



**15th INTERNATIONAL OPERATIONS & MAINTENANCE CONFERENCE** IN THE ARAB COUNTRIES  
UNDER THE THEME: “**SMART MAINTENANCE**” CONICIDE WITH THE 15<sup>TH</sup> ARAB MAINTENANCE EXHIBITION

# Automated Maintenance Team for Confined Spaces: Unmanned Aircraft

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# Introduction



**DANGER**

**CONFINED SPACE  
PERMIT ONLY**

PREPARE FOR ENTRY

- Identify hazards of permit space
- De-energize & lock out all energy source
- Drain, clean & ventilate confined space
- Isolate confined space - disconnect fill & drain lines

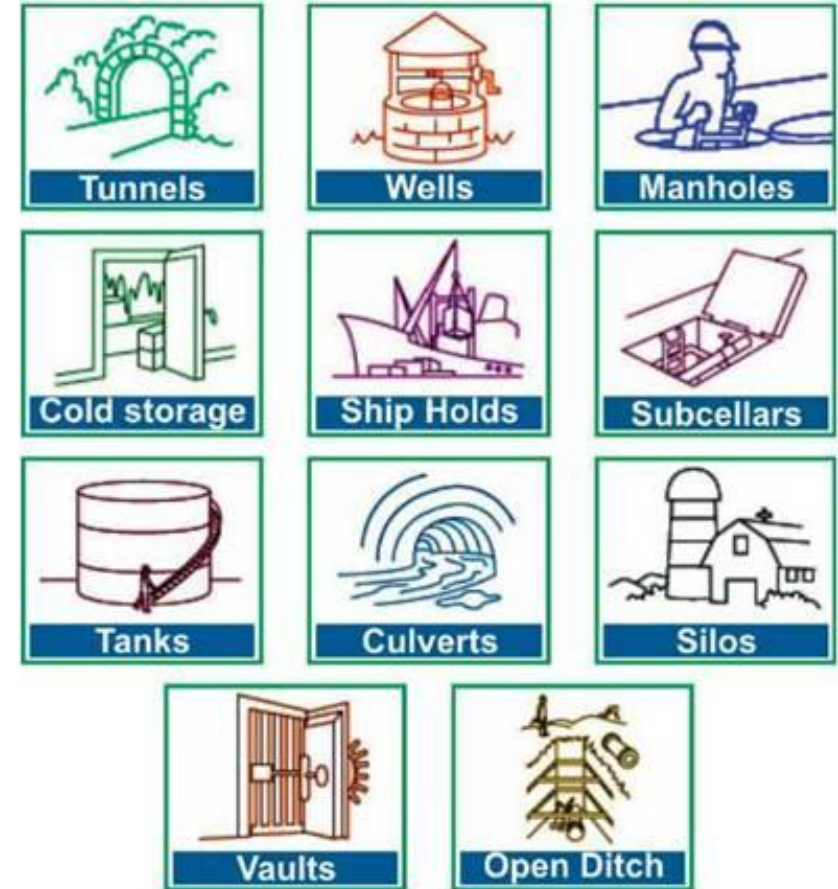
TEST ATMOSPHERE

- Oxygen level between 19.5 % & 23.5%
- Flammable gases/vapors less than 10% of LEL
- All substances below established PEL

