EUDEM2

The EU in Humanitarian Demining- State of the Art on HD Technologies, Products, Services and Practices in Europe

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EUDEM2 Technology Survey

Field Survey Results

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http://www.eudem.info/

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Executive Summary and Disclaimer

Executive Summary

Within the framework of its Technology Survey, the EUDEM2 project addressed the need of collecting information on technologies. This *Study* concerns humanitarian demining technologies currently in use in the field, and the opinions of field staff regarding both current and potential future technologies.

A detailed *Field Survey* has been conducted in a number of mine affected countries. The results include a list of field technologies, deminers' statements of need ("wish lists") for new technologies, and views of the particular situation of each visited country.

The *Study* shows that the application of technologies, in the visited organisations, is generally in the areas of sensors, information and communication technologies (ICT), transport and power supply systems. There is relatively little use of mechanical systems which directly assist the clearance process. The survey findings highlight the significant differences between the different mine clearance organisations. Another area where practices differ widely is in the calculation of the costs and financial benefits of technology. In this case the *Study* reports the answers to the survey questions, without attempting to carry out a direct comparative analysis.

Disclaimer

EUDEM2, University of Genova/PMAR Lab and the catalogue authors have prepared this report in good faith and to the best of their ability. All information contained herein is based on the stated opinions of the individuals and organisations who contributed through interviews and questionnaires, and therefore reflects the view of the respondents. The reader is reminded that the aim is to present the view of end users. Some of the information contained in the report is country specific, or even programme specific, and should not be extrapolated to other countries; individual replies to the same question can, at times, differ substantially from one country to another.

Note

In case you notice errors or incoherence's please send comments to K. De Bruyn kdebruyn@vub.ac.be

Content

1 INTRODUCTION

1.1 Aims and Objectives

There is a common understanding that research into humanitarian demining technology has not yet provided the positive results that were initially expected. Although large resources, of the order of hundreds of millions of US$ in the last 10-15 years[1], have already been spent on research, and promising technologies have been developed and tested, there has been only very limited introduction and integration of new technologies into common demining practices. As a result, some humanitarian demining organisations have become cynical about the future potential of technology to improve the demining process.
The reason that many humanitarian demining operations continue to rely principally on manual demining is perhaps not due to any lack of funds, nor to the lack of high level technology specifically designed for this purpose, but rather in *the approach used to design such technology and to present it to end-users*.

The EUDEM2 conference on humanitarian demining technology research in 2003 showed that there is a lack of quantitative and qualitative analysis of the relatively few technologies that are actually used in the field, and in particular there is a lack of information about how humanitarian deminers and demining organizations view these technologies. There is also a need for studies on what the end-users themselves consider their most urgent technology requirements. Without this information it will continue to be difficult to correctly focus research and development efforts.

Within the framework of its Technology Survey, the EUDEM2 project, with the support of the University of Genova-Italy, defined and realized a field *Study*, with the aim of collecting information on technologies in use and their operational aspects, including application/use conditions and costs and demining practices. The *Study* has been realised by visiting minefield sites and demining organizations, conducting interviews and analyzing the collected data.

This report summarizes the analysis of the collected information. It presents a map of the survey locations, a summary of the collected data, an analysis of all data on a country-by-country basis, and the results. The Methodology and Aims of this *Study* are detailed in the EUDEM2 Deliverable *D19-Interviews Final Report*. For clarity reasons, we do not present all the collected information, however, the EUDEM2 project is happy to provide the complete results upon request.

In addition to this report, a “Catalogue of Demining Technologies in Field Use” has been prepared. As is the case for this report, the aim is to disseminate information to both researchers and also field managers in countries other than those visited.

Understanding the local, specific situation of a mine affected area in order to provide realistic and useful technical solutions is clearly important. Despite the wide variation of local conditions, this report nevertheless seeks to provide technology developers with a collection of basic information on the cultural and technological situation of several mine affected countries and to draw out common elements.

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[1] Prof James Trevelyan of the University of Western Australia estimates total R&D funding for demining at about US$300 million per year, see http://maic.jmu.edu/journal/4.3/process.htm

We consider that the data reported in this *Study* will also be useful for demining programme managers who want to know what technology has been used in other countries and what end-users think about it.

For reasons of time and resources, the study was limited to four representative countries: Mozambique, Angola, Sri-Lanka and Cambodia. The data collected concern the field operational aspects of technologies already in use, and also end-users' requirements for new technologies, in particular new machine technologies. The opinions of representatives of relevant organisations regarding the general landmine problem in the country, on the efficiency of used technologies and on end-users skills, have also been collected.

This *Study* is the result of substantial amount of work, carried out by the EUDEM2 project in collaboration with the University of Genova/PMAR Lab during 2004[2].

EUDEM2, University of Genova/PMAR Lab and the catalogue authors have prepared this report in good faith and to the best of their ability. All information contained herein is based on the stated opinions of the individuals and organisations who contributed through interviews and questionnaires, and therefore reflects the view of the respondents. The reader is reminded that the aim is to present the view of end users. Some of the information contained in the report is country specific, or even programme specific, and should not be extrapolated to other countries; individual replies to the same question can, at times, differ substantially from one country to another.

1.2 Related Documents

The *Field Survey* has been conducted under the EUDEM2 WP4 Technology Survey. The following table lists all related documents, available on the EUDEM2 web site:

Title	Content
D15 Technology Survey Report II	Field Survey objectives
D19 Interviews Final Report	Information collection methodology and questionnaires
Field Survey Results	This document
Catalogue of Demining Technologies in Field Use	Catalogue of technologies in field use

2 SUMMARY OF RESULTS

This *Study* presents the results of the undertaken *Field Survey*. The survey allowed the team to establish good even if short relationships with end-users, by gathering information and opinions directly from them, especially during **Group Interviews**. End-users appeared to be really curious, open to communicating and expressing their opinions, as well as to learning new skills. Group interviews proved to be a very useful tool, both for the interviewers and for the group interviewed.

From the data collected on **technologies already in use**, it was found that the number of **mechanical technologies** employed by the organisations was limited to 1 or 2 items

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[2] The work done to elaborate the methodology and prepare for the fieldwork, and the subsequent data analysis effort, were each comparable to the actual field survey duration.

of equipment, used to support manual demining activities by preparing the ground. The one exception was MgM in Angola, who use nine different machines at different stages of demining operations. This appears to show that the strong interest in new technologies by senior management of this mine clearance organisation led them to rapidly introduce mechanisation to a far greater degree than is usual, and supports the conclusion that the barriers to new technology are not primarily technical but organisational.

At the same time, the *Study* found a **strong general desire for new, small, light and cheap machines**, and it shows that there is a *unanimous opinion, held by organisation representatives, that deminers are willing to learn new technologies*.
End-users have in general appeared to *consider mini and medium flails as useful*, while representatives have expressed the desire to *have at their disposal earth processing and agricultural machines*, to employ them in humanitarian demining operations. A general requirement for machines is to *work in hot-humid weather and to last at least five years*.

Most of the **other technology** used by the organisations visited was *sensor technology, information & communication technology (ICT), as well as vehicles and power supply systems.*

- *Metal Detectors are the sensors used almost everywhere. Sri Lanka is in part an exception as two organisations employ rakes instead*. Different types of rakes are used for excavating soil, where minimum metal blast anti-personnel mines and no other mines or UXO are known to be found. The average calculated cost per year of operating a metal detector, including the cost of the operator and maintenance, was reported as three times more than the average yearly calculated cost in the case of a rake. The rakes used are standard low-cost commercial products which are adapted by fitting a longer handle. This is an example of how adaptation of commercial-off-the-shelf (COTS) equipment can, with only minor modifications, can fill a need for specialist demining tools.
- *ICT* is mainly represented by GPS, two-way radios, satellite phones, digital cameras and laptop computers, as well as DGPS in one case (FSD in Sri Lanka). These are mostly standard consumer electronics items and not the result of research and development of technologies for deminers.
- The types of *vehicles* used are pick-up trucks, large trucks, vans and motorbikes, whereas the types of power supply systems used are generators. Similarly, this is standard commercial equipment.

Technologies not specific to mine clearance clearly have an important role in improving the production of humanitarian demining. It might therefore be worthwhile to take a broader view of the technology needs of deminers and seek further technologies from other fields which can be directly used or adapted. Also, when discussing the lack of technology improvements for humanitarian demining it may be important to phrase the terms of reference to take note of the impact of this commercially available non-specialist support equipment, and discuss the technology needs in the context of items not otherwise available.

The calculated annual **cost** of all **sensors** used by an organisation, including maintenance and the human resources necessary to operate them, was reported as representing between one quarter and two thirds of that organisation's overall annual programme budget[3]. The annual cost of all the **machines** was usually reported as being much lower than annual cost of all sensors employed by the same organisation. This difference is however partly due to *differences in the accounting procedures*, and the

[3] This figure was not available for all cases.

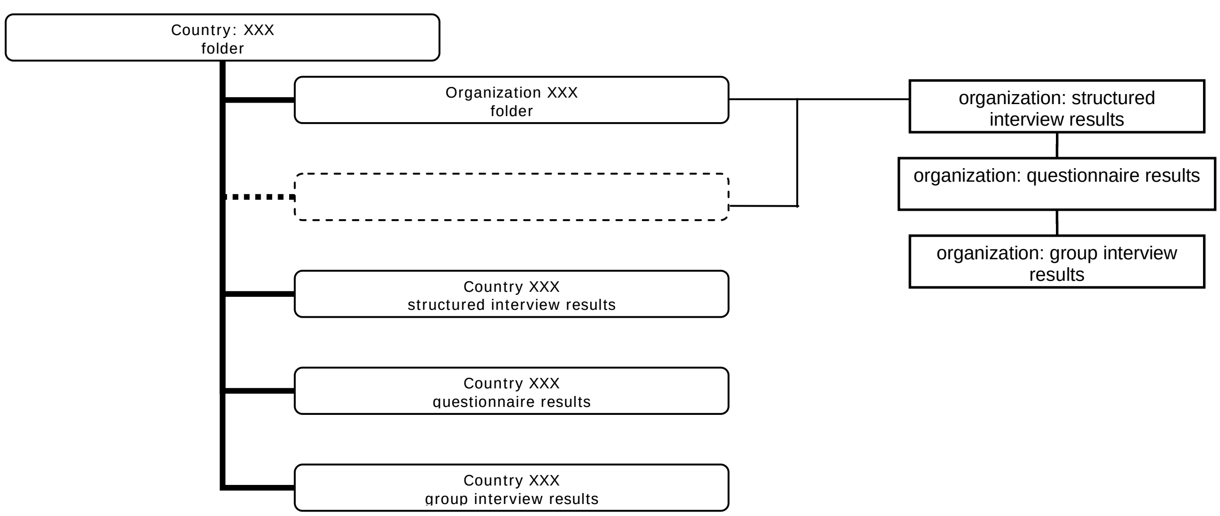
exclusion of costs by some organisations which have been included in the reporting of the others[4].

3 HOW TO READ THIS DOCUMENT

Different types of information have been collected from a range of stakeholders, using different methods. **Data**, **tools** and **stakeholders** are summarised in the table below, together with the corresponding types of **results**.

Data	Tool	Stakeholder	Result
personal opinion on **general landmine problem** in the country	**structured interview** 	**NGO representative**	**structured interview results** for each organisation and for each country
operational aspects of technology in use	**questionnaire** 	**logistics coordinator + deminers**	**questionnaire results** for each organisation and for each country
user requirements for new technologies	**group interview** 	**deminers**	**group interview** results for each organisation and for each country

In general, the results for each country are organised as shown below:



[4] The *Study* did not set out to investigate in detail the different cost analysis and accounting procedures of the organisations visited – the focus was on their opinions of technology for mine clearance, hence these financial results are reported without further analysis.

3.1 STRUCTURED INTERVIEW RESULTS

3.1.1 ORGANISATION LEVEL

The data from the structured interviews has been used, as far as possible, to produce comparable compact tables for the different organisations.
All the structured interviews have been considered in devising general single codes to transform the answers into standardised answers, which can be compared as directly as possible between tables. Preference has been given to qualitative answers, as it was the individual opinion of the person interviewed that was of greatest interest.
Pictograms identifying the questions have been added to allow a faster and easier comparison between tables from different organisations.

Notes on terminology:

- In order to comply with space constraints, terminology is short and therefore sometimes approximate.
- We use “machine” instead of mechanical technology, and
- We call “new machine” a machine still to be invented.
- “No idea” corresponds to the answer “I don’t know”.
- Blank spaces correspond to questions not answered either for lack of knowledge by the person interviewed, or by their choice.

3.1.2 COUNTRY LEVEL

Structured interview result tables at Country level aim at communicating to the reader the common perception, by deminers and other demining organisation staff, of the landmine problem in a specific country.
The criterion followed to present the answers provided by different organisations to a given question, was to report the most common answer. When all the organisations gave the same answer, this unanimous answer was reported in capital letters and underlined. When it was impossible to identify the most common answer, e.g. in presence of only two answers, one of which was “Not Available”, the most significant one was chosen. When there were only two answers and they were contradictory, *contradictory* was reported.

3.2 QUESTIONNAIRE RESULTS

3.2.1 ORGANISATION LEVEL

As far as possible, comparable compact tables of the responses provided by different organisations to the questionnaires were also produced.
The questions to be presented were selected to provide a compact table of results; preference has been given to data contributing to a general picture of the different technologies available within the organisation.
Different types of data collected in the questionnaire have been linked and presented together using functions and graphs to allow easier reading of the data.

