



STO TECHNICAL REPORT

TR-MSG-106

Enhanced CAX Architecture, Design and Methodology – SPHINX

(Architecture, définition et méthodologie
améliorées des exercices assistés
par ordinateur (CAX) – SPHINX)

Final Report of Task Group MSG-106.



Published August 2016





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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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List of Acronyms

ACO	Air Coordination Order
ACT	Allied Command Transformation
ACTORD	Activation Order
ACTREQ	Activation Request
ACTWARN	Activation Warning
AFL	Allied Force List
AIS	Automated Information System
AMSP	Allied Modelling and Simulation Publication
AOI	Area Of Interest
AOO	Air Of Operation
APOD	Airport Of Debarkation
ATO	Air Tasking Order
ATP	Allied Tactical Publication
AUT	Austria
AUTINT	Austrian Armed Forces International Training Centre
BGR	Bulgaria
BIH	Bosnia and Herzegovina
Bi-SC	Bilateral Strategic Command
BLR	Belarus
BML	Battle Management Language
BMP	Boyevaya Mashina Pekhoty (Soviet Mechanized Infantry Vehicle)
BRDM	Boyevaya Razvedyuatel'naya Dozornaya Meshina (Russian combat reconnaissance patrol vehicle)
C2	Command and Control
C3	Consultation, Command and Control
CAX	Computer Assisted eXercise
CBML	Coalition Battle Management Language
CBR VB	Chemical, Biological, and Radiological Virtual Battlespace
CBRN	Chemical, Biological, Radiological, and Nuclear
CCCPA	Cairo Regional Centre for Training on Conflict Resolution and Peacekeeping in Africa
CGF	Computer-Generated Forces
CIMIC	Civil Military Cooperation
CIS	Communication and Information Systems
CJSOR	Combined Joint Statement Of Requirements
CONOPS	Concept of Operations
COP	Common Operating Picture
CPX	Command Post Exercise
CRIP	Crisis Response Intelligence Package
DDM	Dividend Discount Model
DEU	Germany
DIS	Distributed Interactive Simulation
DMAO	DSEEP Multi-Architecture Overlay
DNK	Denmark
DOB1	Deployable Operating Base
DSEEP	Distributed Simulation Engineering and Execution Process
Dstl	Defence Science and Technology Laboratory

EDO	Explosive Ordnance Device
EGY	Egypt
ENDEX	End-of-Exercise
EPT	ODE Exercise Project Team
EVE	Effective Visible Execution
EXCON	EXercise CONtrol
EXDEM	Experimentation and Demonstration
EXDIR	Exercise Director
EXPLAN	Exercise Plan or Experimentation Plan
EXSPEC	Exercise Specification
FAFD	Federation Agreement and FOM Design
FEP	Flow Execution Plan
FF	Friendly Forces
FIN	Finland
FINCENT	Finnish Defence Forces International Centre
FoF	Follow on Force
FOM	Federation Object Model
FORCEPREP	Force Preparation
FRA	France
GBR	Great Britain (United Kingdom)
GMF	German Maritime FOM
GOV	Governance team
HA	Humanitarian Assistance
HLA	Higher Level Architecture
HQ	Headquarters
I/ITSEC	Interservice/Industry Training, Simulation and Education Conference
IAW	International Anti Weapons
ICC	Integrated Command and Control
IDB	Integrated Database
IED	Improvised Explosive Device
IEEE	Institute of Electrical and Electronics Engineers
iGeoSIT	interim Geo-Spatial Intelligence Tool
INIT	Initialization
INTREP	Intelligence Report
INTSUM	Intelligence Summary
IRM	Intelligence Requirements Management
ITA	Italy
JALLC	Joint Analysis and Lessons Learned Centre
JFTC	Joint Force Training Centre
JOIIS	Joint Operations Intelligence Information System
JWC	Joint Warfare Centre
LC2IS	Land Command and Control Information System
LIVEX	Live Exercise
LLOC	Land Lines Of Communication
LN	Lead Nation
M&S	Modelling and Simulation
MCCIS	Maritime Command and Control Information System
MEL	Main Event List

METOC	Meteorological and Oceanographic
MIL	Main Incident List
MNDDP	Multi-National Detailed Deployment Plan
MOU	Memorandum Of Understanding
MRM	Multi-Resolution Modeling
MRM SP	MRM Service Provider
MS3	Modelling and Simulation Standards Sub-Group
MSDL	Military Scenario Description Language
N/A	Not Applicable
NAC	North Atlantic Council
NATO	North Atlantic Treaty Organization
NCIA	NATO Communications and Information Agency
NCRS	NATO Crisis Response System
NCS	NATO Command Structure
NETN	NATO Education and Training Network
NFS	NATO Force Structure
NIAG	NATO Industrial Advisory Group
NIMFOR	NATO Interim Multi-National Force
NITB	NATO Intelligence Tool Box
NLD	Netherlands
NMSG	NATO Modelling and Simulation Group
NRF	NATO Response Force
NSRL	NATO Simulation Resource Library
OCE	Officer Commanding an Exercise
ODE	Officer Directing an Exercise
OLRT	Operational Liaison and Reconnaissance Team
OneSAF	One Semi Automated Forces
OPFOR	Opposing Force
OPLAN	Operational Plan
OPO	Ops Order
OPS	“Operational”
ORBAT	Order of Battle
ORBATTOA	Order of Battle Transfer of Authority
OSE	Officer Scheduling the Exercise
PAO	Public Affairs Office
PEO STRI	Program Executive Office Simulation, Training and Instrumentation
PfP	Partners for Peace
PSOTC	Peace Support Operations Training Centre
ROEAUT	Rules of Engagement Authorisation
ROEIMP	Rules of Engagement Implementation
RPR	Real-time Platform Reference
RRS	Readiness Reporting System
SACEUR	Supreme Allied Commander Europe
SACT	Supreme Allied Commander Transformation
SAE	Stand Alone Experiment
SDM	Simulation Data Exchange Model
SILC	Système d’Information pour le Commandement des Forces
SimC2	Simulation C2
SIMCON	Simulation Control

SISO	Simulation Interoperability Standards Organization
SITREP	Situation Report
SME	Subject-Matter Expert
SOFA	Status Of Forces Agreement
SPHINX	No particular meaning, just a nickname
STARTEX	Start of Exercise
SWE	Sweden
TA	Training Audience
TAS	Task Group
TBD	To Be Determined
TEK	Technic
TENA	Test and Training Enabling Architecture
TIG	Tiger Team
TIM	Toxic Industrial Material
TMR	Transfer of Modelling Responsibility
TNO	Netherlands Organisation for Applied Scientific Research
TOPFAS	Tools for Operations Planning Functional Area Systems
TRL	Technology Readiness Level
UML	Unified Modeling Language
UN	United Nations
UNSC	United Nations Security Council
UNSCR	United Nations Security Council Resolution
US/USA	United States of America
WMD	Weapons of Mass Destruction
WRZ	Weapons Restricted Zone
XML	Extensible Markup Language

Remerciements

Le MSG-106 fut une longue aventure de quatre années si on compte l'année dédiée au MSG-105 pour établir les objectifs du NSMG-106. Les sujets traités furent passionnants comme le montre le nombre important de nations (22 !), d'organismes (7 organismes de l'OTAN) impliqués dans les travaux ainsi qu'un nombre de participants jamais égalés : la barre des 100 a été largement dépassée !

Un groupe d'une taille si importante aurait pu imploser, perdre sa cohésion, se déliter. Mais ce ne fut pas le cas. Le MSG-106 a atteint des objectifs ambitieux avec la production de trois documents de référence (AMSP-03, AMSP-04, AMPS-05), du modèle conceptuel SPHINX et d'une démonstration au cours de I/ITSEC 2014.

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En tant que chairman, je suis particulièrement fier de ce que nous avons produit.

En tant que militaire, cela représente l'aboutissement d'une carrière passionnante et longue de 27 ans dont la majeure partie aura été consacrée à la simulation.

En tant que civil, c'est maintenant le point de départ pour de nouveaux travaux, toujours dans la simulation.

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Enhanced CAX Architecture, Design and Methodology – SPHINX (STO-TR-MSG-106)

Executive Summary

Computer-Assisted Exercises (CAXs) have existed for some years. They are defined as “An exercise using modelling and simulation technology to create an artificial environment, identical to the real-world that will stimulate decision-making and follow-on command and control actions”. They are either distributed where participants remain in their home bases and are linked by high capacity communications or non-distributed where all those taking part are collocated.

The use of distributed CAXs has grown significantly for the following reasons:

- a) **Operational Complexity:** The increased requirement to train at the Multinational and Joint level often simultaneously exercising at the Operational and Tactical level is extremely complex. The CAX is better able to support this and gather accurate Lessons Identified data than the traditional non-technical approach.
- b) **Cost:** As Nations look to reduce the cost of exercises, simulating participating forces is generally far cheaper than physical deployments of troops. If units must participate in the exercise, distributed solutions enable them to remain within their own barracks, reducing the additional travel and accommodation costs.
- c) **Technical Advances:** Rapid advances in simulation technology, mainly in the civilian sector, have enabled far more effective simulation systems to be built. These have enabled a far greater level of realism than in the past.
- d) **Simulation Interoperability:** The adoption of norms and standards in simulation has enabled far greater interoperability between simulation systems. This has greatly increased the simulation environment (Land, Maritime and Air) available to exercise planner whilst reducing the cost of interoperability solutions but with more organisation complexity.

