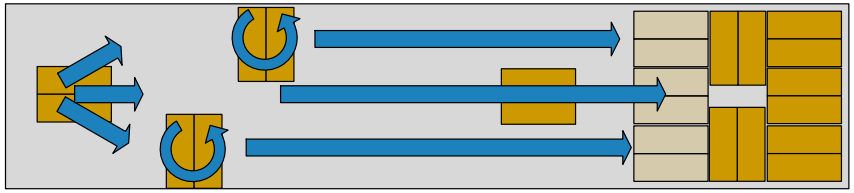
Separator



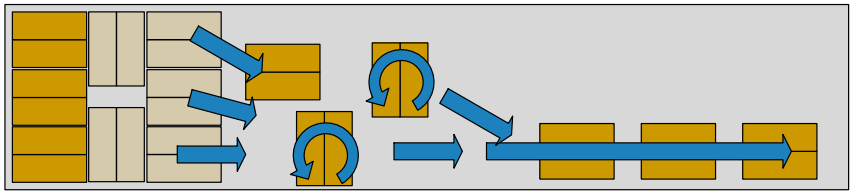
Switch or Cross-Sorter



Sorter



Infeeder for Palletizing

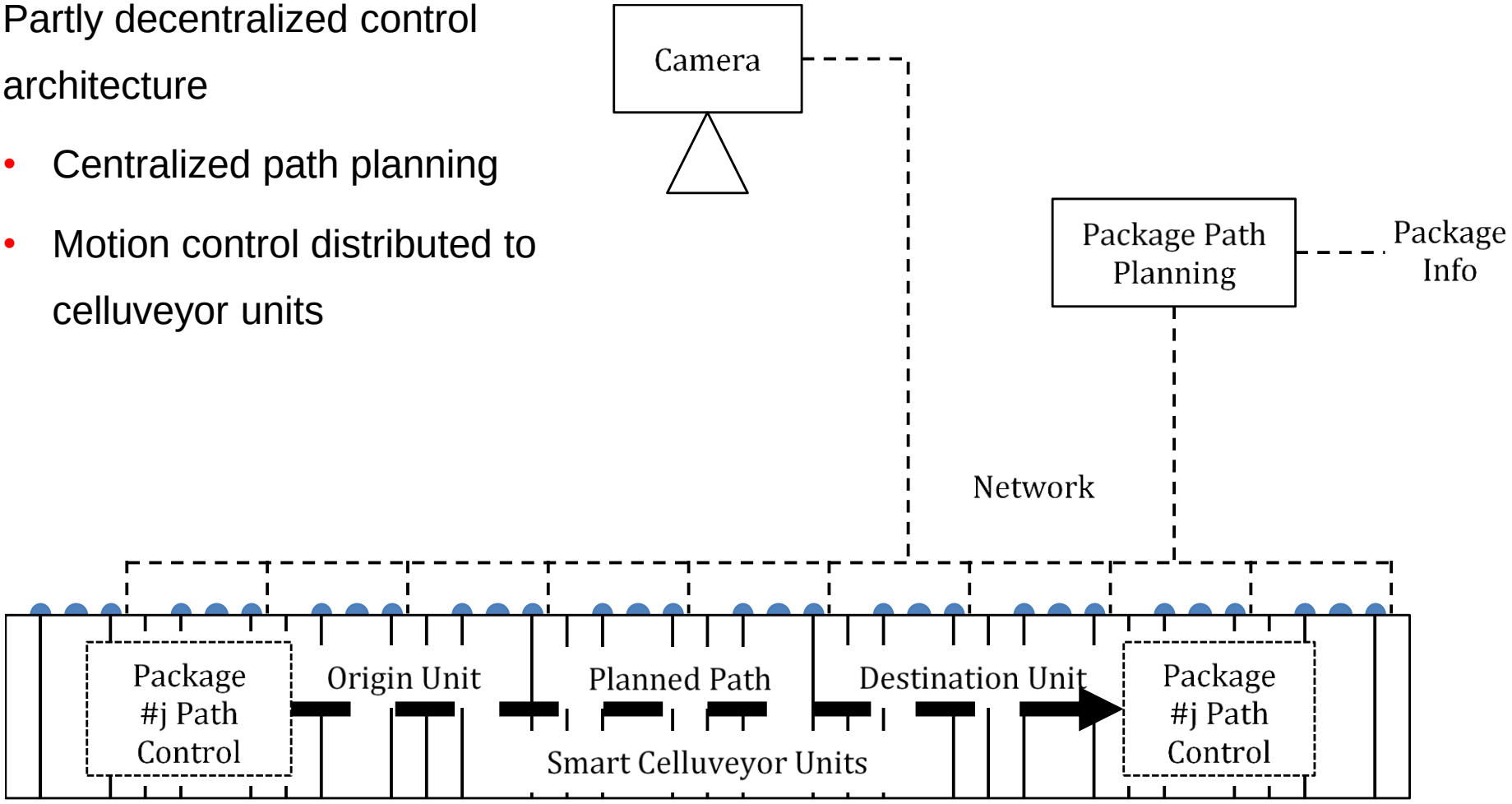


Layer Descrambler for Depalletizing

Celluveyor - Omnidirectional Cellular Conveyor

Partly decentralized control architecture

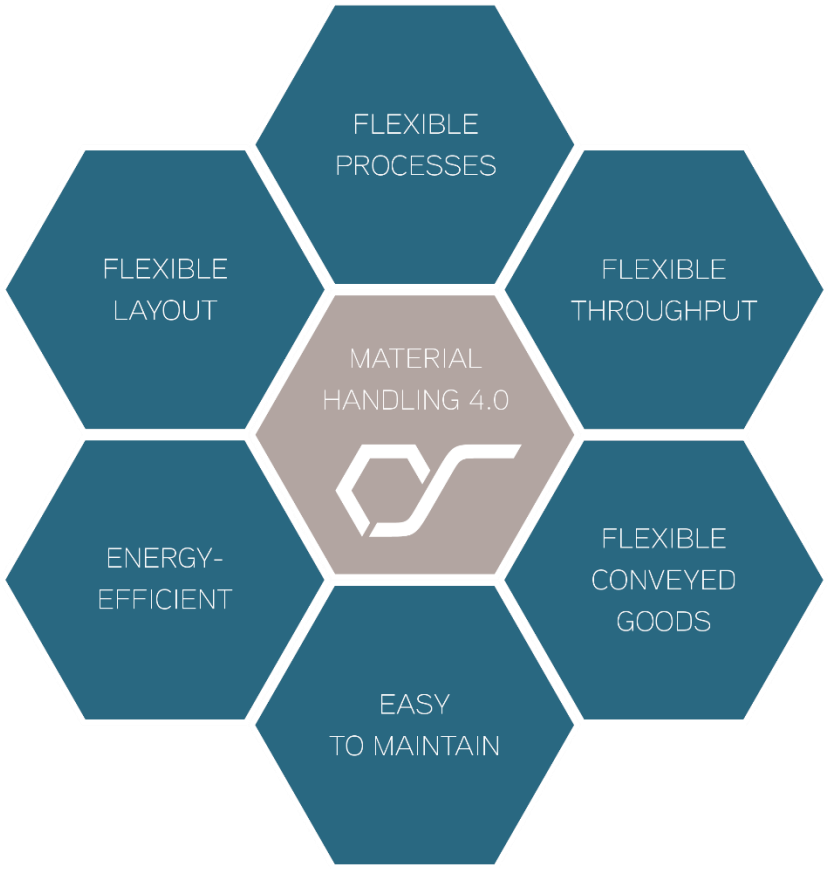
- Centralized path planning
- Motion control distributed to celluveyor units



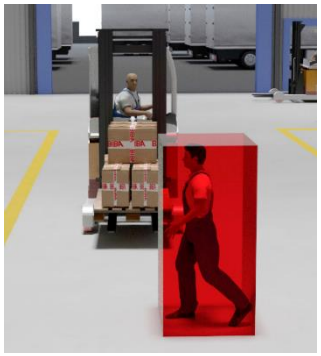
Source: Duffie: Internal working paper, UW Madison 2016

Celluveyor - Omnidirectional Cellular Conveyor

- Highly flexible conveying and positioning system
  - Flexible in layout, process, conveyed goods and throughput
- Omnidirectional movement
  - of any number of objects
  - on arbitrary paths
  - simultaneously and independently from each other
- Modular architecture (hardware and software)
- Partly decentralized control architecture



Summary



Connected IT systems for enhancing Lean Production

Intelligent sensor systems for collision avoidance

Cellular conveying system for increased flexibility

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