INNOVATION SESSION ON AI FOR MINE ACTION

# Innovation Session Report

1–3 OCTOBER, 2024

INTERNATIONAL CONFERENCE CENTER GENEVA (CICG), GENEVA, SWITZERLAND

## Executive summary


This document provides a summary of the GICHD (Geneva International Centre for Humanitarian Demining) Innovation Session on Artificial Intelligence (AI) for Mine Action, recording the structure of the event and its level of participation, as well as summarizing the key takeaways.

The event highlighted two key considerations critical to advancing AI applications in the sector. First, it was made clear that data is the foundation for effective AI solutions. Participants emphasized the importance of both structured and unstructured data for teaching and fine-tuning AI algorithms, as well as extracting valuable insights to inform decision-making. Establishing robust systems for data collection, storage, and sharing is essential to unlock AI's full potential.

Second, the event underscored the need to balance generic AI tools with context-specific requirements. While current AI technologies offer powerful capabilities, they often lack the contextual awareness necessary for mine action. By tailoring AI solutions to regional, national, and technical contexts, the sector can maximize their operational value.

Moving forward, collaborative efforts to develop data-driven approaches and customized AI tools will be pivotal in enhancing the safety and efficiency of mine action operations.

The Innovation Session on AI for Mine Action brought together 75 experts from the mine action sector and AI practitioners. Over three days, participants collaboratively explored AI-driven solutions to pressing challenges in mine action. Through a structured process, groups developed project briefs outlining problem statements, key requirements, potential AI applications, and road maps for implementation.

It included two and a half days of collaborative discussions and knowledge sharing. The event began with cross-briefings between mine action practitioners and AI experts to build mutual understanding of the sector’s challenges and AI’s potential applications. A series of keynote speeches and thematic sessions covered topics such as the transformative potential of AI, ethical and human rights considerations, advancements in large language models (LLMs), geospatial AI (GeoAI), land release principles, and the current use of information management



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systems. These sessions bridged knowledge gaps, explored AI trends, and highlighted practical pathways to leverage AI for improved mine action outcomes.

The Session culminated with the presentation of project ideas and discussions to refine them, fostering collaboration, and identifying the most actionable, groundbreaking, and impactful projects. The nine project ideas emerging from the event and described in this report were:

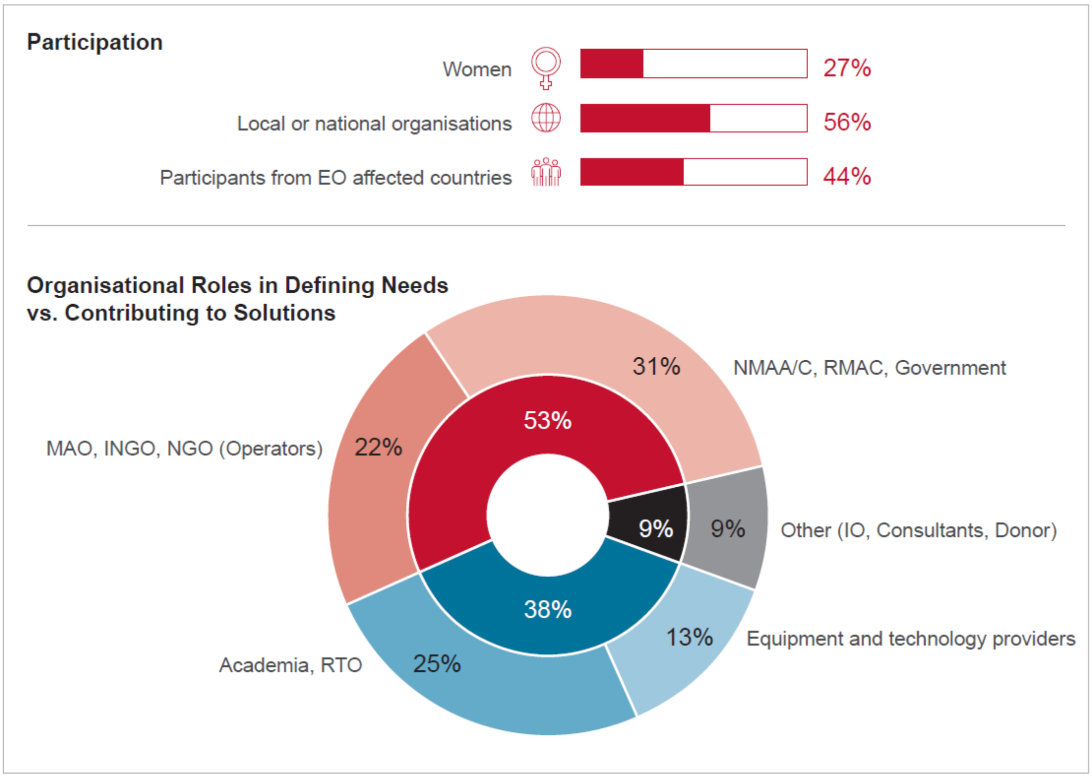
- Reference database for automated image recognition of explosive ordnance.
- Early impact analysis.
- Data analytics and interrogation of information management systems.
- Generative AI supporting organizational processes.
- Impact of AI on community engagement within explosive ordnance risk education.
- Information management systems, data integration and priority setting.
- Robotics and autonomous mechanical systems.
- Satellite imagery processing and analysis.
- Unmanned aerial vehicle-deployed sensor data fusion and analysis.

