

1. Introduction

Background

The concept for the International Pilot Project for Technology Cooperation (IPPTC) originated in the United States Department of Defense in an effort to help answer one of the most frequently asked questions in humanitarian demining, "Which is the best metal detector to use?"

The project, although conceived in October 1997, did not actually become reality until December 1998, when voluntary participants from Canada, the Netherlands, the United Kingdom and the European Commission's JRC teamed with the United States to lay the groundwork. The pilot project took 21 months to complete, with actual testing being conducted in several phases. Laboratory testing took place in the Netherlands and Canada, followed by field-testing in both Cambodia and Croatia.

Purpose

The purpose of the pilot project was to conduct a coordinated, multi-national, technical evaluation of metal detectors suitable for use in humanitarian demining. The project sought to demonstrate, through a "consumer reports" type of evaluation, the mine detection capabilities of commercial-off-the-shelf (COTS) metal detectors. The report is available in the public domain. The background information is available to governments and organizations and individuals involved in the global humanitarian demining effort at the discretion of the holder of the detailed report on that aspect of the results.

It is hoped that this document will assist organizations in selecting the detector(s) most suitable for their particular environment or unique operational conditions. The pilot project also served as a test vehicle to identify and resolve problems in demining technology cooperation as the lead effort for the International Test and Evaluation Program (ITEP).

Project Overview

The detectors involved in the evaluation were purchased after soliciting the recommendations of all manufacturers known to the IPPTC team as to which detectors were suitable for humanitarian demining applications (see Annex C Invitations to participants). No model recommended by a manufacturer was excluded. Some manufacturers did not respond, while others offered prototype models still under development, which were not evaluated. Since the initiation of the project, several new detector models have entered the market and are currently being offered to the humanitarian demining community. Finally, some models currently available may be different from the equivalent models utilized in the pilot project. Readers interested in purchasing detectors are encouraged to contact manufacturers about implications of actual and potential changes prior to acquisition.

The solicitation resulted in the purchase of three copies of each of 25 different detector models from 13 manufacturers. Some detectors had more than one type of search head, resulting in a total of 29 different sensors for evaluation. The detectors finally included in the IPPTC tests were the following:

Adams AD2500 and AD2600S

Ebinger EBEX 420 GC and EBEX 535

Fisher 1235-X, 1266-XB, and Impulse

Foerster MINEX 2FD 4.400.01

Giat Model F1 (DHPM-1A)

Guartel MD4, MD8, MD2000

LG Precision PRS-17K

Minelab F1A4 CMAC and F1A4 MIM

Pro-Scan Mark 2 VLF

Reutech Midas PIMD

Schiebel AN-19/2, ATMID, MIMID

Vallon ML 1620C and VMH2

White's AF-108, DI-PRO 5900 and Spectrum XLT

The project established the following timeline and locations for the various phases of testing:

Phase I , Acquisition of Detectors and Targets	March - May 1999	United States
Phase II , Training and Entrance Test	May - June 1999	The Netherlands
Phase III , In-Soil Tests	June - September 1999	The Netherlands
Phase IV , In-Air Tests/Human Factors	October 1999 - January 2000	Canada
Phase V , Field Tests:	March 2000	Cambodia
	June 2000	Croatia

Project engineers, as well as indigenous deminers, evaluated the detectors against the following inert anti-personnel (AP) landmines: PMN, PMN-2, PMA-2, PMA-3, Type 72, R2M2, PMD-6, and simulants: G₀, I₀, M₀ (see page 126 for full description of test targets).

Project Methodology

The overall approach in designing the pilot project evaluation was progressive in that the detectors would be evaluated from the more controlled conditions (the laboratory tests in Canada and The Netherlands), to the less controlled (the field tests in Cambodia and Croatia).

The evaluation included assessments of detector sensitivity in air, in a variety of soil conditions, and environmental effects such as moisture on the sensor head. 'Human Factors' such as weight and ease of use were also evaluated, along with other aspects such as cost and ruggedness.

