



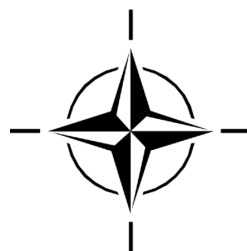
STO MEETING PROCEEDINGS

MP-SAS-115

SMART Cooperation on Operation Analysis Simulation Models

(Coopération INTELLIGENTE sur les modèles
de simulation de l'analyse opérationnelle)

This Report documents the findings from the SAS-115 Research Workshop on “SMART Cooperation on Operation Analysis Simulation Models” which was held from 13-15 October 2015 in Stockholm, Sweden. The Workshop examined the possibilities of SMART cooperation in OA simulation models.



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The NATO Science and Technology Organization

Science & Technology (S&T) in the NATO context is defined as the selective and rigorous generation and application of state-of-the-art, validated knowledge for defence and security purposes. S&T activities embrace scientific research, technology development, transition, application and field-testing, experimentation and a range of related scientific activities that include systems engineering, operational research and analysis, synthesis, integration and validation of knowledge derived through the scientific method.

In NATO, S&T is addressed using different business models, namely a collaborative business model where NATO provides a forum where NATO Nations and partner Nations elect to use their national resources to define, conduct and promote cooperative research and information exchange, and secondly an in-house delivery business model where S&T activities are conducted in a NATO dedicated executive body, having its own personnel, capabilities and infrastructure.

The mission of the NATO Science & Technology Organization (STO) is to help position the Nations' and NATO's S&T investments as a strategic enabler of the knowledge and technology advantage for the defence and security posture of NATO Nations and partner Nations, by conducting and promoting S&T activities that augment and leverage the capabilities and programmes of the Alliance, of the NATO Nations and the partner Nations, in support of NATO's objectives, and contributing to NATO's ability to enable and influence security and defence related capability development and threat mitigation in NATO Nations and partner Nations, in accordance with NATO policies.

The total spectrum of this collaborative effort is addressed by six Technical Panels who manage a wide range of scientific research activities, a Group specialising in modelling and simulation, plus a Committee dedicated to supporting the information management needs of the organization.

- AVT Applied Vehicle Technology Panel
- HFM Human Factors and Medicine Panel
- IST Information Systems Technology Panel
- NMSG NATO Modelling and Simulation Group
- SAS System Analysis and Studies Panel
- SCI Systems Concepts and Integration Panel
- SET Sensors and Electronics Technology Panel

These Panels and Group are the power-house of the collaborative model and are made up of national representatives as well as recognised world-class scientists, engineers and information specialists. In addition to providing critical technical oversight, they also provide a communication link to military users and other NATO bodies.

The scientific and technological work is carried out by Technical Teams, created under one or more of these eight bodies, for specific research activities which have a defined duration. These research activities can take a variety of forms, including Task Groups, Workshops, Symposia, Specialists' Meetings, Lecture Series and Technical Courses.

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SMART Cooperation on Operation Analysis Simulation Models (STO-MP-SAS-115)

Executive Summary

SMART defence (a NATO concept) is mostly related to procurement of materiel and equipment, logistic support and/or operations. However, a SMART approach is also required in Science & Technology (S&T); more specifically in S&T infrastructure which is expensive to acquire, develop and maintain. With regards to SMART S&T infrastructure, a large variety of assets can be considered, such as: test labs; CD&E (Concept Development and Experimentation) facilities; and simulation models. For this study, the scope has been limited to SMART cooperation in the field of Operational Analysis (OA) simulation models.

When the Exploratory Team held their meeting in 2014, a decision was taken to organise a Workshop. During this Workshop, a working group has examined the possibilities of SMART cooperation in OA simulation models. We know that now and in the past, good examples of co-development, sharing and exchanging of OA simulation models do exist. Nevertheless, a lot of potential interesting opportunities to exploit SMART cooperation in OA simulation models failed, due to all kinds of reasons. The overall objective for the Workshop was to increase SMART cooperation in OA simulation models with the objective end-state being cost reductions, improved efficiency and the ability for NATO and Partner Nations to leverage the existing good practices within the Alliance on sharing models.