The criterion followed to present the answers to a given question was to report the most common answer. When it was impossible to select the most frequent answer, all answers were reported.

Notes on terminology:

- In order to comply with space constraints, terminology is short and therefore sometimes approximate.
- Total **calculated cost** (CC) indicates the total annual cost of the technology, based on information as stated by the interviewed organisation, and calculated as follows:

  TC = [(price of item)/(average lifetime)] +
  [[(running cost/month)] + [(# of staff to run) × (monthly cost of operator)] +
  [(repairing cost) × 30/(MTBF)]] ×
  [(# of working months) – (time for repairing)/30]

  where the average lifetime is 10 (years) for machines and 5 (years) for sensors and information and communication technologies, MTBF is the Mean Time Between Failure (in days), and *time for repairing* is in days.

  As already noted, *different organisations have reported the costs differently*. It is possible that equipment which was donated directly, or which was developed by the organisation under a different (previous) contract, has been regarded as free of charge when it was not directly paid for by the programme that is currently using it. This reduces the comparability of these financial results. However, detailed cost analysis and investigation of the exact accounting procedures of the organisations visited were beyond the scope of the questionnaire and methodology used[5].
- When information on the maintenance needs of a technology is not available, related data are not considered in the calculation of the total cost of the technology.
- Generally, answers expressed in days consider only effective working days.
- The answer "one" indicates one or less.
- Answers in *italics* are extrapolated.
- Blank spaces correspond to questions not answered either for lack of knowledge by the person interviewed or by their choice.

3.2.2 COUNTRY LEVEL

Questionnaire result tables at Country level aim at communicating to the reader a general idea of the technologies available in a specific country.
The criterion followed to present the answers to a given question was to report the most common answer. When it was impossible to select the most common answer, e.g. in presence of only two answers, one of which was "Not Available", the most significant one was reported. When there were only two answers and they were contradictory, *contradictory* was reported.

[5] It should indeed be recalled that the primary aim of this *Study* was to discover the views – both subjective and objective – of mine clearance staff regarding technology in general, to illuminate the problem of the generally low uptake of advanced technology by humanitarian mine clearance organisations. The *Study* also investigated some other possible causes such as the level of education of deminers in the countries, and their probable experience of technologies on an everyday basis.

3.3 GROUP INTERVIEW RESULTS

3.3.1 ORGANISATION LEVEL

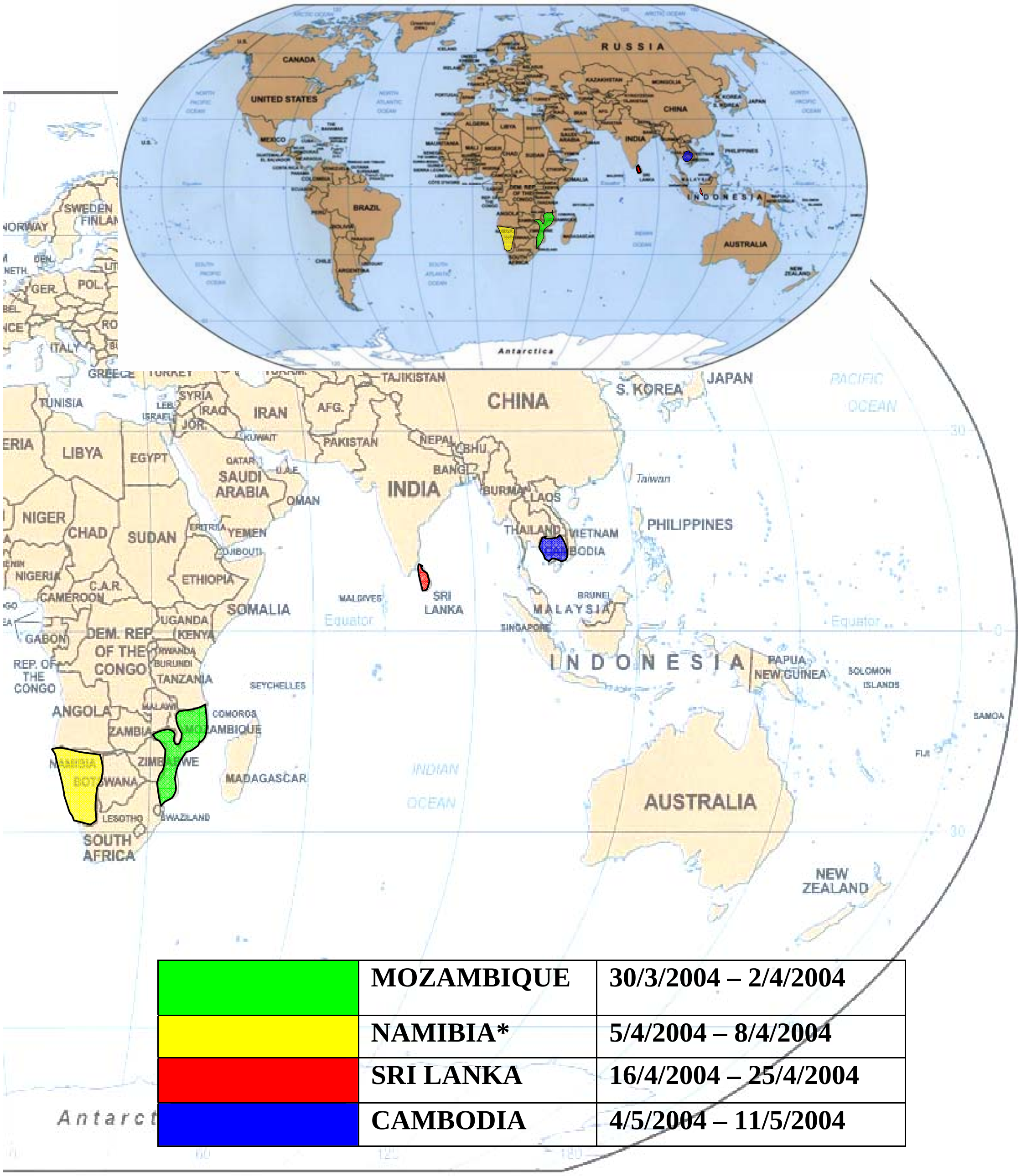
The group interviews were used to produce, as far as possible, comparable compact tables for the different organisations.
The participatory tools used during group interviews were simple, with standardised answers which were easy to record; moreover the same tools have been used for every organisation, allowing immediate comparison of the results.

3.3.2 COUNTRY LEVEL

Group interview result tables at the Country level aim at communicating to the reader a general idea of the requirements for new machine technologies as stated by different end-users within the same country. This may reflect the experience of the people concerned more than a wide knowledge of available technology.
The criterion followed to present the answers provided by different organisations to a given question, was to report only answers common to all groups interviewed.

3.4 SURVEY LOCATIONS

The following figure shows the survey locations.



	MOZAMBIQUE	**30/3/2004 – 2/4/2004**
	NAMIBIA*	**5/4/2004 – 8/4/2004**
	SRI LANKA	**16/4/2004 – 25/4/2004**
	CAMBODIA	**4/5/2004 – 11/5/2004**

Figure 3-1 Survey Locations

***Data collected in Namibia are about operations in Angola.**

4 COLLECTED DATA

Mozambique

Org.	Date	Place	Information collected	Stakeholder	Information on Stakeholder
ADP	March 2004	Maputo, ADP HQ	Structured Interview  Questionnaire 	Assistant Director to Operations (Mr Florencio Chongo)	**years in demining:** 10 **years in country:** 10 **years in this position:** 5
	March 2004	Maputo province, minefields	Questionnaire Group Interview 	Deminers	local people
	April 2004	Maputo province, minefields	Notes to minefield visits		
	April 2004	Maputo, ADP HQ	Final Interview	Assistant Director to Operations (Mr Florencio Chongo)	**years in demining:** 10 **years in country:** 10 **years in this position:** 5

Angola*

Org.	Date	Place	Information collected	Stakeholder	Information on Stakeholder
MgM	April 2004	Windhoek, MgM HQ	Structured Interview  Questionnaire 	Chairman (Mr Hans Georg Kruessen)	**years in demining:** 12 **years in country:** 12 **years in this position:** 8

* Data relative to Angola have been collected in Namibia, as MgM operates in Angola while it is based in Namibia.

Sri lanka

Org.	Date	Place	Information collected	Stakeholder	Information on Stakeholder
FSD	April 2004	Colombo, FSD HQ	Structured Interview	Program Manager (Mr Christoph Hebeisen)	**years in demining:** 6 **years in country:** 2 **years in this position:** 2
			Questionnaire		
	April 2004	Napankulam, Vavunya, minefields	Questionnaire	Deminers	local people
	April 2004	Vavunya, FSD regional office	Group Interview		
UNDP	April 2004	Vavunya, UNDP office	Structured Interview	Technical Advisor (Ms Leonie Barns)	
Sri Lankan Military	April 2004	Vavunya, UNDP office	Structured Interview	Field Engineers	
MAG	April 2004	Kilinochi, MAG regional office	Structured Interview	Program Manager (Ms Abigail Hartley)	**years in demining:** 5 **years in country:** 1,5 **years in this position:** 1,5
			Questionnaire		
NPA	April 2004	Near to Elephant Pass, minefields	Group Interview	Deminers	local people
		Talhadi, NPA house	Structured Interview	Senior Technical Advisor (Mr Richard Schmidt)	**years in demining:** 7 **years in country:** 2 **years in this position:** 1
	April 2004	Kilinochi, NPA regional office	Questionnaire		

Cambodia

Org.	Date	Place	Information collected	Stakeholder	Information on Stakeholder
CMAC DU1	May 2004	Sisophon, CMAC DU1 HQ	Structured Interview 	DU1 Manager (Mr Som Vireak)	years in demining: years in country: years in this position:
			Questionnaire 	Logistic Officer	years in demining: years in country: years in this position:
MAG Battambang region	May 2004	Battambang, MAG regional office	Structured Interview 	Administrative Officer (Mr Chamroeun Puth)	years in demining: years in country: years in this position:
			Questionnaire 	Deputy Administrative Officer	years in demining: years in country: years in this position:

The number of organisations visited is different in each country, as the *Study* met different levels of interest.

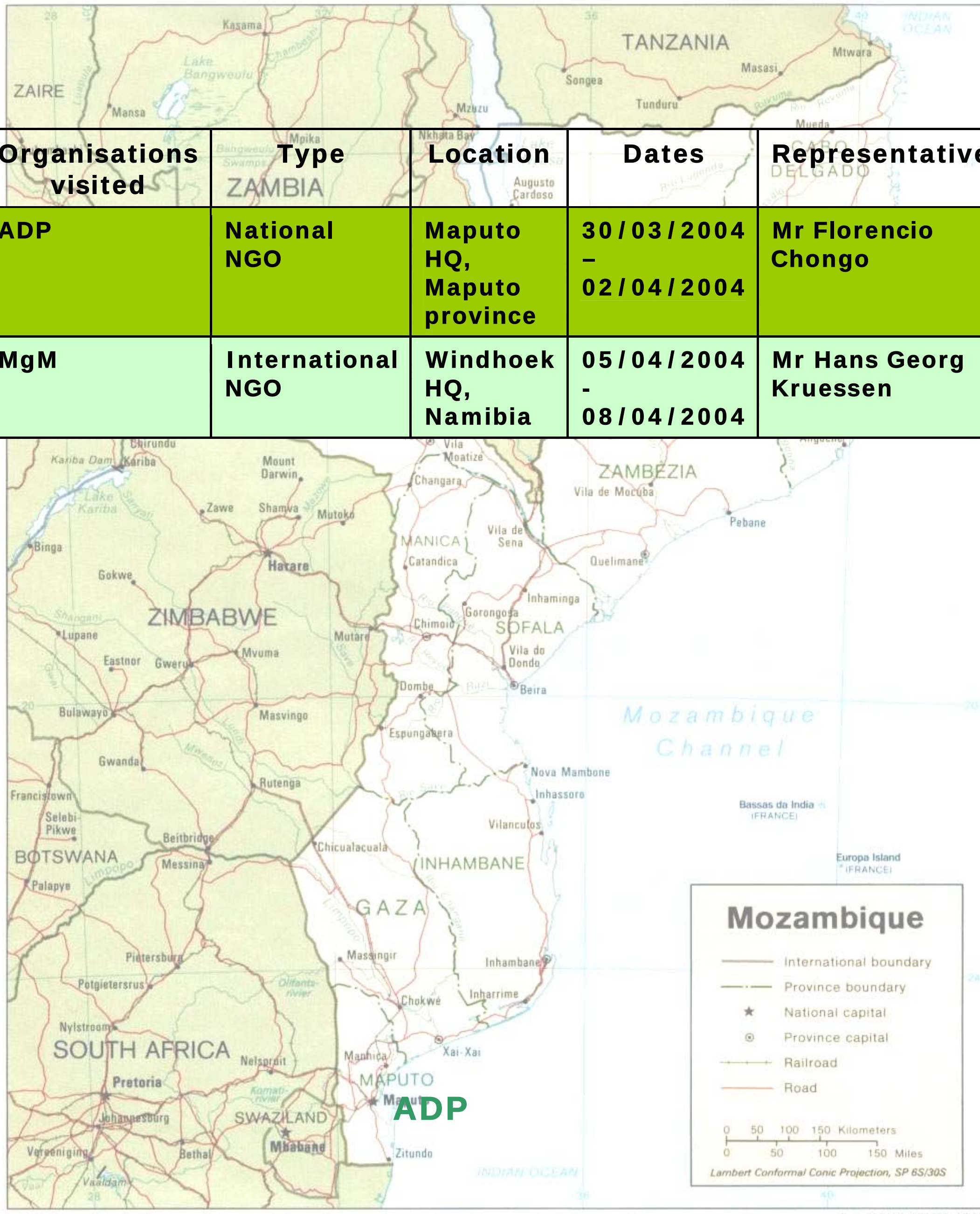
Details of the Interviews used to collect the different types of information are reported in the EUDEM2 Deliverable *D19-Interviews Final Report*. The approximate time and number of questions necessary to collect the different types of information were:

- **Structured interview**: 1 h 45 questions
- **Questionnaire**: 3 h 200 questions
- **Group Interview**: 1 h 45 questions.