To meet with this operational demand, Allied Command Transformation (ACT) requested that NATO Modelling and Simulation Group (NMSG) start a technical activity in 2006 with the result of a standard about technical interoperability in 2010. A following activity was needed to complete works about interoperability issues. Twenty countries and 7 NATO bodies formed this new group also nicknamed SPHINX and delivered several NMSG reference documents:

- AMSP-03: M&S standard profile for NATO and multi-national computer exercises with distributed simulation;
- AMSP-04: NETN Federation Architecture and FOM Design;
- AMSP-05: Guideline for non-CAX experts; and
- The SPHINX conceptual model describing a Computer-Assisted eXercise (CAX).

Architecture, définition et méthodologie améliorées des exercices assistés par ordinateur (CAX) – SPHINX (STO-TR-MSG-106)

Synthèse

Les CAX (*Computer-Assisted Exercises*) existent et prennent une importance particulière depuis quelques années. On peut les définir ainsi : « Un exercice s'appuyant sur les technologies de modélisation et de simulation pour créer un environnement artificiel représentatif du monde réel pour stimuler les processus de prise de décision, le commandement et la conduite des opérations ». En outre, ces exercices sont qualifiés de distribués quand les participants restent à leur base et sont reliés grâce aux réseaux ou de non distribués quand toutes les parties prenantes sont co-localisées.

L'organisation d'exercices distribués s'est largement développée pour les raisons suivantes :

- a) **La complexité opérationnelle** : Le besoin grandissant en entraînement multinational et interarmées conduit souvent à des exercices multi-niveaux, opératif et tactique, d'une complexité extrême. Le CAX est un bien meilleur moyen que les approches non outillées pour soutenir la conduite de tels exercices tout en apportant un retour d'expériences exploitant correctement les données d'exercice.
- b) **Les coûts** : Les nations cherchent à réduire le budget des exercices. Les moyens de simulation sont généralement plus économiques que des troupes réelles déployées sur le terrain. Si des unités doivent participer à un exercice, des solutions en mode distribué leur permettront de rester dans leur garnison, contribuant ainsi à réduire les coûts additionnels liés aux déplacements et aux frais d'hébergement.
- c) **Les avancées technologiques** : Les dernières avancées en matière de technologies de simulation, aussi bien dans les secteurs civils que militaires, rendent possibles des systèmes de simulation de plus en plus réalistes et apportant des environnements représentatifs de la réalité.
- d) **L'interopérabilité de la simulation** : L'adoption de normes et de standards ont rendu possible l'interopérabilité entre les systèmes de simulation. Les exercices distribués dans des environnements variés (terre, air, mer) deviennent désormais accessibles pour les organisateurs des exercices au prix, toutefois, d'une complexité d'organisation plus importante.

Pour répondre à ce besoin opérationnel, en 2006, ACT (*Allied Command Transformation*) a demandé au NMSG (*NATO Modelling and Simulation Group*) de débiter une activité technique qui a abouti à un standard d'interopérabilité en 2010. Une activité complémentaire fut nécessaire pour compléter ces travaux sur les problématiques d'interopérabilité. Vingt nations et 7 organismes de l'OTAN constituèrent un nouveau groupe (SPHINX) et ont produit plusieurs documents de référence du NMSG :

- AMSP-03: *M&S standard profile for NATO and multi-national computer exercises with distributed simulation* ;
- AMSP-04: *NETN Federation Architecture and FOM Design* ;
- AMSP-05: *Guideline for non-CAX experts* ; et
- Le modèle conceptuel SPHINX qui décrit ce qu'est un CAX (*Computer-Assisted eXercise*).

Chapter 1 – INTRODUCTION

1.1 RATIONALE

In 2007, HQ-SACT initiated a NATO Education and Training Network (NETN) project, which later became program Snow Leopard, to establish a persistent, joint NETN capability at the strategic, operational, and tactical levels by leveraging existing national capabilities.

NATO M&S Task Group MSG-068 developed initial technical solutions to enable distributed training and exercises. A final Stand-Alone Experiment (SAE) showed the technical feasibility of a network of distributed simulations. A demonstration during I/ITSEC 2010 elicited strong interest from numerous Nations for a reference architecture and community standards.

However, the initial technical capability is insufficient to support the full vision. MSG-068 recommended additional technical development. MSG-068 noted the lack of an established long-term process for the maintenance of the initial reference architecture and standards, nor provisions for improvement.

Moreover, these actions are a response to three major breaking points of the time:

- **Operational:** A military operation is always joint or multi-national, so training audiences are more and more composed of multi-level audiences or same-level audiences.
- **Financial:** Nations need to reduce cost in the use or the making of simulation systems so distributed is more and more chosen or federation of tools rather than monolithic tools.
- **Technical:** Simulation interoperability is available so new concepts based on distributed training with distributed tools are feasible.

Distributed exercises seem to be the natural direction for a more intensive use of the simulation. In 2012, NMSG delivered a new master plan for modelling and simulation with new definitions of the M&S stakeholders:

- Customers;
- Suppliers;
- Users.

This help for the understanding of a CAX organisation. However, a distributed training exercise is more complicated to be organized by a scheduler or by an OCE (Officer Commanding an Exercise):

- How to manage several customers? Several users? Several suppliers?
- How to manage relationship between customers and users? Between users and suppliers? Between suppliers and customers?

Actually, the exercise sponsors are reluctant to rely on simulation to support exercises because of their lack of knowledge and the fear of complexity that can bring simulation.

MSG-068 started the work and brought the interoperability between suppliers with the FOM NETN. NATO wrote the Bi-SC 75-3 (Collective training and exercise directive) a reference document for organizing exercises well known by OCE. A process has been developed to support the design of a federation composed of simulation and C2 systems (DSEEP, Distributed Simulation Engineering and Execution Process).

MSG-106, whose nickname is SPHINX, had the ambition to bring a more complete response with a conceptual model describing an Computer-Assisted Exercise (CAX) and guidelines for customers, users,

and suppliers that can be taken in account by the exercise community. These works has been used in a final and successful experiment.

1.2 OBJECTIVES

The objectives of SPHINX are:

- Provide guidelines for EXCON and SIMCON (Exercise Control and Simulation Control) in performing CAX.
- Update the MSG-068 reference Federation Architecture and FOM Design (FAFD) document to improve and extend it based on tested technical solutions.
- Support the MSG-106 products for:
 - Recommendations for the governance and maintenance of products;
 - Standardization, dissemination, quality assurance, risk management;
 - Coordination and collaboration with external bodies.

The focus of the NMSG-106 is *distributed* training with several training audience, several training centres and several simulation systems.

The group produced a fruitful documentation:

- This report, which explains the SPHINX concept and reminds the activities of the group during its 4 years live; and
- Three other reference publications under the authority of the NMSG:
 - AMSP-03: M&S standard profile for NATO and multi-national Computer eXercises with distributed simulation.
 - AMSP-04: NETN Federation Architecture and FOM Design.
 - AMSP-05: Guideline for non-CAX experts.

MORS is the repository of the AMP-05; the MS3 is responsible of the AMSP-03 and AMSP-04. These groups are in charge of maintaining these documents in order to support any improving activity. So, these documents are apart and have been set out the perimeter of this final report.

Finally, an experiment concluded the works of the group during I/ITSEC 2014. It was a good support to try the different concepts developed during four years. The main features of the experiment are presented in Annex C.

Chapter 2 – SPHINX CONCEPT

2.1 AIM OF THE CHAPTER

The aim of this chapter is to describe a Conceptual model (SPHINX) designed to facilitate the preparation of a CAX. The chapter will then describe a tool designed and implemented by France which is a concrete application of the SPHINX Concept.

2.2 THE SPHINX CONCEPT

2.2.1 The Requirement

A concept (and subsequently a tool) is required for CAX preparation for the following reasons:

- a) Provide an operating framework to EXCON (Exercise Control) and SIMCON (Simulation Control) in performing a CAX.
- b) Update the MSG-068 reference Federation Architecture and the Federated Object Model (FOM) Design (FAFD) document improving and extending it based on tested technical solutions.
- c) Support the MSG 106 products as regards:
 - Recommendations for the governance and maintenance of products;
 - Standardisation, Dissemination, Quality Assurance and Risk Management;
 - Coordination and Collaboration with external Organisations.