In designing the field tests, 5 and 10 cm were chosen as the two depths at which targets would be buried. It is recognized that the United Nations has established a 20-cm clearance standard for landmines and unexploded ordnance. However, in practice AP mines are mostly found at substantially less than 20 cm, and realistically not many detectors could be expected to find low-metal content mines at that depth. This performance assumption was validated during the conduct of the pilot project.

Inert target mines were utilized in as realistic a manner as possible. For example, all mines were set in the firing position with their detonating mechanisms blocked. This ensured that all metallic components were in the position that would generally be encountered during field conditions. Although all mines were buried in a level manner, in the field tests no systematic records were kept on the orientation of their firing mechanisms to the direction of mine detection.

The lanes chosen for the In-Soil Test are believed to be representative of many humanitarian demining scenarios throughout the world. Specifically, lanes

consisting of sand, clay, peat and ferruginous soils were chosen. In Cambodia, test mines were placed in both clay and laterite soils. In Croatia, mines were placed in the soil predominantly available, which was highly metallic. In both field locations, host nation requests to test detectors against typical mine target configurations were also honored.

Although the testing covered many technical and environmental factors, some elements could not be evaluated due to time and budgetary constraints. These included: sustainability, the effects of electromagnetic interference and the use of multiple field test locations.

How to use this report

The body of this report contains summaries of the full technical reports from the In-Air Tests, In-Soil Tests, In-Country Field Tests and the Human Factors assessment. Copies of the comprehensive test results can be requested from the responsible agencies found in the References Section of this report. The respective agencies have agreed to evaluate each request on a case-by-case basis, with the desire to share the full details of the pilot project as much as possible.

This report should be of interest to a variety of readers including deminers and other operational users, donors, manufacturers of equipment and researchers. The report discusses results from basic laboratory tests through to field tests. Readers are encouraged to consider the relevance and value of each phase of testing to their particular situation.

The section describing the In Air Test results should provide the reader an understanding of the basic variables that affect the detector's performance, as well as the capability of the detector unencumbered by human factors or environment. As such, these results should not be used as the sole indicator of the detector's operational capability but will give an indication of the factors that may cause degradation of performance in the field.

The In-Soil Test, conducted in the Netherlands, was intended to approximate a number of representative soil types that deminers are likely to contend with. To achieve a certain degree of scientific rigor, the soil

test lanes were in a controlled environment. These results should help the reader to understand the effect of various soil types on detector performance.

In the section pertaining to field tests, the reader will find test results that may have more bearing on real-world demining applications. However, the results contained in this section may not be applicable to other regions of the world. These results were achieved in the less controlled field environment.

The Human Factors Assessment provides users with a subjective analysis of detector characteristics that do not lend themselves to scientific measurement. Many of these factors have significant bearing on the safety, usefulness and acceptability of equipment in the field. For example, an incomplete understanding on the part of the user of how the demining equipment functions, or the adjustment of the wrong control could easily lead to failure to detect an anti-personnel mine by the deminer - possibly resulting in severe or even fatal injury.

The results from both the In-Air Tests and the Human Factors Assessment can be used to improve training and operating procedures. In an effort to provide readers with specific test details pertaining to each detector evaluated, the report also contains individual detector data sheets (see Annex A). This section shows the individual detector performance from

various tests relative to the performance of all other detectors evaluated. The results are depicted graphically for easy reference. Additionally, each data sheet includes information from the detector manufacturer related to cost, weight, and dimensions. Selected strengths and weaknesses of each detector are listed, based upon the Human Factors Assessment. The intent of this section is to provide readers more detailed information on a specific detector's performance and specifications, as well as comparative performance charts to aid the reader in selecting appropriate detectors for his situation.

A rating system (similar to ones used in some consumer reports) to rank the overall performance of the detectors was considered. However, in keeping with the original commitment not to convey a bias, no such rating is provided. Instead the results are presented in an objective manner. The data allows the reader, if he so chooses, to devise his own rating system to match his particular requirement.

The results as presented will allow the reader to identify groups of detectors with above average performance capabilities for a variety of demining environments. Therefore, it should be possible for the reader to focus his investigations on a few appropriate detectors in order to answer the question, "Which detector is the best for my needs?".