Technologies towards the Development of a Secure Hybrid Composite Container

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Emerging Areas In Containers Security Research
CORE WP22 Objectives

OBJECTIVES:

Test the development of innovative technologies in order to:

- improve the tamper resistance of shipping containers
- evaluate cost / benefits for all players involved (owners, authorities, shippers, logistic service providers etc.)
Development and testing of a prototype Composite Container

- Overseer of the R&D activities and provide a policy driver
- Upgrades the Container Security Device platform to accommodate embedded sensor technology
- Provides an essential input from the shipping industry
- Development and testing of a prototype Composite Container

CORE WP22 Partners

Georgia Tech

DG TAXUD

Homeland Security

MAERSK

JOINT RESEARCH CENTRE
Requirements

**STRUCTURAL**
- Mechanical Response
- Fire Resistance
- Thermal Insulation
- ISO and Standards
- Repairability

**THREATS**
- Sensor Types
- Data Processing
- Reliability

**COMMUNICATION**
- Scenarios
- Protocols
- Networks

**POWER SUPPLY**
- Autonomy
- Energy Harvesting
- Power
- Batteries
- Safety

**ECONOMICAL and LOGISTIC**
- Cost
- Maintenance
- Market
- Savings
- Added Values
Composites: advantages and potential issues

- Structural efficiency
- Corrosion resistance
- Logistics Energy Saving
- Electromagnetic Transparency
- Sensors Embedding
- Cost
- Design
- Recycling
- Integration with existing industry
What’s cheaper in the long run?

**Assumptions**
- Assuming 1.6 €/litre diesel fuel cost
- UK DfT study found 1 ton payload less equivalent gain of 0.05 km/l (0.117 miles/US gallons)
- Composite container cost 6,000 €
- Steel Container 2,200 €
Embedded Sensors: how?

Wireless Transmission

Signal Acquisition and Processing
Failure Modes and Damage Detection

- Test of **failure modes**
- Investigate the potential to **detect signs of the forthcoming failure** during the critical compressive loading of thick sandwich composite panels
- **Non linear ultrasonic methodologies** to detect composite damage
- **Piezoceramic devices:** actuators and sensing
Wireless sensor network examples
Communication graphs

Container bay profile

Time frame of field of active sensors in the bay

Typical topological motifs of connected sensors

Parametric connectivity landscape
Example: Stack Loading/Unloading Connectivity
Analysis Activities: percolation model in a terminal
Tampering Detection

• CSD
  Container Security Device

• BSD
  Breach Security Device
Economical and Logistic constraints

- Cost
- Low upfront infrastructure investment
- Maintenance/Reparability
- Full lifetime consideration
Conclusions

• There is a potential for the adoption of composite materials in shipping containers and wireless communication and tampering devices.

• Both the industry and the Customs can benefit from the availability of “connected” containers (IoT).

• Due considerations have to be made how to integrate innovative containers with the existing business and industry constraints before substantial uptake is possible (e.g. repair and maintenance, cost/benefit analysis).