Measuring the effectiveness of Small Units in Crisis Response Operations

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Abstract

Nowadays, the Royal Netherlands Army is involved mainly in Crisis Response Operations (CRO)[1] like Bosnia (SFOR) and Afghanistan (ISAF). It is imperative that policy making and procurement issues take these operations into account. TNO Defence and Public Safety, as the strategic partner of the Royal Netherlands Army, is supplementing its support making the CRO element far more important.

This paper presents a detailed overview of the conducted research and the currently started Research Programme Small Unit Operations.

Figure 1: Crisis Response Operations (www.mindef.nl)

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[1] In this paper we use the term Crisis Response Operations (CRO). Alternatives would be Peace Support Operations (PSO) or Operations Other Than War (OOTW), though there are some differences in the definitions.

Contents

Abbreviations

CCMA	Close Combat Modelling & Analysis
CRO	Crisis Response Operations
CUQAM	Customer Question Analysis Method
DCTOMP	Doctrine, Command & Control, Training, Organisation, Materiel and Personnel
DIAMOND	Diplomatic and Military Operations in a Non-warfighting Domain
IFOR	Implementation Force in Bosnia and Herzegovina
INK	Institute Netherlands Quality (Model)
ISAF	International Security Assistance Force
IUSS	Integrated Unit Simulation System
LCC	Life Cycle Costing
MCA	Multi Criteria Analysis
MoE	Measure(s) of Effectiveness
NATO	North Atlantic Treaty Organization
OA	Operational Analysis
OOTW	Operations Other Than War
OR	Operations Research
PSO	Peace Support Operations
QFD	Quality Functional Design
RNLA	Royal Netherlands Army
RTO	Research & Technology Organization
SDA	Soldier Digital Assistant
SFIR	Stabilization Force in Iraq
SFOR	Stabilization Force in Bosnia and Herzegovina
SMP	Soldier Modernisation Programme
TNO	Netherlands Organisation for Applied Scientific Research
UJTL	Universal Joint Task List

1. Introduction

Germany and The Netherlands transferred command of the ISAF-mission in Kabul, Afghanistan, to NATO on August 11th 2003. Dutch Marines are patrolling the southern part of Iraq since the beginning of August 2003 (SFIR). The Netherlands is present with soldiers in Bosnia as part of IFOR/SFOR since the start in the early nineties. These are some examples of Crisis Response Operations (CRO) the Dutch defence forces are participating in, thus helping to stabilise the situation in the different countries.
Nowadays, the Royal Netherlands Army[2] (RNLA) is involved mainly in CRO. While CRO is the daily business for quite some time already, the main focus of the Ministry of Defence (MoD) and RNLA in its policy making (including doctrinal development, materiel procurement) has been on its primary mission: to defend Dutch and NATO territory against a conventional attack ('Article V'). But this is changing rapidly (see for example [1]). An Army transformation has started and with it a shift of focus. It has become imperative that CRO are taken into account prominently in policy making as well as operational planning while in the meantime the needed capabilities for Article V operations are not neglected.

As a result, TNO –as defence research organisation and strategic partner of the MoD– is supplementing its support also making the CRO element far more important. This goes along with a new focus on Small Unit Operations because Small Units perform most of the tasks in CRO while the higher echelons are co-ordinating between the different Small Units. The main question is how does TNO keep supporting the doctrinal development, materiel procurement and operational planning of the RNLA in the near and long future in an optimal way? In our opinion, it is important to have and maintain the capability to translate the effects of, for instance, implementing a new piece of equipment or a change in tactics into operational effectiveness for the whole spectrum of operations. In fact, our midterm ambition is to be able the translate all the different developments in the so-called DCTOMP factors in an integral way into operational effectiveness. The DCTOMP factors are Doctrine, Command & Control, Training, Organisation, Materiel and Personnel.

The following scheme (Figure 2) is used as a guideline for the reader. Chapter 2 focuses on Combat Operations in general while Chapter 3 zooms in on the Small Unit level. Chapter 4 and 5 do the same for CRO. Chapter 6 describes the currently started Research Programme on Small Unit Operations. Finally Chapter 7 ends with concluding remarks.

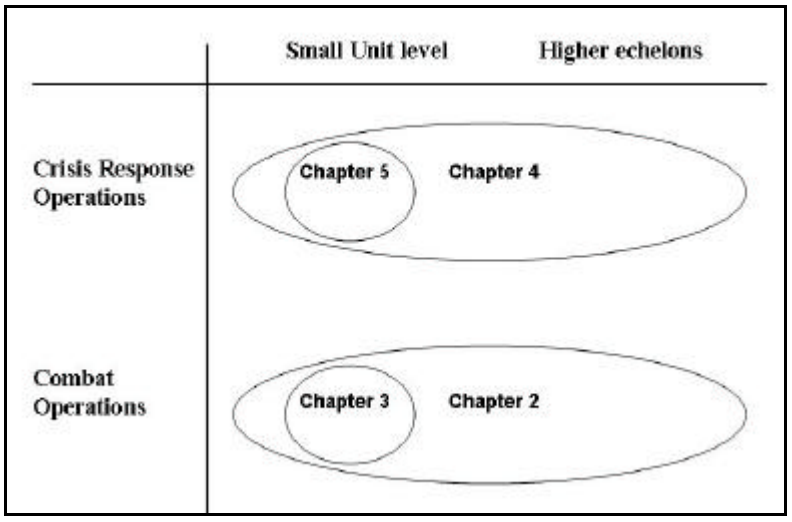

Figure 2: Article reader

[2] In this paper we use 'Royal Netherlands Army' for simplicity reasons. In fact we mean all combat soldiers on the ground: from Army, Marine Corps and Air Force.

