An Effect Based Approach to the Application of Weapon Systems

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ABSTRACT

Nowadays, western armed forces more and more use the effects of their actions as a starting point for operations. Concepts such as Effect Based (Approach to) Operations, Comprehensive Approach and others display this evolution.

When it comes to weapon systems, the armed forces struggle to use these concepts and to translate them into guidelines. Therefore, TNO tries to set up a methodology to efficiently use effects as a starting point to answer questions related to the acquisition and use of weapon systems.

One part of the TNO work is focused on designing a quick and simple method to match multiple weapon systems to multiple tasks. The method matches the effects that are required by the tasks to the effects that can be reached by using the weapon system. The method gives way to tools, for instance:

Weapon Selection Tool: for commanders to make a weapon selection before performing an operation,

Flexibility Rating: for rating a weapon system on flexibility before acquisition,

Quick Task Scanner: for quickly scanning the inventory of weapon systems to find the most appropriate one for a novel task.

The method is able to deal with requirements that can be considered not-primary, such as collateral damage, weapon wear and environmental damage. These secondary effects, together with the primary effects, are used to rate combinations of weapon systems and tasks. In such a way, one can reach a ranking of weapon system – task combinations within a split second. The method has been implemented in a software tool for demonstration purposes.

1.0 BACKGROUND

The RNLA sees rapidly changing ways of operation. Out of area missions are carried out in different parts of the world, in different climates, with varying environments, ranging from deserts to urban areas and with varying attrition levels. In this respect operational requirements on weapon systems are ever changing. The variation in theatres and fast changing tasks also pose changes on the requirements.

Effect Based Approach to Operations (EBAO) also poses changes in requirements. In EBAO military operations are only one level of concerted actions, which range from political to informational aimed at obtaining a certain effect. More and more the focus is on changing behaviour in other ways and on reducing generating secondary unnecessary effects. This will also change requirements on weapon systems.

The consequence is an increasing complexity in the decision process, trying to balance all kinds of alternative effect bringers. In the current processes, experiences and lessons learned form the main basis

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14. ABSTRACT
Nowadays, western armed forces more and more use the effects of their actions as a starting point for operations. Concepts such as Effect Based (Approach to) Operations, Comprehensive Approach and others display this evolution. When it comes to weapon systems, the armed forces struggle to use these concepts and to translate them into guidelines. Therefore, TNO tries to set up a methodology to efficiently use effects as a starting point to answer questions related to the acquisition and use of weapon systems. One part of the TNO work is focused on designing a quick and simple method to match multiple weapon systems to multiple tasks. The method matches the effects that are required by the tasks to the effects that can be reached by using the weapon system. The method gives way to tools, for instance:

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for creating requirements – a basis that doesn't allow for an objective adjustment to new situations. Moreover, the requirements generating process is long and time consuming whilst external factors often necessitate a fast and flexible process.

To handle rapidly changing tasks and the increasing complexity there is a need for a quick, objective method, which helps to determine whether a weapon system is suited for its task, considering all kinds of constraints imposed by this complexity. In this paper such method is described. The method was originally aimed at obtaining supportive methods and tools to detect and capture new, innovative ways of using weapon systems. E.g. to use an anti-tank system for wall breaching.

2.0 DECISION SUPPORT METHOD

Because of the chang es described above, the decision for the deployment of a weapon system needs to be done taking into account a much broader view, with many more parameters. The complex decision process clearly needs supportive methods and tools. A decision support method has been derived on how to apply weapon systems in various contexts.

The purpose of the method is to relate a set of weapon systems to a set of military tasks. To be able to assess whether a weapon system is suited for a task, both weapon systems and tasks need to be defined in a way that comparison is possible. For each task and each weapon system an estimation needs to be made to what extent they match. To enable the estimation tasks are described as a set of parameters, which give the objectives of the task in terms of required effects on certain targets or other objects. On the other side of the balance weapon systems need to be described in a similar way with similar parameters.

The method uses a generic approach to describe weapon systems and effects. For weapon systems and task effects generic normalised descriptions have been derived which enable a comparison between task effects to obtain and weapon systems to obtain the effect. The method uses the normalised description to relate weapon system capabilities to a set of tasks. The method comprises two parts. A modelling part and an analysis part. The modelling provides the basic ingredients for the method. An effect based approach to the application of weapon systems comprises several basic elements: effects, application and weapon systems. Effects can be described in many ways. An effect is defined in this study as a change of state. The situation usually comprises an object or a target for which a state change is required, e.g. a running insurgent who needs to be stopped. A weapon system is used to realise such state change: an interaction.

