A Definition Approach to Smart Logistics

ruSMART 2008
Topics

- What’s smart?
- Who’s paying?
- Scenarios
- Definition of Smart Logistics
- Future Work (Smart Truck)
## LogDynamics

**Bremen Research Cluster for Dynamics in Logistics**

<table>
<thead>
<tr>
<th>Faculty 1</th>
<th>Faculty 3</th>
<th>Faculty 4</th>
<th>Faculty 7</th>
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<tbody>
<tr>
<td>Physics / Electrical Engineering</td>
<td>Mathematics / Computer Science</td>
<td>Production Engineering</td>
<td>Economics, Business Administration</td>
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</tbody>
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- **CRC 637**
  - Autonomous Logistics
  - Collaborative Research Centre 637
  - Autonomous Cooperating Logistic Processes – A Paradigm Shift and Its Limitations

- **LogDynamics**
  - International Graduate School for Dynamics in Logistics

- **LogDynamics Lab**
  - Application and Demonstration Centre for Mobile Technologies in Logistics

- **LogDynamics International Conference**
  - International Conference on Dynamics in Logistics (LDIC)

**Universität Bremen**
Global RF Lab Alliance

New International Journal of RF Technologies: Research and Applications
Smart Products and Services are Technology Initiated

Technology driven Smart Services and Products can lead to large and radical changes.
Why is the Importance of Technology and Method Driven Approaches Growing within Logistics

- Process analysis will become more and more complex
- Methods and technology initiated approaches will gain importance

(Picture taken from: Laudon & Laudon, Essentials of MIS)
Smart Products and Services make live easier

- Fleisch et al.: *Smart products and services help to dispense humans of some of their control activities to products and services. Their function is based on proximate environments and relations including assets, spare parts, tools related to Smart Products as well as product lifecycle history and neighbourhood to other products.*
- Mark Weiser: *Ubiquitous computing just might help to free our minds from unnecessary work…*
Smart Products Examples – 1

- Identify item and perform simple if-then-else algorithm
  - Handgun, which only works if a chip at the wrist of the owner is in close proximity
  - Consumer goods which only work if original spare parts are used (e.g. printer and toner cartridge)
  - Error message is generated, if spare parts are misplaced during assembly
  - Hazardous goods generate an alarm, if other goods are in close proximity that could lead to catastrophes
  - Toolbox checks its own completeness

Source: Fleisch et al.
Smart Products Examples – 2

- Identify item, sense environment
  - Packaging of cold chain goods indicates if cold chain has been disrupted
- Identify item, sense environment, perform simple if-then-else algorithm, communicate
  - Machine (tool, car, airplane) only works if original parts are used; if usage cycle ends, new spare parts are ordered automatically
  - Lot senses its location, communicates to production machines, machine generates warning, if production lot does not fit
  - Vending machine senses its inventory as well as its service needs and generates a message, if replenishment or service is required

Source: Fleisch et al.
What are Smart Services?

- **Smart Services**
  - **Control services** – delegating of control tasks such as tracking and tracing, theft protection, counterfeiting, reordering
  - **Leasing services** – high visibility enables conversion of the basis of calculation from owner based information to usage based information
  - **Risk services** – insurances changes their pricing model from estimates to usage based fees
  - **Information services** – instant online access to ubiquitous computing related information
  - **Complex services** – they offer a combination of the above mentioned services

Source: Fleisch et al.
What Technologies are used in Smart Logistics?

- Mark Weiser forecasts that the defining words for the third wave of computing will not be "intelligent" or "agent", but rather "invisible" and "calm" and "connection". (dispute with Nicholas Negroponte)

- Neil Gershenfeld: *Bill of Things’ rights (Things have the right to)*:
  - Have an identity
  - Access other objects
  - Detect the nature of their environment

- When thinking about Smart Logistics this dispute is still open. While Weiser until today still proves to be right, there is a huge amount of ongoing research about intelligent and agent based logistics. (Moore et al.; Davidson et al.; Graudina et al.)
Auto-ID – Advantages of RFID

- Bulk-reading
- No line of sight required
- Robust compared to barcode concerning dirt etc.
- Large memory
- Re-writable / changeable data storage
- Ease of use
- Speed of data entry
- Cheaper than other solutions
Locating

Differentiators
- Physical / symbolic location
- Absolute / relative location
- Transmission media
- Locating method
- Location computed by object / infrastructure
- Accuracy
- Scalability
- Communication intervals
- Costs for infrastructure and beacon (e.g. tags)

Locating Methods
- Cell-of-origin (transponder-of-origin)
- Amplitude (RSSI, received signal strength indicator) triangulation
- Time of flight ranging systems
- Time difference of arrival (TDOA)
- Angle of arrival (AoA)
Smart Technologies at the LogDynamics Lab

What’s missing?