Data presented have been collected and updated until the 23rd of November 2004.

5 MOZAMBIQUE

Organisations visited	Type	Location	Dates	Representative
ADP	**National NGO**	**Maputo HQ, Maputo province**	**30/03/2004 – 02/04/2004**	**Mr Florencio Chongo**
MgM	**International NGO**	**Windhoek HQ, Namibia**	**05/04/2004 - 08/04/2004**	**Mr Hans Georg Kruessen**



The results presented in the Mozambique section originate from the analysis of data collected during our visit to ADP in Mozambique and MgM in Namibia.
MgM finished its mission in Mozambique in 2004. Therefore, the only data collected from MgM about Mozambique are contained in the structured interview; the questionnaire and the group interview could not be held as MgM does not have any equipment or personnel left in Mozambique.
Locations indicated by "ADP" correspond to the locations where ADP operates and where we have been.

NOTE: Some of the collected information is country specific; individual replies might therefore well differ from one country to another.

5.1 GENERAL FACTS

5.1.1 Landmine Problem

Mozambique's landmine problem is mostly the result of a two-decade-long civil war that ended in 1992.
The area suspected to be mined is of 346 square kilometres, representing 0,04% of the total surface of Mozambique.
Many different types of landmines have been found, among the most common anti-personnel ones are: PMN, PMD6, Gyata and Chinese Type 72.
In 2003, 14 new mine casualties were reported in 13 incidents; six people were killed and eight injured, including four women and two children.

Demining operations in Mozambique are slowed down by the presence of vegetation; the typical landscape is savanna with large flat areas of grassy land and few trees.
The soil is mainly composed of lixisols, i.e. soils with subsurface accumulation of clays, and leptosols, i.e. very shallow soils over hard rock.

5.1.2 Key Players

Humanitarian demining operations started in Mozambique in 1993.
Mozambique signed the Mine Ban Treaty on 3 December 1997, ratified it on 25 August 1998 and the treaty entered into force on 1 March 1999.
In 2003, ten operators were engaged in mine clearance related activities in Mozambique: five NGOs (HALO Trust, HI, NPA, PAD/ADP, and MgM), four commercial firms (RONCO, Mozambique Mine Action, JV Desminagem, and ECOMS Desminagem SARL), and the Mozambique Armed Forces. In 2004, three of these operators were no longer working in the country (MgM, JV Desminagem, and ECOMS).
In the NGO sector, there are approximately 1000 full time deminers, 8 machines and 24 mine detection dogs.
The major organisations involved in demining are reported in the table below, together with the indication of the year in which they began operating and the number of staff employed. The organisations indicated with ** are the ones we visited.

Organisation	**Operating since**	**# of Mozambican Staff employed**
HALO Trust	1994	450
Handicap International (HI)	1998	60
Norwegian People's Aid (NPA)	1993	125
Accelerated Demining Program (ADP)**	1995	381
Menschen gegen Minen (MgM)**	2000-2003	44
Mozambique Mine Action (MMA)	2001	Not known
Mozambique Armed Defence Forces (FADM)	2001	Not known

Information reported in this section has been collected from the following sources:
The Landmine Monitor Report 2004, http://www.icbl.org/lm/2004/
The World Fact Book 2004, http://www.cia.gov/cia/publications/factbook/
The World Reference Base for Soil Resources, http://www.fao.org/ag/agl/agll/wrb/wrbmaps/htm/domsoi.htm
Earth Trends, the Environmental Information Portal, http://earthtrends.wri.org.

5.2 MOZAMBIQUE: STRUCTURED INTERVIEW RESULTS

VIEW OF THE LANDMINE PROBLEM IN THE COUNTRY		
Landmine problem	entity:	***contradictory***
	size:	**medium**
Victims	number:	**much less than 127 /year**
	gender and age:	***contradictory***
	location:	**RURAL AREAS**
Impact of landmines	present:	**low**
	future:	**affect development**
	mined areas fenced:	**NO**
	mined areas violated:	**NO**
Time for removing landmines	all:	**never**
	most urgent ones:	**done**
	time for reducing landmine risk to an acceptable level:	**done**

EVALUATION OF END-USERS SKILLS, TECHNOLOGY ATTITUDES AND CAPACITIES		
Education in school	years:	**4**
Attitude towards technology	at home:	**RADIO**
	at workshop:	**mechanical tools**
	keen to learn new technologies:	**YES**
Communication skills	preferred ways:	**ORAL**

OPINION ON MACHINE TECHNOLOGY			
Experience with machines		type:	**vegetation cutters**
		advantages:	***contradictory***
		drawbacks:	***contradictory***
Desire for off-the shelf machines		type:	**caterpillars, harvesters, compactors**
		use:	**roads**
		NO:	**large machines**
Requirements for new machines	Cost of a new machine	max cost:	**200.000 USD**
		max running cost:	**approx. 7 USD /hour**
	Performances of a new machine	applications:	***contradictory***
		operational conditions:	**humid weather**
	Time for a new machine	min lifetime:	**5 YEARS**
		max delivery time:	
Tests in situ		importance:	**HIGH**

5.3 ADP: STRUCTURED INTERVIEW RESULTS

VIEW OF THE LANDMINE PROBLEM IN THE COUNTRY		
Landmine problem	entity:	**undefined**
	size:	**not known**
Victims	number:	**dropped consistently since 2000 (in 2000: 127/year)**
	gender and age:	**women, children**
	location:	**rural areas**
Impact of landmines	present:	**undefined**
	future:	**affect development together with other problems**
	mined areas fenced:	**no**
	mined areas violated:	**no**
Time for removing landmines	all:	
	most urgent ones:	
	time for reducing landmine risk to an acceptable level:	

EVALUATION OF END-USERS SKILLS, TECHNOLOGY ATTITUDES AND CAPACITIES		
Education in school	years:	**5**
Attitude towards technology	at home:	**TV, radio**
	at workshop:	**mechanical tools**
	keen to learn new technologies:	**yes, a bit frightened to lose their job**
Communication skills	preferred ways:	**oral and visual**

OPINION ON MACHINE TECHNOLOGY			
Experience with machines		type:	**Tempest**
		advantages:	**small and transportable**
		drawbacks:	**hydraulic hoses, low power**
Desire for off-the shelf machines		type:	**none**
		use:	**none**
		NO:	**large machines**
Requirements for new machines	Cost of a new machine	max cost:	**depends on efficiency**
		max running cost:	**approx. 7 USD/hour**
	Performances of a new machine	applications:	**bush clearance**
		operational conditions:	**rainy season**
	Time for a new machine	min lifetime:	**5 years**
		max delivery time:	
Tests in situ		importance:	**very important**

5.4 ADP: QUESTIONNAIRE RESULTS

TECHNOLOGY IN USE

Mechanical technology

Total number:	Types:	Manufacturing company:	Period of use (average):
1	**vegetation cutter**	**Development Technology Workshop**	**1 year**

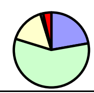
Age of equipment (average):	External conditions:	Use within demining practices:
1 year	**acceptable**	**tripwire, vegetation removal**
Weather conditions to be avoided:	Terrain conditions to be avoided:	N° of accidents in the last year (average):
hot weather	**0**	**0**

Calculated cost/year ($):	Calculated cost/year ($) / annual programme budget ($):
12.666	**12.666 / 2.840.456**

Main reasons for downtime:	Advantages		Drawbacks	
	(coord.):	(deminers):	(coord.):	(deminers):
replacing chains	**0**	**very fast**	**0**	**hoses break too often due to high temperature**
N° of machines developed locally:				
0				

Sensor technology

Total number:	Types:	Models, quantity and frequency of MD used:	Period of use (average):
747	**MD**	**Schiebel 5 166** **Schiebel 7 429** **Foerster 116** **Ebinger 9** **Minelab 27**	**3 years**



Age of equipment (average) :	External conditions:	
3 years	**acceptable**	
Weather conditions to be avoided:	Terrain conditions to be avoided:	N° of accidents in the last year (average):
windy	**rocky**	**0**

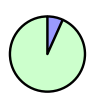
Calculated cost of each sensor/year + average calculated cost of sensors($):

	Model 1	Model 2	Model 3	Model 4	Model 5	Average	Calculated cost of all sensor technology/year ($) / annual programme budget ($):
Calculated cost/year ($)	**2.417**	**2.584**	**2.483**	**2.364**	**2.779**	**2.525**	**1.893.810 / 2.840.456**

Main reasons for downtime:	Advantages		Drawbacks (all)	
	(coord.):	(deminers):	(coord.):	(deminers):
cables	**0**	**usable also in wet conditions, comfortable**	**0**	**not waterproof** **it doesn't work in highly contaminated areas** **it doesn't have a good handle** **it uses too many batteries and when there's strong wind it's difficult to hear the signal**
N° of sensors developed locally:				
0				

Information & Communication technology

Total number:	Types of information technology used and quantity:	Manufacturing company:	Period of use (average):
166	**GPS 11** **radio 155**	**Mth (radio)**	**10 years (radio)**



Age of equipment (average):	External conditions:
10 years	**good**
Weather conditions to be avoided:	
0	

Calculated cost of each technology/year + average calculated cost of technologies($):

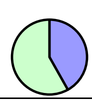
	Model1	Model2	Model3	Model4	Model5	Model 6	Model 7	Model 8	Model9	Average	Calculated cost of all ICT/year ($) / annual programme budget ($):
Calc.cost /year ($)	**724**	**24**	**624**	**624**	**94**	**100**	**250**	**520**	**480**	**382**	**31.819 / 2.840.456**

Main reasons for downtime:	Advantages		Drawbacks	
	(coord.):	(deminers):	(coord.):	(deminers):
it falls down	**0**	**0**	**0**	**0**
N° of technologies developed locally:				
0				

Other technology

Transport technologies

	Total number:	Types of transport tech. used and quantity:
	31	**tractor 13** **pick-up 18**



Power supply systems

	Total number:	Types of power supply systems and quantity:
	9	**generator**

5.5 ADP: GROUP INTERVIEW RESULTS

Number of deminers: Variable between 3 and 7

A. EVALUATION OF PRACTICES			
Practices	**Evaluation A**	**Evaluation B**	**Evaluation C**
1. Checking for tripwires *	**Tedious and Dangerous**		
2. Removing vegetation	**Repetitive**	**Repetitive**	**Repetitive**
3. Checking for mines (Using MD)	**Repetitive**		**Repetitive**
4. Investigating false alarms (Prodding)	**Slow**	**Dangerous**	**Dangerous**
5. Excavating mines (Digging)	**Slow**	**Dangerous**	**Dangerous**

Stakeholder **A**: platoon commander; Stakeholder **B**: deminers; Stakeholder **C**: field supervisor.
* They don't use tripwire detectors but they have been trained to use them.