PREPARE PERSONNEL PROTECTIVE DEVICES

- Respirator, protective clothing, life-line & harness

ATTENDANT & RESCUE EQUIPMENT IN PLACE  
REVIEW COMMUNICATION PROCEDURES  
OBTAIN AUTHORIZED PERMITS





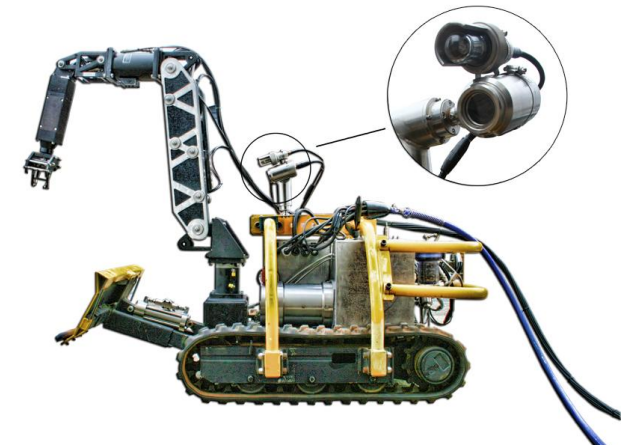
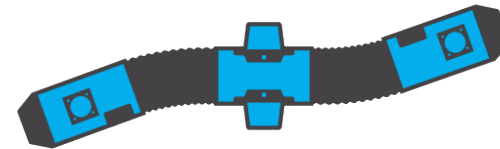
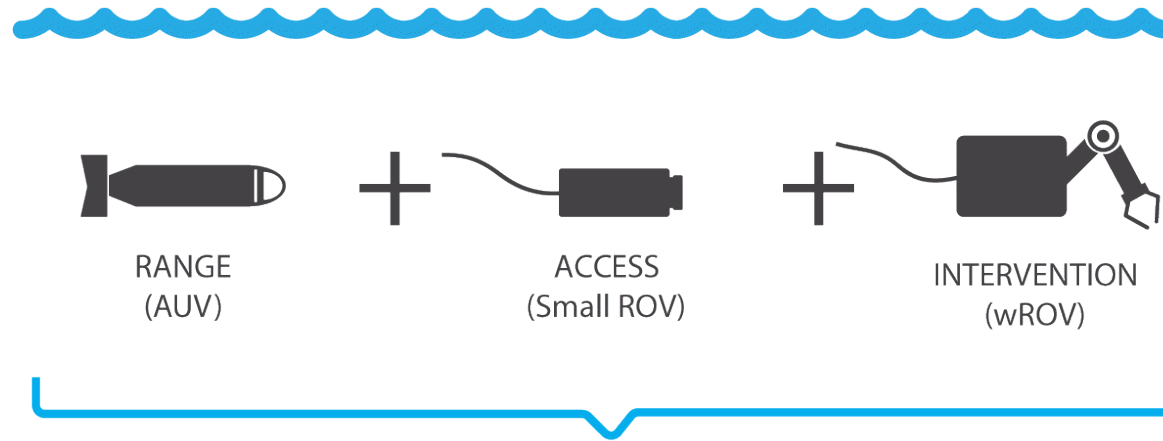