2.2.2 The Stakeholders

In 2012, the NATO Modelling and Simulation Master Plan established 4 key stakeholder groups in the delivery of a CAX:

- a) **Coordinator and Scheduler:** The Officer Scheduling the Exercise (OSE) decides the aims and objectives of the Exercise as he/she is the officer responsible for the levels of readiness of units. The OSE will then delegate the responsibility for the planning and executing phases of the Exercise to the Officer Coordinating the Exercise (OCE).
- b) **The Suppliers:** The suppliers provide the software applications and technical equipment to support the simulation solution. This solution is mapped out in the Reference Architecture which is designed to facilitate communication and interoperability between Simulation and C2 systems. This will enable the supplier to provide the executable scenario in line with the Country Book.
- c) **The Users:** The users are the Training Experts responsible for the organisation of the activity and are traditionally the Training Centres. In a distributed solution they may be spread over many sites and will use the means provided by the suppliers. They introduce realism through the provision of EXCON cells and test the Training Audience ability to perform tasks or vignettes. They are either supported by Simulation (if available) or other means (physical observation). They are concerned with the Exercise data and use this to construct the Conceptual Scenario.
- d) **The Customers:** The Customers are the Training Audience (TA) who are being assessed in line with the objectives laid down by the OSE. They perform missions and operations and their main external activity is the transmission and receipt of information products (Reports/Orders). They do this using the services provided by the Suppliers and the Users. Although traditionally each exercise only tested one TA, it is now common for several TAs to be incorporated into one exercise. The TA also contribute to the Operational Scenario.

2.2.3 The Scenario

The scenario is the background story that describes the historical, political, military, economic, cultural, humanitarian and legal events and circumstances that have led to the current exercise crisis or conflict. It is designed to support exercise and training objectives and there are 4 basic designs:

- Real;
- Synthetic;
- Fictionalised;
- Fictitious.

Figure 2-1 demonstrates that NATO exercises use varying combinations of situations, settings and scenarios.

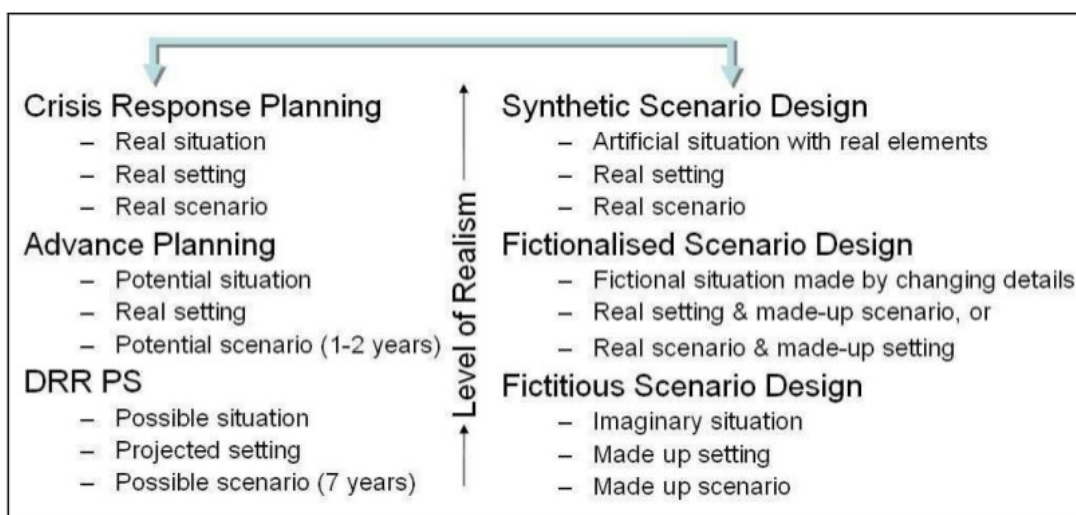


Figure 2-1: NATO Combinations of Scenario Design.

2.2.4 Scenario Development

The guideline on scenario development for (Distributed) Simulation Environments as defined by NMSG-086 demonstrated that the scenario is developed in 3 stages:

- a) **Operational Scenario:** An operational scenario is the “storyboard” of the exercise scenario. It is authoritative descriptions provided by SMEs (Subject-Matter Experts) using their specific terminology of the real world that need to be represented in the simulation environment, if simulation is to be used. It comprises the Geo-Strategic situation, information regarding the Theatre of Operations, Strategic Initiation and Crisis Response Planning which are known as the Country Book¹. The Customer then adds Force Activation and Deployment and Execution Information to complete the Operational Scenario².
- b) **Conceptual Scenario:** Once the Operational Scenario is complete, the User compiles the Conceptual Scenario which describes precisely, step by step, the exercise with the different events, tools, actions, etc. The conceptual scenarios provide a coarse description of the intended situation and its dynamics, but usually do not contain enough information for deriving a conceptual model and designing a simulation environment.

¹ The detail of each of these elements of the Country Book can be found at Annex A (Modules 1 – 4).

² The detail of the elements to be added by the Customer can be found at Annex A (Modules 5 – 6).

- c) **Executable Scenario:** The Executable Scenario is the adaptation of the conceptual scenario to each tool (Simulation or C2 systems). Once the simulation environment is designed and set up, the conceptual scenarios have to be made available to all simulation systems and other member application of the simulation environment. For this purpose, the conceptual scenarios need to be transformed into “executable scenarios”.

2.3 THE SPHINX CONCEPT MODEL ENTITIES

2.3.1 Entity Overview

The SPHINX Concept model comprises 3 distinct and yet linked data groups which are illustrated in Figure 2-2 and tabulated in Table 2-1:

- a) **Business Objects:** The Business Objects are the Stakeholders referred to in Section 2.2.2 – the Training Audience (Customers), the Training Centres (Users) and the Reference Architectures (Suppliers).
- b) **Interfaces:** The Interfaces are the means by which data passes between the Business Objects. This includes Vignettes and Tasks, Country Books and Services.
- c) **Interface Data:** This relates to the data within an interface and includes Missions and Operations, Information Products, Control Cells, Activity Data, Software Applications and Technical Equipment.

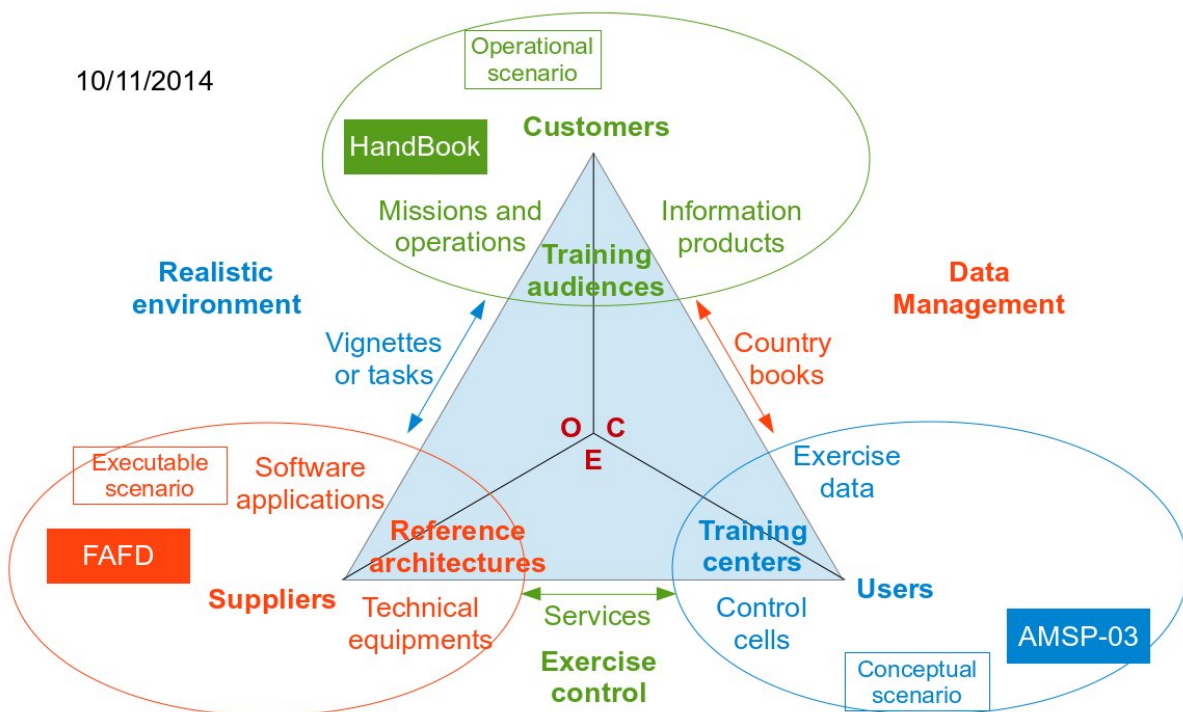


Figure 2-2: The SPHINX Model.

Table 2-1: Business Object Relationship.

Business Object Relationship	Interface	Interface Data	Aim of Relationship
Customer / Supplier	Vignettes and Tasks: §2.3.4.a	Missions and Operations: §2.3.3.a Software Applications: §2.3.3.e	To ensure that the Vignettes meet the Customer Requirement and can be supported by the federation of tools.
Customer / User	Country Book: §2.3.4.b	Activity Data: §2.3.3.d Information Products: §2.3.3.b	To ensure that the Information Products and activity data to be produced by the Customer and the supplier can fit with the country book.
Supplier / User	Services: §2.3.4.c	Technical Equipment: §2.3.3.f Control Cells: §2.3.3.c	To enable the Technical and Operational Management of the Exercise.

