


AI-Driven Autonomous Systems for Hazardous Terrain Operations

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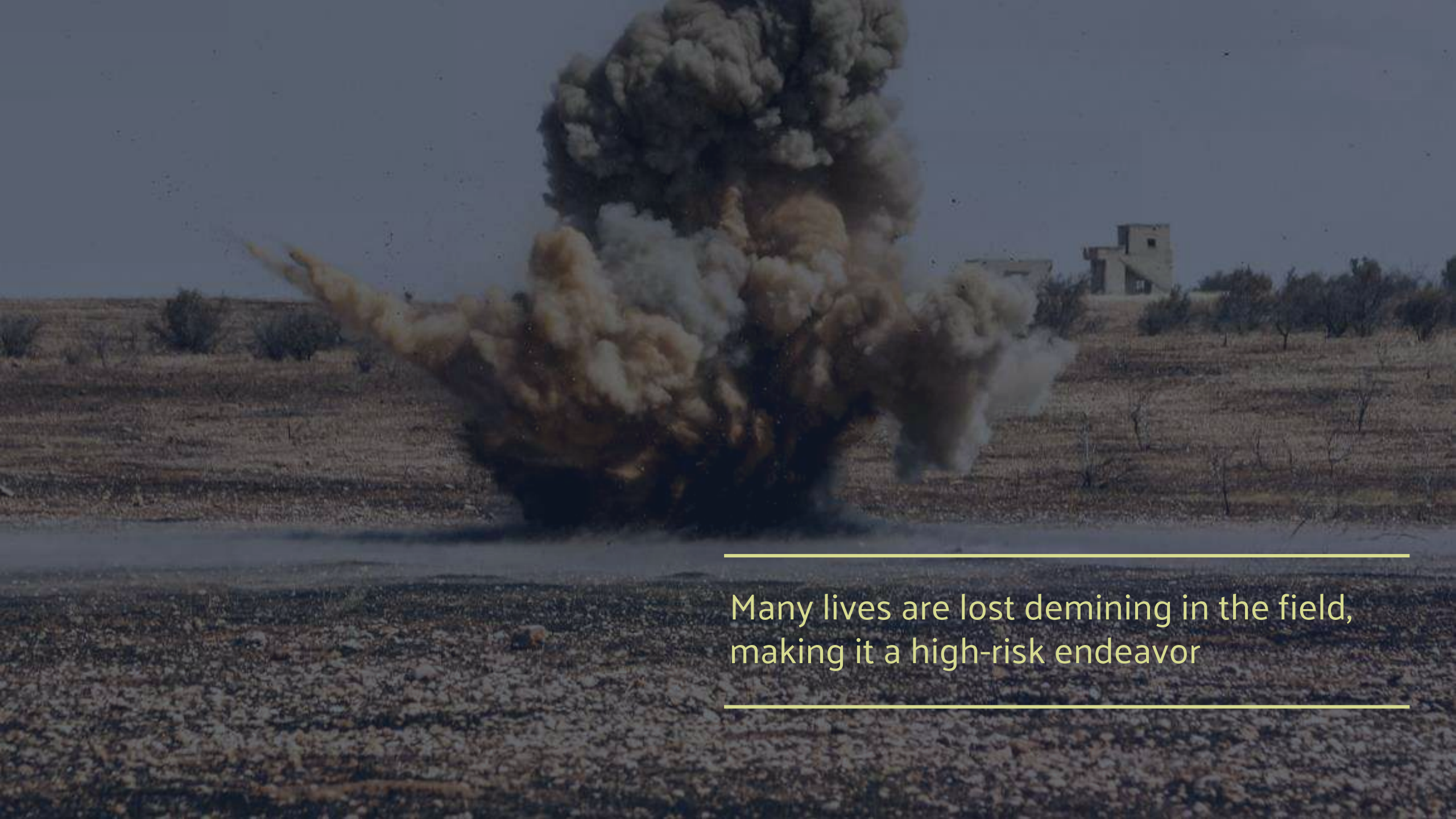
Brussels, October 15th, 2024