# Introduction

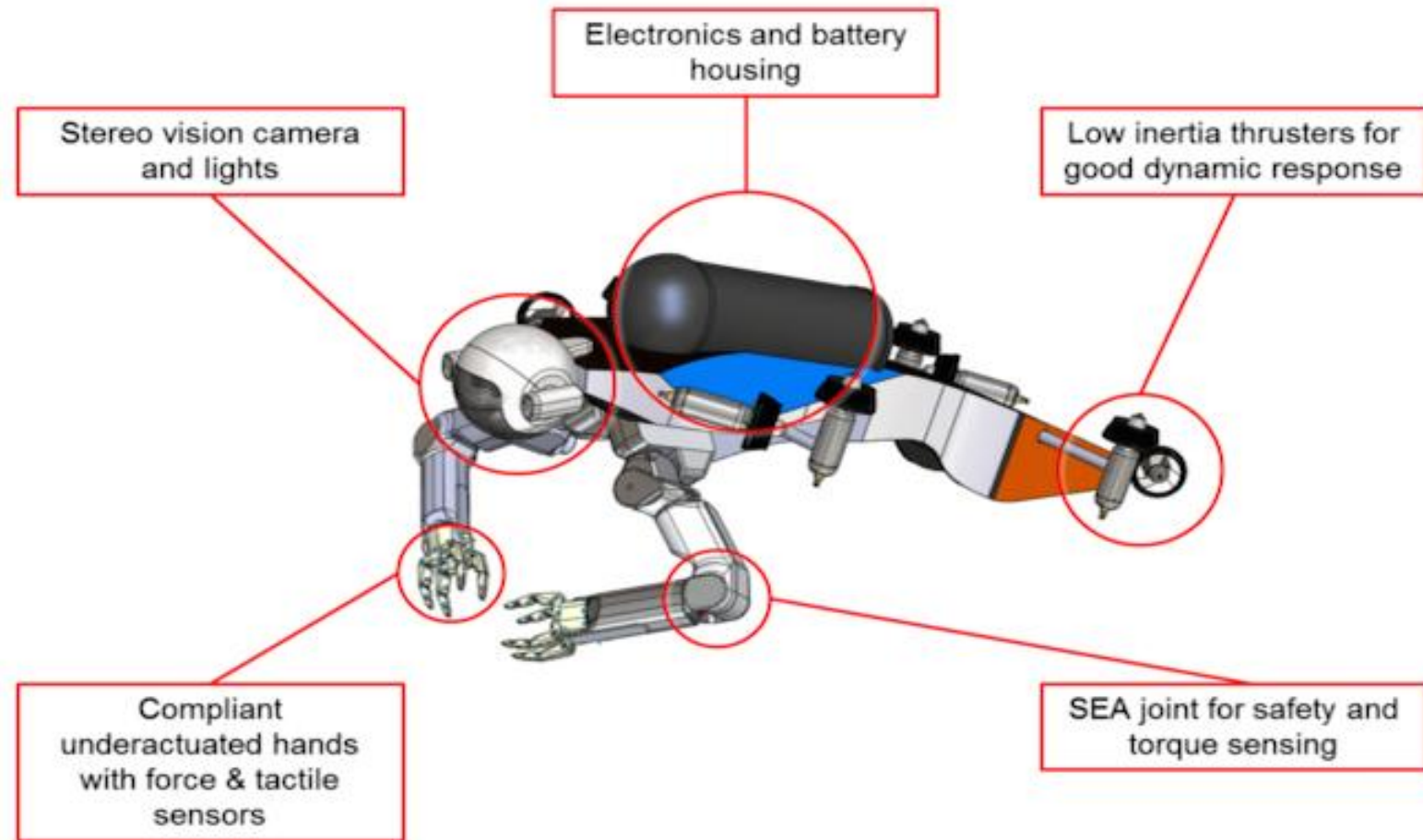
## Unmanned Vehicle Types

1. Unmanned ground vehicle (UGV), such as the autonomous car.
2. Unmanned aerial vehicle (UAV), unmanned aircraft commonly known as a "drone".
3. Unmanned combat aerial vehicle.
4. Unmanned surface vehicle (USV), for the operation on the surface of the water.
5. Unmanned underwater vehicle (UUV) sometimes known as underwater drone, for the operation underwater.
6. Unmanned spacecraft, both remote controlled ("unmanned space mission") and autonomous ("robotic spacecraft" or "space probe").