2.3.2 Business Objects Relationships

- a) **Training Audience:** The Training Audience (TA) is the target of the training event. The levels of TA are Strategic, Operational (Joint) Command, Tactical (Component) Command or Tactical (Unit) Command. A sophisticated exercise may have Primary and Secondary TAs operating at different levels. The exercise may take the form of a Command Post Exercise (CPX), a Live Exercise (LIVEX) or a mixture of the two.
- b) **Training Centres:** Training Centres can either be established facilities such as the Joint Warfare Centre (JWC) and the Joint Force Training Centre (JFTC) or any establishment where a Training Audience will be hosted during an Exercise. Although formally established centres may be preferable as they have been designed to host an exercise, cost savings delivered by the TA remaining in their own barracks may lead to an increase in ad hoc Training Centres.
- c) **Reference Architectures:** The supplier will provide a Modelling and Simulation solution based on a Reference Architecture. Architectures can either focus on a specific application domain (Land, Air or Maritime based)³ or can be domain independent (capable of mixing application domains)⁴. The needs of the training audience will determine the Reference Architecture.

2.3.3 Interface Data

- a) **Missions and Operations:** The data held within Mission and Operations relates to the type of Mission the TAs could be asked to perform. A comprehensive list of Mission Types can be found in Annex B – Section B.6.1. The TA will be assessed through a series of Vignettes and Tasks linked to these Missions and Operations.
- b) **Information Products:** The Information Products are the means by which the TA will communicate Orders to subordinate formations. Examples include the Op Order (OPO), the Air Coordination Order (ACO) and the Air Tasking Order (ATO). A comprehensive list can be found at Annex B – Section B.6.6.

³ Examples of Domain Specific Architectures are DIS and TENA.

⁴ An example of a Domain independent architecture is the Higher Level Architecture (HLA).

- c) **Control Cells:** The Control Cells is the structure put in place by the Supplier and the User to ensure the smooth running of the exercise both technically and in terms of the MEL/MIL.
- d) **Activity Data:** The Activity Data covers all data required to support the exercise. This covers every type of data which is required to construct the Country Book. Examples include Terrain Data, Military Units descriptions and Prototype Data.
- e) **Software Applications:** In order to provide services to the User, the Supplier will provide a number of software applications. These are known as Community of Interest Applications and cover such domains as M&S, Logistics, Environmental and Missile Defence. A definitive List is available at Annex B – Section B.6.5.
- f) **Technical Equipment:** This is data related to the hardware over which technical services will be provided. This includes Servers, cryptographic and communications equipment.

2.3.4 Interfaces

- a) **Vignettes and Tasks:** Vignettes and Tasks are drawn from the Missions and Operations of the exercise as laid down by the Customer. Missions are decomposed into key tasks from which the vignettes (use cases) against which the Customer will be assessed are constructed.
- b) **Country Book:** The make of the Country Book is laid down in detail in Annex A. The Country Book describes every aspect of the Scenario and is put together by the Customer and the User. It enables the Supplier to deliver the Executable Scenario.
- c) **Services:** Services can be divided into 2 distinct categories: Technical Services that are provided by the Supplier; and Exercise Management Services provided by the User. During the exercise, the provision of these services is assured by the Control Cells within EXCON.

2.4 THE SPHINX TOOL

2.4.1 Concept Realisation

In order to ensure that the SPHINX concept is valid, it is important to create a SPHINX tool or tools (each Nation will build its own tool). Tools will help to identify weaknesses in the Concept and will serve to validate work done so far. The tool will serve principally as a tool for the OCE both in the preparation of the exercise providing a common view of progress. In addition it will facilitate the exploitation of Lessons Identified and future exercise planning by the data stored and relationships established.

2.4.2 Tool Description

The French prototype SPHINX Tool is divided into 2 main parts:

- a) **General Description:** Annex C shows all the general information regarding the CAX. This includes the aim and objectives, description, participants, roadmap and federation design. For each of these there links to the detailed data. This enables all stakeholders and those not involved directly in the exercise to rapidly gain an understanding of the background and the current state of planning.
- b) **Data Inventory:** Annex D shows the different data sets (Stakeholders, Interfaces and Interface Data) and their content. Each piece of data is hyperlinked to a page providing a description of that piece of data. The example provided in Annex B is VBS2. The second part contains the “neighbour data”. The example in Annex B shows the CBRN Tanker Incident Vignette, the Reference architecture which in the past has delivered that vignette and the Exercises on which it has been employed.

2.4.3 Services – Capitalization and Preparation of CAX and Experimentations

Capitalization is obvious. SPHINX conceptual model proposes a structure to store CAX. Only structured data can be stored properly, i.e. with the need of exploitation, reuse, able to bring back lesson learned and the contribution of relationships between the data.

The SPHINX tool can provide two services to a sponsor of an exercise:

- **Support for Preparation:** Resolution of internal interoperability issues of customers (training audience), the users (training centres), the suppliers (manufacturers tools) and the external interoperability issues, i.e. between these three stakeholders in pairs. For preparation, the tool can be used along the preparation process. It allows to share a common view of the status of the level of preparation of the exercise.
- **Capitalization:** The structuring of data provides the ability to store exercises and experiments in order to develop relationships between items and thus to enrich the debate for the preparation of new exercises or experiments. Capitalization can directly benefit from the work provided by the preparation. The most useful document for capitalization is the EXPLAN written by the OCE.

2.5 CONCLUSIONS

The SPHINX Concept offers an approach through which CAX planner can prepare an exercise. It can be used for TAs drawn from across the multi-national environment and at different operational and tactical levels.

The first step in transforming the SPHINX Concept into a useable tool has been taken by France and has been demonstrated in this paper. The better developed tools become the greater the amount of historical data will be available to the OCE of any exercise and consequently, the more effective the exercise planning. The French tool has now been tested on more than 200 exercises and experiments.

The proposed next steps are as follows:

- a) Formally integrate the SPHINX Concept into the NATO CAX preparation process.
- b) Construct a generic timeline for exercise preparation.
- c) Formally include the SPHINX concept into the NATO Simulation Resource Library (NSRL).

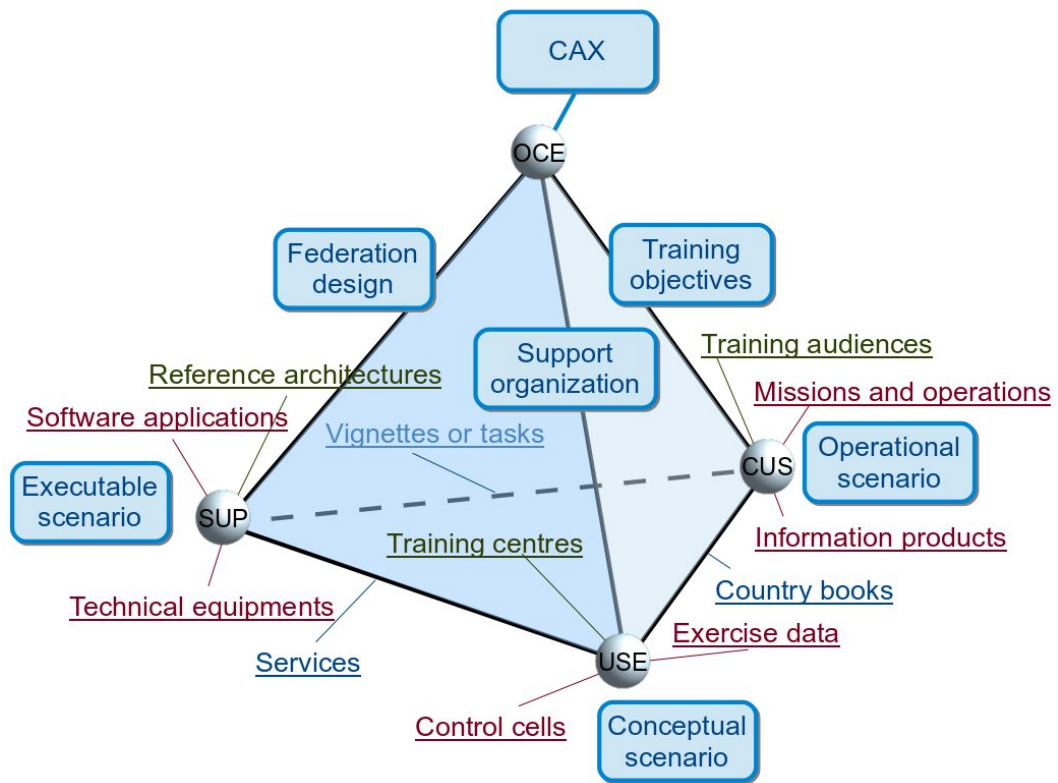


Figure 2-3: 3D View of the SPHINX Conceptual Model.



Chapter 3 – PROGRAM OF WORK

3.1 OPERATIONAL SUB-GROUP

3.1.1 Objectives

When constructive simulation is used in exercises (CAX) it has to produce high-quality results. This means – among other things – that the results have to be robust, traceable and reproducible. In light of the fact that distributed Exercises and distributed Simulations are even more complex projects with a large number of different actors involved, a standardized and practice-oriented procedure model for planning and execution is an important means to achieve this objective.

It was noted that no standardized and practice-oriented procedure model is available for the operational personnel to acquire proper support by the technical community to plan and execute a CAX. Therefore MSG-106 “SPHINX” developed this Handbook to provide a generic process that enables the operational planners to communicate their CAX requirements.