1. Identify
   - RFID
   - Barcode

2. Locate
   - RTLS

3. Sense
   - Logger
   - Meshed networks

4. Process
   - Software agents

5. Communicate

6. Act
   - Robotics

Dipl.-Ing. Dieter Uckelmann: Identifikationssysteme in Produktion und Logistik

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How to Enforce Technology Usage

- **Mandating**
  - Has limits in non-dominated, distributed markets

- **Malus (penalty) system**
  - Has limits in non-dominated, distributed markets

- **Cost and technology sharing**
  - Model fails to scale in large environments

- **Open, market driven and usage based model**
  - Asymmetries concerning the distribution of costs and benefits between Smart Service and Products providers and users may only be overcome, if standard market rules can be applied
Usage Based Billing

- Smart Services (and Products?) offer the ability to measure what could not be measured before. They enable operating, pricing and trading of previous untradeable services (and products?). **Usage based billing** is only possible, if usage can be **quantified**. (Fleisch et al.)

- Jonkers et al. see two elements within usage data acquisition – **metering** and **collecting**. While metering registers the usage of a resource in real-time, collectors aggregate data from one or more meters and forward these data for accounting.
Questions to be Asked for Smart Logistics

- Which additional functionality can be offered to the customer? (Fleisch et al.)
- Which additional functionality offers benefits to the production company? (Fleisch et al.)

- How can this additional functionality be metered, collected and billed?
- How can this be done in an open, scalable, networked environment with multiple beneficiaries?
Scenario 1 – Cross Supply Chain Value (Retail)

Case for time saving within the Distribution Value Chain

Example: 6 items (e.g. DVD-Player) per carton, 12 cartons on 1 pallet

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Transportation</th>
<th>Distribution Center</th>
<th>Distribution</th>
<th>Outlet</th>
<th>Shelf</th>
<th>Customer</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify Delivery</td>
<td>Check items with ship list</td>
<td>Identify Delivery</td>
<td>Check items with ship list</td>
<td>Check shelf inventory</td>
<td>Check out Customer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Barcode</td>
<td>2 sec</td>
<td>203 sec</td>
<td>2 sec</td>
<td>203 sec</td>
<td>144 sec</td>
<td>10 sec</td>
<td>564 sec</td>
</tr>
<tr>
<td>RFID</td>
<td>2 sec</td>
<td>15 sec</td>
<td>2 sec</td>
<td>15 sec</td>
<td>15 sec</td>
<td>1 sec</td>
<td>50 sec</td>
</tr>
</tbody>
</table>

While individual time saving did not exceed 188 seconds, the overall time saved within the value chain added up to 514 seconds.

Source: Accenture
Scenario 2 – Rental System

- Brewery
- Bottler
- Secondary packaging center
- Central store/Wholesaler
- Retailer/Customer

Flow:
- Full products
- Empties
- Data
- Identification + Data carrier (e.g. RFID-Tag)

Steps:
- Meter
- Collect
- Bill
Scenario 3 – Post Key-player Information Handling

Mandate Malus

Supplier

Key-player

After-production logistic provider

Maintenance provider

Recycling companies

Meter Collect Bill

Dipl.-Ing. Dieter Uckelmann: Identifikationssysteme in Produktion und Logistik

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Definition of Smart Logistics – Part 1

- Smart Logistics embraces Smart Services as well as Smart Products within Logistics
- Smart Logistics is derived from a technology driven approach, and thereby subject to change
- Smart Logistics frees humans from (control) activities that can be delegated to Smart Products and Services
- Smart Logistics are invisible and calm and can, therefore, be described as transparent
Definition of Smart Logistics – Part 2

- Smart Logistics are connected, thus they communicate and possibly interact with their environment.
- Smart Logistics facilitate state-of-the-art (innovative and available) data processing (which may include, but do not require, software agents).
- Smart Logistics integrate existing logistic technologies, such as material handling systems, and enable these to react and act in a correspondingly smart manner.
- Smart Logistics include state-of-the-art billing, payment or licensing as integral component.
Who is Prepared for “Smart” Billing

- The upcoming paradigm shift towards ubiquitous computing is highly likely to change the IT and Telecommunications business considerably, probably more than what the Internet did to telecommunications a few years ago. Telcos today are unfortunately not well prepared for this, in particular due to lack of technological involvement. (Eurescom)
- Online-payment services are more familiar with ubiquitous computing. Still, these service providers are not positioned to handle micropayments in business-to-business (B2B) relations. B2B requirements include service level agreements, different charging schemes, and clearance of mutual bills before payment. (Jonkers et al.)
What Could be a Possible Solution?

Object Name Service

Billing Level Events
- Billing Systems

Pointer

EPCIS Discovery Services

EPC Information Service
- Networked Database

Application Level Events
- Middleware

Reader Protocol

Reader

ISO/IEC 18000-6c transponder

Billing aware infrastructure

Based on: Harrison
Project: Smart Truck

- RFID
- Sensors
- Telematic unit
- Web-based services
- Software-agents
- Information billing capabilities
- (under development)
References

Thank you for your attention

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