B. SORTING PROBLEMATIC ENVIRONMENTS	
More problematic	**Bamboo**
	Thick vegetation
	Water
	Forest
Less problematic	**Hilly terrain**

C. EVALUATION OF MACHINES	
1. Mini flail	**Useful**
2. Medium flail	**Useful**
3. Heavy flail	**Never seen**
4. Tiller	**Never seen**
5. Multi tool	**Not useful**
6. Sifter	**Never seen**

D. SORTING OF CONTROL INPUT	
Best	**Controlling light signals + Eyes**

E. SORTING OF CONTROL OUTPUT	
Best	**Clicking directional arrows**
	Touching a screen
Worst	**Acting on a lever**
	Pushing a button
NOT USABLE	**Moving a mouse**

F. SORTING OF ASSEMBLY METHOD	
More used	**Welding**
	Gluing
	Screwing
Less used	**Tying**

G. SORTING OF MATERIAL	
More used	**Steel**
	Wood
Less used	**Plastic**

H. SORTING OF COMMUNICATION MEANS	
Best	**Drawing + Words**
	Cartoon
	Drawing
Worst	**Written words**

(round brackets include names generally used by deminers to indicate an action)

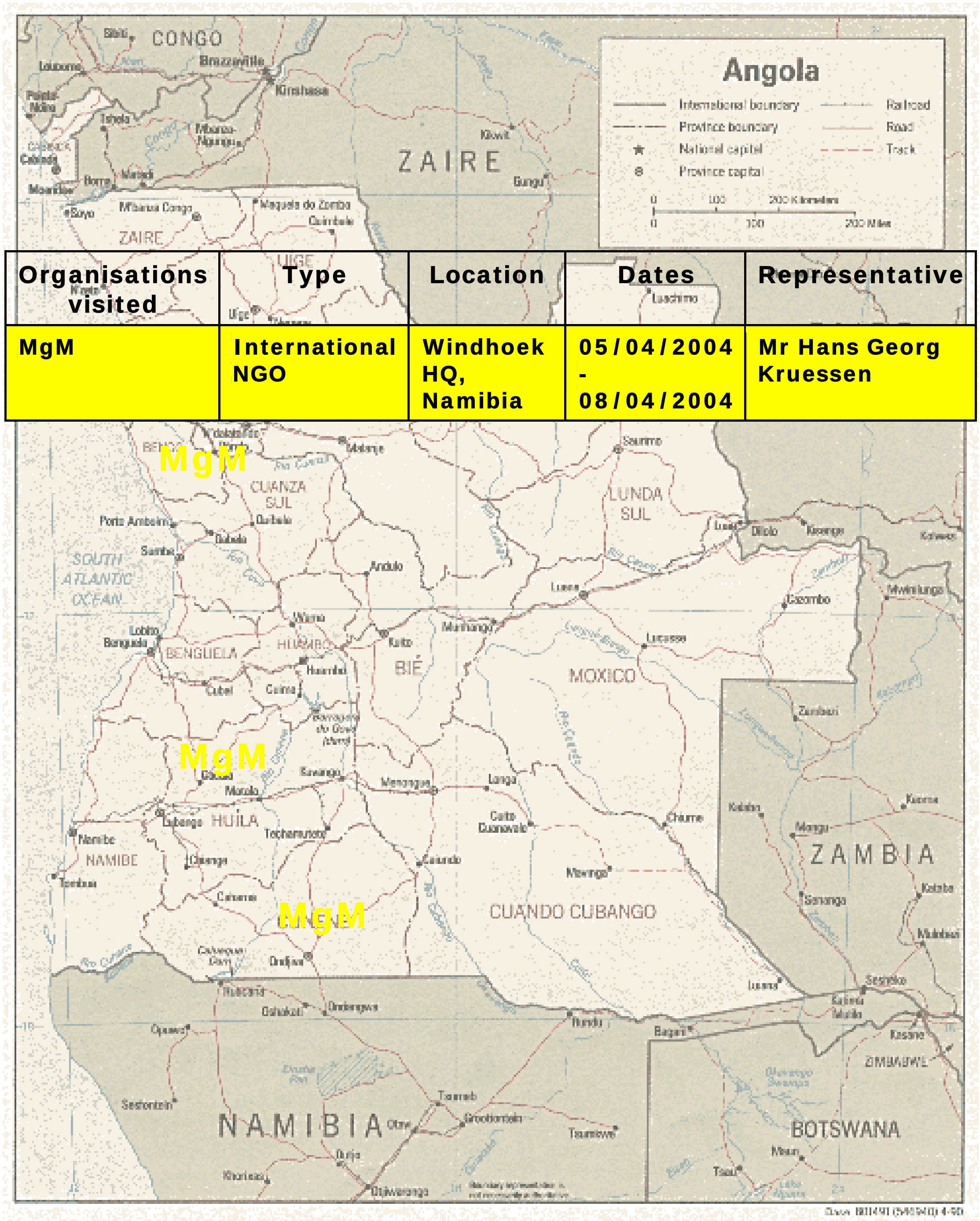
5.6 MgM: STRUCTURED INTERVIEW RESULTS

VIEW OF THE LANDMINE PROBLEM IN THE COUNTRY		
Landmine problem	entity:	**defined**
	size:	**medium**
Victims	number:	**no idea**
	gender and age:	**men**
	location:	**rural areas**
Impact of landmines	present:	**low**
	future:	**delay in reconstruction and resettlement**
	mined areas fenced:	**no**
	mined areas violated:	**no**
Time for removing landmines	all:	**never**
	most urgent ones:	**done**
	time for reducing landmine risk to an acceptable level:	**done**

EVALUATION OF END-USERS SKILLS, TECHNOLOGY ATTITUDES AND CAPACITIES		
Education in school	years:	**3 to 4**
Attitude towards technology	at home:	**radio**
	at workshop:	**engines**
	keen to learn new technologies:	**yes**
Communication skills	preferred ways:	**oral**

OPINION ON MACHINE TECHNOLOGY			
Experience with machines		type:	**many, the best are: vegetation cutters and graders**
		advantages:	**productive, robust**
		drawbacks:	**nothing**
Desire for off-the shelf machines		type:	**caterpillars, harvesters, compactors**
		use:	**roads**
		NO:	**no idea**
Requirements for new machines	Cost of a new machine	max cost:	**200.000 USD**
		max running cost:	**depends on the size of the project**
	Performances of a new machine	applications:	**soil sifting withstanding AT blast**
		operational conditions:	**hot-humid weather, limited extras for logistics**
	Time for a new machine	min lifetime:	**5 years**
		max delivery time:	
Tests in situ		importance:	**very important**

6 ANGOLA



Organisations visited	Type	Location	Dates	Representative
MgM	International NGO	Windhoek HQ, Namibia	05/04/2004 - 08/04/2004	Mr Hans Georg Kruessen

The results presented in the Angola section originate from the analysis of data collected during our visit to MgM in Namibia.
Locations indicated by "MgM" correspond to locations where MgM operates.
A visit to field operations in Angola was foreseen, but could not take place as at the time when we where there, operations were interrupted due to Easter holidays.

NOTE: Some of the collected information is country specific; individual replies might therefore well differ from one country to another.

6.1 GENERAL FACTS

6.1.1 Landmine Problem

Angola is coming out of more than 20 years of civil war. A peace accord was finally achieved in April 2002. Landmines have been a constant feature of the fighting in Angola, and were used in great numbers by all parties to the conflict. Prior to April 2002, and even after signing the Mine Ban Treaty, Angolan government officials admitted to the continued planting of mines by their military forces on many occasions.
In Angola there are 4,200 areas that contain or are suspected to contain mines.
Many different types of landmines have been found, among the most common anti-personnel ones are: OZM-4, POMZ and GYATA.
In 2003, at least 36 people were killed and 142 injured, including seven children, in 103 landmine incidents. The true number of casualties is presumed to be higher than those reported, as many incidents are not recorded due to inaccessibility of casualties, and the lack of an organised reporting system.

Demining operations in Angola are slowed down by the presence of vegetation, typically shrubland, savanna, grassland and forest.
The soil is mainly composed of ferralsols, deep, strongly weathered soils with a chemically poor, but physically stable subsoil, and arenosols, sandy soils featuring very weak or no soil development.

6.1.2 Key Players

Humanitarian demining operations started in Angola in 2002.
Angola signed the Mine Ban Treaty on 4 December 1997, ratified it on 5 July 2002 and the treaty entered into force on 1 January 2003.
In 2004, ten operators were engaged in mine clearance related activities in Angola: eight NGOs (HALO, MAG, NPA, InterSOS, SBF, BTS, MgM, and DCA), the National Demining Institute and the Angolan Armed Forces. In the NGO sector, there are approximately 1000 full time deminers, 8 machines and 24 mine detection dogs.
The major organisations involved in demining are reported in the table below, together with the indication of the year in which they began operating and the number of staff employed. The organisations indicated with ** are the ones we visited.

Organisation	Operating since	# of Angolan Staff employed
Mines Advisory Group (MAG)	1994	386
HALO Trust	1994	620
Norwegian People's Aid (NPA)	1995	500
Menschen gegen Minen (MgM)**	1996	150
Santa Barbara Foundation (SBF)	1996	Not known
InterSOS	1997	Not known

Information reported in this section has been collected from the following sources:
The Landmine Monitor Report 2004, http://www.icbl.org/lm/2004/
The World Fact Book 2004, http://www.cia.gov/cia/publications/factbook/
The World Reference Base for Soil Resources, http://www.fao.org/ag/agl/agll/wrb/wrbmaps/htm/domsoi.htm
Earth Trends, the Environmental Information Portal, http://earthtrends.wri.org.

6.2 MgM: STRUCTURED INTERVIEW RESULTS

VIEW OF THE LANDMINE PROBLEM IN THE COUNTRY		
Landmine problem	entity:	**defined**
	size:	**high**
Victims	number:	**no idea**
	gender and age:	**men**
	location:	**rural areas**
Impact of landmines	present:	**high**
	future:	**delay in reconstruction and resettlement**
	mined areas fenced:	**no**
	mined areas violated:	**no**
Time for removing landmines	all:	**never**
	most urgent ones:	**5 to 10 years**
	time for reducing landmine risk to an acceptable level:	**5 to 10 years**

EVALUATION OF END-USERS SKILLS, TECHNOLOGY ATTITUDES AND CAPACITIES		
Education in school	years:	**3 to 4**
Attitude towards technology	at home:	**radio**
	at workshop:	**engines**
	keen to learn new technologies:	**yes**
Communication skills	preferred ways:	**oral**

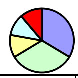
OPINION ON MACHINE TECHNOLOGY			
Experience with machines		type:	**many, the best are: vegetation cutters and graders**
		advantages:	**productive, robust**
		drawbacks:	**nothing**
Desire for off-the shelf machines		type:	**caterpillars, harvesters, compactors**
		use:	**roads**
		NO:	**no idea**
Requirements for new machines	Cost of a new machine	max cost:	**200.000 USD**
		max running cost:	**depends on the size of the project**
	Performances of a new machine	applications:	**soil sifting withstanding AT blast**
		operational conditions:	**hot-humid weather, limited extras for logistics**
	Time for a new machine	min lifetime:	**5 years**
		max delivery time:	
Tests in situ		importance:	**high**

6.3 MgM: QUESTIONNAIRE RESULTS

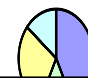
TECHNOLOGY IN USE

Mechanical technology

Total number:	Types of machines used, quantity and frequency of use:		Manufacturing company:	Period of use (average):
9	**vegetation cutter**	**3**	**MgM Mine Clearance NGO – R&D**	**5 years**
	grader	**3**		
	armoured backhoe tractor	**1**		
	armoured front wheel loader	**1**		
	armoured excavator	**1**		



Age of equipment (average):	External conditions:	Use within demining practices:	
12 years	**acceptable**	**tripwire, vegetation, mine, earth removal**	**3**
		tripwire, vegetation removal	**1**
		tripwire, vegetation, mine, earth removal, soil sifting	**2**
		earth removal, soil sifting	**1**



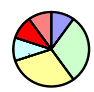
Weather conditions to be avoided:	Terrain conditions to be avoided:	N° of accidents in the last year (average):
flood, wet weather	**0**	**0**

Calculated cost of each machine/year + average calculated cost of machines ($):

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Average	Calculated cost of all mechanical technology/year ($) / annual programme budget ($):
Calculated cost/year($):	**0**	**6.350**	**8.350**	**8.350**	**20.350**	**22.350**	**60.650**	**18.057**	**147.450 / 8.000.000**

Main reasons for downtime:	Advantages (coord.):	Advantages (deminers):	Drawbacks (all) (coord.):	Drawbacks (all) (deminers):
tyres, mechanics	**robust**	**0**	**hot inside the cabin**	**0**
			too small	
			leaves behind uneven surfaces	
			high operational costs	

N° of machines developed locally:	Why?	Types of machines adapted to HD:	
10 (all)	**better, cheaper**	**commercial BROXX**	**1**
Time for development (months):	Funded by:	**military troop carrier**	**3**
8 months	**Dutch gov., German gov., US gov., EU**	**road construction machines**	**3**
		CAT 916	**1**
		CAT 928	**1**
		CAT Mdl 325 B	**1**



Sensor technology

Total number:	Types:	Models, quantity and frequency of MD used:		Period of use (average):
73	**MD**	**Foerster**	**8**	**3 years**
		Ebinger	**50**	
		Vallon	**15**	

Age of equipment (average) :	External conditions:	
3 years	**good**	
Weather conditions to be avoided:	Terrain conditions to be avoided:	N° of accidents in the last year (average):
wet weather	**0**	**0**

Calculated cost of each sensor/year + average calculated cost of sensors($):

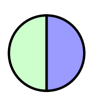
	Model 1	Model 2	Model 3	Average			Calculated cost of all sensor technology/year ($) / annual programme budget ($):
Calc. cost/year ($)	**3.250**	**3.250**	**3.250**	**3.250**			**237.250 / 8.000.000**

Main reasons for downtime:	Advantages (coord.):	Advantages (deminers):	Drawbacks (all) (coord.):	Drawbacks (all) (deminers):
cables	**robust**	**0**	**electronics affected by humidity**	**0**
			cables	

N° of sensors developed locally:
0

Information & Communication technology

Total number:	Types of information technology used and quantity:	Manufacturing company:	Period of use (average):
20	**GPS 10**	**Garmin (GPS)**	**2 years**
	Digital camera 10		



Age of equipment (average):	External conditions:
2 years	**acceptable**
Weather conditions to be avoided:	
0	

Calculated cost of each technology/year + average calculated cost of technologies($):

	Model1	Model2	Model3	Average	Calculated cost of all ICT/year ($) / annual programme budget ($):
Calc. cost /year ($)	**2.790**	**2.790**	**2.900**	**2.827**	**56.900 / 8.000.000**

Main reasons for downtime:	Advantages (coord.):	Advantages (deminers):	Drawbacks (coord.):	Drawbacks (deminers):
0	**Compact (GPS)**	**0**	**antenna easy to break (GPS)**	**0**

N° of technologies developed locally:
0

Other technology

Transport technologies

Total number:	Types of transport tech. used and quantity:	
40	**mine protected vehicle**	**4**
	truck	**9**
	fire engine	**4**
	truck tractor	**1**
	van	**2**
	pick-up	**20**

Power supply systems

Total number:	Types of power supply systems and quantity:
23	**uninterrupted power supply, generator**

7 SRI LANKA

Organisations visited	Type	Location	Dates	Representative
FSD	International NGO	Colombo HQ, Vavunya, Talaimannar	16/04/2004 - 21/04/2004	Mr Christoph Hebeisen
UNDP	United Nations programme	Vavunya office	19/4/2004	Ms Leonie Barns
Sri Lankan Military	Military	Vavunya, UNDP office	19/4/2004	Field Engineers
MAG	International NGO	Kilinochi, office, Kilinochi area	23/4/2004	Ms Abigail Hartley
NPA	International NGO	Kilinochi office, Elephant Pass area	24/4/2004 - 25/4/2004	Mr Richard Schmidt

The results presented in the Sri Lanka section originate from the analysis of data collected during our visit to FSD, UNDP, SL Military, MAG and NPA.
Locations indicated by red text show the places where we have been.
UNDP and SL military provided only general information about the landmine problem in the country, as contained in the corresponding structured interviews. There was insufficient time to organize a group interview with MAG.

