

1. INTRODUCTION

1.1. Framework in which the EUDEM project has been executed

Needless to say, the general public's awareness of the landmine problem has constantly grown in the last 5-10 years, and so has the response of the international community. Political activities have culminated in the signature in 1997 of the Ottawa ban treaty. At the convention, the European Union (EU) committed to reinforce its efforts in helping afflicted nations clear their land of these deadly weapons. Given the scale and complexity of the problem, it would be highly beneficial to *increase the co-ordination for maximum efficiency*.

At the EU level, *civil research* activities have started within the High Performance Computing and Networking (HPCN) domain of the Information Technologies (IT) programme, to promote industrial R&D activities in Europe in support of humanitarian demining operations world-wide¹. The aim is to bring advanced equipment to the field in 2-4 years to improve speed, cost and safety of demining operations.

Three *ESPRIT*² R&D projects started in early 1998 and six more in early 1999. These projects aim at *researching, developing and testing new systems for detecting anti-personnel landmines*. These R&D projects are supported by a set of activities carried out in common, which include testing and evaluation, surveys, and data collection. *EUDEM is one of these support activities*.

Other projects, outside the ESPRIT programme, are also ongoing. A lot of initiatives are starting up, even if not necessarily in a well structured and optimal way, and *the overall European picture is not always clear*. This is where this study also wants to help by *providing scientific and technical support to Community policies*, in addition to direct support to ongoing ESPRIT projects. This will hopefully help improving efficiency and reducing the duplication of efforts in R&D programmes on humanitarian demining at national and EU level.

1.2. What are the EUDEM goals?

The general purpose of the EUDEM project is *to study the state of the art in the EU related to humanitarian demining technology*, products and practice. The detailed goals are as follows:

1. Establish a *list of organisations to be consulted*, primarily industrial companies producing or developing equipment, used in humanitarian demining actions, and organisations performing or supervising humanitarian demining operations. Also include key research centres and university laboratories active in this field.
2. Set-up a *public, detailed and open database* (<http://www.eudem.vub.ac.be/>), to be filled in according to the information provided by individuals or associations actively involved in Humanitarian Demining, or feeling that their products/services/research topics stand a serious chance of being used in the field one day. The EUDEM database is meant to be a tool for understanding the state of the art in EU humanitarian demining technology, products and practice, facilitating strategic decisions and interactions between the various parties (industrial partners among themselves, researchers with deminers and industrial partners, etc.), and improving the flow of information.
3. Perform a *survey* of the identified organisations.
4. Summarise *existing techniques*, and identify *new technology* developments, their state of maturity, and their potential impact on demining practice.

1.3. How did we achieve the EUDEM goals?

1. The following existing information sources have been exploited, to establish *an initial list of organisations to be contacted*:

¹ See also the corresponding official Website at <http://www.cordis.lu/esprit/src/hphdhome.htm>.

² ESPRIT, the information technologies (IT) programme, was an integrated programme of industrial R&D projects and technology take-up measures managed by DG III, the Directorate General for Industry of the European Commission. It formed part of the EU's Fourth Framework programme, which ran from 1994 to 1998.

Internet: list of existing links and data bases
Internal list of persons and organisations, active in humanitarian demining, accumulated in previous VUB/EPFL projects
EU financed projects
Participants lists to well known conferences in the domain
Literature on the subject.

2. In parallel we defined the technical details of the database software and its contents, which in fact correspond to the two page *questionnaire* (see Annex 3), which was mailed to the organisations identified during the previous step. The **EUDEM database** was gradually populated during the survey, and *will remain an open working tool allowing updates and new entries* on a continuous basis.
3. The **survey** itself exploited a combination of literature review, telephone contacts, questionnaires, *face-to-face interviews*, and other methods. Information already entered into the database was used as a starting point whenever possible.
4. Selected organisations were visited (see Annex 4). *Persons active at an organisation level, or in demining practice and technical development were interviewed*. Also, some organisations not yet active in the field but showing relevant interest and/or innovative ideas were included.