The Workshop identified current barriers that restrict the sharing of models and provided a range of solutions to minimise or remove those barriers. The participants also presented lessons learned from past experience with respect to model exchange and/or collaborative development and use. Finally, the Workshop discussed and came up with recommendations on how to create and manage a NATO model portfolio containing up-to-date information on potentially sharable OA simulation models.

One of the basic sources for the Workshop was a document called “Guidance on good practice for sharing models”¹. One of the recommendations in the document states “that the guidance continues to be revisited and, if necessary, updated in light of further experience on a regular basis”. Although the scope of the TTCP document is on models in general, it was expected that the guidance provided would also be relevant for OA simulation models.

How to take advantage of the TTCP document was discussed during the Workshop. It was decided not to simply review the TTCP document, but instead to first brainstorm on the topics and recommendations for cooperation in OA simulation models, drawing on the experiences of the (Nations of the) participants. Subsequently, the results were compared with the TTCP document, to assess whether or not a new NATO document had to be produced.

The comparison proved that the TTCP document provided a solid base, with sound guidance for cooperation in OA simulation models – and with a few minor additions, would also satisfy the SAS-115 objectives.

¹ This document is produced by the Joint Concept and Analysis Panel (JAS-TP-3) of the TTCP, with reference TR-JSA-TP3-7-2000. Version 3, dated October 2002 is publicly available. The TTCP is The Technical Cooperation Program, a collaboration of Australia, Canada, New Zealand, the United Kingdom and the United States of America.

Coopération INTELLIGENTE sur les modèles de simulation de l'analyse opérationnelle

(STO-MP-SAS-115)

Synthèse

La défense INTELLIGENTE (un concept de l'OTAN) est principalement associée à l'achat de matériel et d'équipement, au soutien logistique et/ou aux opérations. Il est toutefois nécessaire de mettre aussi en place une approche INTELLIGENTE de la science et de la technologie (S&T) et plus précisément de l'infrastructure de S&T dont l'acquisition, le développement et l'entretien coûtent cher. En matière d'infrastructure INTELLIGENTE de S&T, une grande variété d'éléments peut être envisagée : des laboratoires d'essai, des installations de développement de concepts et d'expérimentation (CD&E), et des modèles de simulation. Pour cette étude, le champ a été limité à la coopération INTELLIGENTE dans le domaine des modèles de simulation de l'analyse opérationnelle (OA).

Quand l'équipe exploratoire s'est réunie en 2014, il a été décidé d'organiser un Atelier. Pendant cet Atelier, un groupe de travail a examiné les possibilités de coopération INTELLIGENTE concernant les modèles de simulation de l'OA. Nous savons qu'il existe de bons exemples actuels et passés de co-développement, de partage et d'échange de modèles de simulation de l'OA. Néanmoins, beaucoup d'occasions potentiellement intéressantes d'exploitation de la coopération INTELLIGENTE à ce propos ont été manquées, pour toutes sortes de raisons. L'objectif global de l'Atelier était donc d'accroître la coopération INTELLIGENTE relative aux modèles de simulation de l'OA, dans le but d'obtenir des réductions de coûts, une meilleure efficacité et de permettre aux Nations et aux Partenaires de l'OTAN de tirer bénéfice des bonnes pratiques existantes au sein de l'Alliance concernant le partage de modèles.

L'Atelier a permis d'identifier les obstacles actuels limitant le partage des modèles et a proposé un éventail de solutions pour minimiser ou lever ces obstacles. Les participants ont également présenté les leçons tirées de leur expérience de l'échange et/ou de l'élaboration et l'utilisation collaboratives des modèles. Enfin, le séminaire a débattu et abouti à des recommandations sur la façon de créer et gérer un catalogue de modèles de l'OTAN contenant des informations à jour sur les modèles de simulation de l'OA potentiellement échangeables.