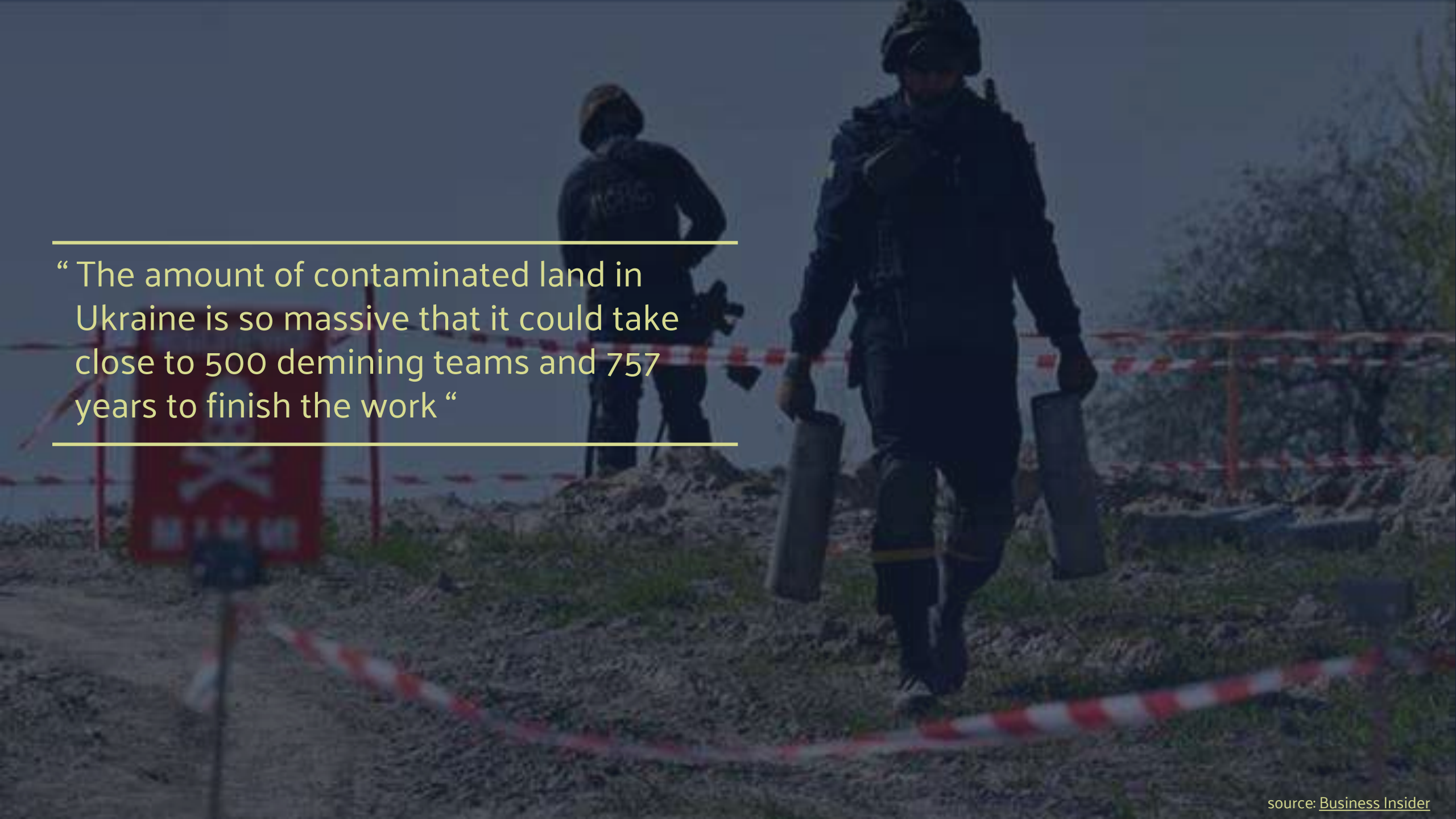
DEFENCE

A person wearing camouflage clothing is using a metal detector in a field of dry leaves. The detector's coil is buried in the ground, and the person is leaning over it. The scene is dimly lit, suggesting an overcast day or a shaded area. The text is overlaid on the left side of the image, framed by two horizontal lines.

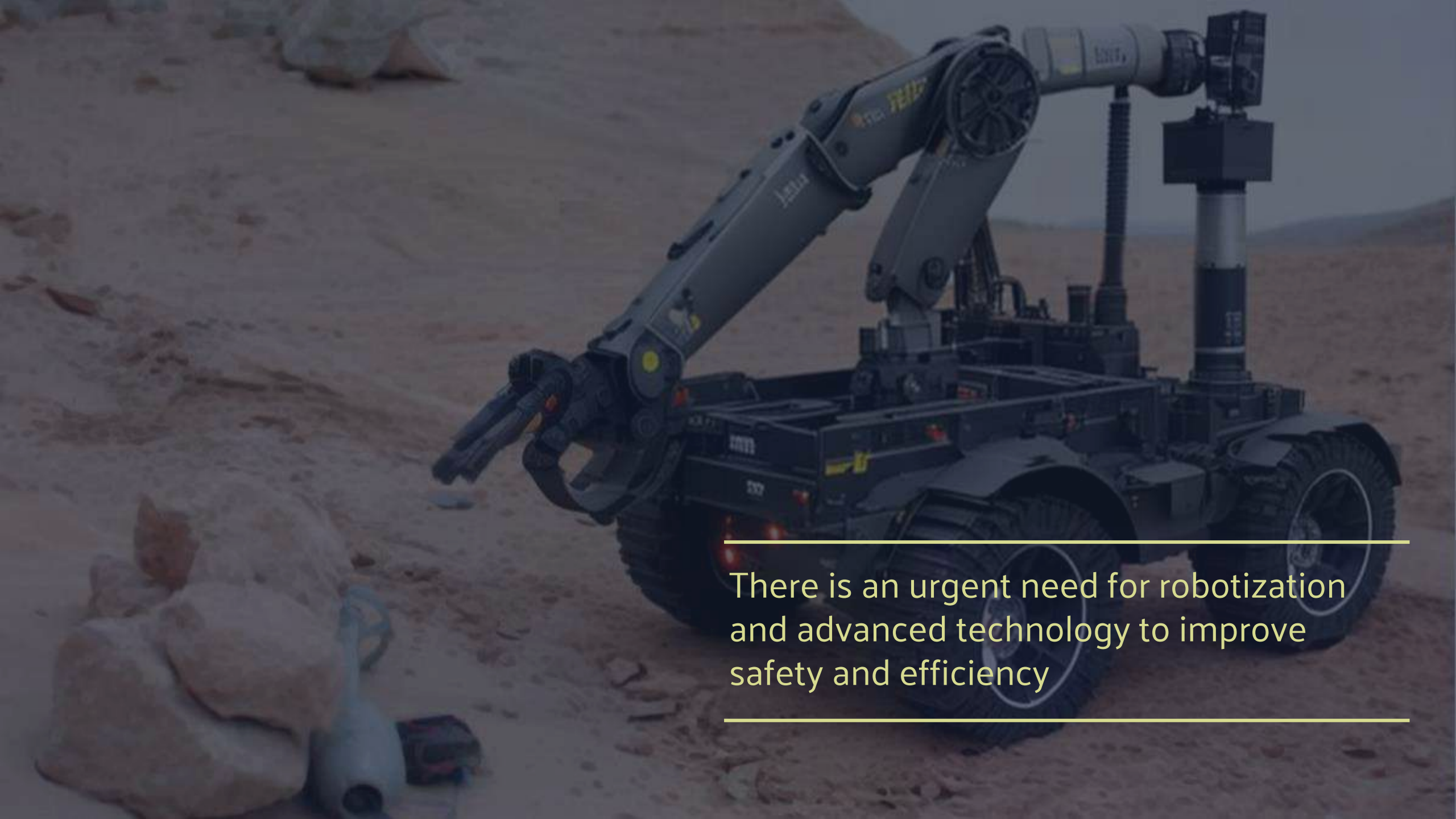
Human intervention in land mine removal is slow, dangerous, and resource-intensive