1.4. Nature of this report

This report is complementary to the previously mentioned database; it contains an overview of the basic assumptions and methodology followed during the survey. It also provides a synthesis of the state of the art and of the general conclusions, which can be drawn at this stage. Its target audience is broad and includes the general public, managers, and decision-makers. Technically involved people might find detailed information, interesting views and comments on strategies for future activities in the summary reports of the personal interviews (see Annex 8). Although a case study on research projects in the US is included (see Annex 5), only the EU activities are covered in a systematic way.

The EUDEM database is a continuously updateable data repository, which can be used as a tool for active search and consultation of information provided by the organisations themselves. *The EUDEM database is accessible world-wide and not limited to organisations active in Europe.*

1.5. How was EUDEM perceived by the contacted actors?

Generally speaking, EUDEM was well regarded by most organisations included in the study. Although it was often pointed out during the interviews that making available an overview of the European humanitarian demining picture could be interesting, criticism was not completely spared. Demining NGOs and deminers see huge sums of money being spent on conferences, research and surveys. The latter is done supposedly on their behalf, and yet financial means to do what they are actually doing are extremely hard to find. The fact that the money for the two activity types does not necessarily come from the same sources seems difficult to understand for the affected and involved communities. Yet, it was admitted by several of the interviewees that there is a great need to collect data at supranational level in order to avoid duplication of efforts. A certain level of transparency into the “why” of surveys was demanded since this seemed to form an obstacle for voluntary participation.

2. METHODS

In making the selection of actors to be contacted, we tried to reach the whole spectrum in the EU. The database now covers a population that goes beyond the list of people that were directly contacted by us for making an entry. Apart from an announcement through the ARIS network, no other publicity was made, since the time frame of the EUDEM project was too short. In order to be useful for the humanitarian demining community, the database should *remain an open working tool allowing updates and new entries* on a continuous basis, even after termination of the EUDEM project.

2.1. Justification of the chosen database system

As already pointed out we wanted **a public, detailed and open database**, in which each user could quickly set up an account in order to *create and modify his own entry*³, as well as *carry out searches on the full database*. The

³ Which we did ourselves whenever we received a filled in questionnaire on paper, but direct access was and is preferred.

basic idea was to make records containing at least some contact information and a short profile, with the possibility of adding more detailed information. The Web interface had to be simple and easily adaptable, preferably with the necessary administration facilities already available.

Given these constraints, the small data quantity requirements, and the short time frame for set-up – the database had to be up and running shortly after the study’s start and before the mailing of the questionnaire – we opted for a public domain software package⁴, *DBMan* v2.0. DBMan works on a simple text file (a flat ASCII file) and uses a number of Perl scripts to provide a Web interface to individual records. Administrative tasks (add/remove/modify/view records, or add/remove users for example) can be carried out, and there is no need for reprogramming.

2.2. The questionnaire for the EUDEM database

After the initial establishment of the list of organisations to be contacted, the second phase of EUDEM consisted of a mailing, which was carried out in three different parts. At first 110 organisations were contacted at the end of January (January 26, 1999). These organisations received a one-page accompanying letter and a *two-page questionnaire* (see Annex 3). The survey was divided in three different sections:

- PART I: **Identification Data** (mandatory reply, unless otherwise specified) – *Organisation name, type, contact person, staffing figure, involvement in demining and type of involvement;*
- PART II: **Structural data on the organisation type** – *Products/services/research topics, current activities, Specific technologies, etc.;*
- PART III: **Background data** on the organisations’ partners and more specific information – *Comments, needs, references.*

The questionnaire is short and most questions can be answered by ticking boxes, to lower the threshold for participation. The deadline for filling out the questionnaires – either directly in the database or by mail/fax to the VUB – was placed on February 26 (one month after the initial mailing).

At the beginning of March a reminder was either e-mailed or faxed to 82 organisations that had not replied by then. In addition, another 58 organisations that were not contacted in the initial phase, including a number of organisations outside Europe, were contacted. The new deadline for all submissions was set for the end of March.

As already mentioned, plans exist to ensure that the EUDEM database will remain an open working tool allowing updates and new entries on a continuous basis, even after the termination of the current project.