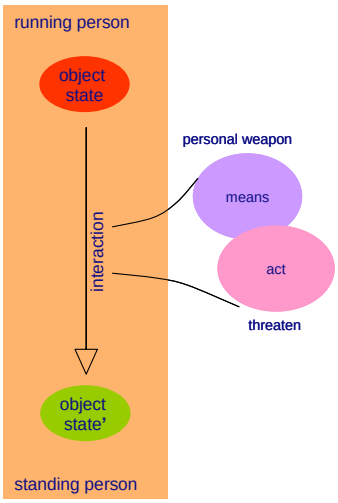

Figure 1: Schematic of method ingredients.

To stop a running person may be accomplished by actually firing the weapon system. However it may also suffice to threaten to fire the weapon system. In both cases the state of the target has been changed from running to stopped. Two different interactions with the same weapon systems, resulting in the same effect. The modelling part results in a set of libraries containing descriptions of weapon systems and descriptions of tasks.

The analysis part of the method is used to determine the suitability of weapon systems to certain tasks or set of tasks. The suitability is based on required effects. It is analysed whether required effects (on an object) can be obtained by a certain weapon system.

2.1 Modelling

Weapon system capabilities

Weapon systems provide capabilities to perform tasks to accomplish missions. A weapon system has the capability to kill or damage a target system. To realise this a set of subsystems is used to fulfil specific sub-functions which in conjunction provide the primary capability. Weapon systems are described by their capabilities. The capabilities are based on the generic effects. A list of generic effects is shown in a subsequent paragraph. For a weapon system it is noted at what range the effect needs to be established and whether the weapon system would likely result in collateral damage.

In various environments different definitions of a ‘weapon system’ are used. In the context of this research a weapon system is the whole of firing platform, firing mechanism, munition and operator. An example is main battle tank including its crew and ammunition, or a personal weapon and its bearer. The weapon system as a whole is a means to obtain some effect.

Tasks and Effects

In military context a task is a set of actions in an operation. For instance ‘protection of sites, areas and persons’. This task is very complex, and it is unclear what weapon systems might be suitable. In many situations different weapon systems might be used. Therefore we like to describe a task in a slightly different way by defining its effect. An effect is a changed object state. The effect is obtained by an interaction, using a weapon system against the object.

A task may be described as ‘stopping a running insurgent’. The term stopping might be interpreted in various ways: having him killed; having him unmoving on the ground; having him standing still. Depending on context either of the alternatives is possible, but some may not be acceptable. Figure 1 shows an example of the terms. A set of generic effects has been established based on earlier EBAO research. The following effects are used:

Destroyed (Killed)	Degraded (Wounded)	Delayed	Denied
Disrupted	Decapacitated	Dislocated	Diverted
Defended	Deterred	Deceived	Demoralised
Isolated	Controlled		

Table 1: Generic effects

The generic effects might be expressed as ‘object is degraded’ where object types are further detailed for instance using the following object categories.

Objectcategory
Human
Platform
Infrastructure

Table 2: Object categories

2.2 Analyses

Using some generic effects and the objects the following table describes what a certain weapon system might obtain when used against a human, a platform or infrastructure.

Effect of weapon system X	Human	Platform	Infrastructure
Object is denied	x		
Object is identified	x	x	x
Object is destroyed	x	x	x
Object is dislocated	x	x	
Object is degraded	x	x	x
Object is deterred	x		
Object is demoralised	x		

Table 3: Example weapon system effect

Tasks can be described in a similar way resulting in similar tables.

Required effect of task Y	Human	Platform	Infrastructure
Object is denied	x	x	
Object is degraded	x	x	x

Table 4: Example task required effect

The suitability of the weapon system to the task can then be assessed by comparing the two tables. For convenience the associated rows have been made gray. It can be seen that the weapon system does not fully match. It does not obtain the effect ‘platform denied’.

This is a rather crude way of assessing suitability. To increase credibility and improve usefulness additional information is needed. We might add an initial cost parameter, which differentiates between various weapon systems. We also might add some parameters based on the categories cost and effect. Effect parameters may include the importance of the required effect (must have or nice to have) and capability ranges. At the cost side one might think of whether the combination weapon system – effect is a feasible possibility or it provides an oversized possibility which will result in collateral damage.