# I. Introduction

The Innovation Session on AI for Mine Action, organized by the GICHD, was held from 1 to 3 October 2024, in Geneva. This event was attended by 75 experts from the mine action sector and AI practitioners to collaboratively explore AI-driven solutions to pressing challenges in mine action.

Over three days, participants worked through a structured process to understand the challenges and needs of the mine action sector, to brainstorm AI-driven solutions, and develop actionable road maps for going forward. Each group developed a project brief, which included a detailed problem statement, key factors and requirements, potential AI applications, and a road map for implementation. These project briefs were the foundation of the Session's outcomes, representing actionable road maps to tackle identified challenges. On the final day, the groups presented their project ideas and engaged in discussions to refine them, exploring collaborative opportunities. Participants also voted on projects in three categories: most actionable, most groundbreaking, and most impactful.

Out of 220 registrations, participants were carefully selected to promote a balanced representation across national mine action authorities, mine action organizations, academia, and research and technology institutions, as depicted in the graph below.



## II. Event overview

The Innovation Session aimed to achieve the following outcomes:

- Develop a shared understanding of AI and its intersection with mine action.
- Identify and characterize needs-based problems which can be addressed with the support of AI computational methods.
- Develop project briefs on applying AI to specific mine action challenges.

### Day 1 – Cross-education: AI meets mine action

The two-and-a-half-day event began with one day of initial cross-briefings between mine action practitioners and AI experts. This promoted a wider awareness of the unique challenges of mine action, as well as a better understanding of what AI is and what it could bring to the sector. Bridging this knowledge gap established a common foundation for the collaborative thematic sessions that followed for the entire second day of the event.

The sessions covered:

- **Keynote speech: transformative potential of AI** (*Michal Tjalve, PhD, Founder of the Humanitarian AI Advisory, Assistant Professor, University of Washington*): highlighting the transformative potential of AI for mine action while emphasizing the need for caution, ethical responsibility, and strategic oversight in its application. Key points included the distinctions between types of AI computational methods, applications in humanitarian action, and practical considerations for responsible implementation.
- **Artificial intelligence, ethics, and human rights** (*Alexander Kriebitz, PhD, Postdoctoral Researcher at the Ludwig-Maximilians-Universität München*): focused on ethical considerations and the human rights approach to AI development and use, highlighting gaps and proposing strategies to address global risks associated with AI in humanitarian contexts.
- **The evolutionary journey and future directions for large language models** (*Ahmed Al Qayed Al Hammadi, PhD, Principal Researcher at the Artificial Intelligence Cross Center Unit of the Technology Innovation Institute in Abu Dhabi, United Arab Emirates*): explained generative AI, natural language processing, and LLMs, their evolution, limitations and how they can be used to enhance decision-making and knowledge management.
- **GeoAI in ArcGIS: machine learning and neural networks** (*Rami Alouta, Senior Solutions Engineer at Esri*): showcased how machine learning and neural networks are combined to speed up geospatial analysis.
- **Introduction to mine action** (*Greta Zeender, Head of External Relations and Policy, GICHD*): a broad overview designed to provide non-experts with essential knowledge of the sector.