2.3. Typical interview skeleton

An interview was always started by giving the interviewee a short introduction of what our survey consisted of, and for what purpose it will be used. Consequently, a brief overview of the interviewed organisation was asked for. This part was followed with an attempt to clarify the involvement in Humanitarian demining activities. A brief discussion was held on the past and current activities of the organisation. Most emphasis was placed during the interviews on *the personal opinion of the interviewee* with respect to a certain technology and/or practice.

When specific projects – not necessarily directly related to humanitarian demining – were discussed, we tried to identify the (i) **Project aims**, (ii) **Maturity** of the different technologies involved, and corresponding **Cost estimates**, (iii) **Testing** procedures, (iv) “**Transferability**” of the developed techniques to different aspects of humanitarian demining, (v) **Technical specifications** of the equipment, performances in certain circumstances, compatibility between different techniques, degree of success in the field, and (vi) **R&D activities and strategies**, research funding, commercial perspectives.

Whenever time was available, it was a pleasure to talk about diverse topics of interest in a non-structured way. Several examples can be found in the written transcripts of the interviews (see Annex 8).

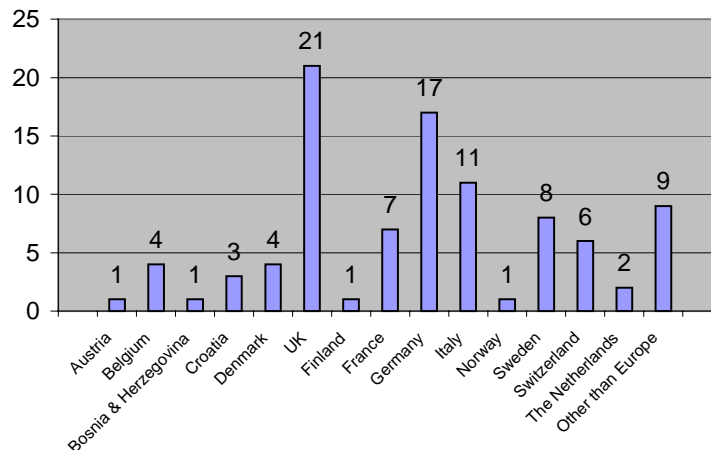
⁴ See also <http://www.gossamer-threads.com/scripts/dbman/index.htm>.

3. THE EUDEM DATABASE: ANALYSIS OF THE CONTENTS

3.1. In general

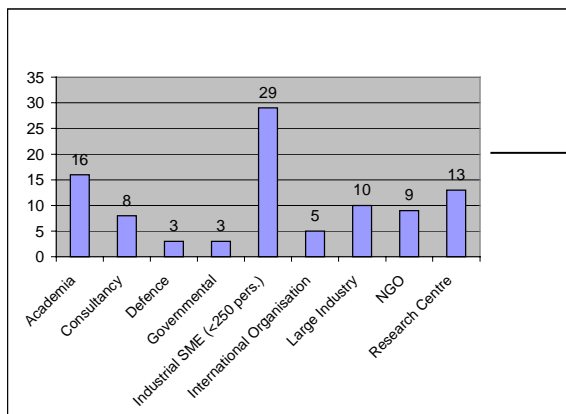
The overall response rate to the questionnaire has been very high. Out of the 168 contacted organisations, **96 entries⁵** were made in the online database at <http://www.eudem.vub.ac.be/>, either by the organisation or by us when the questionnaire was received on paper.

The distribution of the database entries over the different countries reveals the highest score for the **UK (21)**, followed by **Germany (17)**, and **Italy (11)**. For the Scandinavian countries, the highest score is found for **Sweden (8)**. Note that also 9 entries of organisations from outside the EU have been registered.

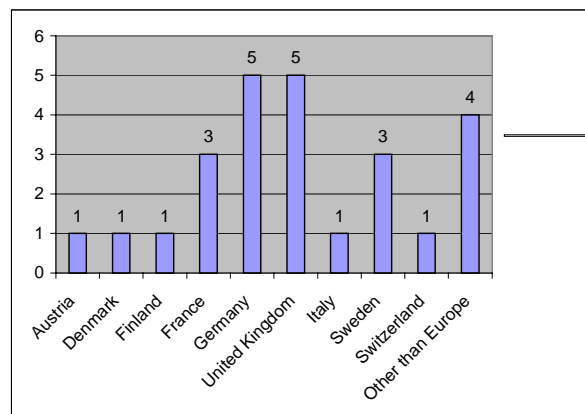


Graph 1. Distribution of entries in the EUDEM database over countries (total: 96)