NOTE: Some of the collected information is country specific; individual replies might therefore well differ from one country to another.

7.1 GENERAL FACTS

7.1.1 Landmine Problem

In nearly two decades of conflicts both the Sri Lankan Army (SLA) and the Liberation Tigers of Tamil Eelam (LTTE) used anti-personnel mines extensively. Fighting halted in December 2001 and a formal cease-fire agreement came into force in February 2002. Since December 2001, there have been no confirmed reports of new mine use by either the government or the LTTE.
The area suspected to be mined is 200 square kilometres, representing 0,3% of the total surface of Sri Lanka.
Many different types of landmines have been found, among the most common anti-personnel ones are: Chinese Type 72 A, Pakistani P4, as well as some produced by the LTTE: the “Jony” mine (a small wooden box mine), a plastic mine designated Rangan 99 (which resembles the Pakistani P4 mine), and a Claymore-type directional fragmentation mine.
In 2003, 99 landmine/UXO casualties, including 24 killed and 75 injured, were recorded. Of the total casualties, 18 were female and 23 were children under 18 years; only three were military personnel.
Demining operations in Sri Lanka are slowed down by the presence of vegetation, typically cropland and forest.
The soil is mainly composed of acrisols, soils with subsurface accumulation of low activity clays and low base saturation, and lixisols, soils with subsurface accumulation of low activity clays and high base saturation.

7.1.2 Key Players

Humanitarian demining operations started in Sri Lanka in 1999. The Democratic Republic of Sri Lanka has not acceded to the Mine Ban Treaty.
The two main agencies engaged in mine clearance in 2003 and 2004 are the Sri Lankan Army (SLA) and the Humanitarian Demining Unit (HDU), an implementing arm of the Tamil Rehabilitation Organisation (TRO). The HDU has received support from NPA, MAG, FSD, and the Danish Demining Group (DDG). Another important organisation is the HALO Trust which is working in the Jaffna Peninsula and in Trincomalee. There are approximately 1500 full time deminers working in Sri Lanka.
The major organisations involved in demining are reported in the table below, together with the indication of the year in which they began operating and the number of staff employed. The organisations indicated with ** are the ones we visited.

Organisation	Operating since	# of Sri Lankan Staff employed
Humanitarian Demining Unit (HDU)**	1999	850
Mines Advisory Group (MAG)**	2002	200
Fondation Suisse de Deminage (FSD)**	2002	88
Norwegian People’s Aid (NPA)**	2002	600
Sri Lankan Army (SLA)**	2001	280
HALO Trust	2002	250

Information reported in this section has been collected from the following sources:
The Landmine Monitor Report 2004, http://www.icbl.org/lm/2004/
The World Fact Book 2004, http://www.cia.gov/cia/publications/factbook/
The World Reference Base for Soil Resources, http://www.fao.org/ag/agl/agll/wrb/wrbmaps/htm/domsoi.htm
Earth Trends, the Environmental Information Portal, http://earthtrends.wri.org.

7.2 SRI LANKA: STRUCTURED INTERVIEW RESULTS

VIEW OF THE LANDMINE PROBLEM IN THE COUNTRY		
Landmine problem	entity:	**defined**
	size:	**limited to the north-east**
Victims	number:	**5 to 7 /month**
	gender and age:	**men**
	location:	**rural areas**
Impact of landmines	present:	**deny access to areas with major income**
	future:	**affect development**
	mined areas fenced:	**some**
	mined areas violated:	**some**
Time for removing landmines	all:	**6 years**
	most urgent ones:	**2 years**
	time for reducing landmine risk to an acceptable level:	**2 years**

EVALUATION OF END-USERS SKILLS, TECHNOLOGY ATTITUDES AND CAPACITIES		
Education in school	years:	**10**
Attitude towards technology	at home:	**<u>RADIO</u>**
	at workshop:	**light industrial tools/ telephones, internet**
	keen to learn new technologies:	**<u>YES</u>**
Communication skills	preferred ways:	**oral**

OPINION ON MACHINE TECHNOLOGY			
Experience with machines		type:	**flails**
		advantages:	**clearing vegetation, preparing ground**
		drawbacks:	***contradictory***
Desire for off-the shelf machines		type:	**armoured excavator**
		use:	**removing ground**
		NO:	**heavy machines**
Requirements for new machines	Cost of a new machine	max cost:	**depends on donors**
		max running cost:	**< 40% of total machine budget**
	Performances of a new machine	applications:	**verification, area reduction, quality assurance**
		operational conditions:	**T > 40°C**
	Time for a new machine	min lifetime:	**4 years**
		max delivery time:	**3 months**
Tests in situ		importance:	***contradictory***

7.3 SRI LANKA: QUESTIONNAIRE RESULTS

TECHNOLOGY IN USE

Mechanical technology

Total number:	Distribution per organization:		Types:	Period of use (average):
1	**FSD**	**0**	**mini flail**	**1 year**
	MAG	**1**		
	NPA	**0**		

Weather conditions to be avoided:	Terrain conditions to be avoided:
wet	**large rocks, hard soil**

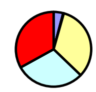
Calculated cost/year ($):
34.523

Main reasons for downtime:	Advantages		Drawbacks	
	(coord.):	(deminers):	(coord.):	(deminers):
replacing hammers, cleaning air filters, cleaning cycles	**small, well controlled, easy to transport, one of the cheapest mini flails**	**0**	**hammers must be replaced often in hard ground**	**0**

N° of machines developed locally:
0

Sensor technology

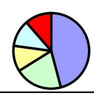
Total number:	Distribution per organisation:		Types of sensors used and quantity:		Period of use (average):
1.491	**FSD**	**65**	**MD**	**61**	**2 years**
	MAG	**100**	**Locator**	**4**	
	NPA	**1.326**	**Plastic light rake**	**492**	
			Metal light rake	**442**	
			Heavy rake	**492**	



Weather conditions to be avoided:	Terrain conditions to be avoided:
rain	**hard soil**

Average Calculated cost of sensors/year ($):

MD	Locator	Plastic light rake	Metal light rake	Heavy rake
4.448	**1.972**	**1.102**	**1.104**	**1.098**



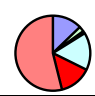
Main reasons for downtime:	Advantages		Drawbacks (all)	
	(coord.):	(deminers):	(coord.):	(deminers):
contradictory	**contradictory**	**safe, comfortable (MD); it goes deep (locator)**	**contradictory**	**contradictory**

Types of sensors developed locally:	Why:	Types of tools adapted to sensors:
Plastic light rake	**contradictory**	**commonly used tools**
Metal light rake		
Heavy rake		

Modifications:	Time for development (average):	Funded by
increased length of handle	**days**	**local NGO**

Information & Communication technology

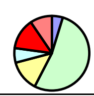
Total number:	Distribution per organisation:		Types of information technology used and quantity:		Period of use (average):
93	**FSD**	**12**	**GPS**	**12**	**2 years**
	MAG	**21**	**DGPS**	**2**	
	NPA	**60**	**Correction signal**	**1**	
			Satellite phone	**15**	
			Laptop	**13**	
			Radio	**50**	



Weather conditions to be avoided:
wet, cloudy

Average Calculated cost of technologies/ year ($):

GPS	DGPS	Correction signal	Satellite phone	Laptop	Radio
700	**7.892**	**2.000**	**955**	**1.995**	**1.412**



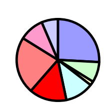
Main reasons for downtime:	Advantages (all)		Drawbacks	
	(coord.):	(deminers):	(coord.):	(deminers):
contradictory	**contradictory**	**Comfortable (DGPS)**	**short battery life**	**short battery life (radio, sat. phone)**
		multi purpose (sat. phone)		**when it is cloudy there's no proper coverage (sat. phone)**

N° of technologies developed locally:
0

Other technology

Transport technologies

Total number:	Distribution per organisation:		Types of transport tech. used and quantity:	
62	**FSD**	**10**	**land cruiser**	**16**
	MAG	**16**	**dual cab**	**5**
	NPA	**36**	**crew cab**	**1**
			pick up	**7**
			twin cab truck	**9**
			motorbike	**14**
			truck	**6**
			small truck	**4**



Power supply systems

Total number:	Distribution per organisation:		Types of power supply systems and quantity:
27	**FSD**	**1**	**generator**
	MAG	**10**	
	NPA	**16**	

7.4 SRI LANKA: GROUP INTERVIEW RESULTS

A. EVALUATION OF PRACTICES	
2. Removing vegetation	**Dangerous**

B. SORTING PROBLEMATIC ENVIRONMENTS	
More problematic	
	Forest
Less problematic	**Thick vegetation**

C. EVALUATION OF MACHINES	
1. Mini flail	
2. Medium flail	
3. Heavy flail	
4. Tiller	
5. Multi tool	
6. Sifter	

D. SORTING OF CONTROL INPUT	
Best	**Watching machine moving (eyes)**
	Hearing signal
Worst	

E. SORTING OF CONTROL OUTPUT	
Best	
	Moving a mouse
	Acting on a lever
Worst	**Pushing a button**

F. SORTING OF ASSEMBLY METHOD	
More used	
	Welding
Less used	**Tying**

G. SORTING OF MATERIAL	
More used	
Less used	

H. SORTING OF COMMUNICATION MEANS	
Best	**Talking drawing**
	Cartoon
	Drawing + Words
	Drawing
Worst	**Written words**

(round brackets include names generally used by deminers to indicate an action)

NOTE: see also §3.3.2.

7.5 FSD: STRUCTURED INTERVIEW RESULTS

VIEW OF THE LANDMINE PROBLEM IN THE COUNTRY		
Landmine problem	entity:	**defined**
	size:	**8/25 districts**
Victims	number:	**4 to 7 /month**
	gender and age:	**men**
	location:	**rural areas in the north and east of the country**
Impact of landmines	present:	**delay in resettlement**
	future:	**stopper to development**
	mined areas fenced:	**some**
	mined areas violated:	**in some places people cultivate mined paddy fields**
Time for removing landmines	all:	**> 4 years**
	most urgent ones:	**2 to 3 years**
	time for reducing landmine risk to an acceptable level:	**3 to 4 years**

EVALUATION OF END-USERS SKILLS, TECHNOLOGY ATTITUDES AND CAPACITIES		
Education in school	years:	**10**
Attitude towards technology	at home:	**1 radio/village**
	at workshop:	**hand tools**
	keen to learn new technologies:	**yes**
Communication skills	preferred ways:	**oral**

OPINION ON MACHINE TECHNOLOGY			
Experience with machines		type:	**flails**
		advantages:	**good at clearing vegetation, preparing ground, surveying, area reduction**
		drawbacks:	**bad in areas with 50cm of hard soil**
Desire for off-the shelf machines		type:	**armoured excavator, Scanjack, another MV4**
		use:	**armoured excavator for supporting access to hillocks and clearing wells, Scanjack for clearing large areas, MV4 for clearing medium-heavy vegetation**
		NO:	**heavy machines**
Requirements for new machines	Cost of a new machine	max cost:	**depends on donors**
		max running cost:	**< 40% of total machine budget**
	Performances of a new machine	applications:	**wide range**
		operational conditions:	**T > 40°C, easy to use and maintain**
	Time for a new machine	min lifetime:	**4 to 5 years**
		max delivery time:	**2 months**
Tests in situ		importance:	**high (for Sri Lankan army)**

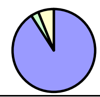
7.6 FSD: QUESTIONNAIRE RESULTS

TECHNOLOGY IN USE

Mechanical technology

Total number:			
0			

Sensor technology

Total number:	Types:	Models, quantity and frequency of sensors used:		Period of use (average):
65	**MD**	**Ebinger 59**		**2 years**
	MD	**Vallon 2**		
	Locator	**Schonstedt 4**		