Many lives are lost demining in the field,
making it a high-risk endeavor

A photograph showing two demining team members in full protective gear working in a field. One person is in the foreground, walking towards the camera, carrying two cylindrical containers. Another person is in the background, standing near a pile of earth. The area is cordoned off with red and white striped caution tape. The background shows a body of water and some trees under a clear sky.

“ The amount of contaminated land in Ukraine is so massive that it could take close to 500 demining teams and 757 years to finish the work “



There is an urgent need for robotization and advanced technology to improve safety and efficiency

Toward a More Efficient Mine Removal

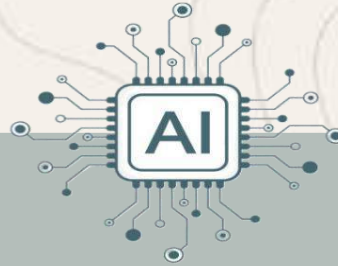


Investments in technology can
speed up the demining phase

Toward a More Efficient Mine Removal



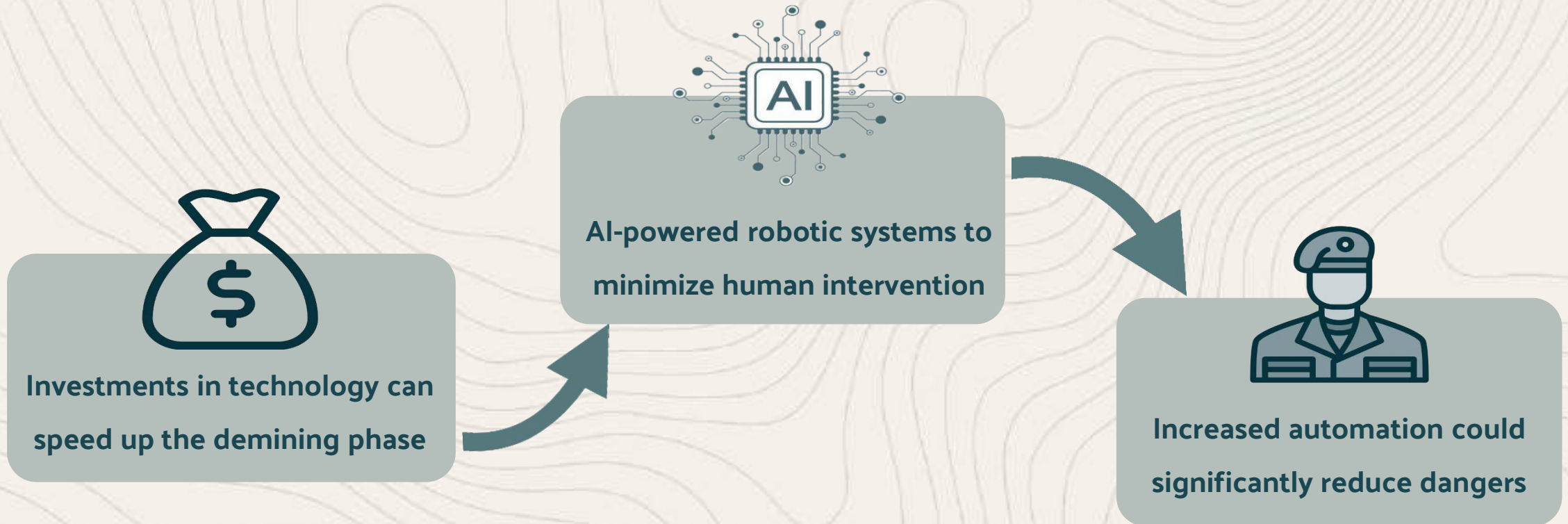
Investments in technology can speed up the demining phase