This Handbook (AMSP-05) provides guidelines primarily to operations personnel on what to consider during the planning/development process and what interaction and information requirements to other contributors are required to achieve success. Furthermore it outlines the entire planning, development and execution process of possibly distributed CAX. It does not serve all participants included in the planning and development process.

The aim is to provide additional guidelines to operational personnel who refer to the Bi-SC Collective Training and Exercise Directive 75-3 ANNEX N for their CAX utilizing simulation planning. It provides a “roadmap” for considerations:

- What information is required to plan, execute, analyse and report the results of the exercise?
- Information exchange requirements between the different stakeholders throughout the whole Exercise process.

3.1.2 Activities

Emphasis has been laid on providing guidelines to operational personnel on how to plan a CAX using simulation.

This Handbook should increase the operational personnel's awareness of special requirements and demands from the supporting technical personnel. Furthermore the necessary feedback from the technical side towards the operational planning process that should be provided has been identified.

The following publications provided necessary standards and important inputs for the development of this Handbook:

- NATO BI-SC Collective Training and Exercise Directive 75-3, Edition 2013.
- “Computer-Assisted Exercises and Training, A Reference Guide”; by Erdal Çayirci and Dusan Marincic.
- “A Procedure Model for Distributed Simulation”, VEVA Handbook (developed for the German Procurement Office by the German Armed Forces University Munich and the ITIS GmbH).
- “Exercise White Book, Guidelines for Comprehensive Civilian-Military-Police Exercises”, by David Lightburn for the Folke Bernadotte Academy.

Experiences made during the planning of various different exercises like for example the VIKING EXERCISES (SWE) or the NetOpFueEXER (DEU) supported the process to cross-reference this theoretical approach with real-life exercise planning. Furthermore the knowledge and experiences from different commands and institutions (e.g. Joint Force Training Centre, NATO M&S Centre of Excellence, German Navy Headquarters Methodology Branch) were considered and incorporated.

Table 3-1: Tasks of the OPS Sub-Group.

Topic	TIG/TAS	Status
Analyze the German Maritime FOM (GMF) from the operational point of view for its value to the MSG-106 FOM development	TIG GMF	Completed, Analysis report and recommendations presented to MSG-106
Provide operational scenario to MSG-106	OPS SG	Completed
Create a Handbook providing Guidelines to the operational personnel in planning, executing and analyzing CAX utilizing simulation	OPS SG	Finalizing

3.1.3 Deliverables

This Handbook was designed to complement and augment the BI-SC 75-3 “Collective Training and Exercise Directive” with regard to the planning of CAX. The foundation of the seven modules of this Handbook is laid in the BI-SC 75-3 with its description of the four stages of the NATO Exercise Process:

- Concept and Specification Development.
- Planning and Product Development.
- Operational Conduct.
- Analysis and Reporting.

The seven modules of this Handbook are linked to the above four stages as depicted in the table below.

Table 3-2: Links Between Bi-SC 75-3 and Handbook Parts.

BI-SC 75-3	HANDBOOK
Concept and Specification Development	Module 1: Goal Definition Module 2: Conceptual Planning
Planning and Product Development	Module 3: System Dependent Planning Module 4: Execution Preparation
Operational Conduct	Module 5: Execution
Analysis and Reporting	Module 6: Analysis Module 7: Follow Up

The Handbook's 7 modules are further detailed into various steps. The process sequence is iterative, which means that going back and forth within the process is possible and may even be necessary. In addition, this Handbook includes a role concept that represents all actors involved in a CAX and outlines their duties and responsibilities.

3.2 GOVERNANCE SUB-GROUP

3.2.1 Objectives

The main objective of the "Governance team (GOV)" was to provide an **M&S standards profile for NATO and Multi-national Computer-Assisted eXercises (CAX) with Distributed Simulation** including recommendations for Governance of the profile evolutions.

This M&S Standards Profile (AMSP-03) complements the AMSP-01 document on relevant standards for M&S and the Bi-SC 75-3 document on Collective Training and Exercise directives. The aim of AMSP-03 is to support configuration and deployment of NATO and Multi-Nation Computer-Assisted eXercises (CAX) using distributed simulation.

The objectives of this document are to provide:

- Recommendations for setting up CAX systems on a distributed infrastructure comprising training centres and networks.
- Recommended standards or methods for Information data exchange between the CAX system components (exercise control tools, simulations and C2) based on identified M&S standards of the AMSP-01 document and results from a number of specific NMSG Task Groups (MSG-049, MSG-071, MSG-080, MSG-085, MSG-086, as well the results of the MSG-106 technical team).
- Guidance for governance of standards and identification of technical gaps.

In reference to the Bi-SC 75-3 document, the document is addressed mainly to:

- The Officer Conducting an Exercise (OCE).
- The Officer Directing an Exercise (ODE).
- The Exercise Director (EXDIR).
- The ODE Exercise Project Team (EPT).
- The technical staff supporting a CAX event using distributed simulation.

Potential use of distributed simulation for CAX concerns:

- National exercises including multiple C2 and tactical levels.
- Bi-lateral or multi-national exercises (NATO Nations and PfP Nations).
- NATO Force Structure (NFS) exercises.
- NATO Command Structure (NCS) exercises with or without NFS.
- Future Mission Network Training.

3.2.2 Activities

- NETN Reference architecture and techniques.
- Tool and services to support the technical baseline.

PROGRAM OF WORK

- NETN Governance.
- Assessment of NETN Standards.
- Long-Term Maintenance process for NETN products.
- Coordination with external bodies, MS3, SISO, other MSG, NIAG, etc.

3.2.3 Deliverables

- AMSP-03 document on Distributed Simulation Handbook for Multi-national NATO Computer-Assisted eXercises.
- A living table of the recommended M&S standards for CAX including a TRL indicator on maturity level.
- A document library on reference documents.

3.2.4 Team Members

- Jean-Pierre FAYE, NIAG (Team lead)
- Niels Krarup-Hansen, Danish Procurement Office, DNK
- Horst Behner, MoD, DEU
- Wim Huiskamp, TNO Defence, Safety and Security, NLD
- Yuri Fedulov, BLR

With contributions from:

- Erdal Cayirci, JWC
- Philip Draper, JWC
- Jean-Louis Igarza, Anticyp Simulation, FRA
- Bruno Di Marco, ITA
- Peter Jackson, Thales, GBR
- Jan Van Geest, NCIA
- Bharat Patel, Dstl, GBR
- Bob Kean, US Joint Staff J7, USA
- Steve Kostoff, US Joint Staff J7, USA
- Rob Cox, PEO STRI, USA
- Tom van den Berg, TNO, NLD

3.3 TECHNICAL SUB-GROUP

3.3.1 Objectives

- Develop and test technical solutions (consistent with operational sub-group guidance) in accordance with the IEEE 1730- 2010 DSEEP.

- Update the MSG-068 NETN Federation Agreements and FOM Reference Document to improve and extend it based on tested technical solutions.
- Cooperate on a technical level with external organizations.

3.3.2 Activities

Table 3-3: Tasks of the TEK Sub-Group.

Topic	TIG/TAS	Status/Description
NETN FOM Configuration Management	FOM TIG	Supporting other TIGs with FOM integration.
Common ORBAT and Initialization	INIT TIG	Completed. Included in FAFD. Multi-national tests (not distributed) done with successful result.
Simulation-C2	SIMC2 TIG	Completed. Included in FAFD. Multi-national tests done with successful result. Discussions still open about the Low-Level CBML module.
Transfer of Modelling Responsibility – TMR	TMR TIG	Completed. Included in FAFD. Pattern stable. Multi-national tests done with successful result.
Logistics revisited	FOM TIG	Completed. Included in FAFD.
Federation Execution Control	FEDEX TIG	Proposal. Included in Final Report.
Multi-Resolution Modeling	MRM TIG	Completed. Included in FAFD. Pattern stable. Multi-national tests done with successful result.
Scalability	TMR TIG / FOM TIG	Future work.
Fault Management	TMR TIG	Future work.
Maritime Simulation and German Maritime FOM	MARITIME TIG	Completed. Included in Final Report.
CBRN FOM	CBRN TAS	Completed. Included in FAFD.
Persistent Test and Integration Network	FOM TIG	Available.

Prioritization and/or changes of the activity list is a management group decision. Two planned activities have been cancelled and further work in follow-on MSGs is recommended. These are:

- Scalability specific aspects using DDM and other mechanisms to support large-scale scenarios and/or federations with large number of participating federates.
- Fault Management aspects to support fault detection and recovery including but not limited to fail-over and redundancy management.

3.3.3 Deliverables

3.3.3.1 NETN FAFD

The NETN Federation Architecture and FOM Design (FAFD) Version 2 is the main deliverable of MSG-106 TEK sub-group. It is an updated version of NETN FAFD v1.0 delivered by MSG-068 and maintained under custodianship of NATO NMSG MS3 (Modelling and Simulation Standards Sub-Group). Version 2.0 builds on feedback and experience from using NETN FAFD v1.0 in several distributed simulation events and exercises. Enhancements of existing modules and inclusion of additional modules based on the HLA Evolved modular FOM approach provides the users of NETN FAFD v2.0 with additional flexibility and increased support for interoperability and simulation components.