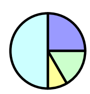
Age of equipment (average) :	External conditions:	
2 years	**good**	
Weather conditions to be avoided:	Terrain conditions to be avoided:	N° of accidents in the last year (average):
rain (locator)	**high vegetation, rocks (large head MD)**	**0**

Calculated cost of each sensor/year + average calculated cost of sensors($):					Calculated cost of all sensors/year ($) / annual programme budget ($):
	Model 1	Model 2	Model 3	Average	
Calc. cost/year ($)	**4.247**	**4.649**	**1.972**	**3.623**	**267.735 / 1.115.003**

Main reasons for downtime:	Advantages (all) (coord.):	Advantages (all) (deminers):	Drawbacks (all) (coord.):	Drawbacks (all) (deminers):
connections and electrical parts (standard MD)	**simple design, light, ergonomic, easy to operate (standard MD)**	**safe: it detects all metals, comfortable (standard MD)**	**very large head: useful only in open ground (large head MD)**	**when the battery charge is low, the signal changes and becomes more frequent (standard MD)**
	very large head: it covers large areas (large head MD)	**it goes deep (locator)**	**delicate, uses special rechargeable batteries (locator)**	
	low false alarm rate, small head (locator)			

N° of sensors developed locally:
0

Information & Communication technology

Total number:	Types of information technology used and quantity:			Manufacturing company:	Period of use (average):
12	**GPS**	**3**		**Thuraya (satellite phone)**	**2 years**
	DGPS	**2**			
	Correction signal	**1**			
	Satellite phone	**6**			

Age of equipment (average):	External conditions:
3 years	**good**
Weather conditions to be avoided:	
wet, cloudy (DGPS)	

Calculated cost of each technology/year + average calculated cost of technologies($):						Calculated cost of all ICT/year ($) / annual programme budget ($):
	Model1	Model2	Model3	Model4	Average	
Calc.cost/ year ($)	**2.036**	**7.892**	**2.000**	**2.071**	**3.499**	**36.320 / 1.115.003**

Main reasons for downtime:	Advantages (coord.):	Advantages (deminers):	Drawbacks (coord.):	Drawbacks (deminers):
bad coverage (sat. phone)	**it's possible to tell the system not to measure when the accuracy is lower than a defined value (DGPS)**	**it gives the exact location in different coordinate systems (GPS)**	**0**	**short lasting batteries (GPS)**
		it can take sketch maps, it is comfortable, it allows to see a preview of the sketch and make corrections directly in situ (DGPS)		**when it is cloudy there's no proper coverage (sat. phone)**
		multi-purpose (sat. phone)		

N° of technologies developed locally:
0

Other technology

Transport technologies

	Total number:	Types of transport tech. used and quantity:		
	10	**land cruiser**	**4**	
		dual cab	**5**	
		crew cab	**1**	

Power supply systems

	Total number:	Types of power supply systems and quantity:
	1	**generator**

7.7 FSD: GROUP INTERVIEW RESULTS

Number of deminers: 6 people

A. EVALUATION OF PRACTICES	
1. Checking for tripwires	**Dangerous**
2. Removing vegetation	**Tedious, Dangerous, Slow**
3. Checking for mines (Using MD)	**Tiring**
4. Investigating false alarms (Prodding)	**Difficult**
5. Excavating mines (Digging)	**Tedious, Slow, Dangerous, Difficult**

B. SORTING PROBLEMATIC ENVIRONMENTS	
More problematic	**Water**
	Bamboo
	Hilly terrain
	Forest
Less problematic	**Thick vegetation**

C. EVALUATION OF MACHINES
They have never worked with machines

D. SORTING OF CONTROL INPUT	
Best	**Watching machine moving (eyes)**
	Hearing signal
	Controlling digital signal (numbers)
	Controlling light signals (lights)
	Controlling words (words)
	Controlling analogical signals (indicator)
Worst	**Controlling diagram (diagram)**

E. SORTING OF CONTROL OUTPUT				
Sorting	1 Stakeholder	1 Stakeholder	1 Stakeholder	3 Stakeholders
Best	**Clicking directional arrows**	**Clicking directional arrows**	**Clicking directional arrows**	**Clicking directional arrows**
	Moving a mouse	**Acting on a lever**	**Touching a screen**	**Acting on a lever**
	Touching a screen	**Pushing a button**	**Moving a mouse**	**Pushing a button**
	Acting on a lever	**Moving a mouse**	**Pushing a button**	**Moving a mouse**
Worst	**Pushing a button**	**Touching a screen**	**Acting on a lever**	**Touching a screen**

F. SORTING OF ASSEMBLY METHOD				
Sorting	2 Stakeholders	1 Stakeholder	2 Stakeholders	1 Stakeholder
More used	**Welding**	**Gluing**	**Gluing**	**Gluing**
	Gluing	**Welding**	**Welding**	**Tying**
	Screwing	**Screwing**	**Inserting**	**Welding**
	Inserting	**Inserting**	**Screwing**	**Screwing**
Less used	**Tying**	**Tying**	**Tying**	**Inserting**

G. SORTING OF MATERIAL	
More used	**Wood**
	Plastic
Less used	**Steel**

H. SORTING OF COMMUNICATION MEANS	
Best	**Talking drawing**
	Cartoon
	Drawing + Words
	Drawing
Worst	**Words**

(round brackets include names generally used by deminers to indicate an action)

7.8 UNDP: STRUCTURED INTERVIEW RESULTS

VIEW OF THE LANDMINE PROBLEM IN THE COUNTRY		
Landmine problem	entity:	**undefined**
	size:	**limited to the north-east, 80 mined affected areas in one district alone**
Victims	number:	**5 to 7 /month**
	gender and age:	**men and children between 10 and 15 years old**
	location:	**areas where Tamil people live**
Impact of landmines	present:	**deny access to areas with major income**
	future:	**decrease in funding from donors**
	mined areas fenced:	**some**
	mined areas violated:	**only if necessary**
Time for removing landmines	all:	**6 years**
	most urgent ones:	**2 years**
	time for reducing landmine risk to an acceptable level:	**2 years**

EVALUATION OF END-USERS SKILLS, TECHNOLOGY ATTITUDES AND CAPACITIES		
Education in school	years:	**10 or more**
Attitude towards technology	at home:	**radio, 1 TV/village**
	at workshop:	**light industrial tools/ telephones, internet**
	keen to learn new technologies:	**yes**
Communication skills	preferred ways:	**singing**

OPINION ON MACHINE TECHNOLOGY			
Experience with machines		type:	**Bozena mini-flail**
		advantages:	**good at clearing vegetation, preparing ground, access**
		drawbacks:	**slow at clearing large areas**
Desire for off-the shelf machines		type:	**armoured excavator**
		use:	**removing ground and barbed wire**
		NO:	**very heavy machines, machines without very good vegetation clearance capacity**
Requirements for new machines	Cost of a new machine	max cost:	**100.000 USD**
		max running cost:	**no idea**
	Performances of a new machine	applications:	**no idea**
		operational conditions:	**no idea**
	Time for a new machine	min lifetime:	**no idea**
		max delivery time:	**no idea**
Tests in situ		importance:	**no idea**

7.9 SL MILITARY: STRUCTURED INTERVIEW RESULTS

VIEW OF THE LANDMINE PROBLEM IN THE COUNTRY		
Landmine problem	entity:	**defined**
	size:	**limited to the north-east, 15.000.000 mines**
Victims	number:	**On SLA side 500/regiment**
	gender and age:	**men**
	location:	**rural areas**
Impact of landmines	present:	**deny access to areas with major income**
	future:	**affect children's life**
	mined areas fenced:	**most**
	mined areas violated:	**sometimes, people demine themselves**
Time for removing landmines	all:	**> 50 years**
	most urgent ones:	**5 years**
	time for reducing landmine risk to an acceptable level:	**5 years**

EVALUATION OF END-USERS SKILLS, TECHNOLOGY ATTITUDES AND CAPACITIES		
Education in school	years:	**8**
Attitude towards technology	at home:	**radio**
	at workshop:	**lathes, milling machines, drills/ telephones, computers, videogames**
	keen to learn new technologies:	**yes**
Communication skills	preferred ways:	**oral**

OPINION ON MACHINE TECHNOLOGY			
Experience with machines		type:	**no experience**
		advantages:	**no idea**
		drawbacks:	**no idea**
Desire for off-the shelf machines		type:	**no idea**
		use:	**no idea**
		NO:	**no idea**
Requirements for new machines	Cost of a new machine	max cost:	**no idea**
		max running cost:	**no idea**
	Performances of a new machine	applications:	**no idea**
		operational conditions:	**no idea**
	Time for a new machine	min lifetime:	**no idea**
		max delivery time:	**no idea**
Tests in situ		importance:	**no idea**

7.10 MAG: STRUCTURED INTERVIEW RESULTS

VIEW OF THE LANDMINE PROBLEM IN THE COUNTRY		
Landmine problem	entity:	**defined**
	size:	**limited to the Vanni region, 1.000.000 mines**
Victims	number:	**12 to 17/month**
	gender and age:	**men**
	location:	**rural areas**
Impact of landmines	present:	**block agriculture, pasture, housing**
	future:	**reduce opportunity for socio-economic development**
	mined areas fenced:	**some**
	mined areas violated:	**no**
Time for removing landmines	all:	**6 years**
	most urgent ones:	**2 years**
	time for reducing landmine risk to an acceptable level:	**2 years**

EVALUATION OF END-USERS SKILLS, TECHNOLOGY ATTITUDES AND CAPACITIES		
Education in school	years:	**8**
Attitude towards technology	at home:	**radio, generator**
	at workshop:	**drills, soldering iron, screwdrivers/ telephones, computers**
	keen to learn new technologies:	**yes**
Communication skills	preferred ways:	**oral**

OPINION ON MACHINE TECHNOLOGY			
Experience with machines		type:	**flails**
		advantages:	**good at ground preparation**
		drawbacks:	**no idea**
Desire for off-the shelf machines		type:	**no idea**
		use:	**no idea**
		NO:	**huge machines**
Requirements for new machines	Cost of a new machine	max cost:	**depends on donors**
		max running cost:	**depends on donors**
	Performances of a new machine	applications:	**verification, area reduction, quality assurance**
		operational conditions:	**long hours run, hard ground, heat, dust**
	Time for a new machine	min lifetime:	**3 to 4 years**
		max delivery time:	**4 months**
Tests in situ		importance:	**not necessary**

7.11 MAG: QUESTIONNAIRE RESULTS

TECHNOLOGY IN USE

Mechanical technology

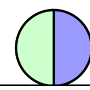
Total number:	Types:	Manufacturing company:	Period of use (average):
1	**mini flail**	**WAY Industry a.s., Slovak Republic**	**1 year**

Age of equipment (average):	External conditions:	Use within demining practices:
1 year	**good**	**vegetation removal, ground preparation, verification, QA, area reduct.**
Weather conditions to be avoided:	Terrain conditions to be avoided:	N° of accidents in the last year (average):
wet	**large rocks, hard soil**	**0**
Calculated cost/year ($):	Calculated cost/year ($) / annual programme budget ($):	
34.523	**34.523 / N/A**	

Main reasons for downtime:	Advantages (coord.):	Advantages (deminers):	Drawbacks (coord.):	Drawbacks (deminers):
replacing hammers, cleaning air filters, cleaning cycles	**small, well controlled, easy to transport, one of the cheapest mini flails**	**0**	**hammers must be replaced often in hard ground**	**0**
N° of machines developed locally:				
0				

Sensor technology

Total number:	Types:	Models, quantity and frequency of sensors used:	Period of use (average):
100	**rake**	**Light rake 50** **Heavy rake 50**	**2 years**



Age of equipment (average) :	External conditions:	
not recorded	**acceptable**	
Weather conditions to be avoided:	Terrain conditions to be avoided:	N° of accidents in the last year (average):
0	**hard soil**	**0**

Calculated cost of each sensor/year + average calculated cost of sensors($):

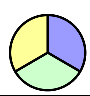
	Model 1	Model 2	Average	Calculated cost of all sensors/year ($) / annual programme budget ($):
Calc.cost/year ($)	**1.103**	**1.097**	**1.100**	**110.013 / N/A**

Main reasons for downtime:	Advantages (coord.):	Advantages (deminers):	Drawbacks (all) (coord.):	Drawbacks (all) (deminers):
blunt, broken tines	**cheap, safe, easy to train, fast**	**0**	**only used on removal of top two centimetres at a time** **usable only on with minimum metal blast AP mines, limited depth, when soil is hard it must be wet**	**0**

N° of sensors developed locally:	Why:	Types of tools adapted to sensors:
50	**urgent need and limited funds**	**commonly used tools**
Modifications:	Time for development (average):	Funded by:
increased length of handle	**days**	**local NGO**

Information & Communication technology

Total number:	Types of information technology used and quantity:	Manufacturing company:	Period of use (average):
21	**satellite phone 7** **GPS 7** **laptop 7**	**Thuraya, Garmin, Toshiba**	**2 years**



Age of equipment (average):	External conditions:
2 years	**good**
Weather conditions to be avoided:	
0	

Calculated cost of each technology/year + average calculated cost of technologies($):

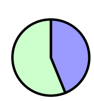
	Model1	Model2	Model3	Average	Calculated cost of all ICT/year ($) / annual programme budget ($):
Calc.cost/ year ($)	**675**	**30**	**3.516**	**1.407**	**29.549 / N/A**