AI-powered robotic systems to minimize human intervention



Toward a More Efficient Mine Removal



Logic



Recognition



Processing



Confirmation



Disposal

Approach



Co-design



Co-development



End users



Stakeholders

Approach



Co-design



Co-development



A priori requirements



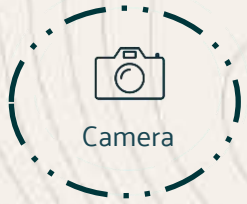
Frequent field trials



Recognition



Recognition Phase: Mapping



Non-technical survey



'A priori' knowledge of the infested area



Aerial mapping and technical survey

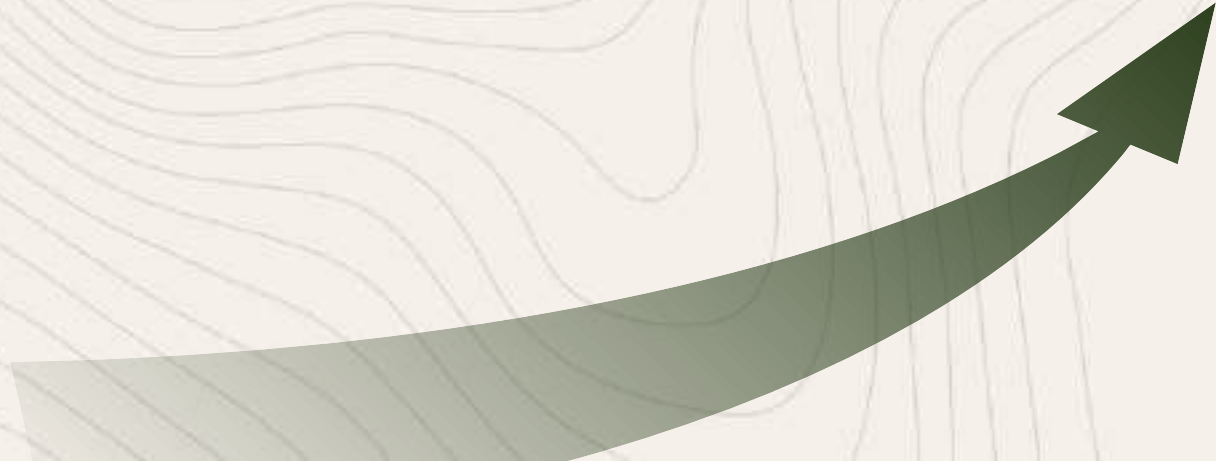
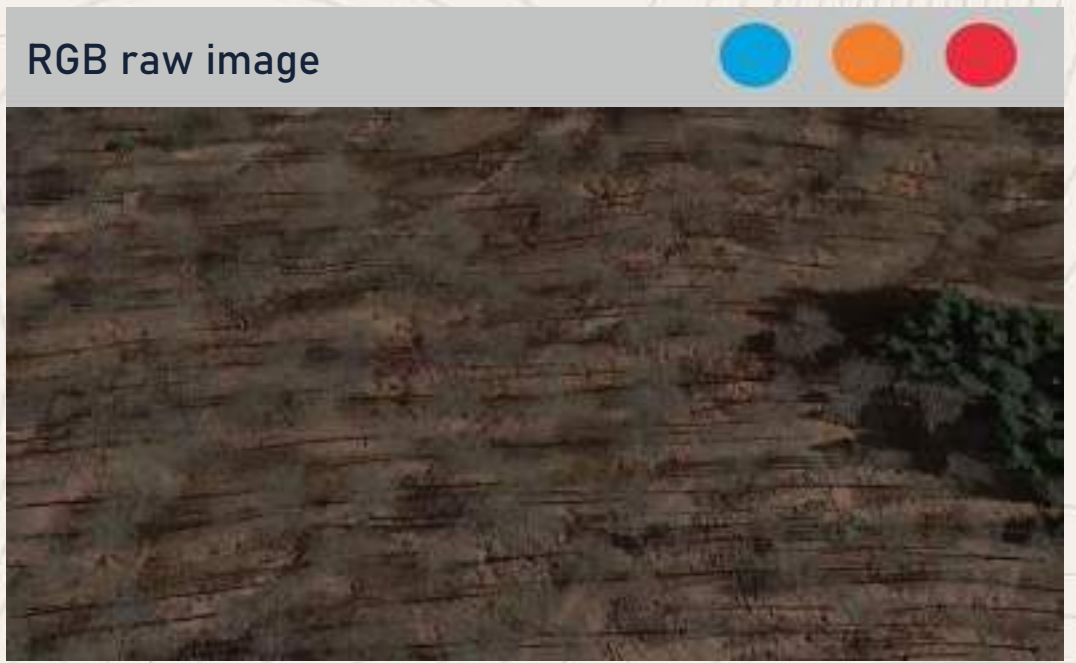
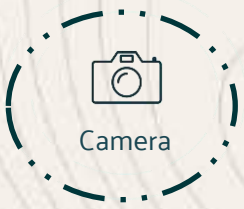