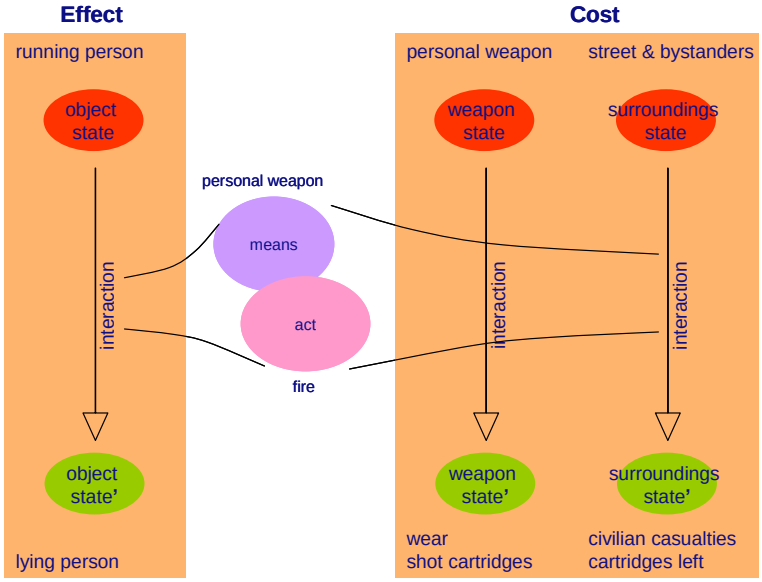

Figure 2: Interaction effect and cost.

Result parameters from vulnerability-lethality studies might be included to discern between the various possible weapon system – task combinations and to further detail weapon system – object effects.

3.0 SOFTWARE TOOL

The method as described above has been implemented into a software proof-of-concept. The user (e.g. operational commander) enters the expected tasks and expected objects, he might encounter. Subsequently he queries the tool on weapon systems for 'fit for use'. The tool replies with a 'fit for use' report showing a measure for the suitability of a specific weapon system for a certain task. The examples shown contain completely arbitrary data. The functionalities of the tool are based on the main aspects of the method:

- Input, storage and maintenance of tasks;

Tasks are described by their required effects. A list of generic tasks is shown for a specific target object type. It is noted whether the effect needs to or must be obtained (mandatory or not), and at what range the effect needs to be established.

Note: The example screens display the Function and function names where Effect and associated effects are used.

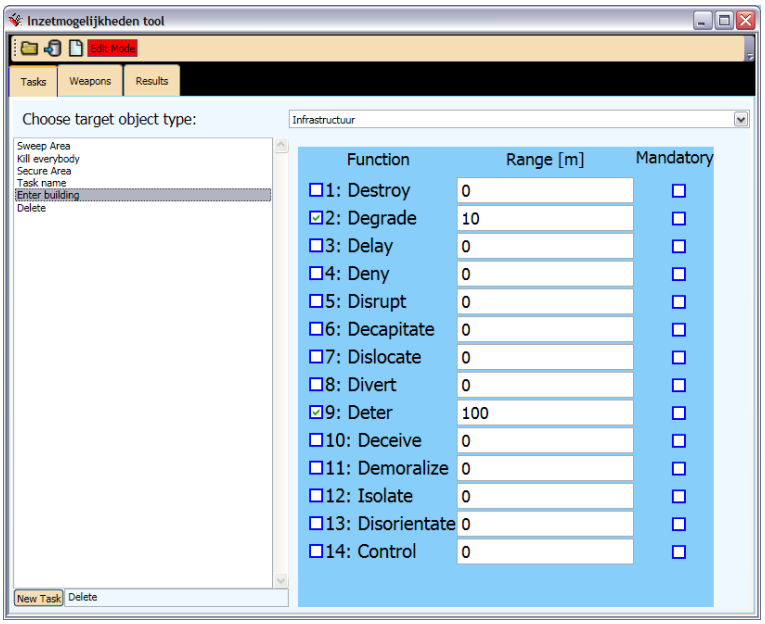

Figure 3: Software example screen: task input.

- Input, storage and maintenance of weapon systems;

Weapon systems are described by their capabilities. Weapon system capabilities comrise effects which are similar to those required by tasks. The same list of generic effects is used. And at what range the effect can be established is added as a parameter. Additionally a parameter is added giving an indication of the expected amount of collateral damage with respect to the effect – range values and the selected target object type.