2. Measuring the effectiveness in Combat Operations

2.1 Support philosophy

TNO has a lot of experience in measuring the effectiveness of doctrine and equipment in combat operations. We have constructed an internationally as well nationally accepted support philosophy for conducting operational analyses. Figure 3 depicts the support philosophy. Answering the (operation-related) question of the customer[3], in this case the RNLA, is the final goal and the key element in the pyramid. To achieve this, a well-conducted operational analysis (OA) is needed. In this analysis means, tasks, effects and finally measures must be charted before the question can be answered using the most suited methods and models.

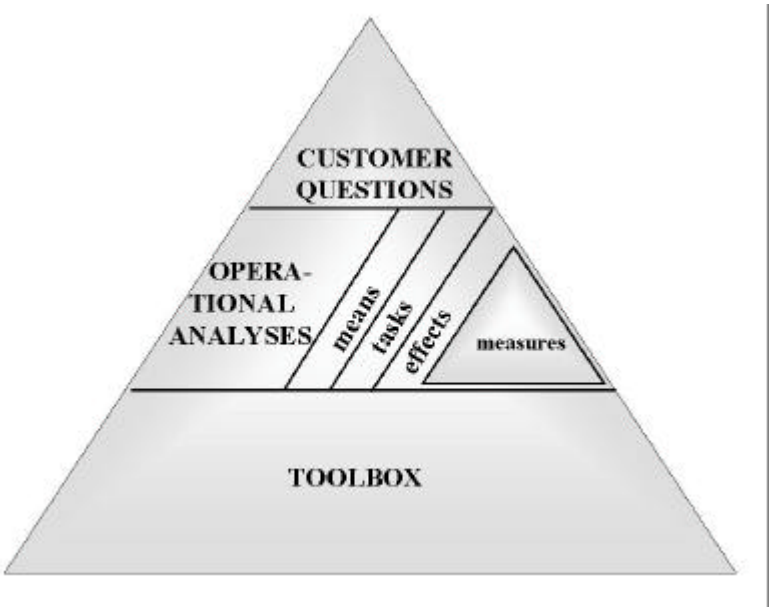

Figure 3: General support philosophy

This remains very useful for analysing CRO, because the methodology used in this philosophy is independent of the kind of operation. Furthermore, there is no clear distinction between Combat Operations and CRO because combat actions can be part of CRO as well. This implies that part of the knowledge, skills and infrastructure developed for Combat Operations can be applied for CRO as well.

2.2 Customer Question Analysis Method

The first step in the analysis is looking at the customer's question more thoroughly. This can be done using the nationally developed Customer Question Analysis Method (CUQAM) [2], in which the customer's (RNLA's) operational question is interpreted and translated into one or more research questions. The CUQAM (see Figure 4) is aimed at the breakdown of an operational question into hypotheses and MoE.

[3] With customer we mean our sponsor.

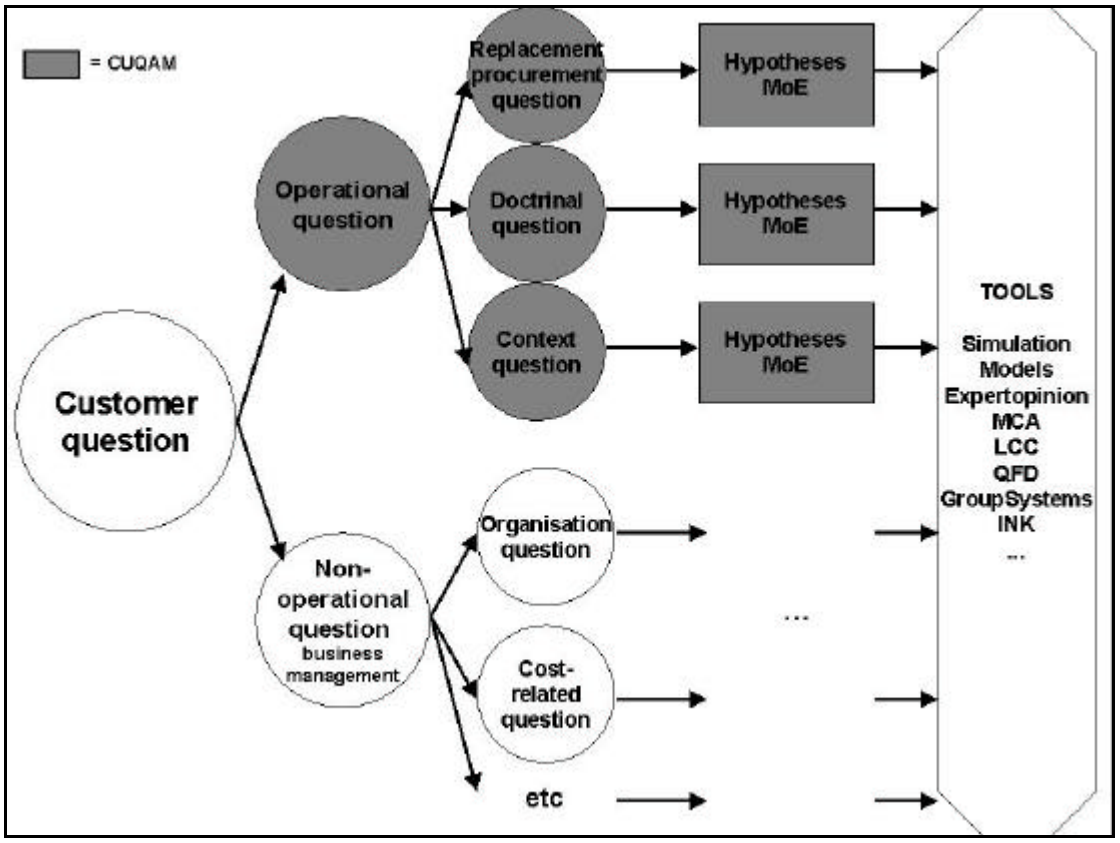

Figure 4: Relation between customer question and solution methods.