L'un des points de référence de l'Atelier était un document intitulé « *Guidance on good practice for sharing models* (Guide des bonnes pratiques de partage de modèles) »². L'une des recommandations dans ce document est que « le guide soit régulièrement revu et, si nécessaire, mis à jour à la lumière de l'expérience emmagasinée ». Bien que le document du TTCP porte sur les modèles en général, il était espéré que les conseils fournis soient également pertinents pour les modèles de simulation de l'OA.

Au cours de l'Atelier, les participants ont discuté de la manière de tirer parti du document du TTCP. Il a été décidé de ne pas se contenter d'un simple passage en revue du document, mais de réaliser d'abord un brainstorming sur les sujets et recommandations de coopération en rapport avec les modèles de simulation de l'OA, en s'appuyant sur l'expérience des (pays des) participants. Les résultats ont ensuite été comparés avec le document du TTCP, afin d'évaluer la nécessité de produire ou non un nouveau document OTAN.

² Ce document a été rédigé par la Commission interarmées de concept et d'analyse (JAS-TP-3) du TTCP, avec pour référence le TR-JSA-TP3-7-2000. La version 3, d'octobre 2002, est du domaine public. L'abréviation TTCP désigne *The Technical Cooperation Program*, une collaboration entre l'Australie, le Canada, la Nouvelle-Zélande, le Royaume-Uni et les Etats-Unis d'Amérique.

L'analyse comparative a démontré que le document du TTCP offrait une base solide, avec de bons conseils en matière de coopération sur les modèles de simulation de l'OA, et qu'il répondrait également aux objectifs du SAS-115 avec quelques ajouts mineurs.



SMART COOPERATION ON OPERATION ANALYSIS SIMULATION MODELS

1.0 INTRODUCTION

When the Exploratory Team (NATO SAS ET.CT) held their meeting in 2014, a decision was taken to organise an SAS Workshop on the topic “SMART Cooperation in OA Simulation Models” with the aim to increase SMART cooperation in OA simulation models with the objective end-state being cost reductions, improved efficiency and the ability for NATO and Partner Nations to leverage the existing good practices within the Alliance on sharing models.

This is the documentation from the Workshop from the NATO SAS-115 RWS held 13-15 October 2015 at FOI in Kista, Sweden.

2.0 PARTICIPANTS

The working group consisted of following participants:

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3.0 AGENDA

The Workshop covered these main activities:

- Introduction and practical issues;
- Presentation of FOI;
- Discussion on what to achieve;
- Participants/Nations briefs on OA simulation models with focus on experiences from sharing models;
- Brainstorming exercise;
- Presentation of results from brainstorming exercise;
- Documentation (small groups); and
- Discussion on how to take this further.

4.0 OBJECTIVES

- Participants Identify current barriers that restrict the sharing of models and provide a range of solutions to minimise or remove those barriers.
- Identify best practices and lessons learned from past experience with respect to model exchange and/or collaborative development and use.
- Provide recommendations on how to create and manage a NATO model portfolio containing up-to-date information on potentially sharable OA simulation models.

5.0 PROCESS AND RESULTS

The participants of the 2014 Exploratory Team meeting were already aware of a relevant document titled “Guidance on good practice for sharing models”. This document was produced by the Joint Concept and Analysis Panel (JAS-TP-3) of the TTCP¹, with reference TR-JSA-TP3-7-2000. Version 3, dated October 2002 is publicly available. One of the recommendations in the document states “*that the guidance continues to be revisited and, if necessary, updated in light of further experience on a regular basis*”. In fact, in 2014 an update of this document was created (reference TR-JSA-TP3-7-2014). The point of contact for the JCA Panel informed the working group that while the 2014 version had not yet been officially released, the 2002 version remained a valid point of reference when considering sharing models between Nations.

Although the scope of the TTCP document is on models in general, it was expected that the guidance provided would also be relevant for OA Simulation Models.

During the SAS-115 meeting it was discussed how to take advantage of the TTCP document. It was decided not to simply review the TTCP document, but instead to first brainstorm on the topics and recommendations for cooperation in OA simulation models, drawing on the experiences of the (Nations of the) participants. Subsequently, the results were compared with the TTCP document, to assess whether or not a new NATO document had to be produced.

