

# DEVELOPMENT OF A M&S CONCEPT TO SUPPORT THE MILITARY OPERATIONS PROCESS

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## The need

Military interventions aim to influence the world in order to establish a desired end-state. To this end, a commander follows the operations process by which a desired end-state is translated to tactical activities conducted by the units under his command. Doing so successfully requires a high level of situational understanding. A commander will have to make inferences about effects and future behaviour in the face of deep uncertainty. Modelling and simulation (M&S) methods, such as System Dynamics, could serve as a useful capability to support the operations process.

## Approach Case based concept development and experimentation of a M&S concepts to support the military operations process

### Challenge 1: Actors, factors and complex interactions across the physical, information and human landscape

The recent increase in hybrid threats signals the importance of considering a broader scope of factors and actors than solely military. A multi-method M&S approach is needed that integrates time and space factors, tangible factors as well as intangible factors.

### Challenge 2: Uncertainty: M&S in the 'fog of war'

Many relevant variables cannot be directly, accurately and/or continuously observed. This causes inherent uncertainty about the state of the world, the drivers of behaviour, effects of actions and what goals a commander can best aim for. Analysis of a broad set of plausible futures generated by variations in models, relations and parameters is needed with the aim of robustness and adaptability.

### Challenge 3: Beyond problem understanding: Support the COA development and evaluation

A commander will need to decide *what* to do, *when* and *where*. M&S should therefore support analysis of *time* and *place* specific actions and effects in the human, information and physical terrain.

### Challenge 4: The need for flexibility

To handle new environments, new opponents and evolving dynamics, model building and refinement should be fast and flexible. Model iterations should capture growing understanding. This requires easily altered and re-usable structure, distributed collaboration, separation between structure and data, short run time and accessible analyses. Transparency is vital for collaboration and hand-overs.

## Proof of concept model

- Collaborative development with end-users
- Entity based SD
- Spatial and non-spatial factors
- Capable of COA testing under uncertainty
- Interactive data displays

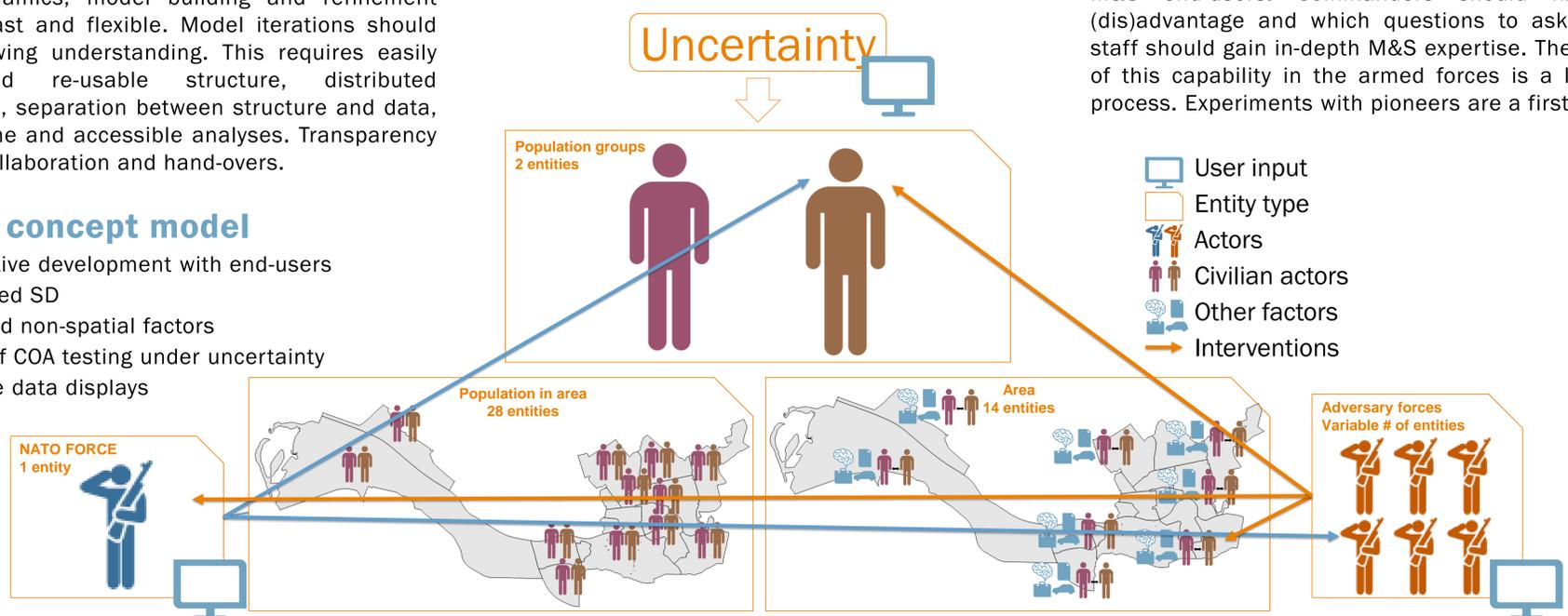


Figure 2. High level description of the proof-of-concept model developed and used in the latest experiment

