USE OF DRONES FOR RAILWAY INFRASTRUCTURES INSPECTIONS IN SPAIN

Leendert de Haan
Senior Expert in Structural Evaluation and Pathology

www.ineco.com
INECO IS A SPANISH STATE-OWNED TRADING COMPANY UNDER THE MINISTRY OF PUBLIC WORKS THROUGH ITS SHAREHOLDERS:
OUR FIGURES

Turnover
182.46 million euros

Operating profit
4.37 million euros

Staff
2,366 employees

As at December 2014
WHAT WE DO

Ineco is a global leader in transport engineering and consultancy

Our global and multimodal nature, as well as being present throughout the life cycle of infrastructures, really sets us apart from our competitors.
INECO AROUND THE WORLD

- Headquarters in Madrid, Spain
INNOVATION

R&D+i effort
€ 3,886 M

Percentage of turnover
2.13%

34 innovation projects
20 internal projects
14 collaborative projects in a consortium

As at December 2014
INECO’S FIRST STEPS WITH DRONES

Kick-off innovation project in May 2014

MICRODRONES FOR STRUCTURAL INSPECTIONS
WHY THINK OF DRONES

Bridge bearings are located in difficult places

High costs for inspection
Access is not possible
WHAT DID WE DO

- Market research
- Analysis of Legal aspects
- Acquisition of drones
- On site practice
- Summary report
- Opportunities

**Development of a New Product**
ALL WE NEED

Remote controls

- http://igoodbags.weebly.com/
- http://www.dronetech.co.uk/drones.html
- http://www.dronesunam.es/fotografia_aerea/
- www.skytec.com
- www.cambridgeeasy.com
- www.subritz.es
- www.carvedata.com
- http://www.radios.com/8f.html
- http://www.todohelicopteros.com/
- www.dji.com
- www.orbusi.es
- www.marcussau.com
- http://www.egr.co.rug.nl/images/Antenna/index.html
- http://www.ge-scr.com/Products/6/1/0/1/0/1/0/1/Antenna/index.html
- http://www.uavdesign.net/
- http://www.drones.com/
- http://www.baldr.com/products/6/1/0/1/0/1/0/1/Antenna/index.html
- http://www.onlineaesthetics.org
- http://www.haithtech.com/products/

Drone Manufacturers

Models
Spanish Law 18/2014, article 50:

**Operations with aircrafts piloted by remote control**

- Two groups, MTOM under or above 25 kg
- Pilot license required
  - Includes a theoretical and practical exam
- Pilot > 18 years
- Medical certificate Class 2
- Maximum height 400 feet (120 m)
- Maximum distance to operator 500 m
- Far from urban zones and people
- Drone Operator registration in AESA
Draft of new European Law in progress

European Aviation Safety Agency

Advance Notice of Proposed Amendment 2015-10

Introduction of a regulatory framework for the operation of drones

RMT: n/a — 31.7.2015

New categories

Figure 2: Limitations in the ‘open’ category: visual line of sight, maximum altitude and minimum distance with respect to uninvolved persons on the ground.
Acquisitions

SYMA X5C Explorer

DJI Inspire 1
Flight simulators

Phoenix R/C5

Flightgear 3.0
We work with all kind of structures

<table>
<thead>
<tr>
<th>Bridges</th>
<th>Buildings</th>
<th>Earthworks</th>
<th>Tunnels</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Bridge Image" /></td>
<td><img src="image2" alt="Building Image" /></td>
<td><img src="image3" alt="Earthworks Image" /></td>
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<td><img src="image15" alt="Earthworks Image" /></td>
<td><img src="image16" alt="Tunnel Image" /></td>
</tr>
</tbody>
</table>
We analyze all kind of materials

Concrete

Masonry

Steel

Wood

Soil

Water
Building inspection
Environmental
BRIDGE INSPECTION
Bridge inspection
INECO’S NEXT STEPS WITH DRONES

*Kick-off innovation project in August 2015*

MULTIPURPOSE DRONES
LINES OF INVESTIGATION

- Certification of drone pilots
- Registration of Ineco as a drone operator
- On site training
- 3D modeling using photogrammetry
- Topographic surveying
- Thermal imaging
CERTIFICATION OF PILOTS & REGISTRATION AS DRONE OPERATOR

Spanish Law 18/2014

- Pilot - Theoretical exam
- Pilot - Practical exam
- Pilot - Flying test
- Pilot - Medical test
- Insurance

- Characteristics drone
- Safety measures
- Maintenance manual
- Risk analysis
- Flight routes

Registration
SAFETY – BEST PRACTICES

Height, limit 400 ft. (120 m)
Distance between drone and pilot, limit 500 m
No flying over cities and villages
No flying over concentrations of people
8 km distance to airports (CTR)
Always in direct visual line of contact
No flying at night
Checklist

No fly zones
No fly zones Madrid, Spain
DIFFICULTIES TO TRANSFORM INNOVATION INTO BUSINESS

Legal limitations
Investments (second drone)
Risks during flying (crashes)
Weather conditions
Battery limitations (max. 20 minutes)
Clients don’t want to change
Work schedule of the pilots
How to do the pricing
Bridge bearing inspection

Viaduct in High Speed Line
Madrid-Valladolid
New road bridge construction site
3D Modeling

Viaduct in High Speed Line Madrid-Valladolid
3D Modeling

Viaduct in High Speed Line Madrid-Valladolid
3D Modeling

Construction new road bridge
Topographic surveying
Thermal imaging
Thermal imaging
SOLUTIONS IN ARID CLIMATES

- Detection of sand and rocks on the train track
- Extreme climatic conditions
- Compatibility of RPAS with high speed lines
- Movements in earthworks
- Structural inspections
- IR cameras
- Digital Surface Modeling

Special interest for Haramain High Speed train Makkah-Madinah

*) Financed by:
*) Supported by:
SIMULATION: TRACK INVASION OF ROCKS

Tested on an abandoned railway line

Automatic detection of changes
(participation: Elecnor Deimos)
Inventions: boat-dron for bridge inspection
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