In short the CUQAM works as follows:

1. Get agreement with the customer on the exact question to be answered and its context (and write it down!)

2. Make a breakdown of the customer's question into study questions
   - ? Define the system to be analysed
   - ? Define the area of interest and the environment
   - ? Define the study questions

3. For every study question:
   - ? Specify the question further if needed
   - ? Determine the hypotheses
   - ? Determine the MoE for the hypotheses

4. Describe a baseline scenario and its alternatives to be used for the analysis

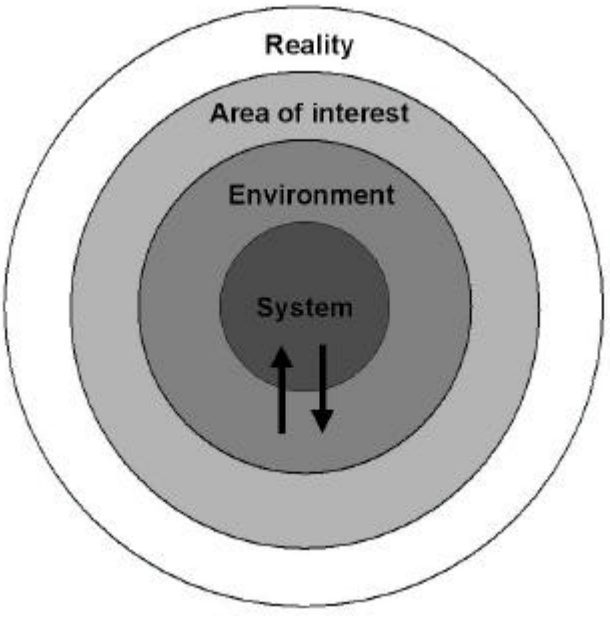

Figure 5: Relation between reality, area of interest, environment and system

The area of interest is that part of the reality that will be taken into account in an analysis of a certain study question. Consequently, the system is that part of the area of interest of which the characteristics or performances are studied. The environment of the system is that part of the area of interest which is influencing the system or influenced by the system (is interacting with the system). Figure 5 illustrates the relation between the reality, the area of interest, the environment and the system to be studied.

Based on the aforementioned definitions of system, area of interest and environment, three categories of operational questions can be distinguished (see also Figure 4):

? Replacement/Procurement questions
  These questions are about the influence of a variation in the nature of the system and/or number of systems on the system efficacy (with a given doctrine and context).
? Doctrinal questions
  These questions are about the influence of doctrine change (or tactics) on the system efficacy (with a given system and context).
? Context questions
  These questions are about the influence of a different context of operation (environment) on the system efficacy (with a given system and doctrine).

We pose that a customer's operational question can always be translated into study questions in these categories. It is possible, for instance, that a customer's question related to the procurement of equipment can be broken down into study questions in all the categories: procurement, doctrinal and context. Answering these study questions may take different kind of analyses!

2.3 Conducting an operational analysis

If the customer's question requires an operational analysis (OA), the study methodology presented in Figure 6 has proven to be very helpful [3]. Figure 6 depicts the study methodology. The light coloured arrows (from left to right) show the process before the use of a model, starting at the study objective (the customer's question). This process results in an analysis plan. The dark coloured arrows (from right to left) represent the second phase of the operational analysis in which the study objective is reached i.e. the customer's question is answered.

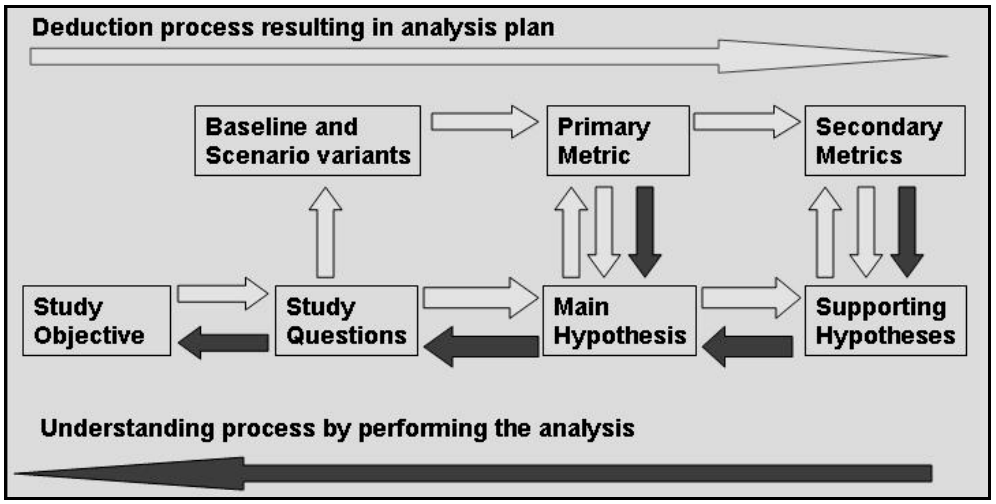

Figure 6: Study Methodology

First the study objective (the customer's question) that is put forward is analysed and translated into study questions (using the CUQAM). Based on these study questions, hypotheses that will be rejected or not are defined. It is possible that there are two (or even more) layers of hypotheses. The main hypothesis is strongly linked to the study objective. The rejection or not of the main hypothesis is based on the primary metric, in general mission success because quite some thought has been given to the idea that it is preferable to measure the effects of the operation instead of only measuring the outcome of tasks [4].

Operational effectiveness measures to which extend the reached effects of an operation are similar to the desired effects. The desired effects of Small Unit Operations are strongly linked to the operational goals of the military operation as a whole. By executing the appropriate tasks of small units it is tried to reach the desired effects.
Figure 7 illustrates the relation between effects, task execution, tasks and means. The execution of tasks is done by combining the individual tasks (tactics) (A) and materiel (and personnel) means (B). It is influenced by the operational environment (C). The quality of the operation (operational effectiveness) (D) is determined by the quality of the task execution.

