DRONES FOR RAILWAY INFRASTRUCTURE MONITORING (DRIM)

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UIC
What is Drone?

The term ‘drone’ is the generic popular term of any aircraft without a pilot on board, although technically 'drone' would include unmanned craft designed to be used underwater.

Unmanned Aerial Vehicles (UAV)

Unmanned Aircraft (UA)

Unmanned Aircraft System (UAS)

Remotely Piloted Aircraft Systems (RPAS)

Remotely Piloted Aircraft (RPA)

Pilotless Aircraft (PA)
Commercial Application of Drones

- **Agricultural Services** (agricultural services, ranging from precisely spraying pesticides and fertilizers, monitoring crops growth);

- **Search and Secure** (monitoring of catastrophes, monitoring of natural disasters, searches for missing persons);

- **Surveillance** (monitoring public events, border controls against illegal cultivation and investigation of crimes);

- **Inspection and Monitoring** (inspection of infrastructures, pipelines and the atmosphere)
Application of Drones in Railways

Benefits of using drones in the railway industry:

- Reduction of risk to staff and people and infrastructure in the project area;
- Reduced planning cycle;
- More efficient work processes;
- More flexible, affordable verification tools;
- Higher quality data available in larger quantities at lower costs.
• Privacy, ethics and legal related issues (unauthorized data collection, privacy violation, photography);

• Cybersecurity related issues (unauthorized access to sensitive communication networks, theft of information on critical infrastructure);

• Physical related issues (UAS flies through controlled airspace and across flight paths, collisions between drones and piloted aircrafts, damage/injure any critical assets/people);

• Breaching secure perimeters (military bases, boundaries of other states).
Approaches to Drone Regulation

- Understanding the situation
  - What are UAVs doing?
  - Where are UAVs flying?
    - Who is flying?
    - Other considerations

- Effective ban

- Requirement for constant VLOS

- Wait-and-see

- Permissive

- Experimental uses of BVLOS
EU Regulations

<table>
<thead>
<tr>
<th><strong>Open category</strong></th>
<th><strong>Specific category</strong></th>
<th><strong>Certified category</strong></th>
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<tbody>
<tr>
<td>(low risk)</td>
<td>(increased risk)</td>
<td>(high risk)</td>
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<tr>
<td>No prior authorization</td>
<td>One of the requirements for open category is not met</td>
<td>Over assemblies of people</td>
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<tr>
<td>C0 to C4 classes of UAV</td>
<td>Operational authorisation</td>
<td>Transportation of people</td>
</tr>
<tr>
<td>&lt; 25 kg</td>
<td>Operational authorisation</td>
<td>Carrying dangerous goods</td>
</tr>
<tr>
<td>120 meter height limit</td>
<td>Operator shall perform a risk assessment</td>
<td>Certification of the UAV</td>
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<tr>
<td>Keeping UAV at a safe distance from people</td>
<td>Operational limitations to be set out in the operational authorisation</td>
<td>Certification of the UAV operator (licensing of the remote pilot)</td>
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<tr>
<td>Keeping UAV in VLOS</td>
<td>No carrying dangerous goods</td>
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<tr>
<td>No carrying dangerous goods</td>
<td>No dropping any material</td>
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<tr>
<td>No dropping any material</td>
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COMMISSION DELEGATED REGULATION (EU) 2019/945 of 12 March 2019 on unmanned aircraft systems and on third-country operators of unmanned aircraft systems

COMMISSION IMPLEMENTING REGULATION (EU) 2019/947 of 24 May 2019 on the rules and procedures for the operation of unmanned aircraft

U-SPACE
AeroNet National Technological Initiative

the associated roadmap for the purpose of legislation improvement and elimination of administrative barriers (approved by order of the Government of the Russian Federation no. 576-r of 03.04.2018)

Anticipated AeroNet results include:

- No permission for the use of airspace (VLOS operations) within 150 meter height limit;
- No permission of local authorities for flying over communities

Benefits for railway domain:

It will allow to use a drone as part of a recovery train. A drone could be flown in near real time (one hour after receiving a message about an accident), at altitudes up to 150 meters above ground level and within a radius of 1 km from the scene of an accident

* ICAO recommendations
Concept for UAV Application in Russian Railways

**Infrastructure**
- Integrity of superstructure elements
- Engineering structures condition
- Quality of switch heating
- Quality of current roadbed maintenance

**Transportation safety**
- Perimeter control
- Provision of real-time data for facility certification
- Vulnerability assessment and transportation safety planning

**Construction and overhauling**
- Construction supervision at all stages with progress assessment
- 3D simulation of structures with subsequent control of deviations from design parameters

**Emergency response**
Situational awareness as part of damage assessment, assignment of recovery assets, real-time management, emergency development prediction, recovery supervision

**Power supply system**
- Detection of clamp and pull-off wire defects
- Condition control of catenary support and foundation elements
- Detection of insulator contamination, deviations from thermal conditions of conductive elements
Concept for UAV Application in Russian Railways

**Communications**
Communication relay during possessions, when communication is not available

**Bridge inspection**
Assessment of the technical state of railway bridges

**Delivery**
Delivery of cargo and documents

**Interaction with freight terminals**
- Assessment of bulk goods terminals loading
- Supervision of wagon clearance before delivery to classification station

**Energy saving**
Monitoring of heat and water supply systems (boiler houses)

**Construction activities supervision**
Monitoring of possession execution
Case “Drones for Recovery Trains”

INMARSAT

Emergency
Recovery Centre

Station for recovery trains

Mobile video conferencing equipment

GSM
(if available)

On-board control station

HD video

50-150 m

Drone

Control

Real time video

Accident
1. Physical coupling:
- connection via physical links;
- leader-follower control scheme;
- physically constrained motion;
- low number of vehicles

2. Formations:
- not physically coupled;
- user-defined distances with other group members;
- new members can be introduced;
- relative motions are strongly constrained to keep the formation

3. Swarms:
- collective behavior of drones;
- cooperation based on concepts from biology (homogeneous individuals);
- agents execute the same program, and interact only with other nearby agents

4. Intentional cooperation:
- moving according to trajectories defined by individual tasks;
- these trajectories typically are not geometrically related;
- determination of tasks for each drone
THANK YOU!