Monitoring technologies for road freight transport

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Background

- Current logistics systems are complex networks
  - A variety of different actors
  - An increasing number of interactions and interdependencies
- A capability of handling multi-dimensional information flows related to the physical flow of goods is required
- The paper describes monitoring and security technologies that are applicable to road transport in logistics processes including:
  - Drivers for tracking
  - Different levels of tracking
  - Technical issues
Drivers for road transport tracking

- Complexity of transport chains
- Increased cost pressures and competitive edge
- Development of new value-added services and business concepts for road transport
- Detecting exceptions and deviations
- Improving supply chain efficiency and the optimisation of resources
- Security of high-value goods against theft
- New production concepts (e.g. lean)
- Requirements posed by the nature of transported goods (e.g. temperature, shock sensitivity)
- Increased delivery accuracy
- Weather and route planning information for estimated time of arrival prediction
Levels of tracking for transport

- **Parcel level**
  - Parcel identification
- **Handling unit level**
  - Pallet identification
- **Transport unit level**
  - Container identification
- **Vehicle level**
  - Vehicle identification/tracking

**Information flow**

- Goods tracking system
- Pallet tracking system
- Container tracking system
- Vehicle tracking system
Monitoring models for freight transport

- The process of monitoring can be described by four different models depending on user needs, business models and used technologies:
  - Black box
  - Notification
  - Identification
  - Continuous monitoring
- The main difference between the models is the frequency of monitoring data updates:
  - Black box – no information shared during transport
  - Notification – manual updates at nodal points
  - Identification – Auto-ID technologies, updates at nodal points
  - Continuous – positioning and multi-functional devices, real-time updates
Monitoring technologies

- Each of the examined technologies has some characteristic features
- The most suitable technology for a given task depends on
  - the needed level of monitoring,
  - the structure of the supply chain (e.g. utilized means of transport and the nature of goods), and
  - the infrastructure already available.
- Future outlook of the technologies is dependent on several different issues varying from the macro-economic situation to the requirements of individual customers
## Identification technologies

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<tr>
<th>Technology</th>
<th>Main characteristics</th>
<th>Outlook</th>
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| **RFID**   | Promising, technologically ready  
Requires a lot of harmonising and integration with other enterprise systems.  
Should be implemented in the broader supply chain, when questions of sharing costs and information arise.  
Usage is quite modest  
To be applied mainly at nodal points | Taking off may take longer than predicted but should become more common in the future. |
| **Barcode**| Primary identification technology  
Only globally standardized ID technology  
Cheap and widely applied  
To be applied mainly at nodal points | Will remain as the primary identification method in the near future. |
## Positioning technologies

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| **Satellite** | Provides real-time location information with an accuracy of a few meters  
To be applied in the transportation leg of the supply chain | Currently the only feasible location technology. Options to complement GPS are evolving. |
| **Network** | Employs mobile phone network for positioning  
Not yet very accurate even though the technology has been constantly developed  
To be applied in the transportation leg of the supply chain | Very limited possibilities to replace satellite positioning, used for supporting functions. |
| **Indoor** | Can be combined with other technologies  
To be applied in closed areas like terminals and warehouses and other locations that have trouble with satellite positioning (e.g. urban canyons).  
Utilize technologies like infrared, RFID, and ultrasound | Used increasingly, especially if technology becomes cheaper. |
| **Hybrid** | Employs / combines several technologies to increase the location accuracy  
To be applied in the whole supply chain | Should become increasingly common through improved integration. |
# Multi-functional devices

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<tr>
<td><strong>CSD</strong></td>
<td>Technology is functional</td>
<td>If companies perceive added value or cost savings, CSDs should become more common. Also authorities (e.g. green lane in customs) may increase utilization.</td>
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<td>Processes and integration to IT systems are complicated</td>
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<td>Allows real-time monitoring and detection of problems and exceptions at an early stage, but requires advanced software, including mechanisms to react on problems</td>
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<td>Needs an operator, who provides a one-stop-shop for customers</td>
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<td>To be applied in the transport leg</td>
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<td><strong>Electronic seal</strong></td>
<td>To be applied mainly in customs operations and security aspects. E.g. RFID based e-seals are utilized.</td>
<td>The use of EPC Gen. 2 e-seals will increase reducing the cost of the devices. E-seals will remain as standalone devices due to their role in customs procedures.</td>
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# ICT and information exchange

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| **IT-architecture** | Regional IT architectures (e.g. e-Freight project) and national recommendations (e.g. TARKKI in Finland) are provided by non-commercial actors [http://www.efreightproject.eu/](http://www.efreightproject.eu/)  
Global commercial branch-specific approaches are available (RosettaNet - electronics, Odette - car manufacturing, and PapiNet - forest industry)  
Customized commercial solutions are also provided by several local and international IT solution providers | Broader architectures for monitoring and other logistics related operations are in demand.  
It is likely that the market share of large IT solution providers will remain high.  
The e-Freight project is one potential solution that would combine the results of earlier EC projects. |
| **ERP** | Aim at integrating the (supply chain) management practices of internal and external resources with the company’s business processes  
Drivers: desire to streamline and facilitate the flow of information, a more efficient utilization of the real-time monitoring of goods, better data availability, improved visibility, and increased task automation | Due to costs, ERPs have been used at larger companies.  
Lately, SMEs have been getting in the game as well.  
The demand for integrating monitoring solutions with ERPs is expected to increase. |
## ICT and information exchange

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<td><strong>EDI</strong></td>
<td>The computer-to-computer transmission of information related to business transactions employing specific sets of standards. X12 (North America) and EDIFACT (elsewhere) standards are the most common traditional EDI standards. EDI provides frequent and automatic transfer of information leading to improved coordination within the length of supply chain, and generating cost savings through optimization, improved speed and accuracy.</td>
<td>Traditional EDI standards have been the norm for decades, but recently XML-based messaging standards have gained popularity (e.g. UBL). This trend will gain momentum.</td>
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<td><strong>IoT</strong></td>
<td>A concept where all objects form a network and they can all be uniquely identified and thus managed by computers in different kinds of information systems. Identifying devices can be complemented by different sensors. Related to wireless technologies such as Bluetooth, NFC, and WLAN, and positioning systems (e.g. GPS).</td>
<td>Developments in wireless technologies are making the realization of the IoT concept possible. Progress towards the IoT is highly dependent on how quickly everyday objects will be equipped with wireless capabilities.</td>
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ICT and information exchange (e-Freight project)
Information exchange between road users and public actors
Conclusions

- The need for improved road transport monitoring is recognized by both private and public actors
- Monitoring enables better planning both on public administration and in business - increased operational efficiency
- Technological elements for monitoring freight transport are available
- Different tracking levels (e.g. pallet, load unit, truck and supply chain define applicable technologies)
- Monitoring technologies are usually researched as sole technologies, not by considering these to cover all the processes of supply chain.
Conclusions

- Identified obstacles for implementation
  - Disharmonised system interfaces
  - Reluctance to cooperate and to share information between supply chain parties and public bodies
  - A lack of valid business models
VTT creates business from technology