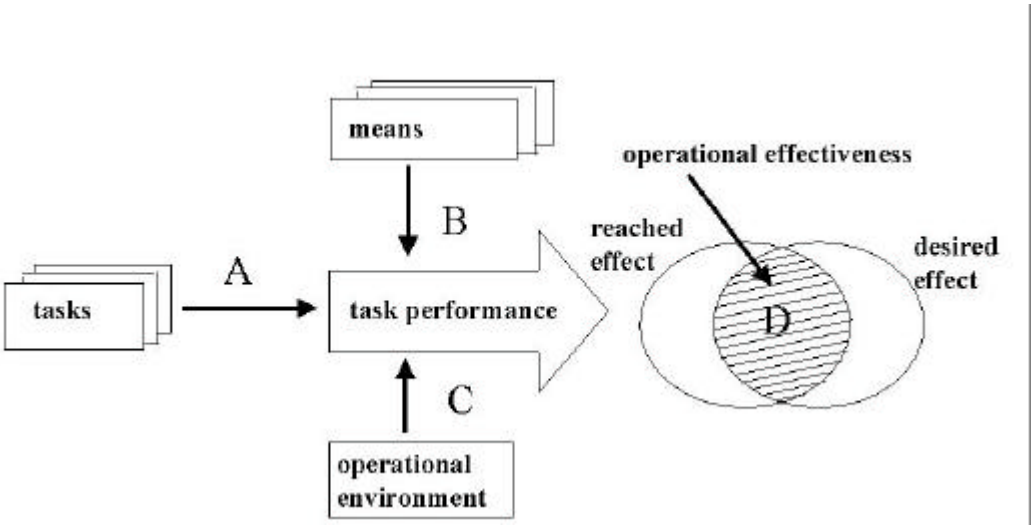

Figure 7: Relation between effects, task execution, tasks and means

In general, the primary metric does not give explanations for the rejection or not. Therefore, supporting hypotheses are needed. Each supporting hypothesis concentrates on a particular aspect. The testing of the supporting hypotheses produces insights and explanations for understanding the rejection or not of the main hypothesis.
Next a model is used to calculate the metrics. Until now, this model is a simulation model. This implies the design of a baseline scenario and a number of alternatives. The scenarios are implemented in the model and then simulated. Each scenario is repeated a number of times due to the use of random variables. The functionality of the used model and the deduced hypotheses together identify the metrics that are both useful for testing hypothesis and that can be calculated from the raw output data of the model.
Finally, the results are interpreted and are thus giving an answer to the original customer's question.

3. Measuring the effectiveness of Small Units in Combat Operations

3.1 Close Combat Modelling

Close combat is a highly dynamical and uncertain process. Dynamical systems evolve in time. A common way to describe a dynamical continuous time process is by means of a differential equation. Unfortunately, 95 percent of these equations can not be solved analytically. The relations of the variables are too complex, meaning that an explicit description of a cause-effect relationship is impossible.
Real life is even worse, since it is probabilistic in nature. As a consequence a future state can not be identified by a single value, but must be described by a probability distribution.

Close combat is extreme in both aspects. It is highly dynamical and extremely stochastic. Simulation is an appropriate way to handle this complex and distributive character. The complexity takes its form in a model - with a vast number of variables and relationships - which needs to be validated. The stochastic variables in turn ask for thorough statistical techniques.

Complexity and uncertainty together pose limitations on the outcome of a simulation study. The results are local in the sense that only small deviations of the chosen parameter settings are allowed (a combat of 9 soldiers against 3 soldiers is incomparable to a combat of 27 against 9 soldiers). Big differences in local behaviour in combination with uncertainties will lead to strongly varying outcomes of simulation runs.
Therefore mean results, accompanied by a confidence interval, are useful to compare alternatives, but hide the whimsical nature of close combat, which deserves persistent attention during the analysis of simulation outcomes [5][6].

3.2 Mission success

Maximizing the number of casualties is not the primary objective of an operation. Therefore MoE based on the number of own and enemy casualties are not the primary metric. What is decisive is winning or loosing the battle (that is the individual simulation run); the number of causalities comes on the second place. Only after a battle is won, the number of blue casualties becomes important (it is not an aim of the military to maximize the number of red casualties, since the aim of the military is victory, not slaughter). If the number of blue casualties is taken as a MoE, immediate surrender is the best we can do. With certainty, this gives no blue casualties at all! Although the number of blue casualties is not a primary MoE, it has a strong influence on the outcome of the battle, since a platoon that suffers too big losses will break off its attack and withdraw. This stopping criterion is a very important indirect part of the definition of winning. The number of blue survivors in the battles won can be taken as a secondary MoE. Neither the number of red casualties nor the number of blue casualties in the battles lost, are useful performance measures. Whether the sample mean and sample variance of the number of blue casualties in the battles won, give adequate

information, depends on the probability distribution of this stochastic variable. Since these probabilities are conditional (to winning), advanced statistics is required for this MoE, so one has to be very careful.

The decisive MoE that must be used to compare alternatives in Small Unit Combat Operations, is the probability of mission success. Alternatives with non-overlapping confidence intervals for this probability differ significantly. Equally important would be a conclusion that two alternatives do not differ significantly when their confidence intervals do not overlap. These statistically justified conclusions, however, do not reveal any insight into the mechanism determining these probabilities. Understanding this mechanism requires more than statistical techniques alone. It is important to realise that the probabilities found can be very sensitive to changes in the scenario and the parameter settings. This stresses the importance of the qualitative insights won during the close combat simulation.

Statistically founded conclusions are only a small part of the total results of a close combat simulation study. The rigor forced by the statistical part, however, guarantees a certain quality level of the total study. The main part of the results consists of all insights won during the research. Documenting these is difficult. Keeping a logbook of all relevant facts, noticed by all members of the simulation project team, is a way to keep track of the advances made. Selecting and summarising the most important results is a necessary but time-consuming task. Without it, one can be sure that the insights will be lost.