The comparison proved that the TTCP document was a solid base with sound guidance for cooperation in OA simulation models, and with a few minor additions would also satisfy the SAS-115 objectives. The recommendations with regards to the TTCP document are provided in this SAS-115 document.

An additional advantage to this approach is that if the SAS-115 recommendations are approved by the TTCP panel, then there will be one common guidance document shared by the TTCP and NATO (taking into account that three of the five TTCP countries are also NATO Nations).

6.0 WORKSHOP

The Workshop began with presentations from each participant, which focussed primarily on their experience with sharing models. These presentations are available as “Supporting Documents”, which will be published on the CSO/STO website as part of this report.

The main activity was the brainstorming session where the focus was to identify barriers for sharing models. The focus question for the brainstorming session was:

What are the challenges for developing and sharing OA-simulations models (tools, databases, models within tools, procedures, etc.)?

¹ The TTCP is The Technical Cooperation Program, a collaboration of Australia, Canada, New Zealand, the United Kingdom and the United States of America.

7.0 RESULT FROM BRAINSTORMING SESSION

Cluster 1A

- Comparable development process
- Common concept language
- Modularity based models
- Common programming interface
- Making people use existing standards

Cluster 1B

- Common standards for VVA
- Mistrust – “Not invented here”
- Risk for misuse by others
- Trust vs. known usability
- Algorithmically suitability – Different principles

Cluster 1C

- Configuration management

Cluster 2A

- Data requirement availability
- Must highlight what we can expect from a model
- User friendliness for others:
 - Interface
 - Documentation
- Complete documentation (current)
- Using only parts of a model

Cluster 2B

- Lack of fora for sharing model experience
- Long-term commitment:
 - Guaranteed funding
- One organisation responsible for the complete M&S sharing process
- Need for a Lessons Learned process

Cluster 2C

- Convincing decision-makers
- Beneficence for the giver

Cluster 3A

- How to know what models are on the “Market”
- Common sharing framework:
 - Who is responsible?
- Dealing with classified issues
- What to tell the “Market”
- Know what is possible to give or not

Cluster 3B

- Limitations of responsibility in changes in models
- Ownership responsibilities
- Official bureaucracy
- Who is responsible for what?
- Responsibility for given models

Cluster 3C

- Professional assistance to use the model
- Cost for elaborating the model for new use
- Obtaining cost
- Cost for sharing:
 - License
 - Training
 - ...

The results from the brainstorming were then used as reference points for reviewing the TTCP document “Guidance on good practice for sharing models”. One purpose of this review was to identify content that should be changed or added to address the NATO perspective.

This work was done in smaller groups, where each group addressed three clusters each. The focus of this work was to compare the identified challenges to the TTCP document and see if there were any differences of opinion. If such a difference was identified, the group formulated a solution/recommendation.

To conduct this review, a template was used (see Appendix 1) to address all the questions (which are noted in “bold” text) – the questions and responses resulting from the review are presented below.

Cluster 1

Section 29, Dash 5. TR-JSA-TP3-7-2000, Section 24, Bullet 3.

It is recommended to replace the statement “RELEASE THE SOURCE CODE” with “CONSIDER RELEASING THE SOURCE CODE”.

The described arguments for releasing the source code are valid and commendable, but another issue with multiple users changing source code is that it makes configuration management more complex (see recommendation for “*Recipient Responsibilities*” below).

TR-JSA-TP3-7-2000, Annex B, Section B5, bullet 4.

It is stated that “There is no cut-and-dried process to model validation”.

It is recommended that Bullet 4 be replaced with the following text:

However, within SISO and NMSG, a standard has been developed that can be used as a guideline. It is described in SISO guide 001.1-2012 “Generic Methodology for Verification and Validation (GM-VV) to Support Acceptance of Models, Simulations and Data”, dated 13 January 2012.

It has also been recommended that this standard be adopted by NATO in the NATO Standard AMSP-1, NATO Modelling and Simulation Standards Profile, Edition C, Version 1, March 2015”.

It is recommended that STO assumes responsibility for managing a single NATO repository for OA models (to be fed by NMSG and SAS), in close cooperation with, or as part of, the NCIA efforts.