# The ROVs as a smart maintenance solution



# The ROVs as a smart maintenance solution



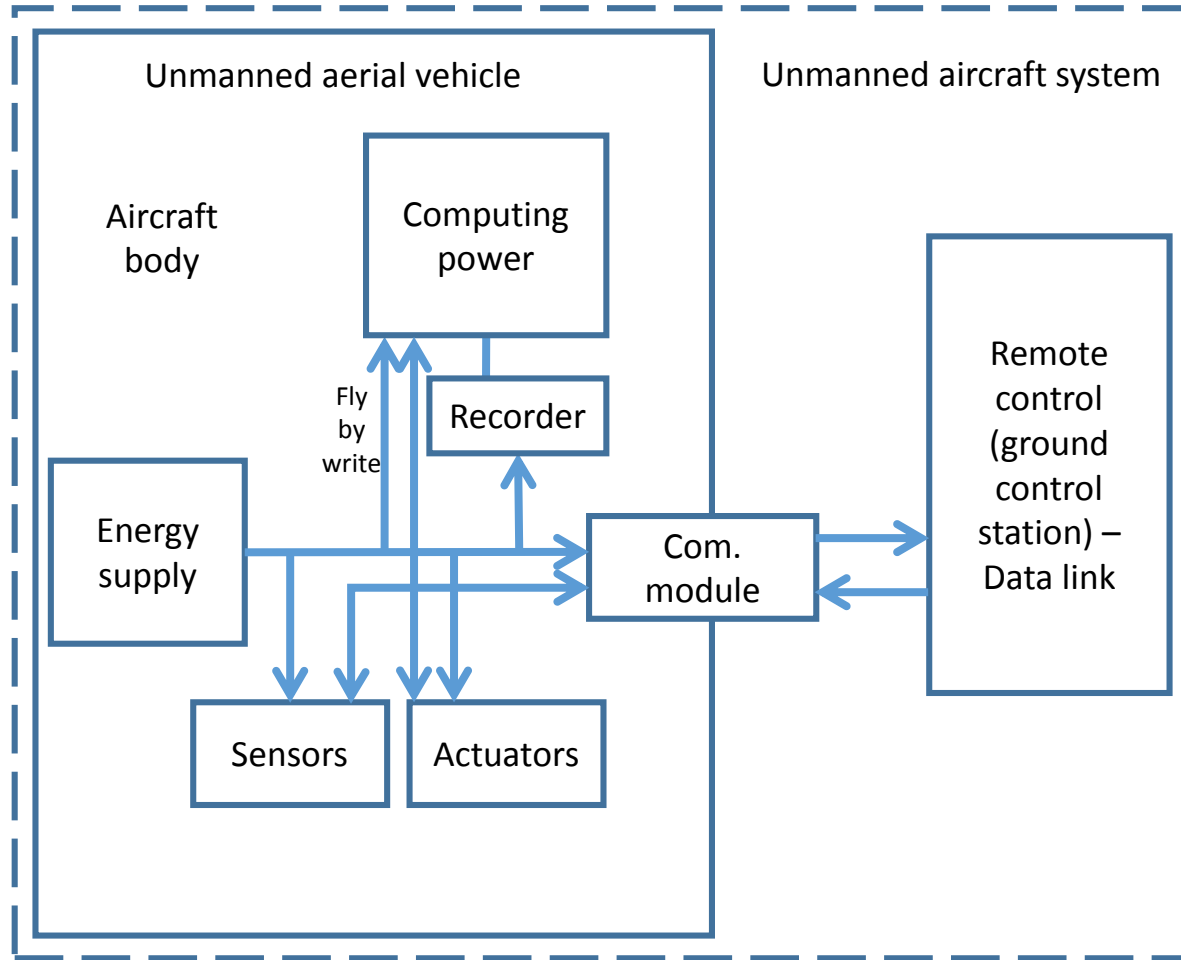


# The ROVs as a smart maintenance solution

## *The use of ROVs offers advantages*

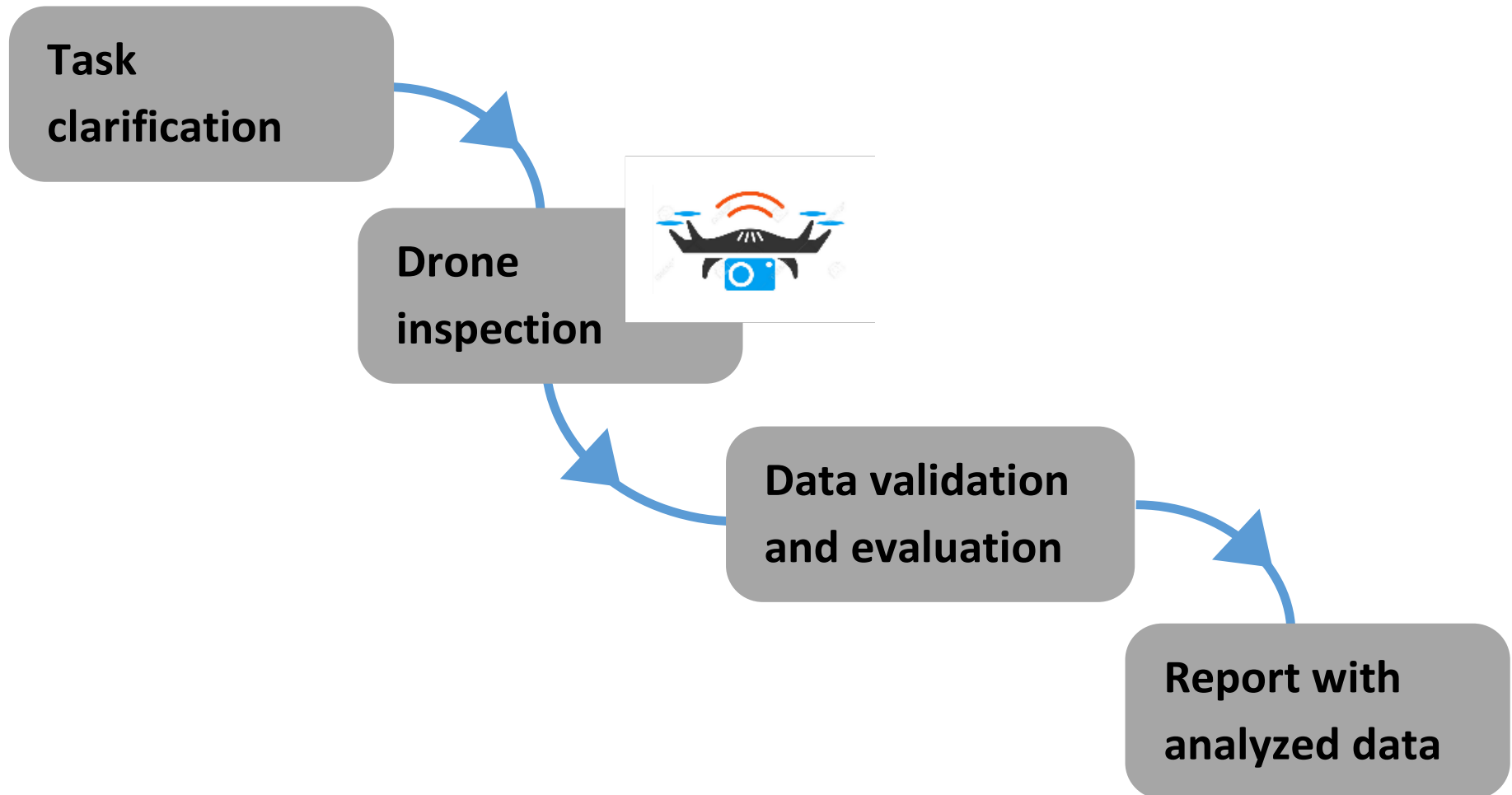
1. Quick overview and evaluation of the condition.
2. Sharp and detailed photographs of defects.
3. Preventive maintenance planning and optimized production.
4. Access to hard to reach areas such as confined spaces.
5. Reduced maintenance downtime.
6. High level of safety.