3.3 Integrated Unit Simulation System

Looking at our toolbox, simulation is a very important element. We use the American Natick Soldier Center's Integrated Unit Simulation System (IUSS) as our primary model [7]. During the last years we established a productive and close relationship with the Natick Soldier Center, enabling us to thoroughly understand the ins and outs of the model and –perhaps even more important– the ideas behind the model. Furthermore, it gives us the unique opportunity to exchange views on how to conduct the operational analyses at hand and analyses on Small Units Operations in general. The collaboration between the United States and The Netherlands in the area of 'Dismounted Combatant Operations' will be intensified in the coming years.

3.4 Teamwork

Above all, it is imperative that in any analysis performed, the appropriate study team is assembled. This team must have multi-discipline scientific skills, organisational and knowledge-integrating abilities and enough military background. Von Karman (founder of the NATO Research & Technology Organisation (RTO)) once said: "Scientific results cannot be used efficiently by soldiers who have no understanding of them and scientists cannot produce results useful for warfare without an understanding of the operations". We keep this in mind constantly.

3.5 Case-study: the Soldier Digital Assistant

In 2002 TNO performed a case-study about the operational value of a new command & control component for dismounted infantry operations, the Soldier Digital Assistant (SDA) [3][8]. The studied concept of a SDA is given in Figure 8.

Figure 8: Concept of the Soldier Digital Assistant (2002)

For this study we used the methodology, methods and tools described earlier. The goal of the case-study was twofold: testing and improving our support philosophy and helping the RNLA directly by answering their question: "What is the added value of the SDA in an operational environment?"

The CUQAM was applied thus breaking the RNLA's question down into study questions, in this case replacement and doctrinal questions. They were defined as follows:

? What is the operational effect on conducting a mission if a group is equipped with radio instead of no specific communication system?
? What is the operational effect on conducting a mission if a group is equipped with SDA?
? What is the operational effect if a group equipped with SDA conducts a mission with adjusted tactics?
? What is the operational effect if a group equipped with SDA conducts a mission with new tactics supported by the availability of 'immediate' indirect fire support?

In the SDA case-study the system was defined as a group of soldiers with their (current) equipment and either no specific communication equipment, a radio or a SDA. The area of interest for this system definition is dismounted infantry operations. Figure 9 gives an impression of the environment and the reality as well.

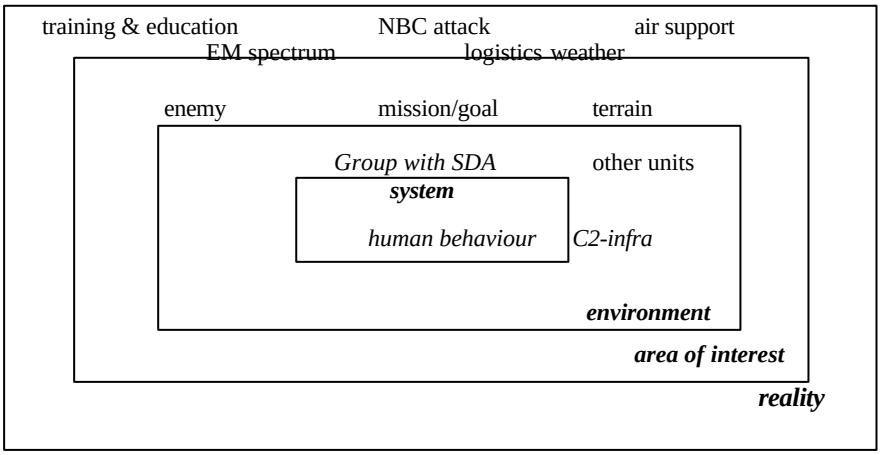

Figure 9: Definition of the system, environment, area of interest and the reality

In the next phase of our operational analysis we defined our hypotheses and MoE and constructed the scenario to be implemented. We used IUSS as our simulation model. Our main hypothesis was 'the operational effectiveness of the blue group increases with the use of dismounted C2-equipment and can be further increased with doctrine/tactic changes'. And the primary metric was 'the average probability for the blue group of mission success'. About ten other supporting hypotheses with their MoE were used.

In the end we finished our case-study both helping the RNLA with their decision whether or not to procure the SDA and helping ourselves in improving our methodology, methods, tools and skills in this area of research.

4. Measuring the effectiveness in Crisis Response Operations

4.1 Literature search

Although in the previous sections some examples are given of methods used for traditional combat operations studies, TNO –like other research organisations– also has started working on research issues concerning the performance of analyses of CRO. Examples of these are our preliminary study on Measures of Effectiveness (MoE) for CRO [9], the work done on measuring effects during army operations [10] and our preliminary research on influence diagrams [11].

TNO's preliminary study on Measures of Effectiveness (MoE) for CRO [9] started with a search on the available literature about a classification of CRO and about MoE and method to determine MoE. This was not limited to small units, army or CRO but encompassed all defence forces and operations. Two questions were answered:

? What makes CRO special in comparison to Combat Operations?
? Which MoE and methodologies to determine MoE for CRO already exist and can be used for our purposes?

In short the questions were answered as follows. CRO is but a collective noun for a very diverse kind of operations. There are a number of classifications used, for instance that of NATO. Furthermore, there are no ready-to-use methods available to determine the MoE is CRO. Here also different classifications exist. Some work on drawing up an inventory of MoE had been done in the UJTL (Universal Joint Task List) [12].

How can the effects of CRO of the RNLA be determined and/or how are they measured? That was the main question in our conducted research on measuring effects during army operations [10]. We found that although the Army is touching on this subject, no fixed or well-developed structure of measuring the effects during an operation is in place. Measuring the effects in an optimal way makes it imperative to clearly state the goals of the mission and isolate as much as possible the effects of the RNLA on the environment. This is no easy task. Furthermore it is extremely difficult to assess the overall force effectiveness or even the policy effectiveness during operations. We found several methods appropriate for measuring effects (either qualitatively or quantitatively), for instance influence diagrams, the definition of performance indicators, trend analysis, surveys under the local population and benchmarking.

