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Use of Multi-Criteria Analysis in Allocating EOD Teams in Humanitarian Mine Action

The author explains how a standard economic planning tool, multi-criteria analysis (MCA), can be used to help plan allocation of mobile explosive ordnance disposal (EOD) teams between regions in a humanitarian mine action program and solicits comments on how the model could be developed.

by Robert Keelley

Introduction

Many demining programs face significant problems in attracting resources. There may be several reasons for this, but one that is commonly heard is that donors are not comfortable with the observed outcomes of programs. However, over the last few years, socio-economic issues have come to be a greater part of planning in mine action projects, and, in particular, demining or area clearance projects. The reasons for this are comparatively clear: demining capacity is a scarce and expensive resource and may help EOD planners to demonstrate that they are being used in an optimum manner.

Background

All readers will be familiar with MCA techniques, though the name is rarely used outside economic circles. In its most trivial incarnation, MCA is the method consumer magazines use to rate items such as electrical appliances. For example, most people will have seen tables that compare digital cameras such as the one in Table 1.

It is worth taking some time to analyse this table. "Option" covers the choice open to the stakeholders (in this case, the five cameras available to the public that have been considered by the survey). In MCA, the options have to be discrete and distinct, i.e., option 1 is not the same as option 2.

"Attributes" are the attributes (a.k.a. criteria) that the surveyors have considered for the analysis (attributes also have to be discrete and distinct). The surveyors then score the options in terms of each of these attributes.

Note first that there are different ways of scoring. The "score" question is comparatively simple: does the camera have a zoom or not? This produces a simple yes/no response that economists refer to as a "dummy." We will come back to potential application of this yes/no filter later. Memory is measured here in megabytes, and price in dollars. Finally, the more subjective attributes are scored in stars, with the camera with the "best" rating given five stars and the others ranked accordingly. Again, we will come back to the questions of units and numbers later.

In this simple application, the MCA table does not attempt to select which camera is the "best" because the stakeholder, according to their need, will do this. For example, a potential buyer on a tight budget constraint may decide that the price criterion is much more important than the others. In economic parlance, the stakeholder will "weight" this criterion.

Use of MCA in Project Analysis

The use of such a simple model as an introduction to the MCA concept should not mislead the power of the tool, however. Indeed, governments regularly use MCA as a way of making choices about major development projects. Imagine a western government having to decide whether to expand the airport serving their capital. They may have identified three main options:

1. Do nothing, i.e., live with the level of air traffic at present.
2. Build a new runway at the existing airport (which is badly served by land transport connections).
3. Build a new airport on a green field site (which has access to motorway and international rail links but is in an environmentally sensitive area).

Each option has several advantages and disadvantages, and the application of the MCA process helps set these out clearly.

The first thing to note about this use of MCA is that it is possible to resolve everything in the same terms (i.e., in the same unit of measure). In this example, the government’s economists could estimate the benefits of the extra flights and jobs and also the environmental costs. Substituting these figures into the table, it would be possible to work out the value in dollar terms of each option. In other words, by using common units of measure, the MCA process can actually produce a cardinal result — i.e., the options are automatically ranked and their relative values determined. In more simple terms, MCA is a process by which we can compare apples and oranges.

Application of MCA Techniques for EOD Resource Allocation

It is suggested that MCA techniques can be used to divide mobile EOD teams between provinces in a national humanitarian program in an objective and transparent manner to achieve the optimum allocation of resources.

Selection of Criteria

For the purposes of EOD resource allocation, the following criteria are proposed:

- Size of province in square kilometers
- Degree of contamination reported in each province
- Number of reported casualties per province
- Population of province

These criteria fulfill the requirements of the MCA process in that they are (a) relevant and (b) distinct from each other. The list may not be exhaustive, and suggestions as to how the list could be expanded are welcome. The underlying data for the MCA process should be easily accessible from the national gazetteer and the national landmine/UXO survey (providing such a survey has been carried out).

Options

Of course, there is only one option available (i.e., the provision of EOD services), but use of survey data means that, in this case, each province can be scored in terms of the criteria. Furthermore, by scoring on a percentage basis, the "large-numbered" attributes (such as area in square kilometers, which may be a five-figured number) will not overwhelm a "small-numbered" attribute (such as number of casualties, which may be in the low hundreds at the most). This generates an MCA table similar to the example in Table 3, based on a fictional country with five provinces.

At first, this appears to provide a simple ranking of each province, but at the moment this includes a score for province B, which in fact has no contamination. This is where the "dummy" technique referred to above comes into use. By simply multiplying the scores by either 1 (has contamination) or 0 (does not have contamination) the scores can be amended to take account of this. This is done in Table 4.

Weighting

Weighting requires participation of stakeholders to make the process more inclusive. While this approach is more subjective than the earlier steps, which have been based purely on application of data, it is comparatively objective when compared to simply "flying by the seat of the pants."

For the purposes of this paper, it is suggested that, as the prime function of EOD teams is to save lives and prevent injuries from accidental detonation of UXO, the criterion that is most relevant to this function (i.e., the number of casualties) could be weighted.

In this example, the casualty figures are given a weighting of a factor of three. When this weighting is inserted in the table, the result has the following effect (see Table 5).

