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How Product Design Can Improve Manual Demining

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Design Without Borders

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The Design without Borders (DwB) programme was initiated and is led by Norsk Form, the Norwegian Centre for Design and Architecture. It aims to use designers' creative and analytical skills to create solutions for developing countries and areas of emergency. DwB aims to create meeting points between problem owners and professional problem solvers, and to be a catalyst for cooperation and development of new products and services. Our demining work is carried out in close collaboration with Norwegian Peoples Aid (NPA).

**Introduction**

Manual demining is a key component in the humanitarian demining projects run by NPA. Currently, significant resources are invested internationally on issues such as mine dogs, mechanically assisted demining and ground penetrating radar. However, none of these technologies replaces manual demining—each only complement. Despite this, manual demining receives relatively little attention.

Manual demining is very resource-intensive. NPA has found that a day's work for a deminer can range from as little as 0.5 sq m up to 80 sq m in different projects. If we can improve the working conditions for deminers without compromising safety, so that more projects can manage 80 sq m/person/day and fewer 0.5 sq m, our effort will make a difference for all demining operations. DwB has joined NPA in this effort, providing knowledge in product design issues such as ergonomics/human factors, materials and manufacturing processes.

**Analysis and Field Study**

In order to gain a proper understanding of the challenges of manual demining, it was necessary for DwB to carry out an extensive analysis, including a field study. This work was partially funded by the Norwegian Agency for Development Cooperation (Norad). Three professional product designers were chosen for the task, carrying out the analysis and a 10-day field study in Tete, Manica and Sofala provinces in Mozambique.
The study concentrated on the deminer's work situation, tasks, protection equipment and personal tools (except the detector)—and especially their mutual interaction. These equipment and tools were chosen because they are bought and used in sufficient numbers to also make them commercially interesting. NPA has been manufacturing a range of their prodders and other hand tools locally where possible. The field study investigated local manufacture, highlighting possibilities, but to see if local manufacturing could be further utilised for other products. The full report is published in pdf format on the Internet at http://www.norskform.no/dug/rapport_fasct.pdf.

**Potentials for Improvement**

First, the demining operations all seemed well run. The equipment and work operations were overall held to be satisfactory or good, but not without scope for improvements. The results from the field study and analysis are summarized in figures showing potentials for improvement in six important categories. This is done for each piece of equipment that has been considered, and forms the background information for our project proposals. Generally (and unsurprisingly) the protection against landmine blasts appears to be adequate. Usability, both in terms of comfort and performance, seems to be less considered. Also, safety and health beyond explosives protection are issues in need of attention. Dehydration and overheating are consequences of working with heat and non-ventilated protection gear in hot climates. This rarely has major direct effects on human health, but besides being uncomfortable, it will certainly influence the deminer's concentration and reaction time, which are crucial. Interviews with deminers support that this is a problem to be taken seriously.

General body protection should be improved, especially of the knee joint. The kneeling posture used in demining has been noted to cause damage to the joints when used often and over time. Integration of explosives protection may be considered, as the knee will be exposed to any explosion. Reinforcement in the uniforms will reduce the number of cuts and scars, in addition to increasing uniform lifetime. It is difficult for an officer to make a judgement on the operating procedures, but it is obvious that the way deminers relate and conform to standard operating procedures (SOP) can be made more efficient. This can especially be seen when deminers are switching between tools after identifying a potential mine or UXO, the deminer often has to change his focus completely, from the potentially dangerous object looking for where the right tool might be lying. Sometimes a long look may be sufficient, but sometimes the deminer has to get up from the baseline, walk back to where the toolbar is kept, and reloction the location. This is inefficient and potentially dangerous. This also encourages the deminers to take shortcuts. We observed one-hand operation of two-handed equipment and deminers pushing excavators under their vests and sceptres in their belts. Carpenters, rock-climbers and others have solved this problem by using a tool belt—it seems we would find it a good solution to consider for deminers as well.

**The Vest**

The vests studied in the field were developed for NPA, by the Norwegian manufacturer Rolfg. The dialogue between NPA and Rolfg is good, and hence the most recent vests are functioning very well as they are modified and improved according to NPA requirements. However, there are some issues that are not solved satisfactorily:

- The deflector/overlap between vest and visor restricts mobility and adds weight away from the body. Also, we must bear in mind that the visor is not worn completely down in each and every operation.