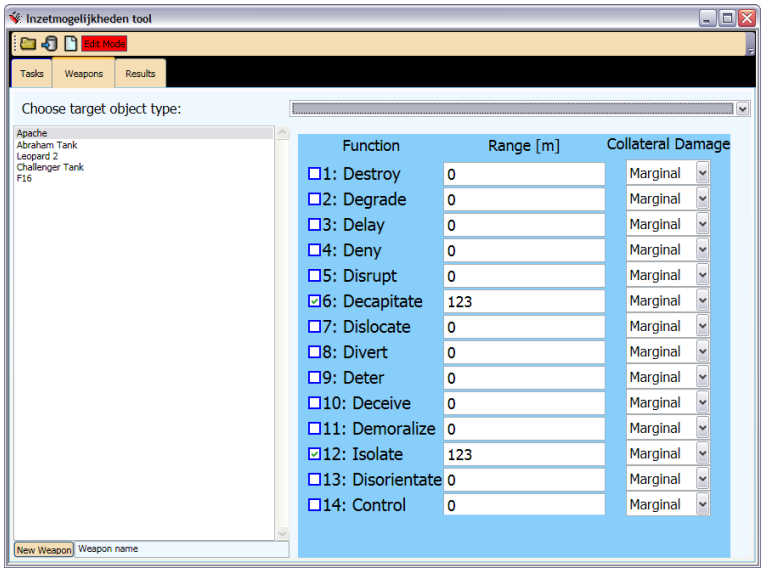

Figure 4: Software example screen: weapon system input.

- Comparing a selected set of weapon systems and tasks, resulting in an assessment report for each task-weapon system combination.

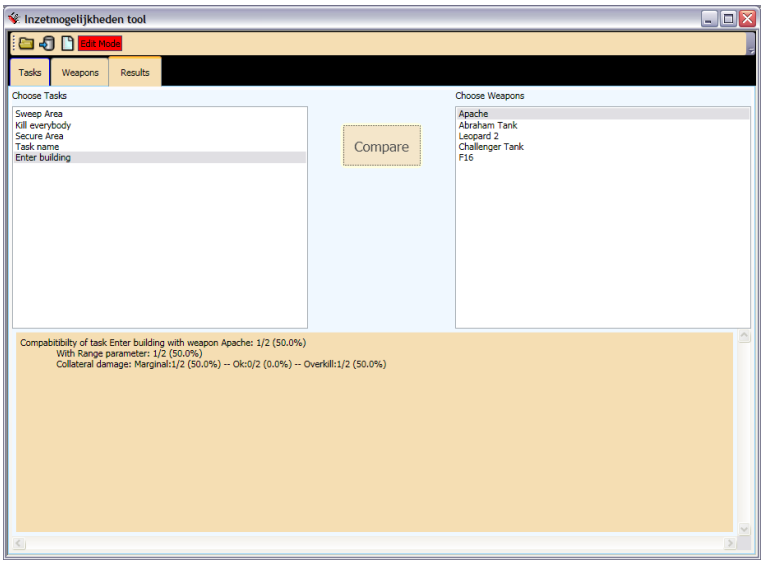

Figure 5: Software example screen: compare.

4.0 CONCLUSION AND FUTURE APPLICATIONS

The result of the investigations is a method and a proof-of-concept implementation to assess the suitability of effects of weapon systems for tasks. Therefore weapon systems and tasks are transformed in a neutral format which enables comparing weapon system – task combinations. This has been realised by:

- describing a weapon system as a set of capabilities based on generic effects;
- describing a task as a set of required effects;
- relating specific parameters to the capabilities and to the required effects.

The method and tool described do not claim to give exact answers or to provide an objective way for selection of a weapon system in any environment. As such it will very unlikely be used in the field. It is a simple tool and merely a first research step into the area of EBAO at the lowest level of operations.

It can be seen as a first approach to a more extended and mature method and application. During the development additional methodical steps have been identified to extend and improve the method. One of the steps has been mentioned: the addition of parameters for the cost and benefit of using a weapon system. Future work might address the following topics.

The method and software have only be minimally tested on usability and usefulness. Trying it out with domain experts may clarfiy the strengths and weaknesses and lead to future extensions.

Only a single weapon system for a task has been addressed in the limited scope of the project. In practice mixes of weapon systems are present. The method might be extended in this respect. Also distributed capabilities and effects might be considered.

Another way to extend the method and software to relate required effects to available capabilities is to obtain the physical results (damage) of a weapon system on various targets. Therefore tasks and weapon systems can be specified as a set of values describing the physical characteristics of an interaction.

The tool has been designed as a first step to support the selection of weapon systems for tasks. Future investigations will also address using the method in other defence processes, such as acquisition of new or upgrades for existing weapon systems.

We consider to use the tool as a Quick Task Scanner for new tasks. We might introduce new tasks by describing them in terms of the generic functions available in the software tool. With newly defined tasks we may analyse the suitability of weapon systems for the task and find the most appropriate one.

The tool might be used for Flexibility Rating to rate a weapon system on flexibility of use before acquisition. This can be obtained by investigating which tasks can be feasibly carried out using a specific weapon system or weapon system design.