Table 3: EOD MCA Step 1 (Initial Scoring)

<table>
<thead>
<tr>
<th>Province</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size (km²)</td>
<td>14.36</td>
<td>32.65</td>
<td>72.78</td>
<td>16.51</td>
<td>19.20</td>
<td>100</td>
</tr>
<tr>
<td>Degree of contamination casualties</td>
<td>27.61</td>
<td>0.00</td>
<td>11.47</td>
<td>37.77</td>
<td>23.15</td>
<td>100</td>
</tr>
<tr>
<td>Reported casualties</td>
<td>34.66</td>
<td>0.00</td>
<td>0.00</td>
<td>19.79</td>
<td>27.35</td>
<td>100</td>
</tr>
<tr>
<td>Population</td>
<td>21.99</td>
<td>20.00</td>
<td>15.72</td>
<td>21.32</td>
<td>20.37</td>
<td>100</td>
</tr>
<tr>
<td>Subtotal</td>
<td>99.62</td>
<td>55.23</td>
<td>47.47</td>
<td>117.59</td>
<td>95.07</td>
<td>100</td>
</tr>
</tbody>
</table>

For the purposes of this paper, it is suggested that, as the prime function of EOD teams is to save lives and prevent injuries from accidental detonation of UXO, the criterion that is most relevant to this function (i.e., the number of casualties) could be weighted. In this example, the casualty figures are given a weighting of a factor of three. When this weighting is inserted in the table, the result has the following effect (see Table 5).

Stakeholder Analysis and Sequence of Events

It is worth making the point here that the MCA tool is at its best when used to increase transparency. This can be done in this context by involving stakeholders.
in selection of criteria and decisions on weighting before populating the table with data, as this then means that the conclusions about resource allocation can be shown to have been done in a transparent and objective manner, which should help maximise donor confidence and thus help in the release of funds. It may also be useful to involve beneficiary groups (such as provincial government officials) in the criteria selection and weighting process as it may help them buy into the way that teams are allocated. This is also in line with modern development approaches in that it encourages local ownership of the program at all levels. Once the data is entered in the table and the weighted scores obtained, the final score can be used as the ratio in which the EOD teams can be allocated. In this fictional example, imagine that the program has 24 EOD teams. Therefore, they should be allocated in the ratio: 106:94:190:114.

Dividing each score by 517 (the total of the scores), and multiplying the result in each case by 24 (the number of available teams) and rounding the result gives us the ratio to divide the teams. This is set out in Table 6.

Therefore, given the above data on the country and the extent of contamination, and the decision to weight the casualty data by a factor of three, the 24 existing teams would be divided amongst the four contaminated provinces in the ratio of 8:29:9:5:1.

Effect of Time

In general, the MCA process is used to assist in making irreversible decisions. One can imagine that a dissatisfied customer can return a digital camera to the store, but it is harder to imagine dismantling an airport! In both cases, the MCA process is a “one-shot” analysis done to help make the decision about which option to adopt. However, when using MCA to assist in EOD planning, we do have the ability to modify resource allocation on a periodic basis. In this case, given that the size of each province would remain constant (and assuming either a constant population or equal proportions of caspian across each province), it would be simple to revisit the MCA process armed with the most recent casualty data and re-calculate the most appropriate ratio. Of course, it would also be possible to change the weighting over time, and even introduce different criteria.

One can imagine doing this on an annual basis as part of the project cycle/annual budget allocation process. Figure 1 represents this process diagrammatically.

Advantages & Limitations

Advantages

There seem to be several advantages to this process. First, it is logical and easy to understand (and hence easy to explain to others in the planning process). Second, it allocates resources objectively, which, when reinforced by appropriate inclusion of stakeholders in identification of criteria and weighting, makes the process very transparent (thus helping with donor confidence). The use of the weighting mechanism also allows policy makers to intervene in a transparent and comparatively objective manner. Finally, periodic review would allow planners to take account of changing circumstances over time.

Limitations

The MCA process relies on the existence of suitable survey data. While geographic information might be available from stakeholders, data on casualties and the extent of UXO contamination may not be so easily obtainable. It may be possible to use MCA without casualty and contamination data in the early days of an emergency program as a “least worst” approach. However, the development of structured landmine/UXO survey processes over the last few years has meant that there is more chance that the information may be available. If nothing else, the development of MCA as a means of allocating EOD resources may provide further justification for the timely conduct of such surveys.

One possible apparent limitation may be the need to involve stakeholders in the planning process. Although this makes the process more open and inclusive, it may at first require some education of stakeholders in MCA techniques in order to maximize their input, thus placing a further strain on time—especially in the budget formulation season. However, the MCA process is not too difficult to understand and the good news is that many agencies already use it for other types of projects. Furthermore, including the stakeholders in this process helps “mainstream” EOD activity with general development activity. Different organisations will of course be best placed to deal with this issue in the way most appropriate for their own structures.

In its current format, the proposed MCA process is intended for use in developing countries emerging from conflict that are being assisted by humanitarian donor programs supported by external donors. As such, it is not optimised for EOD organisations operating in developed countries. However, it might be possible, through the substitution of criteria, to use this process to allocate EOD teams in developed countries. For example, the casualty figure could be replaced by the number of improvised explosive device (IED) incidents. Comments on this would be welcome from EOD planners.

Summary & Conclusions

In summary, the MCA process does seem to offer a means by which an established economic planning tool could be adapted for use in EOD resource allocation. It does, however, require availability of contamination and casualty data as well as active participation by stakeholders if it is to be so effective. When such participation is achieved, the MCA process seems to offer a means to increase transparency and hence donor confidence. Nevertheless, there may be other potential pitfalls in the process that are not readily apparent to the author, and input from readers would be very welcome at this stage.