BELRIM
BELGIAN RISK MANAGEMENT ASSOCIATION

Drone applications in the industry

TRINOVA
engineering in the sky

Offices: De Lochtlaan 13, 2530 Boechout, BELGIUM
+32 476 751 664 | www.trinova.be | info@trinova.be
BIC: GEBABEBB | IBAN: BE60 0014 1434 4670 | BTW BE 0862 476 587

BELRIM
BELGIAN RISK MANAGEMENT ASSOCIATION

Aerial Inspection & Surveying

Trinova is an **innovative** UAV service provider in Belgium.

Trinova helps companies to carry out aerial inspections & surveying of **complex sites** such as sensitive industrial installations or densely populated areas.

Offices: De Lochtlaan 13, 2530 Boechout, BELGIUM
+32 476 751 664 | www.trinova.be | info@trinova.be
BIC: GEBABEBB | IBAN: BE60 0014 1434 4670 | BTW BE 0862 476 587

Drone technology?

1. What is a drone?

'*Unmanned Autonomous Vehicles*' (UAV)

1. Airborne

2. Confined spaces

Drone technology?

2. Inspection techniques

- Visual inspection (Single image or video, 3D modelling, Vibration measurement)
- Thermographic inspections (Relative or absolute T° measurement, Optical Gas Imaging, Lock-in thermography, Active thermography, …)
- Volatile Organic Compounds (VOC) Detection & measurement
- Ultrasonic measurement
- Light Detection and Ranging (LIDAR) 3D scanning.
- Multispectral inspection

In the industry?

Applications:

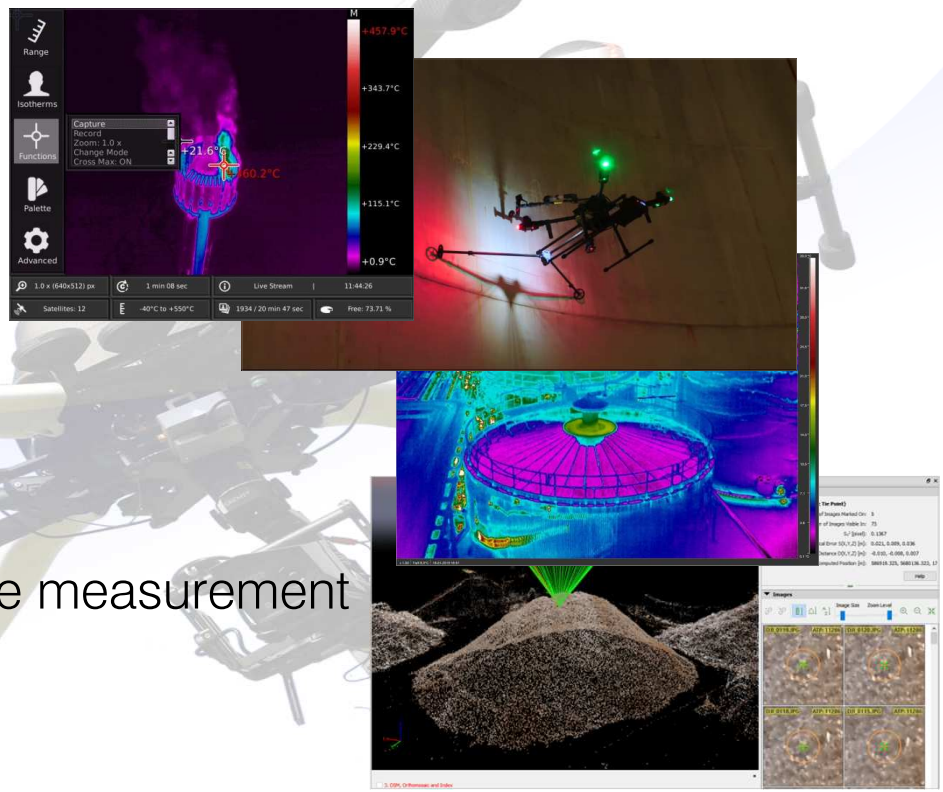
Asset inspection and anomaly detection of:

- Gas Flares
- Smoke Stacks
- Pipe racks
- Jetties
- Storage tanks
- Vertical infrastructures
- Cooling structures
- Buildings & roofs

In the industry?