- **Land release: key principles and overview** (*Angela De Santis, PhD, Deputy Head of Operations, Fondation suisse de déminage*): an accessible explanation of land release and its key challenges, covering key concepts and best practices.
- **Information management in mine action** (*Lina Castillo Méndez, Advisor, Standards and Operations, GICHD*): showcased the current use of information management systems within the sector, offering diverse context-specific examples and respective challenges.
- **AI in mine action: current trends, challenges, and future directions** (*Sulaiman Mukahhal, Information Management Advisor, GICHD*): at the intersection of mine action and AI, provided a systematic review of research publications on the use of AI computational methods in mine action, offering valuable insights for the path forward.

## Day 2 – Thematic working sessions

The second day was pivotal for the event. Through thematic working sessions, in small diverse groups, participants harnessed their collective expertise to develop a clear understanding of the challenges, develop AI-driven solutions, and create actionable road maps for implementation. This format created a safe space for open dialogue and critical discussions, while at the same time building trust between the different participants.

The following themes were discussed:

- Reference database for automated image recognition of explosive ordnance.
- Early impact analysis.
- Data analytics and interrogation of information management systems.
- Generative AI supporting organizational processes.
- Impact of AI on community engagement within explosive ordnance risk education.
- Information management systems, data integration and priority setting.
- Robotics and autonomous mechanical systems.
- Satellite imagery processing and analysis.
- Unmanned aerial vehicle-deployed sensor data fusion and analysis.

## Day 3 – Presentation and discussion

The outcomes of the collaborative working sessions on the second day were integrated through a progress back brief and a final presentation of the project idea was made to the plenary, during the third day. The audience voted for the most actionable, most groundbreaking and most impactful projects.

All the slide decks and videos of the interventions are available on the GICHD Innovation webpage.

## III. Innovation Session outcomes

The Innovation Session on AI for Mine Action highlighted the potential of AI for the future of mine action, from optimizing operational efficiency to enhancing community engagement. By fostering a collaborative environment, the event offered a hands-on learning experience, setting itself apart from traditional conferences and symposiums. Participants worked in thematic groups to define problem statements and develop practical, AI-driven solutions tailored to the sector's unique challenges. This approach not only encouraged innovation but also underscored the importance of combining diverse expertise from the AI community, humanitarian organizations, and government representatives to create impactful, sustainable AI-driven solutions.

The following key considerations emerged from the wide range of discussions within the working sessions and in plenary sessions:

- **Data as the foundation for AI applications**

  A recurring theme throughout the event was the central role of data in enabling effective AI solutions. Participants emphasized that while computational algorithms offer immense potential — whether based on machine learning, neural networks, or natural language processing —, the true raw material for AI is data. AI thrives on two interconnected uses of data. The first is teaching and fine-tuning algorithms to perform efficiently and the second is supporting the data analysis to inform decision-making.

  Additionally, data for AI applications are no longer limited to traditional, structured formats like Information Management System for Mine Action (IMSMA) forms, geospatial data, and maps. AI unlocks the potential to use vast pools of unstructured data, such as potentially any digital documents, images, videos, and social media content. To ensure that the mine action sector is ready to leverage AI in the future, efforts must begin today to establish robust data collection, storage, and sharing architectures.

- **Balancing generic AI tools with context-specific needs**

  While AI technologies offer impressive potential — for example, in geospatial applications or generative AI chatbot development — they remain inherently generic. Current tools lack the contextual awareness essential for effective mine action. Decades of experience in humanitarian demining underscore the critical importance of regional, national, local, and technical contexts in tailoring responses to explosive ordnance contamination.

  This present limitation, however, presents an opportunity as well. AI's adaptability as a general-purpose technology means it can be tailored to meet the specific requirements of the mine action sector. Customizing AI tools to incorporate contextual sensitivity will enhance their effectiveness and operational value.