4.2 Influence Diagrams

One method of measuring the effectiveness in CRO which looks promising is the use of influence diagrams. This triggered TNO's preliminary research on influence diagrams [11]. In this research the different kind of influence diagrams were studied, tools helping to construct influence diagrams were tested and two case studies were performed to better understand the advantages and disadvantages of influence diagrams. Furthermore a step-by-step guide for using influence diagrams was constructed. It is often not simple to take into account the interdependencies between events in complex problem environments. Because of the strong

graphical representation of influence diagrams it is possible to (partly) tackle this problem. We are currently modelling a conducted operation in Bosnia with the use of influence diagrams.

5. Measuring the effectiveness of Small Units in Crisis Response Operations

5.1 The need for other Measures of Effectiveness

Most of the existing quantities for measuring the effectiveness of small units are related to the fighting operations for which the Royal Netherlands Army was prepared during the Cold War. The attack and defence tasks of for example dismounted infantry platoons had relatively simple objectives, namely obtain or retain terrain. An acceptable strategy was to destroy the enemy and his (military) infrastructure. MoE like used ammunition and casualties were commonly used to measures the task performance of dismounted infantry in a simulated environment.

CRO require other MoE due to several observations. One can think of much more MoEs due to the broad spectrum of operations, varying from humanitarian relief up to peace making. Furthermore, the military objectives for CRO are often less straightforward because their deduction from the political objectives is not equivocally.

Establishing MoE for CRO is a challenge and requires significant research efforts. The Research Programme Small Unit Operations will incorporate this research. Before describing the outline of this research programme, we would like the give some examples underlining this challenge.

5.2 The Universal Joint Task List

The American Universal Joint Task List (UJTL) [12] provides a guide for combatant commanders and their staffs to establish standards of performance based on their assigned missions. These measures and criteria can be seen as a common language reference system for (joint) force commanders, operations planners and trainers. They are also useful for analysts simulating missions as part of their support related to policy making of the Department of Defence. The UJTL expresses the acceptable proficiency that a joint organisation must perform under a specified set of conditions with 'standards'. A standard consists of one or ore measures for a task (describing varying levels of task performance) and a criterion for each measure (defining the minimum acceptable level of task performance). An important note to make is that the UJTL is developed with the emphasis on fighting operations.

The UJTL give guidelines for the development of measures as well:

1. Keep measures simple.
2. Measures and criteria should reflect an understanding of a task.
3. Measures and criteria should reflect how a task contributes to mission success.
4. Measures should be sensitive to the impact of conditions on task performance.
5. Criteria should reflect the key dimensions of task performance.
6. Measures should be developed that distinguish among multiple levels of performance.
7. Measures should focus on the outputs, results of performance or on the process to achieve the task.
8. Measures should try to take advantage of the strength of both absolute and relative scales.

In an interview, the Dutch commander of SFOR-12 in Bosnia expresses that the number of social patrols is rather strange as a measure for the effect of their task performance. According to his point-of-view, the information obtained by the social patrol or the stability in a certain

area are better measures than the number of social patrols. The task performance measure must deal primarily with the outcome of the activities and not the way how the Army performs its task.
In this example it is clear that a simple measure, namely the number of social patrols, is not sufficient. Two well timed and well performed social patrols can yield much more information than four social patrols. The quantity of the patrols is not important as a stand-alone measure; it goes along with the quality of the social patrol. It is obvious that catching quality of social patrols in a simple measure is an illusion. Therefore, using UJTL guideline 1 is difficult.
UTJL guideline 4 more or less indicates that the status of the operational environment must be reflected in the MoE. It is understandable that the number of social patrols is hardly influenced by the operational environment because the stability of the situation is not directly linked to this value. Sometimes 'softer' MoE, like the obtained quality of the information, that can be determined more qualitatively better expresses the influence of the operational environment on the task performance.

Let us take the second example of a task of securing a safe-area. One can think of the following MoE:
? Number of incidents.
? Number of disarmaments.
? Number of arrests.
Lower values for these MoE are not by definition coherent with a better achievement of the desired effect, namely a safe area. Lower values can mean that a number of incidents of weapon possession are not registered by the operational unit due to a lack of surveillance capability. On the contrary, an operational unit that patrols more often can encounter more incidents, etc. These measures are sensitive to the impact of the conditions (like the operational environment and own organisational capabilities) under which the task is performed, although the relation of the impact is unknown! That seems conflicting with UJTL guidelines 2 and 3.
It is clear that these MoE do not concentrate on the outcome of the task but more on the process. But without the full context of the task performance the values of these MoE are not self explaining! In that perspective these MoE do not reflect how a task contributes to mission success. The underlying problem is that setting criteria for these MoE (which number of weapons must be found in order to achieve a minimal acceptable task performance) is extremely difficult and depend large upon the operational conditions. As a result UTJL guidelines 5 and 7 are challenging to satisfy.

These examples clearly show that the guidelines listed in the UJTL are not directly applicable to the development of MoE for CRO. Especially, the approach of setting criteria does not yield added value at first sight. It is questionable if criteria, in combination with MoE, are needed in operational analyses as support for policy making. The common approach is to compare the outcomes of the MoE a baseline with alternatives. In that perspective, the baseline sets the criteria whether or not the tasks are performed at an acceptable proficiency.
Furthermore, absolute scales are sometimes hard to define for more soft measures like 'the quality of obtained information' or 'the flexibility of a unit to adapt on quickly changing circumstances'. Even measures like 'the number of incidents' are difficult to express on a relative scale because of the obscurity of the maximum number. This is in contradiction with resources of own and enemy forces of which numbers are often available.
Another important observation is that the UTJL speaks in terms of tasks. The newly adapted approach is thinking effect-based instead of task-based. This is in line with the first example and the research described earlier.
The overall conclusion is that the list of UJTL can serve as a baseline for adapting such a list for MoE for CRO.