NETN FAFD v2.0 is delivered as a separate document and is referenced by the draft AMSP-03 (Allied Modelling and Simulation Publication) as the recommended reference federation agreement in Computer-Assisted eXercises (CAX) using distributed simulation.

3.3.3.2 NETN FOM Modules

The NETN FOM is an identified set of HLA Evolved FOM Modules. To support NETN federation design, the NETN FOM modules are recommended for use when implementing NETN FAFD agreements in a distributed simulation. These modules include both references to standard FOMs and FOM modules as well as NETN modules developed and refined in MSG-068 and MSG-106. The modules have inter-dependencies and have been designed to maximize re-use and interoperability both with respect to legacy systems, existing standards and requirements for new patterns of simulation interoperability. The NETN FOM is the complete set of NETN modules and all other modules they depend on (e.g. RPR-FOM modules). A NETN Federation defines the modules that are relevant and each simulation system only loads those modules it requires. The NETN FOM modules are provided as XML files in IEEE 1516-2010 OMT format as well as in print in the appendixes of the NETN FAFD v2.0 document. In MSG-106 the FOM Tiger Team (TIG) has been responsible for the overall structure and harmonization of the NETN FOM.

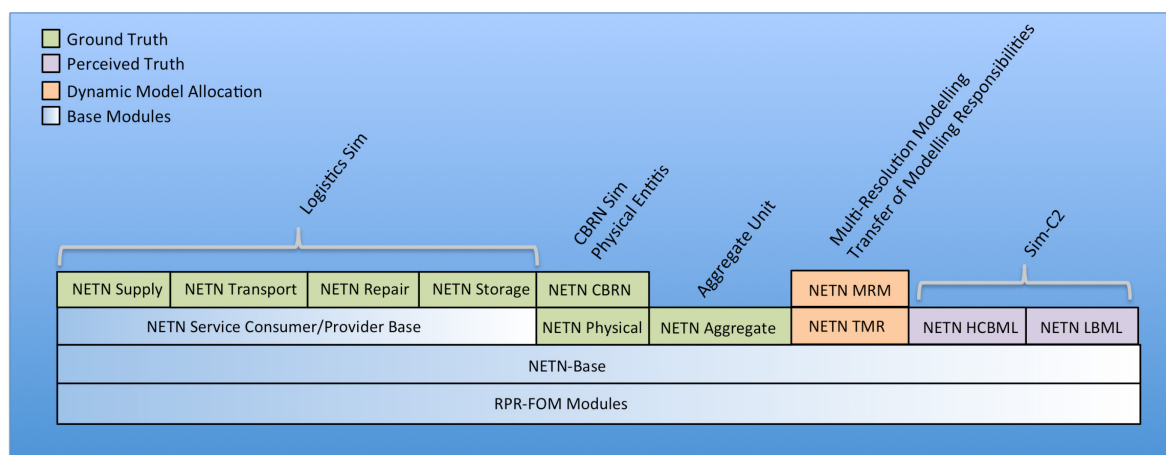


Figure 3-1: Detailed Descriptions of the NETN FOM Module Development is Provided in AMSP-04 and the NETN FAFD v2.0 Includes the Technical Specifications and Supporting FOM Module XML Files.

3.3.3.3 Technical Papers and Presentations

The MSG-106 TEK sub-group have produced several papers and presentations to the wider community. References to all papers and presentations are documented in Chapter 5, References.

Chapter 4 – RECOMMENDATIONS

4.1 OPERATIONAL SUB-GROUP RECOMMENDATIONS

The Ops Sub-group Handbook (AMPS-05) should be a living document in the sense that experience from practical applications should continuously be taken into consideration and incorporated. This is especially relevant for:

- Proposed changes;
- Improvements;
- Clarifications;
- Additions.

Every feedback is highly welcome and contributes to enhancing the quality and applicability of this Handbook, which, in the end, will lead to a high degree of acceptance and utilization on a routine basis.

Please send your feedback to your NMSG/MS3 national representative.

4.2 GOVERNANCE SUB-GROUP RECOMMENDATIONS

One of the significant contributions to MSG-106 study by Governmental Sub-group is a Methodology of DSEEP (Distributed Simulation Engineering and Execution Process) Customization for a distributed CAX. The general approach is that it seems good to have a DMAO (DSEEP Multi-Architecture Overlay) Customization for a distributed CAX as a running separate standard.

Applying DSEEP for CAX several shortfalls on available standards or tools appear. In order to answer to these shortfalls the GOV sub-group recommends the follow-on activities:

- M&S certification tools for CAX simulation environment;
- Conceptual modelling for CAX scenario;
- Gateway developments for Multi-Architecture Overlay;
- Process for environmental modelling;
- Distributed debriefing for CAX;
- Maintenance and evolutions of FOM Module.

4.3 TECHNICAL SUB-GROUP RECOMMENDATIONS

The main deliverable of the MSG-106 TEK sub-group is the updated version of the NATO Education and Training Network (NETN) Federation Architecture and FOM Design (FAFD) document under custodianship of NATO NMSG MS3. The TEK sub-group strongly recommends MS3 to publish the NETN FAFD v2.0 as an Allied Modelling and Simulation Publication (e.g. AMSP-04). It is recommended that MS3, with support from MSG-134, establish procedures and tools to maintain, support and promote the use of NETN FAFD among NATO and Partners Nations.

It is recommended that MS3 continuously, in conjunction with NMSG Business Meetings, report to NMSG on use and status of NETN FAFD to promote its use and to ensure that other research task groups are informed and can contribute to new versions of the document.

RECOMMENDATIONS

New versions of NETN FAFD should be based on feedback from using the document, further research as recommended by MSG-106 (detailed below), change proposals and proposed new content generated by other research task groups.

During the development of NETN FAFD v2.0 the MSG-106 TEK sub-group identified and addressed several topics that did not reach maturity or receive consensus in the group and therefore not included in the document. The following recommendations are provided:

- Further research on use of Low-Level BML is required. Late arriving input and results from national experimentation indicates possible need to revisit this module. Experimentation and use of the existing specification is recommended to gain more insights and identify additional requirements.
- Federation Execution Control topic have been addressed in MSG-106 but requires additional test and experimentation to reach maturity for inclusion in FAFD.
- Combat Adjudication was identified in both MSG-068 and MSG-106 as a high-priority area for research. In MSG-106 this topics was not addressed due to lack of resources.

Chapter 5 – REFERENCES

5.1 DOCUMENTS

MSG-106 Technical Activity Proposal.

MSG-106 Program of Work.

MSG-068 Final Report Annex C – NETN Federation Agreements and FOM Reference Document v1.0.

AMSP-03 DRAFT.

NETN FAFD v2.0.

IEEE 1730- 2010 DSEEP.

IEEE 1516-2010 HLA Evolved.

Bi-SC 75-3: Collective Training and Exercise Directive.

NMSG-086: Simulation Interoperability, Final Technical Report.

C3 Taxonomy: https://tide.act.nato.int/em/index.php?title=C3_Taxonomy.

5.2 PAPERS AND PRESENTATIONS

The following papers and presentations have been produced by MSG-106:

Tard, L. **MSG-106 briefing to NATO Training Working Group**. April 2012.

Huiskamp, W. **MSG-106 Briefing at ITEC 2012**. Presentation at the 2012 International Training and Education Conference. May 2012.

Ruiz, J., Désert, D. and Guillou, P. **Improvement of Simulation Interoperability by Introducing the CBML Benefits into the HLA World**, Proceedings of 2012 Fall Simulation Interoperability Workshop, 12F-SIW-009, Simulation Interoperability Standards Organization, September 2012.

Alstad, A., Amilde Løvlid, R., Mevassvik, O.M., Normann Nielsen, M., Henderson, H. and Jansen, R. **Low-level Battle Management Language**, Proceedings of 2013 Spring Simulation Interoperability Workshop, 13S-SIW-032, Simulation Interoperability Standards Organization, April 2013.

Ruiz, J., Désert, D., Hubervic, A., Guillou, P., Jansen, R., de Reus, N., Henderson, H., Fauske, K.M. and Olsson, L. **BML and MSDL for Multi-Level Simulations**, Proceedings of 2013 Fall Simulation Interoperability Workshop, 13F-SIW-002, Simulation Interoperability Standards Organization, September 2013.

Löfstrand, B. **MSG-106 Briefing at Viking 14**, Presentation at Viking 14 Distinguished Visitors (DV) days for MSG-106 invited guests. April 2014.

Lloyd, J., Newton, N., Mifsud, M., Ruiz, J., Désert, D., Hubervic, A. and Olsson, L. **Chemical Biological Radiological Modelling Capability: UK and NATO HLA Evolved Experimentation**. Proceedings of 2014 Fall Simulation Interoperability Workshop. Simulation Interoperability Standards Organization. 2014.

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Nyløkke, J., Horn, B., Roos, K., Solum, E., Horn, K., Newton, N., Krarup-Hansen, N. and Morris, S. **Interoperability and Harmonization Analysis of the German Maritime Federation Object Model (GMF) in Relation to SISO RPR FOM with Possible Extensions in a Multinational Forum.** Proceedings of 2014 Fall Simulation Interoperability Workshop, 14F-SIW-004. Simulation Interoperability Standards Organization. 2014.