The Innovation Session on AI Applications for Mine Action marked a significant step forward in understanding and advancing AI's role in addressing explosive ordnance risks. The event underscored the importance of data-driven approaches, the need for context-specific adaptations, and the potential for AI technologies to revolutionize operational processes. As the sector looks ahead, collaborative efforts to develop robust data systems and tailored AI solutions will be pivotal in achieving safer, more efficient mine action outcomes.

The event's structure enabled participants to build partnerships, share insights, and build connections, laying the foundation for future collaborations and fostering a spirit of collective action.

In the next pages, the results of the multidisciplinary working sessions in the nine thematic areas are summarized in a one pager per theme, detailing the problem statement, key factors and requirements to consider, proposed solutions and preliminary road maps for implementation. These discussions leveraged the expertise of participants across various sectors, ensuring a holistic approach to AI integration in mine action.

## Reference database for automated image recognition of explosive ordnance

***Most actionable and groundbreaking project***

### Problem statement

How can automated imagery recognition be scaled to improve safety, efficiency, and cost-effectiveness, enabling humanitarian demining operators to have access to such technologies and analyze vast amounts of collected data more effectively?

Key bottlenecks to scaling include the resource-intensive process of model creation, the diversity of explosive ordnance types and designs, and access to explosive ordnance.

### Key factors/requirements

- Incentives to share: encourage data collection from diverse stakeholders (NGOs, commercial, government).
- Data enrichment loop: continuously improve data quality.
- Security and ownership: ensure data security and define ownership rights.
- Contextual coverage: adapt framework for various countries and settings.
- Algorithm updates: develop algorithms for data quality control and maintenance.
- Data correlation: link field data with existing reference databases (e.g. CORD) for effective analysis.

### Proposed response

Establishment of a collaborative global 3D reference database of explosive ordnance, which enables the development of multiple automated imagery recognition end-user applications tailored to specific humanitarian contexts and purposes. This database should be able to integrate technical and expert data, starting with textured 3D models and expanding continuously with enriched field-collected imagery data.

### Road map for implementation

- Phase 1 – Funding and partnerships: secure funding from private and governmental donors and form coalitions with NGOs and governments who could contribute with data.
- Phase 2 – IT technical development: partner with IT providers for IT technical development of the database and its interface.
- Phase 3 – Data collection: an initial campaign to scan/create textured 3D models and compile other existing 3D models.
- Phase 4 – Quality control and pilot: implement quality control and pilot the use of the 3D database through the development or enhancement of a specific imagery recognition application.
- Phase 5 – Maintain database: maintain IT architecture and security protocols and sustain a continuous data collection effort with field images, videos, other sensors, and models.

## Early impact analysis
### *Most impactful project*

**Problem statement**

How can early impact assessments in mine action be enhanced to improve evidence-based planning and resource allocation, enabling humanitarian operators to prioritize areas where the explosive ordnance impact is most critical?

Key challenges include limited integration of explosive ordnance contamination data with socio-economic and environmental data; resource constraints such as insufficient equipment, personnel, and time; the absence of effective prioritization tools; and underutilized opportunities for blending diverse data sources to support strategic decision-making.

**Key factors/requirements**

- Data processing and integration: explosive ordnance contamination (accident reports, bombing data, open source, and social media), socio-economic (e.g. population, income, access to services), and environmental (e.g. climate, biodiversity) data.
- Scope-agnostic functionality: operates across all mine action levels (from country level to confirmed hazardous areas/suspected hazardous areas).
- Impact scoring: provides both summary and component-level results.
  Inference and visualization capabilities: supports multi-level analysis for effective planning.

**Proposed response**

Development of a web application platform to enhance early impact assessments, enabling data upload, automated inference, and visualization for improved planning. The platform calculates impact scores by comparing benchmarks with input data, integrating explosive ordnance contamination, socio-economic, and environmental information. A mapping tool overlays regions with zones, using colour-coded impact scores (e.g. heat maps) to identify priorities and guide resource allocation.