Inspection objectives:

- Corrosion detection
- Liquid leak detection
- Gas leak detection
- Flame ignition and shape
- Insulation
- Wall thickness
- Distance, surface or volume measurement
  (e.g. Stock piles)




TRINOVA
engineering in the sky

SWOT

Strengths

1. Safer

- Eliminate the need for humans to complete high-risk activities (e.g. Rope access; Entering confined spaces, Scaffolding installation; Inspecting hazardous environments)

2. More accurate

- Detect potential issues the human eye cannot see.
- Gather qualitative, comprehensive and reliable data with less room for human error and less variability.

3. Faster

- Reduce man hours to complete the work (e.g. inspections, audits, monitoring)
- Avoid plant shutdown during inspection.

SWOT

Opportunities

These high-tech innovations are carrying the digital revolution into the industry.

'Industry 4.0 ~ Maintenance 4.0'

- Better maintenance planning, before equipment is taken out of service, reduces downtime and shutdowns.
- Digitalisation of inspection data results in better & faster insight about potential problems.
- Data can be viewed via 3D models that provide context and location.


TRINOVA
engineering in the sky

SWOT

Weakness

A Drone Program Management is complex and requires integration of multidisciplinary knowledge in following domains:

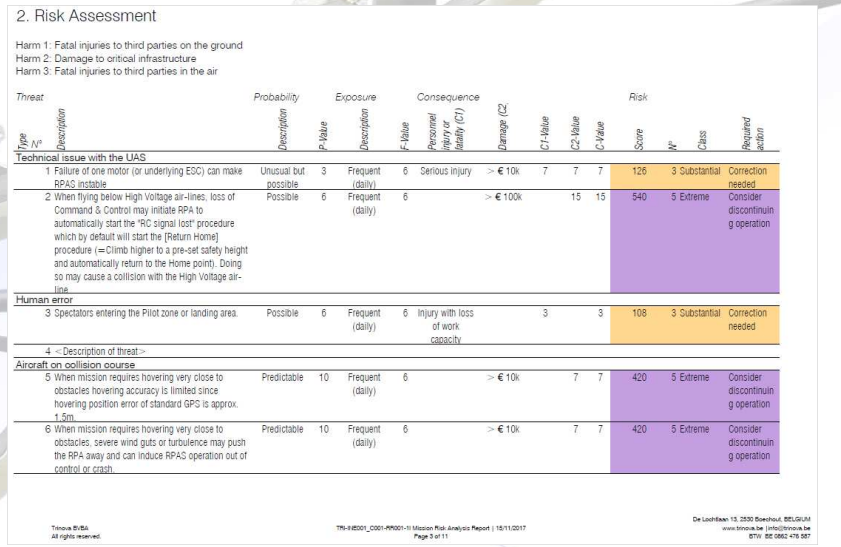
- Document management
- Data analytics strategy
- Data management (images, videos, logs)
- Operating standards
- Safety & Emergency procedures
- Training program management
- Pilot training and skills tracking
- Regulatory requirements and compliance
- Equipment development & maintenance management

SWOT

Threats

1. Complex operation locations:

- People
- Explosion risk zones
- Moving cranes
- Hot vapour exhaust
- Igniting Gas flames
- Wind turbulence
- Earth magnetic disturbance
- Electromagnetic interference
  - HV
  - Ships
- Collisions with manned aircraft



2. Risk Assessment

Harm 1: Fatal injuries to third parties on the ground
Harm 2: Damage to critical infrastructure
Harm 3: Fatal injuries to third parties in the air