# The Unmanned Aircraft as a smart maintenance solution



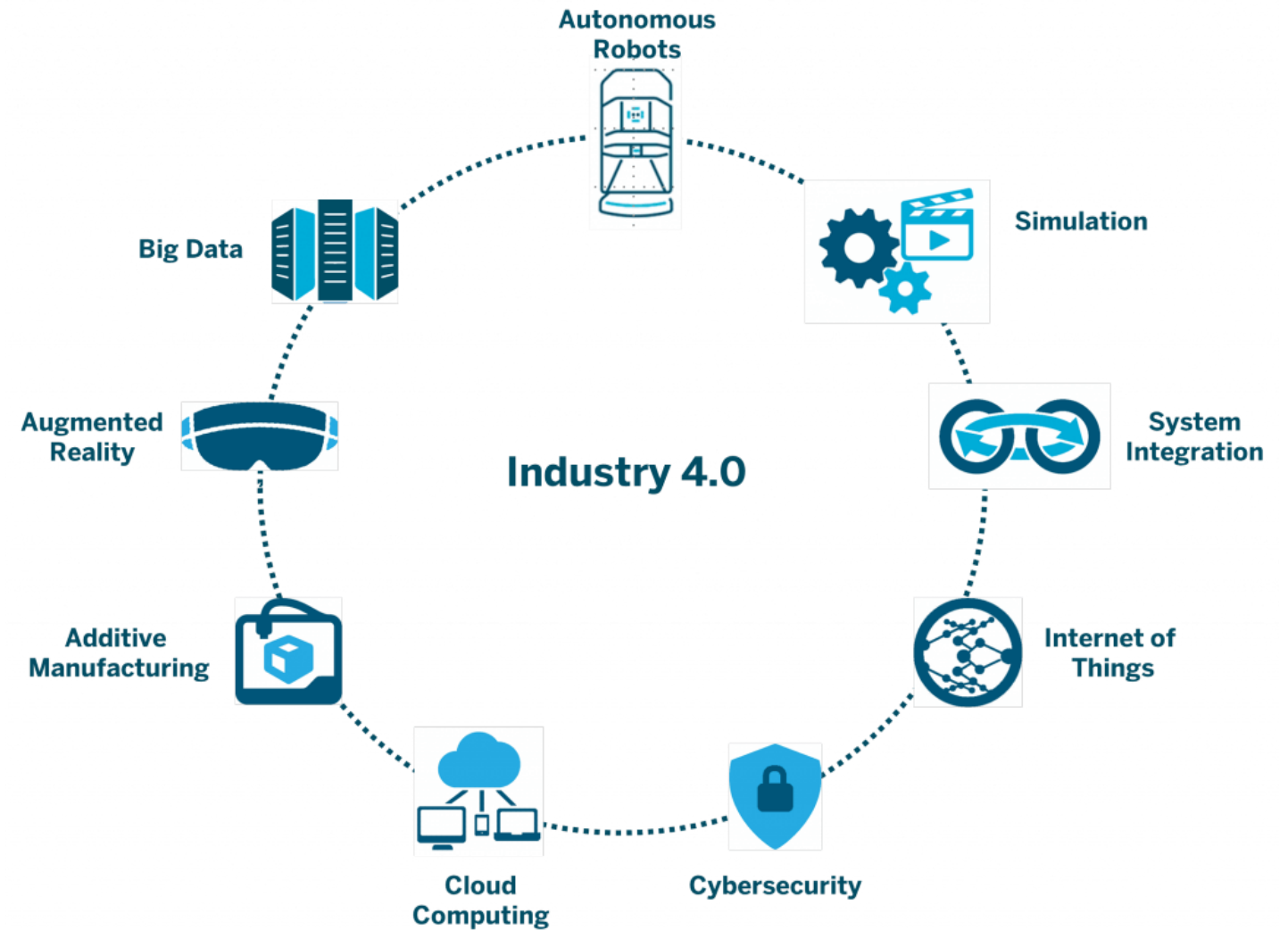


# The Unmanned Aircraft as a smart maintenance solution



# The role of ROV in the Industry 4.0

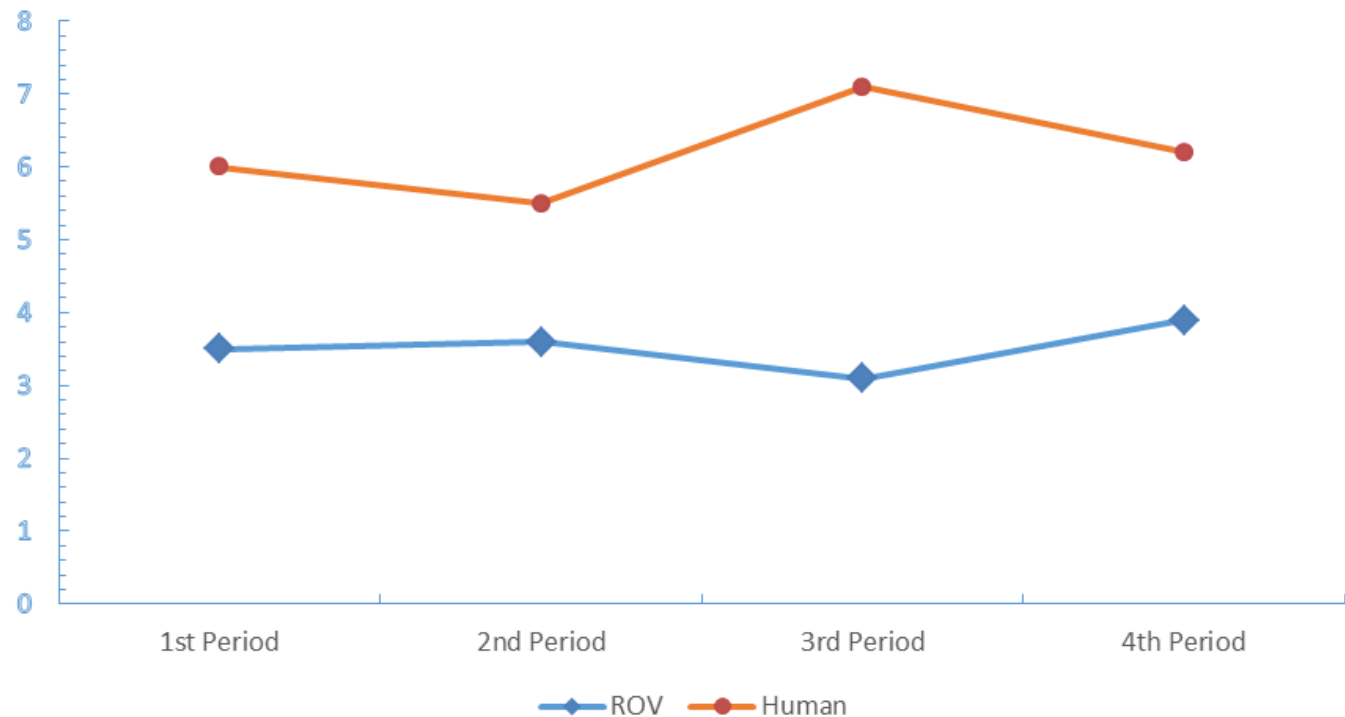
The main arguments of the Industry 4.0



# The case study and Results

Equipment	Maintenance activity	Time
Cooling tower	<ul style="list-style-type: none"><li>• Visual inspection and</li><li>• Cleaning</li></ul>	Every 3 months

The total time (vertical axis in hours) consumed for both inspection and cleaning works for the comparison between human and ROV.