**Road map for implementation**

- Phase 1 – minimum viable product (MVP) creation (0–6 months): define MVP scope focusing on areas with highest data quality; assemble a multi-stakeholder working group (mine action organizations, AI experts); clarify data sources, schemas, and outputs; finalize technical architecture and design; implement basic user journey; validate utility with target users.
- Phase 2 – production phase (6–12 months): incorporate pilot user feedback; refine user experience to gold standard; expand use cases to additional regions; conduct extensive quality testing; prepare the system for real-world deployment.

## Data analytics and interrogation of information management systems

### Problem statement

How can the multiple and diverse datasets collected by non-technical survey teams be more effectively analyzed to identify information gaps, and ensure accurate planning and decision-making?

Key challenges include limited labelled datasets, multiple different formats of data sources, environmental and operational constraints, and high costs associated with data management.

### Key factors/requirements

- Data integration: AI-assisted integration multiple datasets (explosive ordnance, socio-economic, environmental) for comprehensive analysis.
- AI models: leverage machine learning AI models for pattern recognition, and natural language processing AI models to query data (e.g. ask the system "Can you show me all the minefields that have been cleared and the ones that have not yet been cleared in 2024?").
- User-friendly design: intuitive interfaces to support real-time decision-making.
- Community input: incorporate local knowledge through AI-based platforms.
- Cost-effectiveness: scalable solutions that minimize resource use while maximizing impact.

### Proposed response

Development of AI-driven data interrogation models for pattern recognition and data query/extraction, integrated with community input to incorporate local knowledge and context. This system will include natural language processing AI models to query and interrogate data, as well as dynamic dashboards, and tailored visualizations to support decision-making and planning in humanitarian contexts.

### Road map for implementation

- User requirement analysis: conduct workshops and collect requirements.
- Prototype development: build initial AI models and visualization prototypes.
- Testing and validation: field-testing with mine action operators.
- Training and deployment: provide training and deploy refined solutions.

## Generative AI supporting organizational processes

### Problem statement

Accurate, timely and compliant documentation is essential to meet several knowledge management and reporting requirements, such as drafting national and international mine action standards, and international donor and convention reporting, among others. Such management processes can amount to up to 40 per cent of the costs of operations. How can management processes such as the analysis of the existing body of knowledge and the production of documentation/reports be more efficient and effective?

Key challenges include resource-intensive analysis of diverse sources of data, sometimes multilingual, slow, and error-prone manual processes, and the limitations of current pre-trained large language models and generative AI applications.

### Key factors/requirements

- Natural language processing and large language model optimization and expert validation: fine-tuning models and ensuring quality through data annotation and validation.
- Multilingual automated translation: ensure accurate and culturally sensitive translation of mine action terms.
- User interface and data reliability: design for accessibility across technical levels and ensuring precision and error handling in data processing.
- Continuous update and secure infrastructure: deployed on a secure, scalable cloud platform, the model will be continuously updated, with support and training resources.

### Proposed response

Development of a fine-tuned large language model for mine action, capable of accurately interpreting terminology, context, and translation. The model will be trained on a high-quality, cross-vetted dataset and tested rigorously in real-world scenarios, incorporating expert and user feedback.

### Road map for implementation

- Phase 1 – Establish technological infrastructure.
- Phase 2 – Data collection and model fine-tuning: collect and validate mine action datasets; fine-tune the large language model with context-awareness and multilingual support.
- Phase 3 – Testing and feedback: test the model in real-world scenarios, gather user feedback, and refine.
- Phase 4 – Deployment and integration: deploy the model, integrate with existing tools, and provide training.
- Phase 5 – Ongoing updates and support: offer continuous updates, support, and improvements.

## Impact of AI on community engagement within explosive ordnance risk education

### Problem statement

How can the efficiency, reach and impact of digital explosive ordnance risk education be maximized while addressing multi-factor limitations in cost, speed, and accessibility?

Key challenges include the digital divide preventing access in some communities, the need for accurate quality control of AI-generated content, ethical considerations around data collection and consent, and ensuring complementarity between digital and face to face explosive ordnance risk education methods.