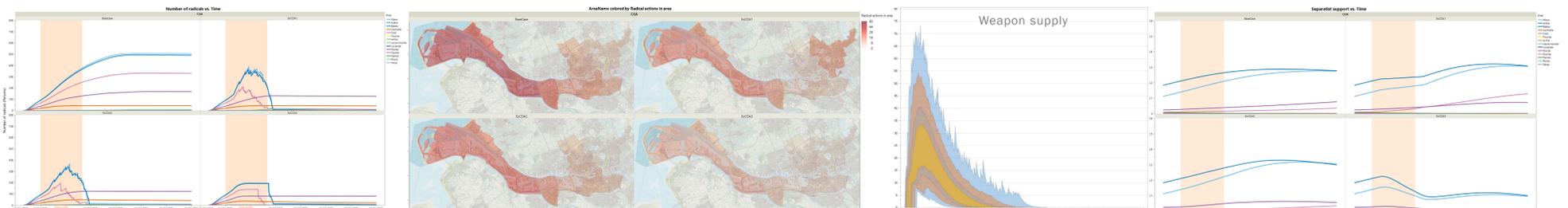


Figure 3. Example outputs of a base case and three COAs. Outputs are accessible through an interactive user interface that allows quick access to time series data (left and right), spatial data (second from left) and uncertainty analyses (second from right). All displays support comparison of different COAs

## CD&E workshops

Iterative concept development and experimentation with stakeholders (military staff, operational analysts, intelligence analysts) over the past 2 years during several workshops with topics such as:

- Needs and challenges
- Integration in the operations process
- Establish GMB as suitable method
- Uncertainty analyses and clustering techniques
- Suitability of data displays
- Latest experiment: Full approach

## Latest experiment

A 2 day workshop with stakeholders focused on a fictitious NATO Article 4/5 situation. Three steps:

- Current state-of-art approach: Asses situation using qualitative MARVEL modelling. Qualitative COA development and comparison.
- Future approach: Analyses of situation aided by proof-of-concept model simulations (see Figure 2.) COA development and comparison by simulation
- Evaluation of benefit for understanding and plan

## Current state-of-art

Within the Netherlands armed forces operations process, qualitative modelling techniques such as Causal Loop Diagrams and MARVEL are used. (Veldhuis et al. 2015). However, the simulation capabilities of M&S methods (such as stock-and-flow or agent-based models) are not. Analysis of US operations research activities during Operations Enduring Freedom and Iraqi Freedom revealed only limited use of M&S, with mixed results (Connable et al., 2014). Which challenges does M&S face when applied in the operations process?

### Challenge 5: Integration within the operations process

When there is no clearly defined role for M&S within existing staff processes, it is at risk of becoming a separate stream of activities with little added value. Structured process integration enables alignment of questions, input and timely delivery of output.

### Challenge 6: Incorporating tacit knowledge

Gathering hard data is difficult, requires scarce intelligence assets while results often have limited reliability. Models can and should rely on the growing understanding that the people on the ground acquire. Not only soldiers, but civilians, diplomats and NGO's. Model building itself can foster cooperation and shared understanding.

### Challenge 7: (P)resenting modelling & simulation

Commanders and their staff are usually not familiar with M&S methods and information displays and the potential uses and limitations of M&S are not intuitive. A tiered approach (M&S expert - OA/Intel analyst - end-user) is required to facilitate both high quality analyses and effective end-user advice in familiar formats and integrated with other available methods.

### Challenge 8: Effective and critical users

Current experience of military staff does not necessarily prepare them to be critical and effective M&S end-users. Commanders should know the (dis)advantage and which questions to ask. Analyst staff should gain in-depth M&S expertise. The building of this capability in the armed forces is a long-term process. Experiments with pioneers are a first step.

- Computer icon: User input
- Orange box: Entity type
- Purple figure: Actors
- Brown figure: Civilian actors
- Blue figure: Other factors
- Orange arrow: Interventions

## Way-ahead

- On-going: implementation of qualitative modelling methods in military staff, such as MARVEL
- Continued development of quantitative methods, raising awareness and acceptance through use in experiments and exercises.

## REFERENCES

- Connable, B., Perry, W. L., Doll, A., Lander, N., & Madden, D. (2014). Modeling, Simulation, and Operations Analysis in Afghanistan and Iraq. RAND National Defense Research Institute.
- Veldhuis, G. A., van Scheepstal, P., Rouwette, E., & Logtens, T. (2015). Collaborative problem structuring using MARVEL. EURO Journal on Decision Processes, 3: 249-273.
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