Cluster 2A

Challenge: User friendliness for others: interface documentation.

Why:

- Increase acceptance by the recipient.
- Shorten the learning curve.

What:

- User and developer interfaces need to follow some well-known and accepted standards.
- This includes providing interfaces that are clear with respect to intent and provide additional documentation through tooltips, online or other available documentation.
- Units of measure must be clear and unambiguous and be flexible to handle common measurement standards.
- Interfaces should be robust and only allow appropriate data types, while also warning the user upon incorrect input as to what data types and ranges are valid for entry.
- Programmer interfaces should be clear and understandable; use of common language principles is encouraged.
- Robustness of the interfaces should also provide soft fall errors that are informative and able to allow the system to continue functioning.

When:

- Prior to sharing.
- During development.

Who:

- Supplier/developer.

In order to amend this barrier we need to know more about ...

- Standards for the user and developer interfaces.

Cluster 2B

Challenge: One organisation responsible with long-term support.

Why:

- Improve overall efficiency of the sharing process.
- Offer support and templates for documents such as contracts.
- Provide a broker function – executing transactions.
- Indicate missing standards and improve processes.
- Organise meetings.

What:

- One organisation that oversees and manages repositories with a long-term commitment.
- Instantiates process for M&S in the repository to keep their information up-to-date.

When:

- Now.

Who:

- STO.

In order to amend this barrier we need to know more about ...

- For the organisations mentioned above, their responsibilities and capacity to handle this requirement.
- How to get long-term funding to support this organisation.

Cluster 3A

Challenge: Dealing with classification issues.

Why:

- Respective Nation's classification requirements are not trivial and must be considered as part of models and simulations sharing processes.
- The TTCP document does not address the challenges associated with classification of data and processes.

What:

- Add the following statement:

Data and Algorithm Classification Considerations:

Classification restrictions and requirements must be included as part of the models and simulations sharing and release agreements for each specific model, module, data sets, and algorithms if applicable. It should be clear and apparent to the recipients what they are receiving, specifically when classification restrictions prevent access to data and/or modules that negatively affect modelling and simulation performance.

When:

- Now.

Who:

- Impacts all NATO and PfP Nations.

In order to amend this barrier we need to know more about ...

- Individual model and Nation requirements (*which should be handled directly between the donor and recipient Nation*).

Cluster 3B

Challenge: Limitations of models and simulation sharing responsibilities.

Why:

- After models have been exchanged, recipient Nations will most likely adapt the models and simulations to meet their specific requirements.
- Unfortunately, the TTCP document is not clear and ambiguous as to what the donor responsibilities are when the recipient chooses to make changes to the model they have received.
- Essentially, the question becomes “at what point in the model change, is the donor relieved of maintenance and configuration management responsibilities, and the recipient assumes these responsibilities?”

What:

- Add the following statements:

Donor Responsibilities:

Provide the model recipient with updated versions and/or updated modules and algorithms and openly communicate concerns or issues that will affect the recipient’s model performance.

Recipient Responsibilities:

Donor Limitation of Responsibility – If the recipient Nation chooses to make their own modifications to the model they receive, they assume responsibility for those changes and the potential impacts those changes have on the functionality of the model. In good practice, the recipient should:

- Understand the negative impacts their changes may have on model performance;
- Have open communications with the donor on the modifications; and
- Clearly articulate support requirements within model and simulation release agreement documents.

Where:

- Add the above statement to two places in the TTCP document:
 - TR-JSA-TP3-7-2000, Section 24.
 - TR-JSA-TP3-7-2000, Section 25.

When:

- Now.

Who:

- Impacts all NATO and PfP Nations.

Cluster 3C

Challenge: Costs for model expansion.

Why:

- To fully realise the extent of costs for the recipient when receiving the model and requesting additional expansions or changes that are required for their purposes.

What:

- Add the following statement:

Recipients should be made aware by the donor of the extent of additional costs (fiscal and resource) when new model functionality and new capabilities are requested. Model expansion can be a part of the release agreement or included within the agreed upon responsibilities of the model user group, the help desk or configuration management process.