### Key factors/requirements

- Efficiency: reduce costs and development time for explosive ordnance risk education content while enabling broader reach through digital tools and remote solutions.
- Inclusivity: address accessibility issues and design solutions that are digitally inclusive, culturally sensitive, context-specific, targeted, and evidence-based.
- Accuracy: ensure AI-generated content is reliable, free from misinformation, and adheres to privacy and consent guidelines in data collection.
- Complementary use: AI tools should enhance, not replace, traditional explosive ordnance risk education methods.
- Collaboration: engage stakeholders and NGOs in pilot testing and feedback loops.

### Proposed response

Explore AI-assisted tools to enhance efficiency in pre- and post-intervention assessments, generate tailored written, audio, and visual content, and deploy 24/7 chatbots for remote explosive ordnance risk education.

### Road map for implementation

- Phase 1 – Scoping application: define AI capabilities and scope the project.
- Phase 2 – Stakeholder engagement: engage stakeholders and identify an NGO partner for pilot testing.
- Phase 3 – AI solution development: develop and test AI solutions for assessments, content creation, and remote guidance.
- Phase 4 – Data analysis: collect and analyze pilot data to evaluate AI impact and refine tools.
- Phase 5 – Finalization: complete solutions and create sector recommendations for AI-driven explosive ordnance risk education.
- Phase 6 – Dissemination: disseminate findings and establish standards for broader adoption.

## Information management systems, data integration and priority setting

**Problem statement**

How can current mine action information management systems be enhanced to support priority setting of demining activities and resource allocation, assisting the definition of prioritization criteria and implementation of transparent and evidence-based decision-making?

Key challenges include the lack of comprehensive data integration from various socio-economic and environmental datasets, the balance between simple design and the complexity of factors that must be weighted in the definition of priority-setting criteria and indicators.

**Key factors/requirements**

- Clear criteria: prioritization guided by economic value, ecological impact, social factors, and safety concerns. Specific criteria and indicators must be tailored to national contexts.
- Data integration: standardized, reliable data from diverse sources (e.g. cadastral data, population statistics).
- Human oversight: ensure ethical, context-sensitive resource allocation with human accountability.
- Collaboration: engage political support, experts, institutions, and local stakeholders.
- Scalability: develop an adaptable, open-source system for diverse regions, that could be tailored for specific country contexts.

**Proposed response**

Development of an AI-assisted prioritization system to standardize multiple datasets in varying formats, reflect pre-defined priority-setting criteria and indicators, perform sensitivity analysis of such criteria and indicators and recommend priorities for mine action activities.

**Road map for implementation**

- Phase 1 – Develop priority-setting systems: secure multi-stakeholder engagement to define context-specific priority-setting criteria, indicators, and weights.
- Phase 2 – Data and protocols: define data needs, collection methods, and standardization protocols.
- Phase 3 – Framework development: develop and test AI-supported applications.
- Phase 4 – Pilot testing: conduct pilot testing in multiple regions and gather feedback.
- Phase 5 – System refinement: refine the system and prepare for broader deployment.
- Phase 6 – Training and support: establish training and support mechanisms for national mine action authorities and operators.

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## Robotics and autonomous mechanical systems

### Problem statement

How can safety be improved with robotics and autonomous systems in challenging environments such as urban areas, debris removal, enclosed spaces, tree lines and forests?

Key obstacles include the limitations of existing systems in navigating complex terrains, detecting mines accurately, and ensuring cost-effectiveness for widespread use, while also addressing challenges related to productivity and user-friendliness.

### Key factors/requirements

- Productivity: enhance navigation, geo-tagging, and mine detection while minimizing false positives/negatives.
- Safety: ensure reliability in hostile environments with robust navigation and collision avoidance.
- Usability: prioritize affordability, ease of operation, repairability, and involve field operators in the design process.
- Data management: ensure access to labelled data for AI training and efficient data-sharing mechanisms.
- Standardization: establish protocols for evaluation, certification, and interoperability of uncrewed systems.

### Proposed response

Further work is needed to define the specific use cases and requirements for the development of robotic systems tailored to mine action. Advanced machine learning, sensor fusion, and navigation technologies are already available and can be integrated into existing mechanical systems, from small, unmanned ground vehicles such as four-legged robots, explosive ordnance disposal robots, to light and heavy machinery rubble removal, ground preparation or mechanical demining machines. Cost-effectiveness remains a substantial challenge in mine action operations.