Main reasons for downtime:	Advantages (all) (coord.):	Advantages (all) (deminers):	Drawbacks (coord.):	Drawbacks (deminers):
battery problem	**reliable** **easy to use**	**0**	**short battery life**	**0**
N° of technologies developed locally:				
0				

Other technology

Transport technologies

Total number:	Types of transport tech. used and quantity:
16	**pick up 7** **twin cab truck 9**



Power supply systems

Total number:	Types of power supply systems and quantity:
10	**generator**

7.12 NPA: STRUCTURED INTERVIEW RESULTS

VIEW OF THE LANDMINE PROBLEM IN THE COUNTRY		
Landmine problem	entity:	**defined**
	size:	**not large, less than 500.000 mines**
Victims	number:	**0 to 3 /month**
	gender and age:	**no idea**
	location:	**rural areas, north-east of the country**
Impact of landmines	present:	
	future:	
	mined areas fenced:	**some**
	mined areas violated:	
Time for removing landmines	all:	
	most urgent ones:	
	time for reducing landmine risk to an acceptable level:	

EVALUATION OF END-USERS SKILLS, TECHNOLOGY ATTITUDES AND CAPACITIES		
Education in school	years:	**10**
Attitude towards technology	at home:	**radio**
	at workshop:	**hand tools**
	keen to learn new technologies:	**yes**
Communication skills	preferred ways:	**oral and written**

OPINION ON MACHINE TECHNOLOGY			
Experience with machines		type:	**no experience**
		advantages:	**no idea**
		drawbacks:	**no idea**
Desire for off-the shelf machines		type:	**no idea**
		use:	**no idea**
		NO:	**no idea**
Requirements for new machines	Cost of a new machine	max cost:	**no idea**
		max running cost:	**no idea**
	Performances of a new machine	applications:	**no idea**
		operational conditions:	**no idea**
	Time for a new machine	min lifetime:	**no idea**
		max delivery time:	**no idea**
Tests in situ		importance:	**no idea**

7.13 NPA: QUESTIONNAIRE RESULTS

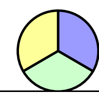
TECHNOLOGY IN USE

Mechanical technology

Total number:			
0			

Sensor technology

Total number:	Types:	Models, quantity and frequency of sensors used:	Period of use (average):
1.326	**rake**	**Metal light rake 442** **Plastic light rake 442** **Heavy rake 50 442**	**2 years**



Age of equipment (average) :	External conditions:	
3 years	**good**	
Weather conditions to be avoided:	Terrain conditions to be avoided:	N° of accidents in the last year (average):
0	**hard soil**	**0**

Calculated cost of each sensor/year + average calculated cost of sensors($):

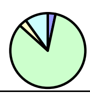
	Model 1	Model 2	Model 3	Average			Calculated cost of all sensors/year ($) / annual programme budget ($):
Calc. cost/year ($)	**1.104**	**1.100**	**1.100**	**1.102**			**1.460.722 / 2.500.000**

Main reasons for downtime:	Advantages (coord.):	Advantages (deminers):	Drawbacks (all) (coord.):	Drawbacks (all) (deminers):
not replaced on time	**flexible, not activating mines**	**0**	**the system: can be very slow in hard soil and clay**	**when the tines' support moves, the force is not transmitted any more properly**
				tines change angle because metal is too soft

N° of sensors developed locally:	Why:	Types of tools adapted to sensors:
1.326	**increase safety of heavy rakes**	**simple rakes**
Modifications:	Time for development (average):	Funded by:
increased length of handle	**days**	**local NGO**

Information & Communication technology

Total number:	Types of information technology used and quantity:	Manufacturing company:	Period of use (average):
60	**GPS 2** **radio 50** **satellite phone 2** **laptop 6**	**Motorola (radio)**	**2 years**



Age of equipment (average):	External conditions:
2 years	**acceptable**
Weather conditions to be avoided:	
0	

Calculated cost of each technology/year + average calculated cost of technologies($):

	Model1	Model2	Model3	Model 4	Average	Calculated cost of all ICT/year ($) / annual programme budget ($):
Calc.cost/ year ($)	**35**	**1.412**	**120**	**400**	**492**	**73.300 / 2.500.000**

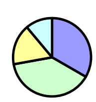
Main reasons for downtime:	Advantages (all) (coord.):	Advantages (all) (deminers):	Drawbacks (coord.):	Drawbacks (deminers):
replace batteries (sat. phone)	**fast reading of coordinates (GPS)**	**0**	**not 100% accurate (GPS)**	**0**
	Effective (radio)		**short battery life, chargers breaking (radio)**	
	Portable (laptop)			

N° of technologies developed locally:
0

Other technology

Transport technologies

	Total number:	Types of transport tech. used and quantity:
	36	**land cruiser 12** **motorbike 14** **truck 6** **small truck 4**



Power supply systems

	Total number:	Types of power supply systems and quantity:
	16	**generator**

7.14 NPA: GROUP INTERVIEW RESULTS

Number of deminers: 8

A. EVALUATION OF PRACTICES*	
0. Marking hazardous areas	**Tedious**
2. Removing vegetation	**Dangerous, Difficult**
5. Excavating mines (Digging)	**No comments**

* They only do: Marking of hazardous areas, Removing vegetation, Excavating mines

B. SORTING PROBLEMATIC ENVIRONMENTS	
More problematic	**Hilly terrain**
	Water
	Bamboo
	Forest
Less problematic	**Thick vegetation**

C. EVALUATION OF MACHINES*	
1. Mini flail	**Not usable**
2. Medium flail	**Useful**
3. Heavy flail	**Useful**
4. Tiller	**Useful**
5. Multi tool	**Very useful**
6. Sifter	**Useful**

* They have never worked with machines, but they were curious to know information on each machine.

D. SORTING OF CONTROL INPUT	
Best	**Watching machine moving (eyes)**
	Hearing signal
	Controlling light signals (lights)
	Controlling analogical signals (indicator)
	Controlling diagram (diagram)
	Controlling words (words)
Worst	**Controlling digital signal (numbers)**

E. SORTING OF CONTROL OUTPUT	
Best	**Touching a screen**
	Clicking directional arrows
	Moving a mouse
	Acting on a lever
Worst	**Pushing a button**

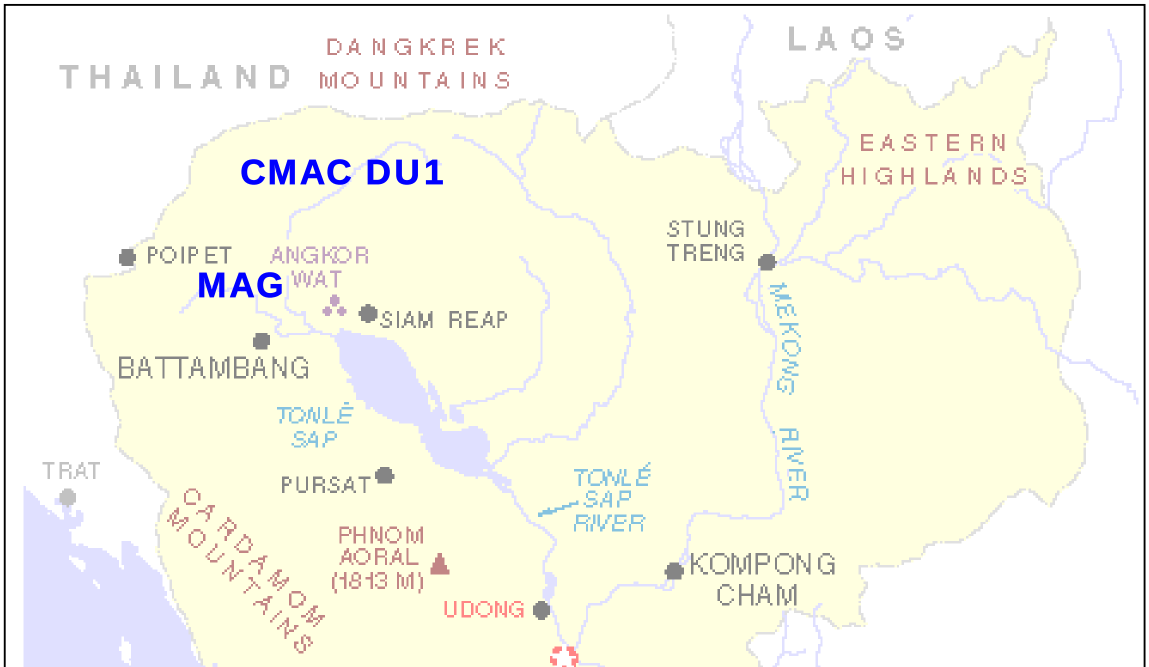
F. SORTING OF ASSEMBLY METHOD	
More used	**Inserting**
	Screwing
	Welding
	Gluing
Less used	**Tying**

G. SORTING OF MATERIAL	
More used	**Plastic**
	Steel
Less used	**Wood**

H. SORTING OF COMMUNICATION MEANS	
Best	**Talking drawing**
	Cartoon
	Drawing + Words
	Drawing
Worst	**Written words**

(round brackets include names generally used by deminers to indicate an action)

8 CAMBODIA



Organisations visited	Type	Location	Dates	Representative
CMAC DU1	**Local NGO**	**Sisophon HQ, Banteay Meanchey province**	**04/05/2004 - 06/05/2004**	**Mr Som Vireak**
MAG	**International NGO**	**Battambang regional office, Ta Krouk area**	**10/05/2004 – 11/05/2004**	**Mr Chamroeun Puth**

The results presented in the Cambodia section originate from the analysis of data collected during our visit to CMAC DU1 and MAG.
Locations indicated by blue text show the places where we have been.

NOTE: Some of the collected information is country specific; individual replies might therefore well differ from one country to another.

8.1 GENERAL FACTS

8.1.1 Landmine Problem

Cambodia is one of the worst landmine and UXO affected countries in the world due to almost three decades of conflict. Landmines were first laid in Cambodia in the mid-1960s, as Cambodia began to be drawn into the Indochina War. During the Democratic Kampuchea regime from 1975 to 1979, the Khmer Rouge used landmines extensively both for military purposes and as an instrument of control over the civilian population. Use of mines intensified during the civil war that followed the overthrow of the Khmer Rouge, and continued well into the 1990s. There were reports and allegations of use of mines by the Royal Cambodian Armed Forces and the Khmer Rouge up to 1998.
The area suspected to be mined is of 2064 square kilometres, representing 1,17% of the total surface. Many different types of landmines have been found, among the most common anti-personnel ones are: PMN, PMN2, PMD-6, MN79, Type 69, DH10, MON 66/50, POMZ-2M, Type 72A and Type 72B.
In 2003, 772 new landmine and UXO casualties were reported in Cambodia: 115 people were killed and 657 injured; 442 were men, 46 women and 284 children; 751 were civilians.
Demining operations in Cambodia are slowed down by the presence of vegetation, typically cropland and forest.
The soil is mainly composed of acrisols, soils with subsurface accumulation of low activity clays and low base saturation.

8.1.2 Key Players

Humanitarian demining operations started in Cambodia in 1992.
Cambodia signed the Mine Ban Treaty on 3 December 1997 and ratified it on 28 July 1999. It entered into force for Cambodia on 1 January 2000.
The four main agencies engaged in mine clearance in 2003 and 2004 are the Cambodian Mine Action Centre (CMAC), HALO Trust, Mines Advisory Group (MAG) and the Royal Cambodian Armed Forces/Engineering Command Force.
There are approximately 4700 full time deminers in Cambodia.
The major organisations involved in demining are reported in the table below, together with the indication of the year in which they began operating and the number of staff employed. The organisations indicated with ** are the ones we visited.

Organisation	Operating since	# of Cambodian Staff employed
Cambodian Mine Action Centre (CMAC)**	1993	2400
HALO Trust	1992	943
Mines Advisory Group (MAG)**	1992	500
Royal Cambodian Armed Forces (RCAF)	1998	830

Information reported in this section has been collected from the following sources:
The Landmine Monitor Report 2004, http://www.icbl.org/lm/2004/
The World Fact Book 2004, http://www.cia.gov/cia/publications/factbook/
The World Reference Base for Soil Resources, http://www.fao.org/ag/agl/agll/wrb/wrbmaps/htm/domsoi.htm
Earth Trends, the Environmental Information Portal, http://earthtrends.wri.org.