Terrain analysis

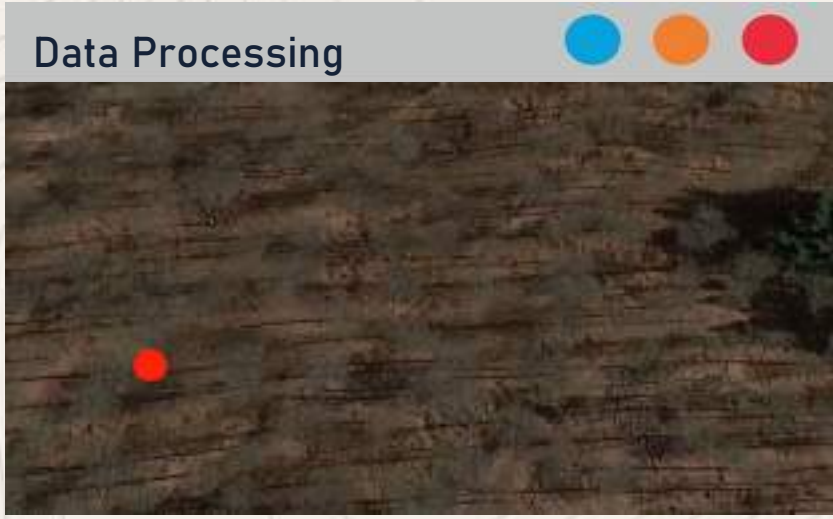
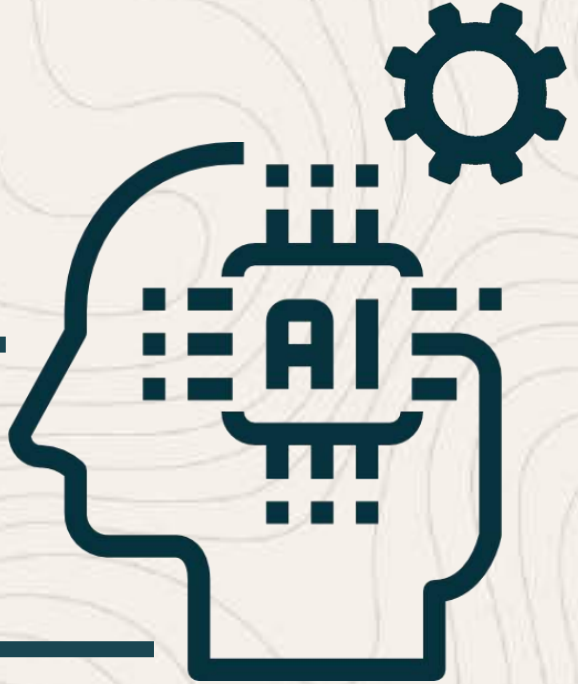
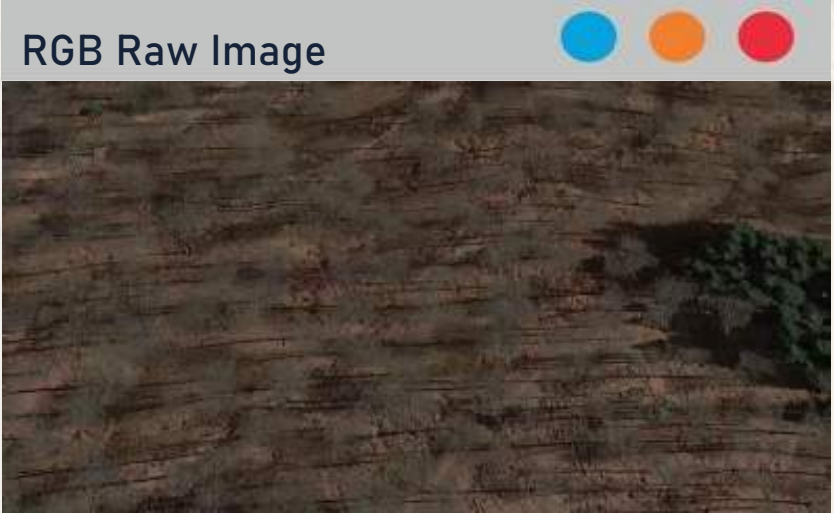