### Road map for implementation

- Phase 1 – Partnerships: secure collaboration with AI/robotics developers, mine action operators, and stakeholders.
- Phase 2 – Requirements: define functional needs and access to high-quality datasets.
- Phase 3 – Design and prototype: develop robotic systems tailored to mine action, focusing on terrain adaptability and explosive ordnance detection.
- Phase 4 – Testing: carry out pilot in diverse environments to refine performance and address challenges.
- Phase 5 – Standards: develop standards for testing, evaluation, and certification.
- Phase 6 – Iteration: refine systems based on feedback and field performance, preparing for scaling.

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## Satellite imagery processing and analysis

### Problem statement

How can non-technical survey processes be enhanced with spatial indirect evidence collated from new technologies, namely satellite imagery, for more efficient and reliable non-technical survey outputs, minimizing the risk of overlooking hazardous areas and misallocating resources?

Key challenges include the lack of knowledge, understanding, and trust in the capabilities of satellite imagery processing and analysis.

### Key factors/requirements

- Defining indirect evidence: establish criteria such as land-use changes, vegetation anomalies, and battlefield indicators.
- Data accessibility: ensure access to high-resolution satellite imagery and spatial data.
- AI integration: use machine learning to automate evidence detection and streamline analysis.
- Ground validation: conduct field verification to ensure model reliability.
- User training: provide training on geographic information systems (GIS) and satellite analysis for technical professionals and awareness for non-experts.
- System integration: align with practices in national mine action standards, IMSMA Core, and desktop assessments.
- Global standards: develop best practices and standards to support adoption.

### Proposed response

Creation of a technical guide for identifying indirect evidence of contamination using satellite imagery, defining clear methodologies, data sources, thresholds, and workflows, all supported by AI-driven automation for analysis. The guide will be tested and refined through case studies, ground truthing, and stakeholder feedback. Integration into national mine action standards will be promoted to ensure alignment with operational practices.

### Road map for implementation

- Phase 1 – Guide development: create a comprehensive guide with criteria, data sources, thresholds, and AI-driven methodologies.
- Phase 2 – Validation: validate through case studies, ground truthing, and stakeholder feedback for reliability.
- Phase 3 – Dissemination: share the guide via training for GIS/remote sensing professionals and awareness campaigns.
- Phase 4 – Integration: integrate into existing international and national mine action standards, IMSMA Core, and desktop assessments.

## Unmanned aerial vehicle-deployed sensor data fusion and analysis

**Problem statement**

How can the use of unmanned aerial vehicle-deployed sensor data in mine action be optimized for greater effectiveness and scalability? What steps are required to bridge the communication and information gap between solution developers, end users/operators, and national authorities?

Key barriers include inconsistent testing and validation, inconsistent methods to define case studies and testing solutions, and lack of accreditation processes within national mine action authorities.

**Key factors/requirements**

- Clear use cases: define needs based on realistic hazard scenarios.
- Certification and validation: ensure access to facilities and streamline certification.
- Continuous feedback: establish a feedback loop with operators to refine performance.
- Data quality: ensure high-quality data for AI development and sensor fusion.
- Legal compliance: address issues such as operational permissions and data ownership.
- National capacity building: develop skills and infrastructure for understanding and managing new technologies.
- Quality assurance: ensure technologies meet required standards for implementation.

**Proposed response**

Creation of an open-access library with use cases, requirements, case studies, and a glossary, alongside a technology forum for discussing tested technologies. A clear testing process will be implemented, with access to test facilities, standardized performance descriptions, and defined metrics and protocols. A curated data library with ground truth and multimodal data will support diverse testing.

**Road map for implementation**

- Phase 1 – Portal development: create an online portal for use cases, case studies, and templates tailored to humanitarian demining needs.
- Phase 2 – Stakeholder input: engage operators and national authorities for content development and outreach, with a vetting process and moderated forum.
- Phase 3 – Test strategies: define test strategies based on use cases and identify suitable test sites.
- Phase 4 – Standardization: establish metrics, scoring criteria, and performance specifications for consistent evaluation.
- Phase 5 – Field testing: coordinate test site access, organize testing events, and collaborate with operators for accurate field testing.