8.2 CAMBODIA: STRUCTURED INTERVIEW RESULTS

VIEW OF THE LANDMINE PROBLEM IN THE COUNTRY		
Landmine problem	entity:	**defined**
	size:	**15.000.000 landmines: 1.5 times the current population**
Victims	number:	**> 100 /month**
	gender and age:	**all**
	location:	***contradictory***
Impact of landmines	present:	**obstacle to agriculture and people movement**
	future:	**affect development**
	mined areas fenced:	**few**
	mined areas violated:	**yes**
Time for removing landmines	all:	***contradictory***
	most urgent ones:	***contradictory***
	time for reducing landmine risk to an acceptable level:	***contradictory***

EVALUATION OF END-USERS SKILLS, TECHNOLOGY ATTITUDES AND CAPACITIES		
Education in school	years:	**4**
Attitude towards technology	at home:	**2 radios /3 houses**
	at workshop:	**mechanical hand tools**
	keen to learn new technologies:	**yes**
Communication skills	preferred ways:	**visual**

OPINION ON MACHINE TECHNOLOGY			
Experience with machines		type:	**brush cutters**
		advantages:	***contradictory***
		drawbacks:	***contradictory***
Desire for off-the shelf machines		type:	**Pierson tractor**
		use:	**pushing mines**
		NO:	**flails, heavy tillers**
Requirements for new machines	Cost of a new machine	max cost:	**200.000 USD**
		max running cost:	**0,5 USD /sqm**
	Performances of a new machine	applications:	***contradictory***
		operational conditions:	***contradictory***
	Time for a new machine	min lifetime:	**7 years**
		max delivery time:	**6 months**
Tests in situ		importance:	***contradictory***

8.3 CAMBODIA: QUESTIONNAIRE RESULTS

TECHNOLOGY IN USE

Mechanical technology

Total number:	Distribution per organisation:		Types:	Period of use (average):
5	**CMAC DU1**	**2**	**vegetation cutter**	**4 years**
	MAG	**3**		

Weather conditions to be avoided:	Terrain conditions to be avoided:
wet season	**rocky areas near to mountains and AT mined areas**

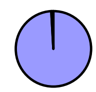
Average Calculated cost of machines / year ($):
33.673

Main reasons for downtime:	Advantages (coord.):	Advantages (deminers):	Drawbacks (coord.):	Drawbacks (deminers):
contradictory	**deminers are very happy**	**0**	**spare parts are expensive and delivery is slow and expensive**	**0**

N° of machines developed locally:
0

Sensor technology

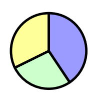
Total number:	Distribution per organisation:		Types of sensors used and quantity:		Period of use (average):
324	**CMAC DU1**	**204**	**MD**	**321**	**8 years**
	MAG	**120**	**Bomb locator**	**2**	
			Large loop detector	**1**	



Weather conditions to be avoided:	Terrain conditions to be avoided:
rain	**0**

Average Calculated cost of sensors/year ($):

MD	Bomb locator	Large loop detector
5.792	**3.935**	**4.602**

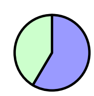


Main reasons for downtime:	Advantages (coord.):	Advantages (deminers):	Drawbacks (all) (coord.):	Drawbacks (all) (deminers):
contradictory	**0**	**0**	**the electronic metal box gets easily damaged (MD)**	**0**

N° of sensors developed locally:
0

Information & Communication technology

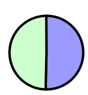
Total number:	Distribution per organisation:		Types of information technology used and quantity:		Period of use (average):
53	**CMAC DU1**	**18**	**GPS**	**31**	**2 years**
	MAG	**35**	**VHF radio**	**22**	



Weather conditions to be avoided:
cloudy, in town affected by buildings (GPS)

Average Calculated cost of technologies/ year ($):

GPS	VHF radio
198	**195**



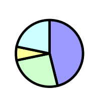
Main reasons for downtime:	Advantages (all) (coord.):	Advantages (all) (deminers):	Drawbacks (coord.):	Drawbacks (deminers):
screen (GPS)	**easy to use, possibility to do a map by connecting it to a computer (GPS)**	**0**	**long time for repairing: it must be sent to UK (GPS)**	**0**
			unclear message (GPS)	

N° of technologies developed locally:
0

Other technology

Transport technologies

Total number:	Distribution per organisation:		Types of transport tech. used and quantity:	
102	**CMAC DU1**	**45**	**pick up**	**47**
	MAG	**57**	**truck**	**26**
			land cruiser	**7**
			motorbike	**22**



Power supply systems

Total number:	Distribution per organisation:		Types of power supply systems and quantity:
22	**CMAC DU1**	**11**	**generator**
	MAG	**11**	

8.4 CMAC DU1: STRUCTURED INTERVIEW RESULTS

VIEW OF THE LANDMINE PROBLEM IN THE COUNTRY		
Landmine problem	entity:	**defined**
	size:	**in Banteay Meanchey province, serious: 176,031 sqkm**
Victims	number:	**in Banteay Meanchey province, 0 to 3 /month**
	gender and age:	**All**
	location:	**areas new to victims**
Impact of landmines	present:	**obstacle to agriculture and people movement**
	future:	**affect development**
	mined areas fenced:	**few**
	mined areas violated:	**yes**
Time for removing landmines	all:	**in Banteay Meanchey province, 50 years**
	most urgent ones:	**in Banteay Meanchey province, 10 to 12 years**
	time for reducing landmine risk to an acceptable level:	**in Banteay Meanchey province, 10 to 12 years**

EVALUATION OF END-USERS SKILLS, TECHNOLOGY ATTITUDES AND CAPACITIES		
Education in school	years:	**6**
Attitude towards technology	at home:	**radio**
	at workshop:	**mechanical hand tools**
	keen to learn new technologies:	**yes**
Communication skills	preferred ways:	**visual, practical training**

OPINION ON MACHINE TECHNOLOGY			
Experience with machines		type:	**brush cutters**
		advantages:	**good at ground preparation**
		drawbacks:	**bad with AT mines and UXO's**
Desire for off-the shelf machines		type:	**no idea**
		use:	**no idea**
		NO:	**flails, heavy tillers**
Requirements for new machines	Cost of a new machine	max cost:	**no idea**
		max running cost:	**no idea**
	Performances of a new machine	applications:	**brush cutting**
		operational conditions:	**high density mined areas, high density fragmentation contaminated areas**
	Time for a new machine	min lifetime:	**4 years**
		max delivery time:	**no idea**
Tests in situ		importance:	**medium**

8.5 CMAC DU1: QUESTIONNAIRE RESULTS

TECHNOLOGY IN USE

Mechanical technology

Total number:	Types of machines used, quantity and frequency of use:	Manufacturing company:	Period of use (average):
2	**vegetation cutter**	**Komatsu, Japan**	**2 years**

Age of equipment (average):	External conditions:	Use within demining practices:
2 years	**good**	**vegetation removal**
Weather conditions to be avoided:	Terrain conditions to be avoided:	N° of accidents in the last year (average):
0	**0**	**0**

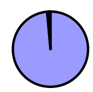
Calculated cost of each machine/year:		Calculated cost/year ($) / annual programme budget ($):
Calc. cost/year($):	**1.418**	**2.936 / N/A**

Main reasons for downtime:	Advantages (coord.):	Advantages (deminers):	Drawbacks (coord.):	Drawbacks (deminers):
problems at oil tubes	**0**	**0**	**0**	**0**

N° of machines developed locally:
0

Sensor technology

Total number:	Types:	Models, quantity and frequency of sensors used:		Period of use (average):
204	**MD**	**Minelab**	**201**	**5 years**
	Bomb locator	**Vallon**	**2**	
	Large loop detector	**Ebinger UPEX**	**1**	



Age of equipment (average) :	External conditions:	
5 years	**acceptable**	
Weather conditions to be avoided:	Terrain conditions to be avoided:	N° of accidents in the last year (average):
rain (MD)	**0**	**0**

Calculated cost of each sensor/year + average calculated cost of sensors($):

	Model 1	Model 2	Model 3	Average	Calculated cost of all sensors/year ($) / annual programme budget ($):
Calc.cost/year ($)	**5.372**	**3.935**	**4.602**	**4.654**	**1.092.245 / N/A**

Main reasons for downtime:	Advantages (coord.):	Advantages (deminers):	Drawbacks (all) (coord.):	Drawbacks (all) (deminers):
cables (all)	**0**	**0**	**0**	**0**

N° of sensors developed locally:
0

Information & Communication technology

Total number:	Types of information technology used:	Manufacturing company:	Period of use (average):
18	**GPS 18**	**Garmin**	**3 years**

Age of equipment (average):	External conditions:
3 years	**acceptable**
Weather conditions to be avoided:	
0	

Calculated cost of each technology/year + average calculated cost of technologies($):

	Model1	Model2	Average	Calculated cost of all ICT/year ($) / annual programme budget ($):
Calc.cost/ year ($)	**169**	**84**	**127**	**2.875 / N/A**

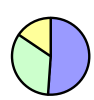
Main reasons for downtime:	Advantages (coord.):	Advantages (deminers):	Drawbacks (coord.):	Drawbacks (deminers):
0	**0**	**0**	**0**	**0**

N° of technologies developed locally:
0

Other technology

Transport technologies

Total number:	Types of transport tech. used and quantity:	
45	**pick-up**	**23**
	truck	**15**
	land cruiser	**7**



Power supply systems

Total number:	Types of power supply systems and quantity:
11	**generator**

8.6 MAG: STRUCTURED INTERVIEW RESULTS

VIEW OF THE LANDMINE PROBLEM IN THE COUNTRY		
Landmine problem	entity:	**defined**
	size:	**15.000.000 landmines: 1.5 times the current population**
Victims	number:	**> 100 /month**
	gender and age:	**woman (more), children (medium), men (less)**
	location:	**forests**
Impact of landmines	present:	**obstacle to agriculture and people movement**
	future:	**affect development**
	mined areas fenced:	**few**
	mined areas violated:	**yes**
Time for removing landmines	all:	**11 years**
	most urgent ones:	**6 years**
	time for reducing landmine risk to an acceptable level:	**6 years**

EVALUATION OF END-USERS SKILLS, TECHNOLOGY ATTITUDES AND CAPACITIES		
Education in school	years:	**3**
Attitude towards technology	at home:	**2 radios /3 houses**
	at workshop:	**mechanical hand tools**
	keen to learn new technologies:	**yes**
Communication skills	preferred ways:	**visual**

OPINION ON MACHINE TECHNOLOGY			
Experience with machines		type:	**Tempest**
		advantages:	**speeds up operations**
		drawbacks:	**spare parts are expensive**
Desire for off-the shelf machines		type:	**Pierson tractor**
		use:	**pushing mines**
		NO:	**no idea**
Requirements for new machines	Cost of a new machine	max cost:	**200.000 USD**
		max running cost:	**0,5 USD /sqm**
	Performances of a new machine	applications:	**large loop detector carrier, withstanding AT mines**
		operational conditions:	**hot**
	Time for a new machine	min lifetime:	**10 years**
		max delivery time:	**6 months**
Tests in situ		importance:	**not necessary**

8.7 MAG: QUESTIONNAIRE RESULTS

TECHNOLOGY IN USE

Mechanical technology

Total number:	Types of machines used, quantity and frequency of use:	Manufacturing company:	Period of use (average):
3	**vegetation cutter**	**Development Technology Workshops (DTW), Cambodia**	**5 years**

Age of equipment (average):	External conditions:	Use within demining practices:
5 years	**acceptable**	**small tree, grass and thick vegetation cutting**

Weather conditions to be avoided:	Terrain conditions to be avoided:	N° of accidents in the last year (average):
wet season	**rocky areas near to mountains and AT mined areas**	**0**

Calculated cost of each machine/year:		Calculated cost/year ($) / annual programme budget ($):
Calc.cost/year($):	**32.823**	**98.469 / N/A**

Main reasons for downtime:	Advantages (coord.):	Advantages (deminers):	Drawbacks (coord.):	Drawbacks (deminers):
replacing parts	**deminers are very happy**	**0**	**spare parts are expensive and delivery is slow and expensive**	**0**

N° of machines developed locally:
0

Sensor technology

Total number:	Types:	Models of MD used:	Period of use (average):
120	**MD**	**Schiebel**	**11 years**

Age of equipment (average) :	External conditions:
11 years	**good**

Weather conditions to be avoided:	Terrain conditions to be avoided:	N° of accidents in the last year (average):
rain	**0**	**1**

Calculated cost of each sensor/year:

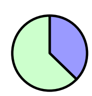
	Model 1	Calculated cost of all sensors/year ($) / annual programme budget ($):
Calculated cost/year ($)	**6.212**	**745.440 / N/A**

Main reasons for downtime:	Advantages (coord.):	Advantages (deminers):	Drawbacks (all) (coord.):	Drawbacks (all) (deminers):
small electronic unit inside the box	**0**	**0**	**the electronic metal box gets easily damaged (MD)**	**0**

N° of sensors developed locally:
0

Information & Communication technology

Total number:	Types of information technology used, quantity and frequency of use:		Manufacturing company:	Period of use (average):
35	**GPS**	**13**	**Garmin**	**2 years**
	VHF radio	**22**		



Age of equipment (average):	External conditions:
2 years	**good**

Weather conditions to be avoided:
cloudy, in town affected by buildings

Calculated cost of each technology/year + average calculated cost of technologies($):

	Model1	Model2	Model3	Model4	Average	Calculated cost of all ICT/year ($) / annual programme budget ($):
Calc.cost/ year ($)	**378**	**90**	**278**	**112**	**215**	**7.354 / N/A**

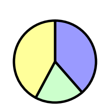
Main reasons for downtime:	Advantages (coord.):	Advantages (deminers):	Drawbacks (coord.):	Drawbacks (deminers):
screen (GPS)	**easy to use, possibility to do a map by connecting it to a computer (GPS)**	**0**	**long time for repairing: it must be sent to UK (GPS)**	**0**
			unclear message (GPS)	

N° of technologies developed locally:
0

Other technology

Transport technologies

Total number:	Types of transport tech. used and quantity:	
57	**motorbike**	**22**
	truck	**11**
	pick up	**24**



Power supply systems

Total number:	Types of power supply systems and quantity:
11	**generator**