

Measures of Merit for Analysis of Small Scale Contingencies Example

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ABSTRACT

Analysis of Small Scale Contingencies (SSCs) under Operations Other Than War (OOTWs) is more complex than comparable analysis under traditional war-fighting operations. Main reason is that the success of, say, a humanitarian operation is related only to a limited extent to the military component.

The success of such a humanitarian operation will be expressed primarily in terms of economic, diplomatic or other non-military achievements. Military successes are merely contributions to the other achievements or may even conflict with them. Often the impact of military actions on the other achievements is little understood.

The NATO SAS-027 Technical Team "Analysis of Small Scale Contingencies" focuses on analysis types prior to actual SSC operations, namely analysis for acquisition of equipment and for force structure development. The Technical Team has combined the ideas and experiences of several NATO and Partnership for Peace (PfP) countries on analysis of the military component in OOTWs. One focus point was to develop a generic framework for constructing suitable measures of merit (MoMs) for SSCs and to describe general pitfalls for these MoMs.

The framework defines multiple levels of MoM, from simple measurable parameters of applied systems up to complex measures of performance at policy level; only at the more complex levels of MoM the interrelations between military and non-military components appear to be relevant. The framework also considers aspects like mission creep, metrics compared to objectives, interrelationships between MoMs, surrogate MoMs and task hierarchies.

INTRODUCTION

This paper gives an example of the general structure of Measures of Merit (MoMs) as discussed by Mr. M. Lidy applied to a fictitious scenario. This example will illustrate the application of the proposed general structure of MoMs in a fictitious scenario. It shows how to construct a coherent set of MoMs working both up and down the proposed MoM hierarchy, along with other aspects like conflicts between defined MoMs and complex relationships.

The MoM structure discussed by Mr. M. Lidy is intended for a specific type of analysis, namely prior to actual operations. It is intended for analysis of future asset purchase projects and of future force structures. It therefore is not intended for use by operational commanders under operational conditions, even though some elements in the structure may be of good use under such conditions.

SCENARIO OUTLINE

The example focuses on the intended purchase of a new helicopter. This new helicopter is to be used mainly during OOTWs and therefore the example will focus on this use. Nevertheless, the analyst performing the analysis as well as the procurer should also bear in mind the option that the helicopter should be of use for traditional theatre wars, too. In this example two helicopter types qualify for the intended use. They are named type A and B respectively, and the analyst is to advise on the preferred one (if any).

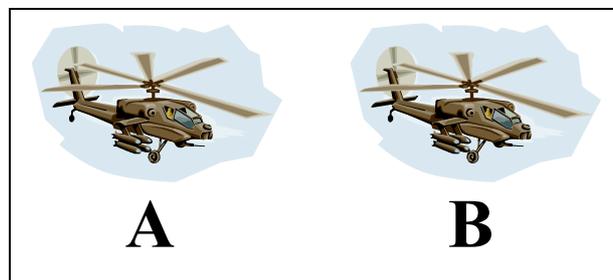


Figure 1: Alternative helicopter types.

For the example analysis, it is assumed that the helicopter is to be used in following fictitious scenario. A certain country named Alpha has a multi-ethnic society. The terrain is generally rugged and there are just poor lines of communication. Among several ethnic groups a civil strife has arisen. Some groups are displaced, moving to refugee camps on the border or hiding in certain hilly regions. Most of the housing of these groups is destroyed, and food is scarce. The international community has decided that intervention is required and sends an international force with following mandate:

- Restore peace.
- Restore political stability.

ANALYSIS OUTLINE

Based on the scenario outline, the analyst has to find criteria to evaluate the suitability for each helicopter type in the scenario. To do this, the analyst has the scenario outline as well as the mandate as a starting point. But obviously, it is impossible to directly establish the effect of a certain helicopter type on the mandate.

