Working Paper

“Application of Advanced and Emerging Technologies in Mine Action”

Submitted by Japan
18 November 2025

I. Introduction

1. The "Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction” (the Convention), which entered into force on the 1st of March 1999, stands at the core of international efforts to end the suffering caused by anti-personnel mines and to achieve a "mine-free world”.

2. While States Parties are striving to fulfil their obligations under Article 5 of the Convention, to destroy or ensure the destruction of all anti-personnel mines in contaminated areas under their jurisdiction or control as soon as possible and no later than ten years after the Convention’s entry into force for the State Party concerned, many States Parties still have contaminated areas due to the difficulties, costs, and risks associated with mine clearance activities. Reducing costs, improving efficiency, and implementing risk mitigation measures in mine clearance activities are urgent issues.

3. As the President of the Twenty-second Meeting of the States Parties to the Convention, Japan, under the leadership of H.E. Ms. ICHIKAWA Tomiko, Ambassador Extraordinary and Plenipotentiary, Permanent Representative of Japan to the Conference on Disarmament, is committed to promoting the “Application of Advanced and Emerging Technologies in Mine Action", identified as one of the Presidency’s priority themes, with a view to reducing costs, improving efficiency, and implementing risk mitigation measures in mine clearance activities.

4. Securing funding often poses a challenge in advancing the use of emerging technologies. In this regard, discussions from the panel "Financing mine action: challenges and new opportunities" held during the intersessional meeting in June 2025 should be taken into consideration.

5. This Working Paper is submitted with the expectation that sharing Japan's efforts in the "Application of Advanced and Emerging Technologies in Mine Action" will promote international cooperation towards the advancement of anti-personnel mine action and accelerate international efforts to achieve a "mine-free world”.

II. Application of Advanced and Emerging Technologies in Mine Action

6. Currently, Japan, working closely with private companies, is applying advanced and emerging technologies in the mine action processes of "Non-Technical Survey", "Detection", and "Clearance", with the aim of reducing costs, improving efficiency, and implementing risk mitigation measures in mine clearance activities.
The following outlines the status of efforts in each step of the mine action process.

A. Non-Technical Survey

7. Traditionally, the task of predicting locations to identify suspected hazardous areas of anti-personnel landmines in target areas has relied heavily on the manual analysis of a vast amount of collected information and the expertise and knowledge of experienced specialists. This requires significant time and effort, and there is room for improvement in terms of accuracy.

8. NEC Corporation has developed an artificial intelligence (AI) platform to predict the location of anti-personnel mine contaminated areas. This platform visualizes the likelihood of anti-personnel mine placement based on AI analysis results learned from relevant data such as geospatial data.

9. This platform facilitates the risk assessment of minefields and the prioritization of clearance operations, contributing to improved safety and efficiency. In a pilot project conducted with the Cambodian Mine Action Centre (CMAC) from 2024 to 2025, using the AI model achieved a prediction accuracy of over 90% for mine placement/non-placement at specific locations.

10. Moving forward, NEC Corporation plans to utilize new types of data, including text data, for AI learning to further improve prediction accuracy. Additionally, NEC Corporation aims to promote digital transformation (DX) in mine action in collaboration with the Mine Action Center of States Parties and international non-governmental organizations (NGOs).

B. Detection

11. The detection of anti-personnel mines has traditionally relied on metal detectors, as even plastic mines contain metal components. While metal detectors are highly reliable with a very low probability of missing mines, they cannot distinguish between small metal parts in mines and other metal debris such as shell casings and bomb fragments scattered under the ground, resulting in prolonged detection and clearance operations. Generally, in current mined areas where battles once took place, the probability that the metal detected by a metal detector is a landmine is said to be about 1 in 1,000.

12. To address the inability of metal detectors to distinguish between mines and other metal debris, the "Dual Sensor" approach, combining a ground-penetrating radar (GPR) and a metal detector, has been proposed. ALISys Co., Ltd. has developed the handheld mine detection device ALIS, a Dual Sensor. ALIS can visualize the shape of buried objects using GPR after detecting metal in the ground with its metal detector function. This allows not only for the determination of the presence of anti-personnel mines but also the identification of the position, depth, and shape of buried anti-personnel mines before clearance. Furthermore, ALIS can visualize anti-personnel mines made partially or entirely of plastic, enabling the detection of special mines containing no metal at all.