Threat			Probability		Exposure		Consequence					Risk			
Type	N°	Description	Description	P-Value	Description	F-Value	Personnel injury or fatality (C1)	Damage (C2)	C1-Value	C2-Value	C-Value	Score	N°	Class	Required action
Technical issue with the UAS															
	1	Failure of one motor (or underlying ESC) can make RPAS instable	Unusual but possible	3	Frequent (daily)	6	Serious injury	> € 10k	7	7	7	126	3	Substantial	Correction needed
	2	When flying below High Voltage air-lines, loss of Command & Control may initiate RPA to automatically start the "RC signal lost" procedure which by default will start the [Return Home] procedure (=Climb higher to a pre-set safety height and automatically return to the Home point). Doing so may cause a collision with the High Voltage air-line.	Possible	6	Frequent (daily)	6		> € 100k		15	15	540	5	Extreme	Consider discontinuing operation
Human error															
	3	Spectators entering the Pilot zone or landing area.	Possible	6	Frequent (daily)	6	Injury with loss of work capacity		3		3	108	3	Substantial	Correction needed
	4	<- Description of threat ->													
Aircraft on collision course															
	5	When mission requires hovering very close to obstacles hovering accuracy is limited since hovering position error of standard GPS is approx. 1.5m.	Predictable	10	Frequent (daily)	6		> € 10k		7	7	420	5	Extreme	Consider discontinuing operation
	6	When mission requires hovering very close to obstacles, severe wind guts or turbulence may push the RPA away and can induce RPAS operation out of control or crash.	Predictable	10	Frequent (daily)	6		> € 10k		7	7	420	5	Extreme	Consider discontinuing operation

De Lochtlaan 13, 2530 Boechout, BELGIUM
www.trinova.be | info@trinova.be
BTW BE 0862 476 587

TRINOVA

engineering in the sky

Threats

2. Safety

- Equipment & procedures specific for the industry
- Requirement for centimeter level 3D positioning & orientation (D-RTK)
- Mind the '*Flight envelop*' – Operation window in which safety is assured!
  Wind speed; Maximum payload; Redundancy


TRINOVA
engineering in the sky

Future applications

1. Sensors

- Miniaturization of sensors
- Multi sensor data capturing and analysis techniques.
  (e.g. Visual and thermographic)

Future applications

2. Digitalization

2.1. '*Predictive*' Maintenance

From '*Run to failure*' maintenance via '*Preventive*' Maintenance towards '*Predictive*' Maintenance.

- Digital data from drones supports '*Predictive*' Maintenance.
- Intelligent software predicts if a failure is likely within a certain time frame.

2.2. Artificial intelligence (AI)

- Robot learning algorithms will be able to autonomously identify, categorize and summarize a myriad of inspection-related outcomes.

Future applications

3. Complete physical tasks

Nowadays drones are flying cameras / sensors.

Drones does not complete physical tasks. One still need to send employees out there to make the repairs.

Robots for Brushing, Painting, Injection, …

4. Autonomy

- Longer flight times
- Autonomous inspection robots without human supervision
- Beyond Visual Line Of Site (BVLOS) operations

BELRIM
BELGIAN RISK MANAGEMENT ASSOCIATION

Thank you!

TRINOVA
engineering in the sky

Offices: De Lochtlaan 13, 2530 Boechout, BELGIUM
+32 476 751 664 | www.trinova.be | info@trinova.be
BIC: GEBABEBB | IBAN: BE60 0014 1434 4670 | BTW BE 0862 476 587

Questions?

TRINOVA
engineering in the sky
Offices: De Lochtlaan 13, 2530 Boechout, BELGIUM
+32 476 751 664 | www.trinova.be | info@trinova.be
BIC: GEBABEBB | IBAN: BE60 0014 1434 4670 | BTW BE 0862 476 587