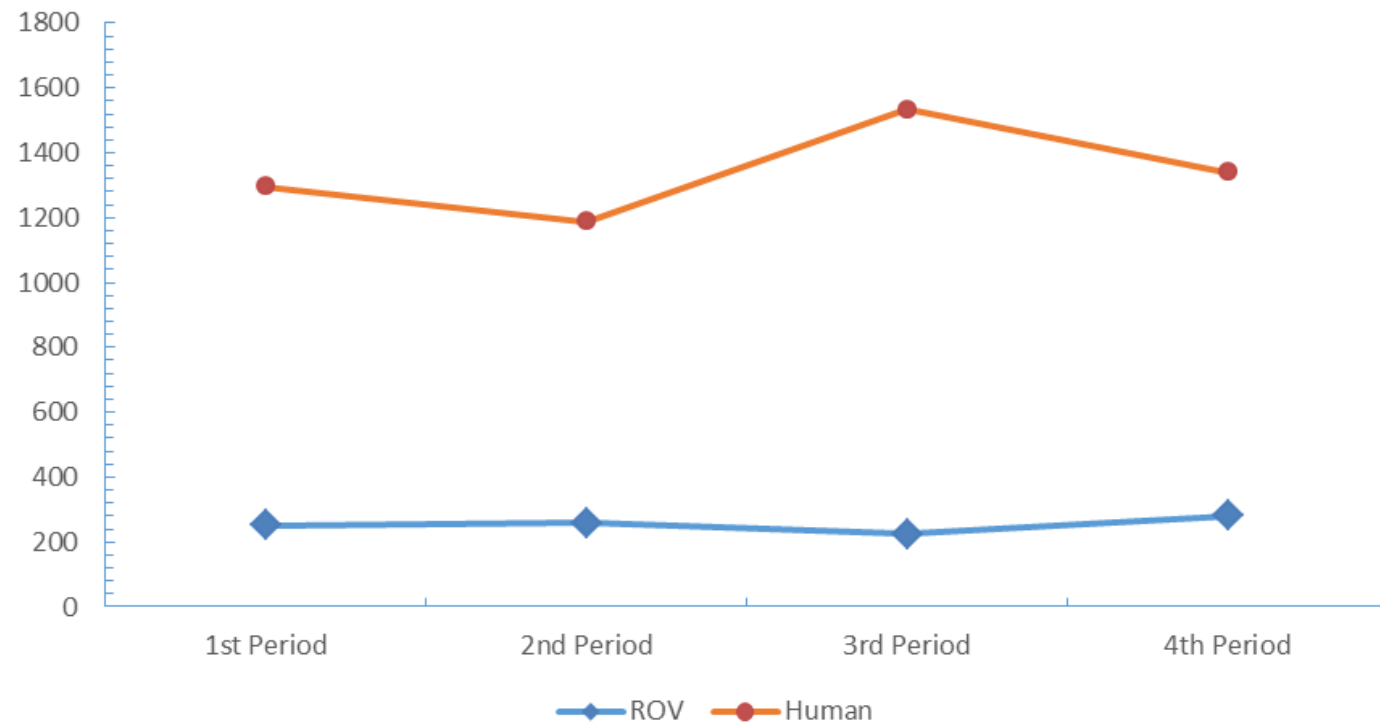




# The case study and Results

Equipment	Maintenance activity	Time
Cooling tower	<ul style="list-style-type: none"><li>• Visual inspection and</li><li>• Cleaning</li></ul>	Every 3 months

The total cost (vertical axis in Euro) consumed for both inspection and cleaning works for the comparison between human and ROV.



# Conclusions

1. The usage of such ROVs in maintenance and inspection work reduces the total consumed time as well as the total cost by 53 % and 80 % respectively.
2. The ROVs are recommended to be used for the maintenance and inspection works at the confined spaces.
3. The usage is highly recommended for those works related to an industry 4.0 system.



Thank You !