6. Research Programme Small Unit Operations

6.1 Objective

The Research Programme Small Unit Operations[4] [13], which has started in 2003 and will run to mid 2006, will have its focus on the operational effectiveness of small unit[5] operations in the whole spectrum of CRO; varying from peace enforcing to humanitarian relief (see Figure 10). As discussed above, the big challenge is to find ways to quantify operational effectiveness where there are no small arms engagements! Besides this research programme, there will be a successor of the performed Soldier Modernisation Research Programme [14], called the Research Programme Soldier Efficacy[6] [15]. This programme concentrates on the soldier level and developed knowledge of the Research Programme Soldier Efficacy will be incorporated in the Research Programme Small Unit Operations. The objective of the Small Unit Operations Research Programme is developing knowledge, skills and infrastructure to quantify and/or qualify the operational effectiveness of small unit operations in the whole spectrum of CRO incorporating the 'violence scale' from almost none to full scale war at the small unit level!

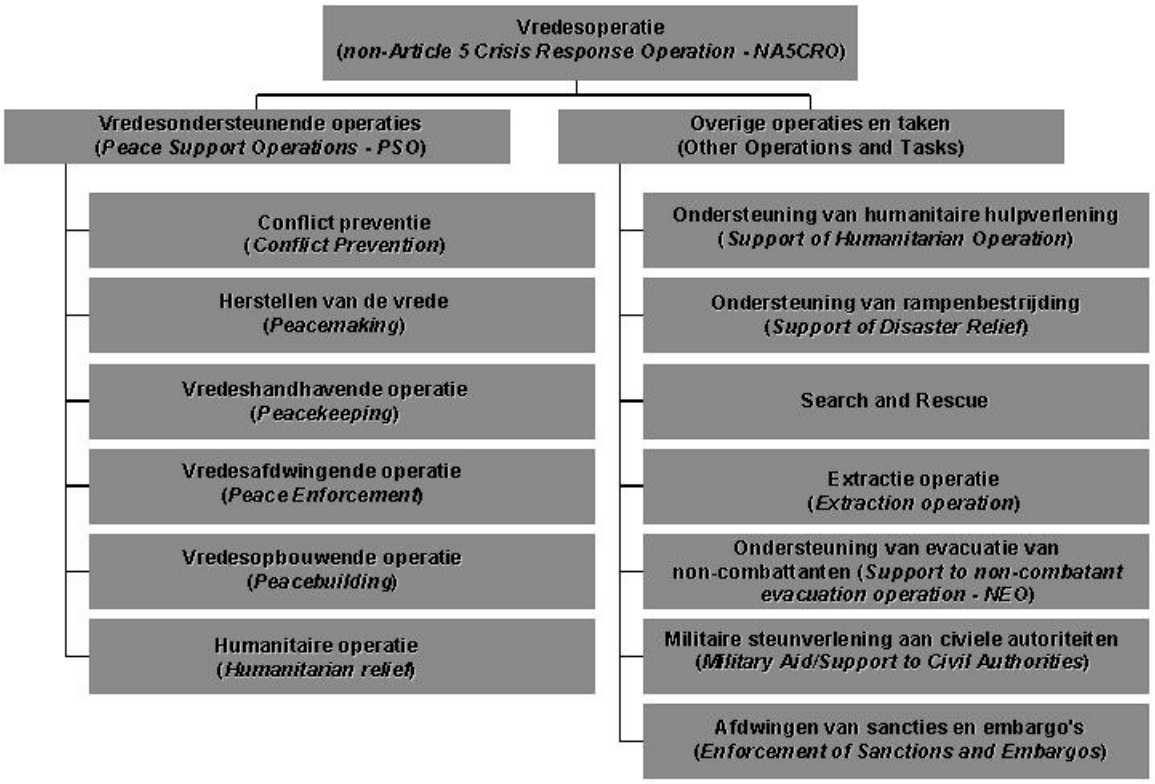

Figure 10: Spectrum of Crisis Response Operations

[4] The Small Unit Operations Research Programme is managed by Ellen N. van Son-de Waard M.Sc.
[5] A small unit is defined as the smallest unit of combat soldiers and their materiel that can achieve the desired effects in the peace support operations.
[6] The Soldier Efficacy Research Programme is managed by Dr. Wouter A. Lotens.

6.2 The overall results

Besides the soldier, other aspects of small unit operations will be taken into account. These aspects are summarised with DCTOMP (Doctrine, Command & Control, Training, Organisation, Materiel, and Personnel (Soldier)) factors. Knowledge of all aspects will be either imported from other research programmes or developed within the Small Unit Operations Research Programme.

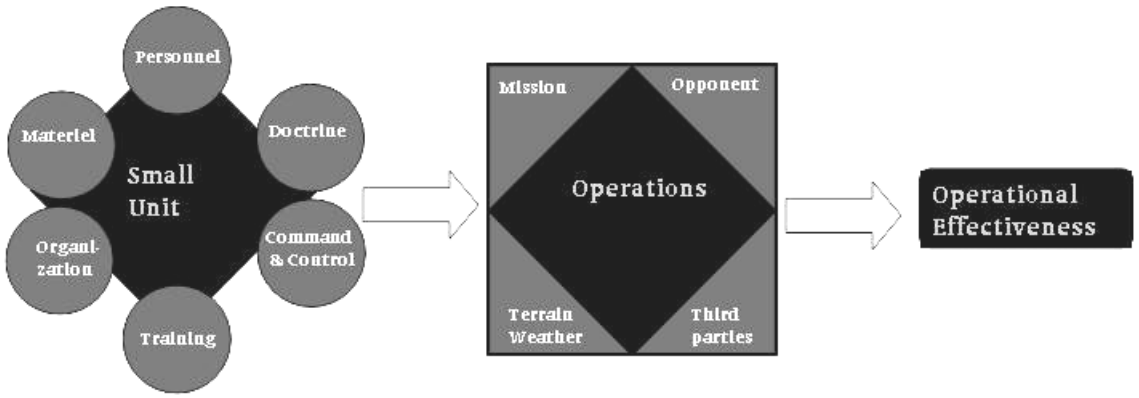

Figure 11: Main result of the Research Programme Small Unit Operations

The overall result of the Research Programme Small Unit Operations will be the capability to translate and to integrate the individual developments in the areas of Doctrine, Command & Control, Training, Organisation, Materiel and Personnel to the operational effectiveness of small units (depicted in Figure 11).