Tard, L. **LTD SPHINX: a Web-Based Tool for CAX Preparation and Capitalization.** NATO Modelling and Simulation Group (NMSG) Multi-Workshop [MSG-126], STO-MP-MSG-126-014. 2014.

Huiskamp, W. and Faye, J-P. **AMSP-03 M&S Standards Profile for NATO and Multinational Computer Assisted eXercises with Distributed Simulation.** NATO Modelling and Simulation Group (NMSG) Multi-Workshop [MSG-126], STO-MP-MSG-126-015. 2014.

Mifsud, M., Löfstrand, B. and Lloyd, J. **An Update on the Developments and Maturity of the NATO Education and Training Network (NETN) Federation Architecture and Federation Object Model (FOM).** NATO Modelling and Simulation Group (NMSG) Multi-Workshop [MSG-126], STO-MP-MSG-126-022. 2014.

Löfstrand, B. **NATO Education and Training Network - Federation Architecture and FOM Design (NETN FAFD v2.0).** Presentation at 9th CAX Forum 2014.

Horn, B. **CWIX 2014 Modelling and Simulation Focus Area Lessons Learned.** Lessons learned from setting up a simulation exercise in a classified environment at CWIX 2014. 2014.

Annex A – THE SIX MODULES OF A SCENARIO

A.1 THE SIX MODULES OF A SCENARIO AS DEFINED BY Bi-SC 75-3

A.1.1 Module 1 – Geostrategic Situation

This includes a generic description of the crisis area including the major regional actors and a description of the crisis. This includes historical background and major political, military, economic, cultural, humanitarian and legal conditions (Arms Control Treaties and agreements) which support a NATO military response. The Geostrategic situation is summarised in the EXSPEC and included in the EXSPEC annex.

A.1.2 Module 2 – Theatre of Operations

This relates to information/data about the region to support strategic assessments and operational planning. This includes:

- a) Mapping/Map Dataset.
- b) Theatre Data.
- c) Country Studies/Information.
- d) Regional and National Orders of Battle (ORBATs).
- e) OPFOR Campaign Plan.

A.1.3 Module 3 – Strategic Initiation

This establishes the international and NATO political desired end-state, objectives, limitations and directions as well as strategic assessments and planning guidance following the NATO crisis response system. The module should include:

- a) Road to crisis (narrative summary of the main events leading to the planning situation to be included in the MEL/MIL database).
- b) UNSC Resolutions and/or other documents providing the legal basis for the operation.
- c) NAC request for advice.
- d) SACEUR's Strategic Warning Order.
- e) SACEUR's Strategic Assessment.
- f) NAC Decision sheet requesting options.
- g) SACEUR's military response options.
- h) NAC Initiating Directive.
- i) Strategic CONOPS.
- j) SACEUR and Intermediate Commanders' Planning Directives.

A.1.4 Module 4 – Crisis Response Planning Information

This provides current updated information/data about the international and regional situation. Information/data are produced in BiSC AIS functional services/doctrine formats (where available). This module includes as a minimum:

- a) Current Intelligence Summary.

ANNEX A – THE SIX MODULES OF A SCENARIO

- b) Friendly Forces. Provides forces available for planning based on NRF Readiness Reporting System (RRS) and NATO ORBAT as well as the current disposition of friendly and neutral forces in the theatre area. Data for generic forces available for planning should be provided in the same formats and level of detail as real forces available for planning would be.
- c) Target Integrated Database (IDB).
- d) Civil military data and information sufficient to support TA development of the production of the Civil Assessment and the CIMIC Estimate as well as the CIMIC input to the Operation Plan.
- e) Environmental Assessment.
- f) OLRT Recce Reports.
- g) NCRS Messages.
- h) TOPFAS Dataset.
- i) LogBase Dataset.
- j) Intelligence Dataset including regional forces' data and scenario specific Crisis Response Intelligence Package (CRIP).
- k) MEL/MIL as appropriate for Phase 2.

A.1.5 Module 5 – Force Activation and Deployment Information

This provides external information and data in response to player CONOPS and CJSOR as well as CCIR as required to complete execution planning and to initiate entry operations. Information/data are produced in Bi-SC AIS Functional Services/doctrine formats (where available). This module includes as a minimum:

- a) ACTWARN/ACTREQ messages.
- b) FORCEPREP messages.
- c) Allied Force List (AFL).
- d) Force Balancing Results.
- e) SOFAs/MOUs/TAs.
- f) Multi-National Detailed Deployment Plan (MNDDP) / Flow Execution Plan (FEP).
- g) ACTORD message.
- h) ORBATTOA messages.
- i) Current Intelligence Summary (INTSUM) / Intelligence Report (INTREP) (as required).
- j) Joint Targets List.
- k) NCRS messages.
- l) Rules of Engagement Authorisation (ROEAUTH) / Implementation (ROEIMPL) messages.
- m) MEL/MIL as appropriate for Sub-Phase 3A.

A.1.6 Module 6 – Execution Information

This describes the current situation at STARTEX, based on OPLAN Operational Information Exchange Requirements. Information/data are produced in Bi-SC Functional Services/doctrinal formats (where available). This module includes, as a minimum:





































- a) Road to Crisis (Narrative summary of the main events leading to the current situation, including MEL/MIL database).

- b) Current Intelligence Summary (INTSUM) / Intelligence Report (INTREP) (as required).
- c) Operational Assessments and Reports. Assessments and reports that would normally be available in a real situation must be developed and provided before the exercise starts and during execution at pre-determined times/situations. These would include periodic Operational Information Exchange Formatted Reports and special reports and these should be included as MEL/MIL injections. Additional information and products should be held until requested by the TA using doctrinal processes and procedures. Examples include special intelligence information, port data and CIMIC-oriented reports. The requests for this information could come through the Intelligence Requirements Management (IRM) system or via other doctrinal processes.
- d) Order of Battle/Transfer of Authority Land, Sea and Air/STARTEX Force laydowns.
- e) Current SITREPs for Land, Air, Navy, PAO, CIMIC, CIS, METOC, Deployment, Logistics, etc.
- f) Area Of Interest (AOI) Common Operating Picture (COP) data and information. These include data/information products required by “Recognised Picture”. Functional Services (ICC, MCCIS, LC2IS) that contribute automatically to the COP; specialised Functional Services (e.g. JOIS/NITB, EVE, TOPFAS) that provide data and information to the COP as required and theatre functional databases (e.g. CIMIC, Medical, Military Engineering) that contribute to the COP overlays through overlay management agents (e.g. interim Geo-Spatial Intelligence Tool (iGeoSIT)). Some of these data/information products may be developed with the assistance of Modelling and Simulation tools.
- g) Main Events List (MEL) / Main Incidents List (MIL). The MEL/MIL is defined as the main tool (normally a database) for the EXCON and it is structured on the main events developed to support the achievement of exercise objectives. Each main event will have one or more incidents that are presented to the training audiences by means of injections. The MEL/MIL should encompass the complete timeline of the exercise and, at ENDEX, be updated to include all dynamic and unscripted events, incidents and injections used in the exercise conduct.



Annex B – SPHINX TOOL

B.1 GENERAL DESCRIPTION OF EXERCISE

	Glossary	Activity summary	
Activité	[254] VIKING_2014		
Activity database	INT		
CAX, EXP or DEM	CAX		
Classification	UNCLASSIFIED		
Beginning date (aaaa-mm-jj)	2014-03-31		
End date (aaaa-mm-jj)	2014-04-10		
Calendar		 calendar	
		 VIKING-2014_TECH-timeline.jpg	
		 VIKING-2014_exercise-schedule.jpg	
		 VIKING-2014_timeline.jpg	
	Pilots (scheduler and commander)	OCE : Swedish Armed Forces / Carl Frederik KLEMAN carl-fredrik.kleman@mil.se	 pilot
	 20140604_BISC-75-3_responsibilities-in-TOD-process.jpg		 20140330_VIKING-2014_EXPLAN1.4-U-joasva03.pdf
	Activity description	> 7th VIKING Exercise : 2 500 participants (15 % civilian), 50 + countries, 90 + organizations, 8 exercise sites > Exercise VIKING is a training platform designed to prepare civilians, military and police together for deployment to a peace or crisis response mission area. > Developed and implemented in "the Spirit of NATO's Partnership for Peace"	 activityDescription
	 20140205_countryBook.odt		 VIKING-2014_introduction-to-VIKING-14.pdf
	 20140205_countryBook.pdf		 cax_description-overview.jpg
	Activity type	> A distributed computer-assisted (CAX) command post exercise (CPX) co-chaired by Swedish Armed Forces and the Folke Bernadotte Academy supported by a large number of partner nations and organisations. > The exercise is multidimensional, multifunctional and multinational, with an emphasis on realism and current operational concepts.	
	 20140930_exerciseTypes.odt		
	 20140930_exerciseTypes.pdf		
Activity aim	The aim of VIKING 14 is to train and educate participants - civilian, military and police - to meet the challenges of current and future multidimensional crisis response and peace operations. This includes planning and conducting a UN mandated Chapter VII peace operation in an unstable environment and based on a comprehensive approach, focusing on co-operation and co-ordination with all relevant actors, understanding their interdependencies and relations		
Activity objectives	(not in priority order) > Understand and apply a comprehensive approach to international peace operations, including the role of the host nation. > Promote mutual understanding, confidence, co-operation and interoperability among all contributing and affected forces, organisations, offices and personnel. > Understand and apply mission command/management, staff roles and functions, procedures and structures and co-ordinated planning processes. > Understand and apply current operational concepts reflecting present and future challenges in international peace operations		
	Activity organization		 USER
	 20101027_PIA_7-3_montexia.pdf		 conceptual-scenario
	 20140604_BISC-75-3_JWC-EXCON-model.jpg		 exercise-data
	 20140604_creation-of-database.jpg		 viking-2014-vignettes.jpg
	 GOV		 viking-2014_exercice-control-structure.jpg
	 MP-MSG-045-01.pdf		
	 bi-sc 75-3_28-10-2010.pdf		
	 bi-sc-75-3_02-10-2013.pdf		
	Federation design	Country book : https://portal.ledss.mil.se/sites/viking14/www/CrisisWeb/default.aspx	 federationDesign
	 20140604_BISC-75-3_JTLS-database-requirements.jpg		 VIKING-2014_CAXCCIS-in-VIKING-14.pdf
	 20140604_BISC-75-3_JWC-EXCON-model.jpg		
	 MP-MSG-060-02.ppt		
	 federation_description.pdf		