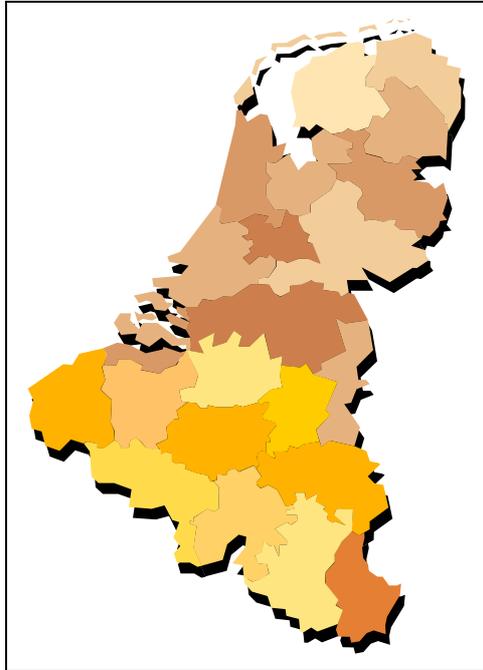


Figure 2: Map of country Alpha.

To analyse the contribution of the helicopter to the mandate, a breakdown of the MoMs must be made. In this breakdown several levels of MoMs are discerned, each following level being more detailed and concrete, and contributing to the above levels of MoM. In the proposed general MoM structure, following levels of MoMs are discerned:

- Measures of Policy Effectiveness (MoPE): measure how well the overall objectives of the mandating authority are achieved.
- Measures of Force Effectiveness (MoFE): measure the degree to which a force meets its objectives. In this context a force may be any organisation or group of organisations, civilian or military, generally under coherent direction.
- Measures of Effectiveness (MoE): measure how well systems or force elements accomplish their assigned tasks within an operational context.
- Measures of Performance (MoP): measure how well a system or force element accomplishes a defined task. It is assessed by the combination of Dimensional Parameters in an appropriate model.
- Dimensional Parameters (DP): the properties or characteristics inherent in the physical systems or force elements.

All levels in this hierarchy are to be linked together, eventually all contributing to the mandate which should be satisfied by all defined MoPEs. This effect is illustrated in the figure below, showing the DPs in the centre contributing to the MoPs, the MoMs in their turn contributing to the MoEs, et cetera, until finally the MoPEs contribute to the mandate. The shaded segment represents the *military* MoMs that can be defined in the scenario. Other segments represent the *political*, *economic* and *other* MoMs that generally are more or less independent of the military MoMs and therefore can be left out of the analysis for SSCs. One exception to this rule of independence between segments in the figure is the level of MoPE. Generally speaking, this means that at a level of policy evaluation military and, say, economic successes are mutually interrelated and dependent. This intertwining of several involved segments during OOTW highly complicates establishing the effects of military activities on the policy and mandate.

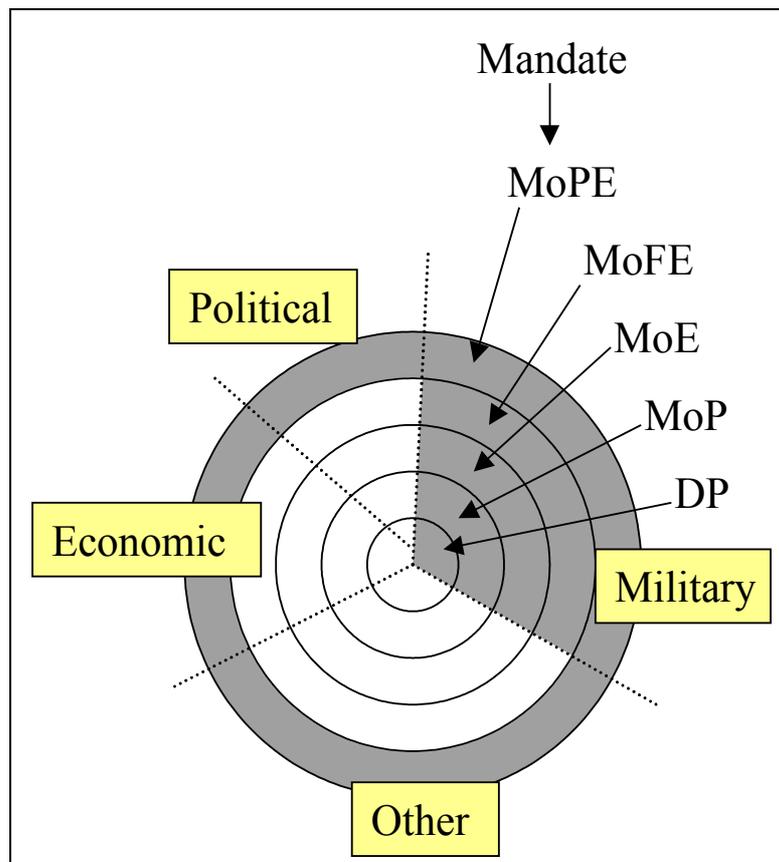


Figure 3. General MoM hierarchy for OOTW.

