FROM RFID TO THE INTERNET OF THINGS
Pervasive Networked Systems

Intelligent and Networked Products
A product and manufacturing perspective

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The Progress of Competitive Advantage

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Value Added

(adopted from Pine, 2000)
Achieving customer satisfaction: Complex offerings require complex processes

Providing Solutions/Benefits require:

• complex offerings/products
  – Extended Products
  – Product Service Systems
  – Hybrid Product Service bundles
  – ...

• complex processes:
  – „End to End“ solutions
  – „From Cradle to Grave“ solutions
  – „From Field to Fork“ solutions
  – ...

• Customisation:

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Evolving the Traditional Concept of a Product

Core Product  Tangible Product  Tangible and Intangible Product Assets

Manufacturing of Parts  Offering of Products / Systems  Offering of Solutions  Provision of Benefits

Shift of Business Focus

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Potential Services Along the Product Life-Cycle

- Disposal of hazardous materials
- Collection services
- Collation of materials
- Dismantling services
- Routine Maintenance
- Benchmarking services
- Repair
- Operations Support
- Formalisation of the needs
- Consultancy services
- Co-development
- Product dependent or independent services
- Services to support co-operations of enterprises
- Qualification and training
- Logistics support

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- Customisation:

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From Field to Fork
New Products: Dimensions to be considered!

“New Product”

“Old Product”

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New Products provide new/additional features. New products can
- be identified (have an identity)
- be localized
- communicate with
  - each other; users; environment
- aggregate data about itself (using sensors)
- provide data (e.g operational, status) about itself
- …

How to make best use of new product features / capabilities and increase competitiveness?

Examples to follow:
RFID supported Tracking and Tracing

Access Point ➔ Server

around 1 transponder / storage location

This is a transponder

antenna

5 mm

40 mm

Transponder

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Tracking and Tracing Infrastructure
WLAN supported tools for efficient warehouse management
Smart materials enabling smart products

Mould knowing its temperature

Integration of sensors by Selective Lasersintering or 3D-Printing

Cell meets Surface

Printing and structuring of cells onto technical surfaces through Maskless Mesoscale Material Depositioning (M^3D)
Autonomous Cooperating Logistic Processes: A Paradigm Shift and its Limitations

Collaborative Research Centre (CRC) CRC 637

- Long-term university (basic) research project (up to 3 x 4 years = 12 years)
- Cross-disciplinary research programme,
- Consists of 10-15 sub-projects (from 10 research groups)

Overall Approach:

- To provide autonomy to logistic objects and enable them to make decisions by themselves to route autonomously through a logistics network.
- Investigation of the impacts of the autonomy paradigm on logistics systems and their future development using modified control methods

www.sfb637.uni-bremen.de
From Hierarchical to Autonomous Control

- Hierarchical IT structure
- Global information processing
- Centralised control

Paradigm Shift

- Distributed IT structure with global communication
- Local information processing
- Autonomous decentralised control
## Autonomous Cooperating Logistic Processes: Scenario: Transportation Logistics

<table>
<thead>
<tr>
<th><strong>Flexibility:</strong></th>
<th>Cargo is able to choose route A or B.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Local decision-making:</strong></td>
<td>Cargo uses rules and decides autonomously, e.g., choose the route with the lowest costs.</td>
</tr>
<tr>
<td><strong>Identification:</strong></td>
<td>Cargo, trucks etc. are able to identify themselves.</td>
</tr>
<tr>
<td><strong>Measuring ability:</strong></td>
<td>Cargo recognises a road blocking using sensors on it.</td>
</tr>
<tr>
<td><strong>Decentralised data processing:</strong></td>
<td>Cargo processes its sensor data decentralised by itself and informs other actors in its environment about its situation.</td>
</tr>
</tbody>
</table>

### Alternatives for decisions:
Cargo can be transported via hub A as well as via hub B.

### Decentralised keeping of data:
Every part of cargo contains its product data and transportation data.

### Ability to interact:
Single packages or pallets communicate with each other, e.g., to assemble a cargo.

### Local, dynamic system of objectives:
Adaptation of system’s objectives of truck A because of the road blocking, e.g., from “cheapest route” to “due-date delivery”.

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Enablers for Intelligent Products
Product related knowledge representations

Integration of material and product knowledge

Paper based information management:
- Documentation
- Drawings
- BOM

CAD, PDM & ERP:
- Documentation
- Drawings
- BOM
- …

Context Awareness & Auto ID Technology:
- Unique identification
- Communication with its environment
- Capability to retain or store data

Product Avatar:
- Deploys a language to display features, production requirements etc.
- capable of participating in or making decisions relevant to its own destiny

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Enablers for Intelligent Products
Sensors, actuators, etc.

Smart Tags + Sensors
- Can-BUS access
- Automatic System Diagnostics
- Positioning
- Proximity detection
- Safety sensors
- Etc.

Smart Dust + simple Sensors:
- Temperature
- Air pressure
- Humidity
- # of revolutions
- Simple diagnostics
- Etc.

Mobile Access
- Sensor aggregation
- Sensor history
- Seamless roaming
- Event-triggered transmission

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Enablers for Intelligent Products:
e.g. Ubiquitous Access
Enablers for Intelligent Products:
Standards and technologies in hybrid world

- Agent Technology
  - Knowledge-based Systems
- Enterprise Systems
  - ERP
  - CRM
  - SRM
  - PPC
- Auto-ID
  - EPC
  - PML
  - OMS
  - Savants
- RFID Smart Tags
- W-LAN, 3GB, ad hoc networks
- Positioning & Navigation
- Product Model
  - STEP
  - IFC
  - ...
- Product Avatar / Virtual Reality
  - Hybrid World
  - Material Product / Real World
- Attributes
  - Virtual
  - Persistent
  - Ubiquitous
  - Flexible
  - Low cost
  - Intelligent
  - Interactive
- Attributes
  - Material
  - Transient
  - Hardly mobile
  - Inflexible
  - High cost
- Context Sensitivity
- Location Based Services
- Ambient Intelligence
- Intelligent Production Environment
What is required to provide „new products“?

- A long lasting life cycle oriented integrated strategy
- A sophisticated communication infrastructure
- Companies that care about their product – beyond warranty
- Concepts, strategies and technologies to enable / support long lasting customer relationship
- To establish a lasting communication channel between Customer and producer
- A central access point to product related data (for producers, service providers and the customers)
- Provision of live-time communication contact with intelligent products …
Thank you for your attention!

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