Identifying obstacles and locating hazards

Recognition Phase: Mapping



Recognition Phase: Data Gathering and Processing

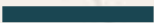




Processing

Processing Phase: Toward an Intuitive User Understanding

Situational Awareness



C2 Station

UI

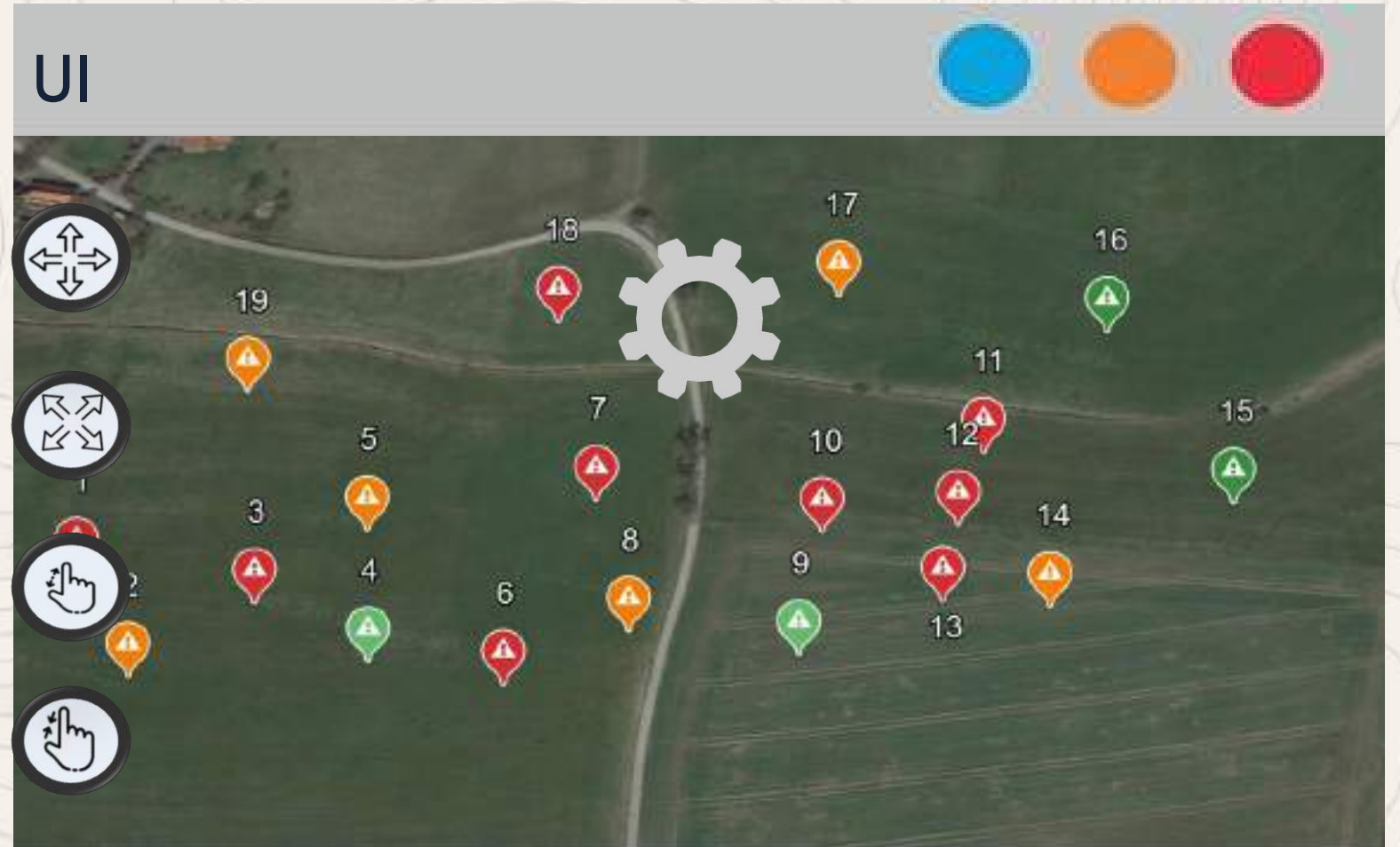


Processing Phase: Global UGV Route is Elaborated

✓ Color follows detection of accuracy

✓ Threat-based planner

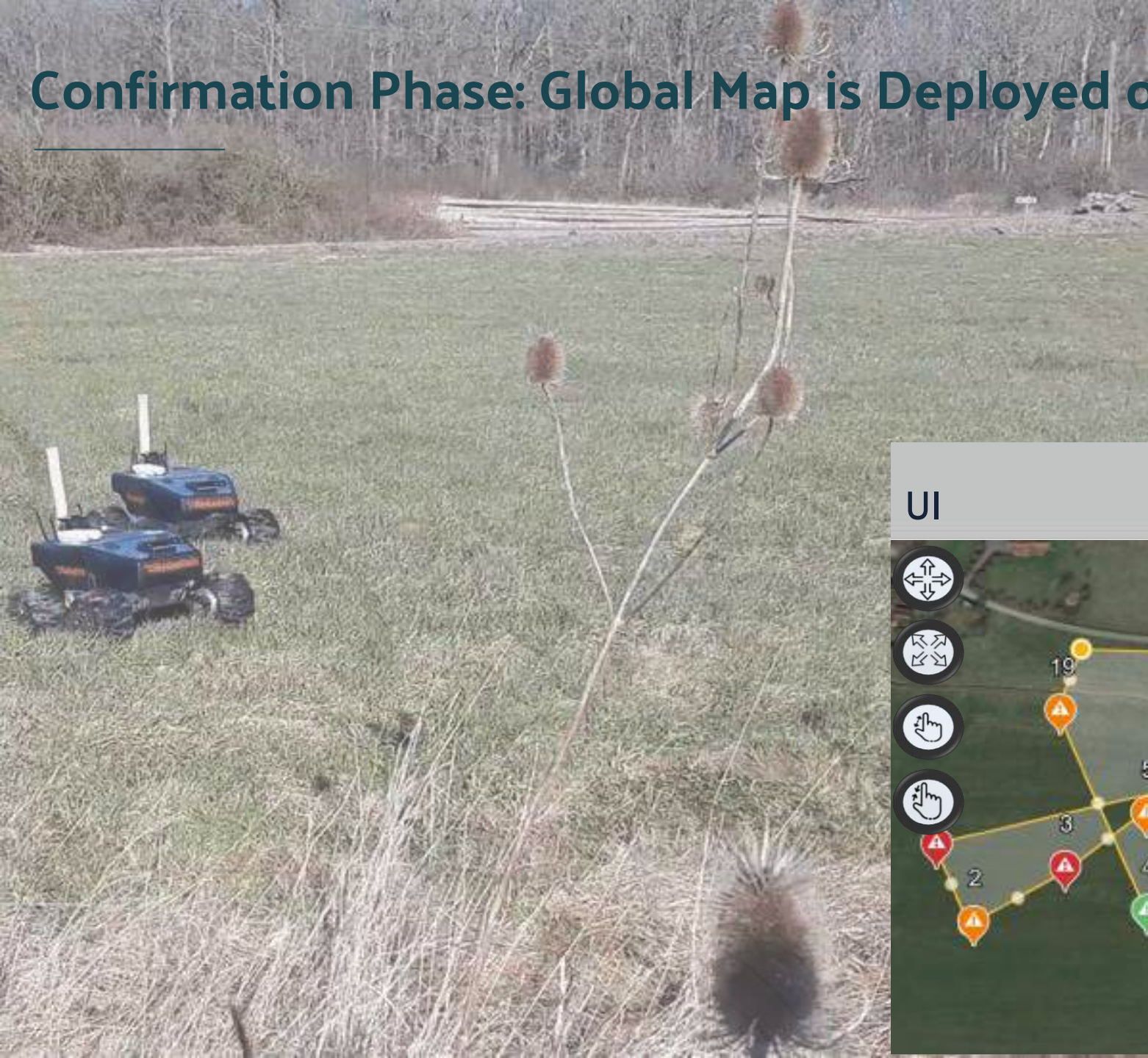
✓ Global plan is deployed





Confirmation

Confirmation Phase: Global Map is Deployed on the UGV Swarm

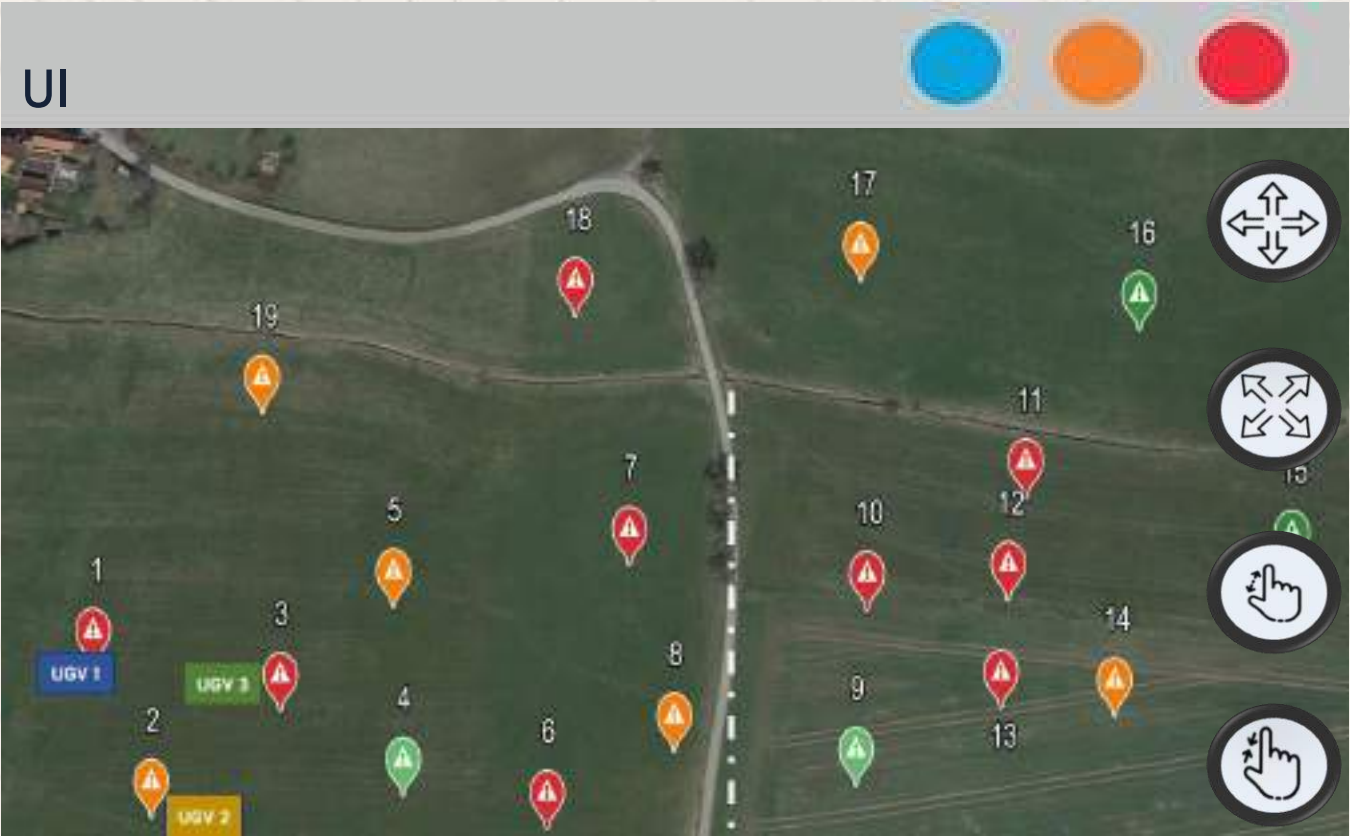


UI

● ● ●

The UI overlay consists of a satellite map with a yellow path connecting 19 numbered nodes. The nodes are marked with colored triangles: red (1-13), orange (14-17), and green (18-19). A yellow dot is positioned at node 19. On the left side of the map, there are four circular icons: a four-way arrow, a four-way arrow with a central dot, a hand cursor, and a hand cursor with a dot. At the top right, there are three colored circles: blue, orange, and red.

Confirmation Phase: UGV Swarm Verifies the Threats at Safety Distance





Disposal

Disposal Phase: Deploying of Manipulator UGVs



Operator Supervision



C2 Station



Source: Clearpath Robotics by Rockwell Automation - Youtube Channel

Disposal Phase: Deploying of Manipulator UGVs

- ✔ Operator supervision
- ✔ Operator may be asked for action
- ✔ Coordination arm-platform



Disposal Phase: Operator Supervision



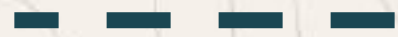
Operator Supervision



Disposal Phase: Operator Supervision

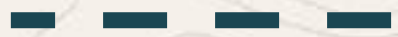
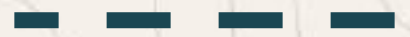