CONSTRUCTING MOMS

To construct the MoMs relevant to analyse the helicopters' performance in the fictitious scenario, the analyst must construct a consistent and relevant set of MoMs. To do this, the analyst follows the MoM hierarchy depicted in Figure 3 two times. First, the analyst works down the hierarchy, starting at the mandate working down to the DPs. Then, the analyst works up the hierarchy, starting at the just found DPs working up to the mandate. In this way, it is best guaranteed that the analyst does not miss a relevant MoM for his study. The guideline for working down and up the hierarchy are tasks. Tasks can be derived from the

mandate, and broken down into subtasks. For these subtasks, relevant MoMs can be found. Not using these tasks as a guideline makes it difficult to establish relevant MoMs.

When working first **down** the MoM hierarchy, the analyst starts at the mandate. This is his only hold in the scenario to develop MoMs. For this mandate, the analyst defines relevant MoPEs which express to what extent the mandate is met, in this case the level of conflict present in the country and the formation of a stable government. This is illustrated in the top rows of Table 1. Unfortunately, these MoPEs are relevant but virtually impossible to determine in an analytical model and therefore relevant for the analyst to understand and break down the problem, but quite irrelevant in the actual analysis.

Then the analyst breaks down the mandate in a number of main tasks needed to reach the mandate's goal. For each of these main tasks, the analyst defines one or more MoFEs which express the success at that main task. In this example one main task, "Humanitarian assistance ops," is broken down further by the analyst into two tasks needed to achieve that main task: "Build & run refugee camps" and "Take care of displaced persons." For each of these tasks the analyst defines relevant MoFEs that can express the amount these tasks are satisfied. Note from this example that within one level of MoMs, for instance the MoFEs, a further breakdown or hierarchy of MoMs that are all at the *same* MoM level can be found. In this case, both the MoM "Death rate" and the underlying MoM "People accepted" are considered MoFEs, even though they are linked to hierarchically related tasks.

Tasks ⇒	MoMs
Mandate	MoPE
- Restore peace	- Level of conflict present in the country
- Restore political stability	- Formation of stable government
⇓	⇓
Main tasks	MoFE
- Peace enforcement ops	- Stability/conflicts
- Humanitarian assistance ops	- Death rate
= Build & run refugee camps	= People accepted = People refused
= Take care of displaced persons	= People taken care of = People not taken care of
- Economic assistance	- Establishment of a currency - GNP
- Political stability	- Parties accepted - Groups represented

Table 1: First step working down the hierarchy: from mandate to main tasks.

In this example the analyst focuses on one task, "Take care of displaced persons." In reality, the analyst has to explore all other tasks in the same way as illustrated in this example to guarantee a complete analysis. The now selected task is broken down further into subtasks, to which more detailed MoMs are related and defined at the level of MoMs. In this example the analyst focuses on two subtasks, namely "Locate population" and "Provide food transport" as shown in Table 2.

Tasks ⇒	MoMs
Tasks	MoFE
= Take care of displaced persons	= People taken care of
	= People not taken care of
⇓	⇓
Subtasks	MoE
* Locate population	* People located * People not located
* Provide food transport	* People fed * People not fed * Tons food arrived * Tons food lost
* Provide medical care teams	* Locations served * Locations not served
* Evacuate	* People evacuated * People not evacuated

Table 2: Second step working down the hierarchy: from tasks to subtasks.

The selected subtasks “Locate population” and “Provide food transport” are not broken down further into more detailed tasks, as this does not seem to provide any more relevant footing to the analysis. The MoMs however need to be broken down further, just to obtain MoMs that can be measured from the different helicopter types and from which the different capabilities of the helicopters emerge. This is illustrated in Table 3.