The **highest number** of database entries clearly comes from **Industrial Small and Medium Enterprises** with less than 250 employees (Industrial SME (<250 pers.)) – see Graph 2. These are often not exclusively focussing their production on tools for humanitarian demining. Their willingness to participate in the EUDEM survey may also be explained by commercial agendas. The 8 entries labelled as “consultancy” in Graph 2 are small companies, mostly created by private consultants. In total, 31 organisations mention consultancy as one of their activities.



Graph 2. Distribution according to the organisation type

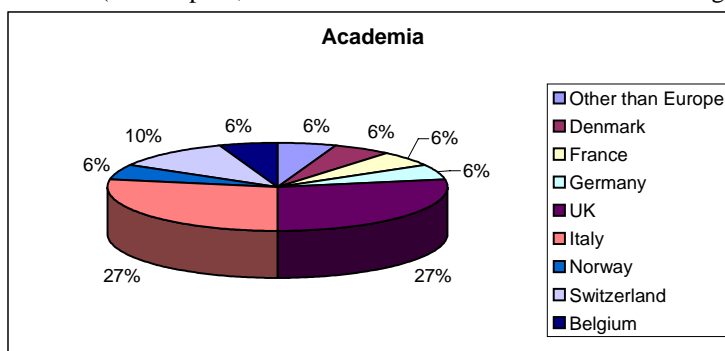


Graph 3. Distribution of INDUSTRIAL SME, according to the country of origin

The highest concentration of Industrial SMEs is found in Germany (5) and the UK (5), followed by Sweden, hosting 3 Industrial SMEs (See Graph 3).

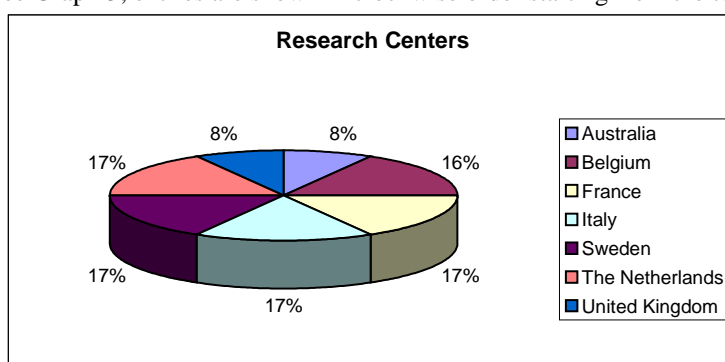
⁵ The entries were taken into account for the extraction of statistics until the end of May 1999. Data entered after this date have not been considered.

Academia's (universities) take the **second largest share** of entries made in the database. This may be explained by their eagerness to participate in collaborative EU research and development projects, their policy of putting results in the public domain (e.g. publications, patents,...) and the less stringent constraints to protect their property rights. The densest concentrations of academic institutions involved in humanitarian demining are again to be found in the UK and surprisingly enough in Italy. They both count for 27% each of the academic organisations (which made an entry in the database) involved in humanitarian demining in Europe, or together for more than 50% of the total (see Graph 4; entries are shown in clockwise order starting from the top).



Graph 4. Distribution of Academic Institutions in the EUDEM database according to the country of origin

Besides universities, **research centres** have also made a large amount of database entries. The research centres in Europe are mostly located in four countries, namely Sweden, The Netherlands, France and Italy, followed closely by Belgium (see Graph 5; entries are shown in clockwise order starting from the top).



Graph 5. Distribution of Research Centers entries in the EUDEM database according to country of origin

Although we have made a distinction between universities and research centres, in practice both are often mainly/partly funded by the government, and hence it depends primarily on the countries' strategy for organising research whether a certain research activity is carried out in universities or in separate research centres. Graph 4 and Graph 5 show that **the EU hosts a very large independent research potential, compared to the industrial involvement.**

3.2. Involvement in humanitarian demining

The 87 European organisations that filled in the field concerning the **type of involvement** in demining, are all mentioning **mine detection**, either or not *combined with clearance/destruction and/or survey/mapping*. Out of the 87 organisations, 64 (i.e. 74%) declared to be involved in mine detection and the remaining 23 (i.e. 26%) mention a combined involvement in mine detection together with Clearance/Destruction and/or Survey/Mapping. Note that the manifest predominance of mine detection in the EUDEM database does not come as a surprise, because we have biased the survey towards that area of demining.