Operator Supervision



No Supervision Alert

Disposal Phase: Operator Supervision



No Supervision Alert

Autonomous Disposal

Disposal Phase: Operator Supervision



Operator Supervision



Supervision Alert

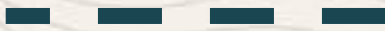
Disposal Phase: Operator Supervision



Operator Supervision



Supervision Alert



Teleoperation

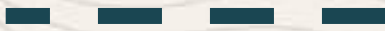
Disposal Phase: Operator Supervision



Operator Supervision



Supervision Alert



Teleoperation



Assisted Disposal

Disposal Phase: Operator Intervention



Operator Supervision



Supervision Alert



VR Feedback



Teleoperation



Assisted Disposal



Added Values

Strategic Advantage

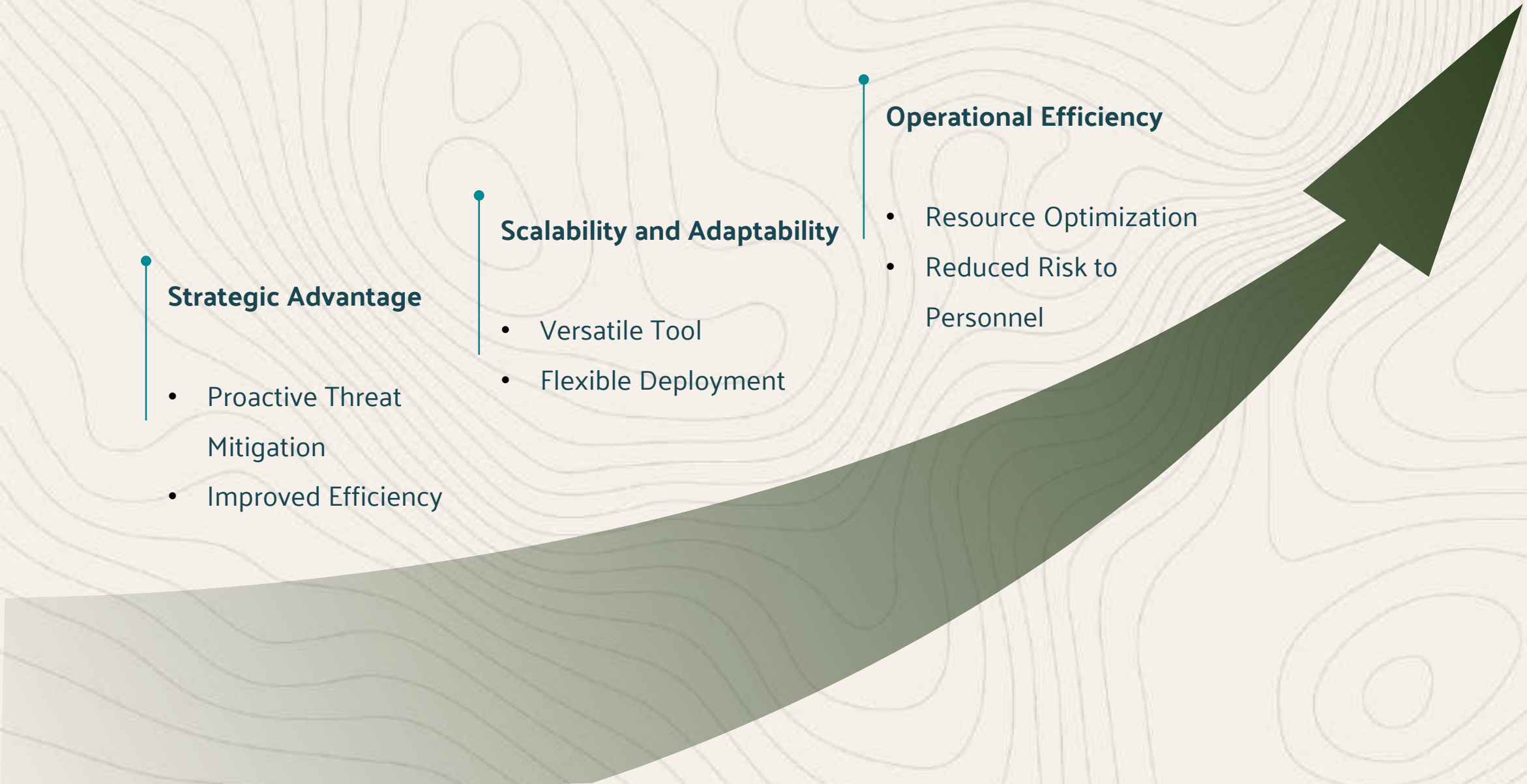
- Proactive Threat Mitigation
- Improved Efficiency

Scalability and Adaptability

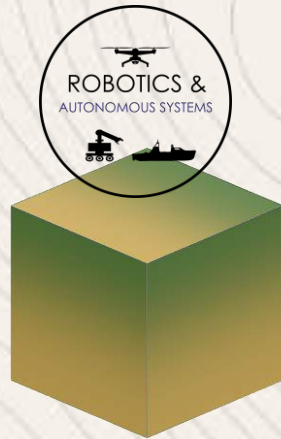
- Versatile Tool
- Flexible Deployment

Operational Efficiency

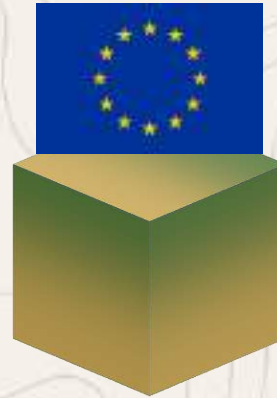
- Resource Optimization
- Reduced Risk to Personnel



Expertise in the Field



Decades of expertise in
the field of robotics



Involved in different
consortia of different EU
funded projects on the
subject



Involved in different
Belgian Defence funded
projects on the subject



Thank you for your attention!



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