Tasks ⇒	MoMs
Subtasks	MoE
* Locate population	* People located * People not located
* Provide food transport	* People fed * People not fed * Tons food arrived * Tons food lost
	⇓
	MoP
	# Square miles searched per day per heli # People transported per day per heli # Tons transported per day per heli
	⇓
	DP
	~ Sensor sensitivity and range ~ People per sortie ~ Payload per sortie ~ Sorties per day

Table 3: Third step working down the hierarchy: elaborate subtasks.

An important aspect of Table 3 is the illustration that MoEs tend to be highly dependent on a specific scenario, while MoPs and DPs appear to be quite independent of the actual

scenario. This illustrates that MoPs and DPs do not take the operational context into account, according to the definitions of MoPs and DPs given above. These two levels of MoMs just focus on plain features of the assets themselves.

Now the analyst has reached the lowest level of MoMs, starting from the mandate at the very top. In this way, he has found the relevant MoMs to measure in his analysis and that contribute to the mandate, in order to be able to distinguish between helicopter type A and B. When working down the hierarchy, the analyst has chosen to follow a certain path of tasks which he thought relevant for his analysis. But, now that the analyst has become a more complete picture of the relevant DPs and MoPs for the helicopters, he just might find some more tasks to which the helicopters can contribute and which he should analyse too for a complete and fair evaluation of both helicopter types.

For this reason, the analyst has to work **up** the hierarchy again, starting at the found DPs and working up until the mandate. This is illustrated in Table 4 where the analyst carefully explores his DPs to find new MoPs (which he does not) and then carefully explores his MoPs to find new subtasks and/or MoEs. In this case the analyst does find a new subtask which seems to be relevant to for the helicopter analysis, given the now known DPs and MoPs: “Evacuate” with two related MoEs that now should be included in the analysis: the number of people evacuated and the number of people not evacuated. These MoEs are relevant for the helicopter decision process and therefore should be included in the analysis.

Tasks ⇒	MoMs
	DP
	~ Sensor sensitivity and range ~ People per sortie ~ Payload per sortie ~ Sorties per day
	↓
	MoP
	# Square miles searched per day per heli # People transported per day per heli # Tons transported per day per heli
↓	↓
Subtasks	MoE
* Evacuate	* People evacuated * People not evacuated

Table 4: Fourth step working up the hierarchy: finding new relevant subtasks.

Now the analyst has to work his way entirely up the hierarchy, up to the mandate. This process is illustrated in Table 5 during which the analyst does not find any extra MoFES or MoPEs.

Tasks ⇒	MoMs
Main tasks	MoFE
- Peace enforcement ops	- Stability/conflicts
- Humanitarian assistance ops	- Death rate
= Build & run refugee camps	= People accepted = People refused
= Take care of displaced persons	= People taken care of = People not taken care of
- Economic assistance	- Establishment of a currency - GNP
- Political stability	- Parties accepted - Groups represented
⇓	⇓
Mandate	MoPE
- Restore peace	- Level of conflict present in the country
- Restore political stability	- Formation of stable government

Table 5: Fifth step working up the hierarchy: back to the mandate.

CONFLICTS BETWEEN MOMS

The above described process can be used to find relevant MoMs to a problem. Although this is a good start, it is not the end of the analyst's struggle to find MoMs and build his analysis model. He is also confronted with the aspect of conflicts between MoMs which highly complicate the contribution of the helicopters to the mandate and therefore his analysis.

First, a helicopter type enabling great successes in feeding the internally displaced persons of country Alpha appears favourable, but the analyst should also be aware of following unexpected consequences:

1. People may not return to their original locations as feeding is well provided.
2. Therefore ethnic regions are cultivated.
3. Therefore imbalance in economic recovery of the country is caused.
4. Therefore a stable, elected government may not be possible.
5. Therefore dependence on international assistance is prolonged.
6. Therefore a long-term stable economy is not possible, creating government instability.