13. ALIS reduces the physical and mental burden on deminers by improving the ability to distinguish between anti-personnel mines and other metals. It also enhances safety in clearance and shortens operation time. ALIS has already been introduced in Cambodia, Ukraine, Colombia, and is being considered for introduction in Lao People's Democratic Republic, with ongoing operational training taking place in cooperation with organizations such as the Cambodian Mine Action Centre (CMAC). Efforts are being made to introduce ALIS to more mine affected countries, including those in Africa, leveraging opportunities such as the Tokyo International Conference on African Development (TICAD). Additionally, discussions on effective utilization methods for the new Dual Sensor technology are underway with Mine Action Authorities in various countries.

14. ALIS not only stores data internally but also allows for cloud service of the data via the internet. In the future, by utilizing cloud connectivity, AI learning using data obtained from actual minefields will enable remote analysis of actual data, aiming for further technological advancement and the consideration of the application of the results of the analysis in other mine-affected countries. (Additionally, the use of animal detection systems by the NGO APOPO for mine detection is considered a technology that, in many cases, can identify mines more cost-effectively than conventional metal detectors. This is mainly due to its advantages in covering large areas within a relatively short time and in disregarding non-explosive objects during the search. The use of such technologies, especially when there is a need to survey large-scale contaminated areas, can be complementary to emerging technologies such as ALIS.)

C. Clearance

15. Many mined areas, such as forests and slopes, are inaccessible to large equipment, using large equipment is often difficult, even in flat areas, if there is a possibility of anti-tank mines being present. Therefore, manual excavation of anti-personnel mines remains prevalent in many mined areas, requiring careful operations to avoid the risk of detonation.

16. IOS. Inc. has developed the remotely operated robot "DMR," which removes soil around buried anti-personnel mines using air pressure. DMR robotizes the excavation work of anti-personnel mines traditionally done with prodders and shovels. DMR can be operated remotely, allowing for a safe distance between the deminer and the excavation location. By optimizing the air pressure and flow rate of the discharge nozzle, DMR can remove soil around anti-personnel mines without triggering detonation, exposing and visualizing buried mines. This enables deminers to safely proceed with the next steps of mined areas excavation, such as retrieval or demolition of buried mines, while avoiding the risk of detonation. The operation procedure of DMR (remote operation of the air-blowing nozzle) considers that deminers in mine-affected countries may not necessarily be engineers. By creating and registering operation programs suitable for field conditions in the control system, the same operation can repeatedly be called up, allowing those without experience in operating robots to be well trained in three days.

17. DMR not only ensures the safety of operators but also enables a faster excavation than that of skilled deminers. The time to blow compressed air onto a potential mine location is 60-90 seconds per location, and even including the time for DMR's movement and setup, excavation time in mined areas can be reduced. Data from a demonstration project in Cambodia conducted over two years from 2022 to 2024 indicates that integrating a DMR with a deminer team of six metal detection operators improved operational efficiency by approximately 20%, expanding the clearance area per unit from 6,000 to 7,000 square meter.

18. The cost of DMR is approximately USD 80,000 per unit, and the results from the Cambodia demonstration indicate that cost recovery is possible in about 3.6 years. IOS. Inc. aims to provide safe, low-cost, and highly efficient field solutions to Mine Action Centers of States Parties and international NGOs.

19. Additionally, companies handling heavy machinery, such as Nikken Corporation and Komatsu Ltd., are maintaining and developing heavy machinery technology that plays a role in the clearance of anti-personnel mines. Nikken Corporation's multifunctional heavy machinery significantly improves the safety and efficiency of pre-processing operations in mined areas, primarily used for shrub removal but also capable of directly neutralizing anti-personnel mines while excavating the ground. Attachments can be customized and developed according to the type of explosive and the terrain. Nikken Corporation is currently developing attachments to secure safe zones even in environments where high-yield explosives are present alongside anti-personnel mines. Komatsu Ltd.'s heavy machinery balances high safety and productivity with high-speed processing, supporting a wide range of activities from clearance to release, such as infrastructure development. Komatsu Ltd. has also developed equipment to remove cluster submunitions, and this new processing method, which does not use explosives, is being utilized

in Lao People's Democratic Republic and Cambodia.

20. Furthermore, the use of emerging technologies is advancing in the field of Victim Assistance, an essential element of mine action. For example, the Japanese startup company Instalimb, Inc. is manufacturing prosthetic limbs using 3D printers and AI, reducing production time to less than 12 hours and production costs to less than one-tenth of conventional prosthetic limbs. Such technology enables a more precise responses to the needs of mine victims, supporting their social reintegration.

III. Conclusion

21. Japan expects that such advanced and emerging technologies would be used to complement and develop existing technologies, thereby increasing safety and efficiency in mine action. In the process, we would also exchange information and consult with State Parties, international organizations, and international NGOs, explore the expansion of the use of advanced and emerging technologies in mine action, and continue to actively work towards a "mine-free world".