Where:

- Add the above statement to place in the TTCP document:
 - TR-JSA-TP3-7-2000, Section 26, end of the section.

When:

- Now.

Who:

- Impacts all NATO and PfP Nations.

8.0 PROPOSED MODEL CATALOGUE DATABASE STRUCTURE

As part of the Workshop, the working group was tasked with determining how to create and manage a NATO model portfolio, and identify the amount and type of information needed to make such a database useful. The proposed structure for the database is presented below:

- 1) Model Title and Short Description
- 2) Problem Class:
 - a) Force structure
 - b) Balance of investment
 - c) Equipment acquisition
 - d) Concepts/doctrine/tactics
 - e) Mission rehearsal
 - f) Training
- 3) Problem Domain:
 - a) Command and control
 - b) Intelligence
 - c) Logistics
 - d) Manoeuvre
 - e) Targeting (direct/indirect, air/ground)

- 4) Warfare Class:
 - a) Major combat operations
 - b) Security operations
 - c) Stability operations
 - d) Peacetime military engagement
- 5) Warfare Domain:
 - a) Land
 - b) Sea
 - c) Air
 - d) Cyber
 - e) Space
 - f) Amphibious/littoral
 - g) Joint
- 6) Model Resolution:
 - a) Force level (Platoon, Battalion, Division, Corps, etc.)
 - b) Aggregation level (entity level, aggregated at Company, Brigade, etc.)
 - c) Terrain level (10, 100, 1000 meters, etc.)
 - d) Time scale (hours, days, months, etc.)
 - e) Geographic location focus (e.g. region of the world)
- 7) Model Type and Characteristics:
 - a) Constructive
 - b) Live
 - c) Virtual
 - d) HITL
 - e) Stochastic
 - f) Deterministic
- 8) Environmental Variables:
 - a) Effects (light, weather, etc.)
 - b) Terrain Types:
 - i) Human Terrain (e.g. social networks)
 - ii) Information Terrain (e.g. cyber, information operations, communications networks)
 - iii) Physical Terrain (open, desert, dense forest, mountainous, urban, jungle)
- 9) Model Status and Status Date:
 - a) Retired
 - b) Active/currently in use
 - c) In development
- 10) POC Information:
 - a) Name
 - b) Email
 - c) Phone
 - d) Nation
- 11) Restrictions/Caveats:
 - a) Classification level
 - b) Required licenses
 - c) Required software to run the model
 - d) Required hardware to run the model

Appendix 1: ACTION TEMPLATE

Cluster: _____

Group: _____

Barrier: _____

Action: _____

1. What

2. Why

3. Who

4. Where

5. When

6. In order to amend this barrier we need to know more about ...

REPORT DOCUMENTATION PAGE											
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13. Keywords/Descriptors	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">Co-development</td> <td style="width: 50%;">Operation analysis</td> </tr> <tr> <td>Cost efficiency</td> <td>Simulation</td> </tr> <tr> <td>Model portfolio</td> <td>SMART Defence</td> </tr> <tr> <td>Modelling</td> <td></td> </tr> </table>			Co-development	Operation analysis	Cost efficiency	Simulation	Model portfolio	SMART Defence	Modelling	
Co-development	Operation analysis										
Cost efficiency	Simulation										
Model portfolio	SMART Defence										
Modelling											
14. Abstract	<p>This is the documentation from a Workshop held 13-15 October 2015 at FOI in Kista, Sweden, with the aim to increase SMART cooperation in OA simulation models, and with the objective end-state being cost reductions, improved efficiency and the ability for NATO and Partner Nations to leverage the existing good practices within the Alliance on sharing models.</p> <p>The Workshop identified current barriers that restrict the sharing of models and provided a range of solutions to minimise or remove those barriers. The participants also presented lessons learned from past experience with respect to model exchange and/or collaborative development and use. Finally, the Workshop discussed and came up with recommendations on how to create and manage a NATO model portfolio containing up-to-date information on potentially sharable OA simulation models.</p>										





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