These types of unexpected consequences are called conflicts between MoMs. It shows that success on one end can easily imply failure on the other end. In this case, success in feeding displaced persons is certainly important but only of limited duration. After some time, people must be stimulated to return to their homes in which process the food transport

capacity of the helicopter does not play any role anymore and even can become unproductive. Conflicts between MoMs are also illustrated by the situation that protection of food transport is required and is actually done very well and intensively. Some unexpected consequences that the analyst might just overlook are:

1. Protected food transports are not allowed to get into certain areas just because of the presence of a military escort. In this way, protected food transports can not reach their final destination.
2. Protected food transports may be avoided by local people as they do not want to be associated with the military party escorting the transport or expect escalation due to the presence of the military party.
3. Protected food transports require deployment of troops that will not be available for other military tasks at that time and may cause undesirable situations.

UNCLEAR RELATIONSHIPS

When constructing the MoMs as described, the analyst ends up with a list of relevant tasks and MoMs, organised in a hierarchical structure. But the analyst's task does not end here, as he has to determine to what extent, say, the number of people evacuated in a certain time frame contributes to the overall mandate. This is where relationships between MoMs are involved.

Typically, MoMs at the level of MoE or even MoFE can be determined by the analyst. So, in this example the analyst could determine for a certain operational scenario the number of people located, the number of people fed (both MoEs) and the number of people taken care of (MoFE, in this case a mere aggregate of the indicated MoEs).

It is quite impossible, however, to determine the effects of the number of people taken care of (MoFE) on higher MoMs like the death rate (MoFE), the level of conflict in the country (MoPE) or the formation of a stable government (also MoPE). This illustrates that in general vertical relationships between MoMs (i.e. up or down the MoM hierarchy) at the level of MoFE or MoPE can hardly be determined by an analyst. Therefore, an analyst can scarcely determine the influence of, say, a helicopter type on the chance the mandate will be met.

Apart from these unclear vertical relationships, through the MoM hierarchy, also numerous horizontal relationships between MoMs (i.e. at the same level in the MoM hierarchy) exist that are hard to describe. In general, this is true for MoMs at the MoPE level. For instance, an MoPE like the level of conflict in the country is indeed influenced by the military aspect and therefore somehow by the selected helicopter type. But is also highly influenced by economic and political MoPEs which are totally out of scope of the analyst focusing on the choice of the right helicopter type.

A main reason for this is, that the mechanisms behind MoMs are generally blurred. A first example may be, that the number of reported conflicts increases after intensified military

patrols. But it is not clear why more conflicts are reported: is it just because intensified patrols can better detect conflicts (in which case the actual number of conflicts does not change), or is it because intensified patrols increase tension and so indeed provoke more conflicts (in which case the actual number of conflicts does change)? A second example may be intensified plundering after intensified food transports. What mechanism is at stake: are stores well supplied and therefore just have a greater chance of being plundered, or do the food transports attract too many (undesired) people, possibly from across the border? These unclear relationships make it hard for an analyst to really determine the correct effects on and values of many relevant MoMs in an OOTW.

CREEP

The constructed MoM hierarchy assumes a certain operational setting. Within this operational setting meaningful MoMs can be determined. During time, a smaller or greater shift in the operational circumstances and/of aim can occur. In that case, the constructed MoMs may not be valid anymore. For instance, if during a mission focus shifts from a peace keeping character to a mere peace enforcing character, certain humanitarian assistance tasks may become (temporarily) less important for the military party and will contribute at that time less to the mandate than before. On the other hand, some typical peace enforcing operations become a (temporarily) more important factor in achieving the mandate. This may (temporarily) mean a shift in preference to one helicopter that is more fit for the emerging circumstances.

To include this effect, the analyst should adapt his MoM hierarchy in order to correctly determine the effect of the helicopter on achieving the overall mandate. So the MoM hierarchy should be dynamic too and correspond with the current operational setting.

For the analysis type discussed here, namely analysis of future asset purchase projects and of future force structures, it is highly dependent on the complexity of the used analysis model whether or not such a dynamic shift of the operational circumstances is at stake. Maybe the analyst will just use several static scenarios and determine the effect of each helicopter in each static scenario. For analysis of actual ongoing operations (which type is analysis is not further discussed here) an analyst should continuously check the appropriateness of his MoMs and their relations just to keep up with changing circumstances and demands.