3.3. Technologies studied or developed in Europe

In this section, we try to give an interpretation of the database entries, with respect to the main foci of interest. The 9 organisations outside of Europe are not taken into account. Out of the 87 respondents in Europe (see Graph 1), only 70 have given information on technology studies. The numbers given in this section are only indicative, and should not be taken as absolute numbers.

We find the highest focus on the **Ground Penetrating Radar (GPR) technology**: 20 organisations declared to be working on or with GPR. The second highest score goes to the **Metal Detector (MD)**, mentioned by 15 organisations. **Infrared (IR)** technology is mentioned in 6 entries distributed over different European countries. The 7 entries mentioning **Dogs** for mine clearance are also spread over the whole of Europe. Research on **Nuclear Quadrupole Resonance (NQR)** is conducted mainly in the UK at several institutes, at one organisation in Italy and one in Switzerland.

4. THE STATE OF THE ART IN EUROPE

This paragraph has been mostly drafted on the basis of the direct interviews carried out during the EUDEM study (the complete list of interviews is given in Annex 4, a summary of the interview contents can be found in Annex 8). The organisations and individuals we encountered include industrial companies, operators, key research centres, university laboratories and government agencies active in humanitarian demining, as well as some organisations not yet active in the field but showing relevant interest and/or innovative ideas. We concentrated mostly on detection, and partly on clearance and destruction equipment technologies; other aspects of the mine action process were partly investigated with the operators themselves, as well as with some government agencies. The organisations previously mentioned can be subdivided as follows:

| ORGANISATIONS | TYPE | Interviews |
|--------------------------------|--|---------------------|
| Industry | Equipment manufacturers (for humanitarian demining) | 6 |
| | R&D | 9 |
| Operators | NGO | 3 |
| | MAC | 4 (Geneva, Croatia) |
| | Commercial | 2 |
| Research centres | Supra-national | 2 (ISL, JRC) |
| | National | 7 |
| University laboratories | | 4 |
| Government agencies | MOD, Foreign Affairs, Development Aid | 5 |

Table 1. Types of organisations and number of corresponding interviews

4.1. Current Equipment in the Field

4.1.1. Mine Dog Programs

Dogs can and are used to smell explosive vapours and/or traces, similarly to what is done at airports and in other security applications. Examples of application go back to the Second World War and in more recent times to the Vietnam War. Dogs were first employed for humanitarian demining in Afghanistan, which nowadays features one of the largest and most successful programs.

Dog training is extremely difficult and time-consuming, and lasts up to 3 years. Two dog-training centres were visited, one hosted by the Swedish Army and a commercial one, also located in Sweden. The training in the country of origin is essential and should be continued in the country where the dog has to work to ensure the adaptation to different working, soil, vegetation and weather conditions and also to a new local handler. The handler and the dog form the demining “system” and cannot perform well without perfect matching.

The price of a good dog is very high. Other **limiting factors** are unfavourable climatic conditions (such as excessive heat, too much wind or wind coming from the wrong direction), thick vegetation, as well as dense and/or mixed (AT and AP mines) minefields that can confuse the dogs. Daily working hours are also relatively short, but dogs can easily cover several thousand square meters per day (figures vary sharply).

The use of dogs is far from being a perfect science, and the detection rate (efficiency) of a dog-handler pair is subject to rather wild guesses. Nevertheless, well run dog programs are nowadays generally accepted by most humanitarian demining organisations for **area verification** (e.g. *Quality Control* after mine clearance activities) and **minefield delineation** (i.e. *area reduction*). For these applications, important time gains are obtained compared to manual clearance. The use of dogs for individual mine detection is somewhat more controversial (although examples exist: e.g. rescue operations, mine clearance in Afghanistan). In general, mine dog programs