+ The weight of the vest and the materials used restrict the ventilation of the body. Heavy perspiration leaves the deminer completely soaking wet after one hour of work. Some deminers claim that this results in colds when they are staying in the waiting area.

+ Possibly as a result of the points above, the deminers have a tendency to "sag" the vest slightly, leading to body areas not being covered as intended.

+ Cleaning, maintenance and replacement parts are not properly cared for, reducing the lifetime of the vest and making it difficult that sharing of vests is quite unhygienic.

Some of these problems are not easily solved, and there may be a need for a complete rethink of how the vests are designed. It may be more appropriate to look into animal life for inspiration, using bionics thinking, rather than the evolution from a human vest. A solution like the Armadillo vest will enable both ventilation and protection.

**The Visor**

The visor, a second-generation design by Security Devices in Zimbabwe, was clearly more problematic. When worn correctly, heat will get trapped behind the polycarbonate glass, causing the deminer to get overheated and the glass to steam up from the breath of the deminer. Many quoted the need to stop work and open the visor in order to cool down, but in some cases, deminers are known to continue working without wearing the visor fully down. The visors also scratch easily, obstructing the deminers' most useful detection device—the human eye. The visors are changed frequently, but not frequently enough; deminers were observed lifting their visors for a better look during their work in minefields.

Quality problems also affect visibility through breakage and slippage of the visor. This is a result of heavy weight and constant readjustment of the straps when two people share a visor. Comments were also made on the rather cumbersome opening and closing mechanism.

When considering a new kind of mask, this must be done together with the vest in order to ensure overlapping protection. Inspiration and knowledge can be taken from masks developed for other demanding applications, such as the baseball catcher, the ice hockey goalie and the smoke diver masks. Most air from the breath can be channelled away, and a combination of materials may be used for the same protective effect the full-face polycarbonate provides today. The polycarbonate part may be smaller, able to retractor into the mask for scratch protection, and easily replaced without needing to discard the rest of the mask.

**Vegetation Cutters**

Deminers may use more than half of their time clearing vegetation. Considering this, we were amazed at the low level of vegetation cutting tools. The tools could be improved, and possibly be adapted to such as the furniture saws issued to cut down trees of low quality and badly maintained, such as the pruning scissors, or just misplaced, such as the machete and axe which largely would be.

This requires a new product development, as surplus products already exist in the market, often locally. It does require knowledge and attention when purchasing equipment. As a minimum, the following points should be observed:

- Appropriateness—Is it made for the intended use? Is it of an appropriate quality?
- Usability—Will the deminers know, or learn, how to use this tool? Is training required?
- Maintenance—Do the deminers know how to maintain this tool? Is training required? Do they have the tools available to do maintenance?

Simply by using the right vegetation cutters and maintaining them, demining productivity can increase considerably.

**Demining Tools**

NPA uses locally manufactured prodders and excavators, Bayonian tools which have also been used if available. These tools are crucial to demining and are identified as the tools
the tool rather than pushing it, in order to maintain maximum control. The smaller muscles should then be left to perform the tasks requiring maximum sensitivity.

**Redesigning Personal Protective Equipment**

Following discussions, the results of the analysis and feedback from the field, NPA and DwB have decided to pursue development of a new set of PPE as our first project. This PPE will be seen as one integrated unit consisting of several parts. Manufacturing will take place with existing suppliers, but also in the local market where possible. We are currently in the process of financing the project, which should run throughout 2003. Discussion partners are most welcome in this project.

**Our Vision Ahead**

We are all sharing the dream of a mine-free world. But in the process of getting there, we want all deminers to be provided with effective, safe and comfortable equipment at a reasonable cost. We want to help develop this equipment, employing our user-oriented design methodology. And we want this equipment to improve and speed up manual demining operations.

In the process, we also want to create positive developmental side effects. We can do this through facilitating local business opportunities, learning from others and transferring skills, among other things. When demining operations eventually cease, these skills can be used for other purposes. We have started on the crucial area of manual humanitarian demining. Gradually, we aim to cover more and more of the areas where we as designers can make a difference.

*All photos courtesy of the author.*

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