6.3 Work packages

In order to achieve the overall research programme result the research effort is structured in five work packages with related questions:

1. Desired effects. What is the contribution of small units operations to the desired effects in the spectrum of CRO?
   - ? What effects must be generated by a small unit operation?
   - ? What quantities can express whether or not these effects are gained?
   - ? How do different aspects (doctrine, command & control, training, organisation, material and soldier) of the small unit operation contribute to these quantities?
2. Methodology. Which methods can measure or calculate quantities (see 1) and how can changes in these quantities be related to the different aspects (see 1) of small units?
   - ? Which quantities can be established with well known methods?[7]
   - ? What are the benefits and constraints of these methods?
   - ? How can all these methods be incorporated in an overall methodology to quantify the operational effectiveness in the spectrum of CRO?
3. Modelling environment (including International Collaboration). How can both deterministic and stochastic computer models be used as support tools for answering customers' questions?
   - ? What is the system description of the system 'small unit operation'?
   - ? What level of detail of each subsystem is needed to answer customers' questions?
   - ? Making computer models (including the American Integrated Unit Simulation System) applicable for research.

[7] Methods include simulation, field experiments and Subject Matter Expert meetings.

4. Case operational analyses. How can be demonstrated that the overall result of the research programme is achieved?
   - ? What are the relevant (technological) developments on the short and mid term with respect to small unit operations?
   - ? What are the consequences of assessing these developments for the modelling environment?
   - ? Conduct two operational analyses as cases with the following themes:
     - ? In what way can technological developments support the reduction of personnel of infantry units?
     - ? In what way can the integration of manoeuvre units and functional areas other be in order to enhance the operational effectiveness?
5. Operations in Built-up Areas. How can the knowledge gaps be filled in related to Operations in Built-up Areas?
   - ? What is need of the RNLA for support related to Operations in Built-up Areas?
   - ? What kind of knowledge, skills and infrastructure is needed with a high priority for the support of the Army?
   - ? Conducting research in order to fill in selected knowledge, skills and infrastructure gaps.

One or more research projects will be conducted in each work package. Work package 'Desired Effects' will run from 2003 up to 2005; the work package 'Methodology' runs in 2004 and 2005 while all the other work packages run during the whole research programme from 2003 up to 2006.

7. Concluding remarks

Because of the CRO the RNLA is conducting, the Dutch soldier and small units have more and new tasks to perform. TNO is extending its research capability accordingly. In our extended research support vision we combine the experience of operational analyses for combat operations and our present knowledge of (analysing) CRO. Furthermore, we are extending our skills through international information exchange and collaboration and broadening the military knowledge of CRO in close co-operation with the RNLA.

In the end, all our effort is done in order to be able to continue our support of the RNLA with their policy making in general and doctrinal development, materiel procurement and operational planning in particular. This requires a shift of focus in our research and in our abilities towards CRO. The Small Unit Operations Research Programme is doing that explicitly. With the eventual results we will –hopefully– be able to present flexible, practical-minded, multi-disciplined and well-informed research teams of peace support operational analysts.

References

1. Peace Operations - Army Doctrinal Publication III (ADP III), Royal Netherlands Army, 29 June 1999
2. Customer Question Analysis Method (Klantvraag Analyse Methode), F.J.G. Toevank, J. Hamers, B.J.E. Smeenk and R.R. Barbier, TNO-memorandum, 5 February 2002 (in Dutch)
3. Case study results of the operational value of a new command & control component for dismounted infantry operations, G.H. Bakema et al, TNO-report FEL-03-A009/PML 2003-A004, February 2003

4. Effect Based Thinking Makes Army Policy More Durable (Denken in effecten maakt KL-beleid bestendiger), F.J.G. Toevank, B.J.E. Smeenk and M.J.M. Voskuilen, Militaire Spectator, February 2002 (in Dutch)
5. Analysis of close combat results, C.A.M. van Moll and E.N. van Son-de Waard, TNO-report FEL-02-I172/PML 2002-IN23, September 2002
6. Close combat – close up, E. Wierenga, TNO-report FEL-02-S233, November 2002 (in Dutch)
7. Close combat modelling & simulation - Preparing IUSS for RNLA research programs, G.H. Bakema et al, TNO-report FEL-02-A071; PML 2002-A71, July 2002
8. Case study description of the operational value of a new command & control component for dismounted infantry operations, G.H. Bakema, R.R, Barbier, E.N. van Son-de Waard, TNO-report PML 2002-A67/FEL-02-A165, July 2002
9. MoEs for Peace Operations (MoE's voor vredesoperaties), A.I. Martins Botto de Barros et al, TNO-report FEL-01-I082, April 2001 (in Dutch)
10. Measuring Effects of Royal Netherlands Army Operations – interim report 2002 (Effectmeting operationeel optreden Koninklijke Landmacht – tussenrapportage 2002), N.P. van Elst, K.Y. de Jong, M.J.M. Voskuilen and R.R. Barbier, TNO-report FEL-02-I318, January 2003 (in Dutch)
11. Exploratory Research Influence Diagrams (Verkennend Onderzoek Invloedsdiagrammen), N.P. van Elst and B.J. Visser, TNO-report FEL-02-B314, March 2003 (in Dutch)
12. Universal Joint Task List (UJTL), United States of America Joint Staff, 1 July 2002
13. Draft Programme V215 Small Unit Operations (Concept-bestedingsovereenkomst programma V215 Optreden Kleine Eenheden), version 16, 15 January 2003 (in Dutch)
14. Programme V903 Soldier Modernisation (Bestedingsovereenkomst programma V903 Soldier Modernisation), november 1999 (in Dutch)
15. Programme V205 Soldier Efficacy (Bestedingsovereenkomst programma V205 Soldaateffectiviteit), version 2.2, 14 March 2003 (in Dutch)