ESTIMATES

Sometimes reliable data on MoMs are not available, either for an analyst using a model or an analyst during an actual operation. For instance, to measure the success of an evacuation the percentage of the population actually evacuated by the helicopter should be measured. To do this, good ideas must exist on the number of people evacuated as well as on the total population. In many cases this information is not available or can not correctly be determined, and the analyst has to resort to estimates or rough assumptions. This affects the exactness of the study which should always be clearly reported by the analyst.

METRICS VERSUS OBJECTIVES

In many studies objectives are put which future assets or future force structures should meet. These generally are simple stated objectives. For example, an objective for a new helicopter could be that a fleet of ten helicopters should be able to evacuate 5,000 people within a certain time frame. But suppose that the analyst finds that helicopter type A evacuates 4,500 people and type B 2,500 people.

In that case, helicopter type A does not exactly meet the objective, but still may be well enough in range, especially taking into account uncertainties and assumptions in the study. And possibly no helicopter type exists at all that can meet the put objective.

So, an analyst should be very careful to use objectives in a binary mode, which is indicating that an objective is either met or is not met. The analyst always should take into account a certain measure to what degree the objective is met and to what extent the objective is realistic.

STANDARD MOMS FOR SSCS

At the current state of knowledge MoMs for SSCs seem to be hard to standardise, implying that for each SSC analysis new MoMs tend to be required. This is due to the numerous parties involved, the numerous relevant aspects of the operation (political, military, economical, social, ...) and complex relationships between these MoMs.

But maybe this is just a consequence of the relative freshness of the subject MoMs for SSCs. It could very well be that after several years some standard ideas on often relevant MoMs for SSCs emerge, including ideas on relations between these MoMs. One help could be the Methods and Models Database that was developed by the NATO SAS-027 Technical Team in which information is gathered on existing methods and models for analysis of SSCs, one information aspect being the DPs, MoPs, MoEs, MoFEs and MoPEs used by the method or model. In this way, a collection is built during time of used and more or less valuable MoMs.

At this moment, it seems that some standard DPs, MoPs and MoEs could be defined. For MoFEs and MoPEs however, it currently is far from likely that a standard will be developed on short notice. This will complicate the analyst's task to distil relevant MoMs for specific operational circumstances.

CONCLUSIONS

Analysis of future military asset purchase projects and of future force structures requires a good set of Measures of Merit (MoMs) to make the right choices. Finding the right MoMs that really contribute to the mandate of a Small Scale Contingency (SSC) is hard. Main cause is the enormous distance in abstraction between the mandate on one hand and the studied features of assets or force structures on the other hand.

Using the proposed MoM hierarchy can help to move away from an abstract mandate and find relevant MoMs for the problem at hand. This MoM hierarchy breaks down the mandate

into tasks and subtasks, associating relevant MoMs to each task. In this way, MoMs at several levels of detail are constructed, down to the actual parameters of the assets or force structures. The lower level MoMs are independent of the scenario, in contrast to the higher level MoMs.

It is suggested to go through the MoM hierarchy twice; first from the mandate down the lowest level, and then up again from the lowest to the mandate. In this way it is more or less guaranteed that all relevant MoMs and tasks for the problem will be found as new insights learned from working down the hierarchy will be used when working up the hierarchy again.

Between MoMs relations exist, both between various levels in the MoM hierarchy and within one level of the MoM hierarchy. Many of these relationships are unclear due to unknown mechanisms in the studied area. Especially at the highest level of the MoM hierarchy, the policy level, great interference exists between the military aspect and other aspects like political and economic aspects.

Once constructed, a MoM hierarchy tends to be only temporal in this sense that changed operational circumstances call for different MoMs or at least different significance for previously defined MoMs.

Standard MoMs for analysis of SSCs are far from available right now. Maybe some of the lower level MoMs can be defined in future as standard, but the higher level MoMs seem to be unlikely to become standardised at reasonable notice. Maybe the Methods and Models Database set up by the NATO SAS-027 Technical Team can help to collect and find often used MoMs.

At this moment, MoMs for SSCs are scarcely out of the egg. Using the MoM hierarchy and the Methods and Models Database set up by the NATO SAS-027 Technical Team in practice can be a starting point for new developments on this subject. We have to learn by doing.