B.2 THE DATA INVENTORY

Stakeholders and means involved in the exercise		
Training or Experimented audience	Training or experimenting centres	Reference architectures
LCC	SE_ACTS	L16
MCC	SE_CCR	HLA 1516 EVOLVED
CAOC	SE_LGR	Standalone
BFOR HQ	SE_NWC	NFFI
ACC	RS_Serbie_Centre	MIP
Bde HQ	BG_Bulgaria	HTTP
NTG	GE_Georgia Centre	HTTPS
UNMIB HQ	IE_Ireland Centre	TCP/IP
DSRSG Political		
DSRSG RC/HC		
UN Police		
UN Military		
UN Country Team		
Regional Office		
Sector HQ - UN		
Country Office		
Regional Office - UN		
EUCAM HQ		
EUBG (F) HQ		

Stakeholders and means involved in the exercise		
Training or Experimented audience	Training or experimenting centres	Reference architectures
LCC	SE_ACTS	L16
MCC	SE_CCR	HLA 1516 EVOLVED
CAOC	SE_LGR	Standalone
BFOR HQ	SE_NWC	NFFI
ACC	RS_Serbie_Centre	MIP
Bde HQ	BG_Bulgaria	HTTP
NTG	GE_Georgia Centre	HTTPS
UNMIB HQ	IE_Ireland Centre	TCP/IP
DSRSG Political		
DSRSG RC/HC		
UN Police		
UN Military		
UN Country Team		
Regional Office		
Sector HQ - UN		
Country Office		
Regional Office - UN		
EUCAM HQ		
EUBG (F) HQ		

Interface data					
Missions and operations	Information products	Control cells	Activity data	Software applications	Technical equipments
Chapter VII peace operation		DIREX	MELMIL	ICC	CAXCON
		Senior Mentors	ODB	VBS2	CISCON
		EXEVAL	Buildings	ARMOR	PIC
		Command Group	Data organizations	VTC system Polycom	RLS
		JEC	Geodata	Lignes téléphoniques commerciales	Security
		OTTM	Map layers	NIRIS	VOB
		JEC Current Cell	Relational schedule	JCATS	
		JEC Plan Cell	Target list	EXONAUT	
				TYR	
				Sitaware	
				Passerelle SIMU-Sitaware	
				FT	
				Portail Web	
				Internet Protocol (IP) Phones	

B.3 DATA DESCRIPTION (VBS2 EXAMPLE)

Data type	Content
FR title	VBS2
Title	VBS2
URL of the object	
FR Description	
Description	VBS2 (Virtual Battlespace 2) offers realistic battlefield simulations and the ability to operate land, sea, and air vehicles. Instructors may create new scenarios and then engage the simulation from multiple viewpoints. The squad-management system enables participants to issue orders to squad members.

B.4 NEIGHBOUR DATA (CBRN TANKER INCIDENT EXAMPLE)

Vignettes or tasks	Reference architectures	Activity
CBRN tanker incident	HLA HLA 1516 EVOLVED	VULCAIN_2012 EVITAC_2012 BFT_2012 HIL_2012 VBS2-VISU_2012 RETEX_AO_2012 VIKING_2014 SPHINX-EXDEM- EXPERIMENTATION_2014 S-JADEX_2014

B.5 DATA SETS OF SPHINX

Each data, or better set of data, can be linked to taxonomies, i.e. a list of names and classifications.

The data sets of SPHINX are distributed in three groups:

- 1) **Business objects** related to the stakeholder: training audience for customers, training centres for users and reference architectures for suppliers.
- 2) **Interface data** or data used an interface between business objects and interfaces.
- 3) **Interfaces** between the stakeholders.

These data sets are described in the following chart.

Table B-1: SPHINX Data Taxonomy.

Business Objects					
Training audience		Training centres		Reference architectures	
Interface Data					
Missions and operations	Information products	Control cells	Activity data	Software applications	Technical equipment
Interfaces					
Vignettes or tasks		Country books		Services	

As told previously, to use the SPHINX conceptual model doesn't impose a standardized taxonomy, even if it may be better for interoperability. So each Nation can use the SPHINX conceptual model with its own taxonomies, if a taxonomy exists. Obviously, in a NATO context, NATO taxonomies and standardized taxonomies will be recommended.

B.6 USE OF EXISTING NATO TAXONOMIES

NATO already provides taxonomies that can be used in the SPHINX conceptual model:

- C3 taxonomy available at https://tide.act.nato.int/em/index.php?title=C3_Taxonomy.
- Bi-SC 75-3 Collective training and exercise directive.
- NMSG-131: Modelling and Simulation as a Service: New concepts and Service-Oriented Architectures.

The purpose of the C3 Taxonomy is to capture concepts from various communities and map them for item classification, integration and harmonization purposes. Recognizing dependencies and relationships, it links Political and Military Ambitions, Mission-to-Task Decomposition, Capability Hierarchy, Statements and Codes, Operational Processes, Information Products, Applications, Services and Equipment definitions and requirements to Reference Documents, Standards, Implementation Programs and Fielded Baselines.

This approach is referred to as enterprise mapping, as the C3 Taxonomy charts NATO's complex C3 landscape.

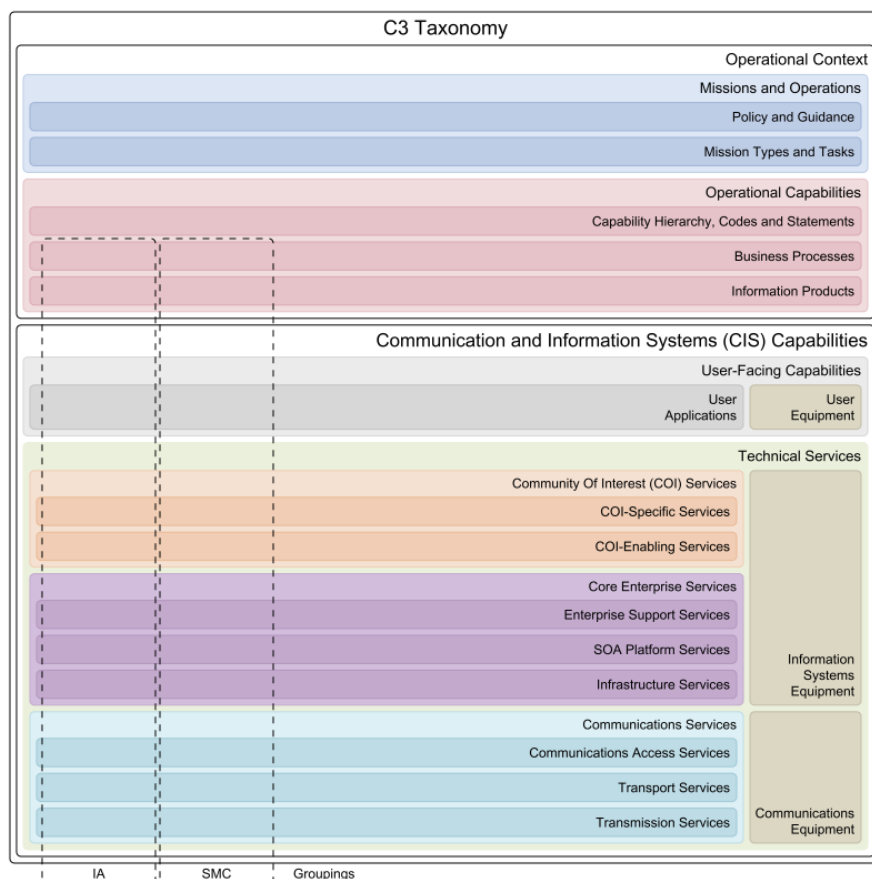


Figure B-1: NATO C3 Taxonomy.

C3 taxonomy can be exploited to support the implementation of the SPHINX conceptual model.

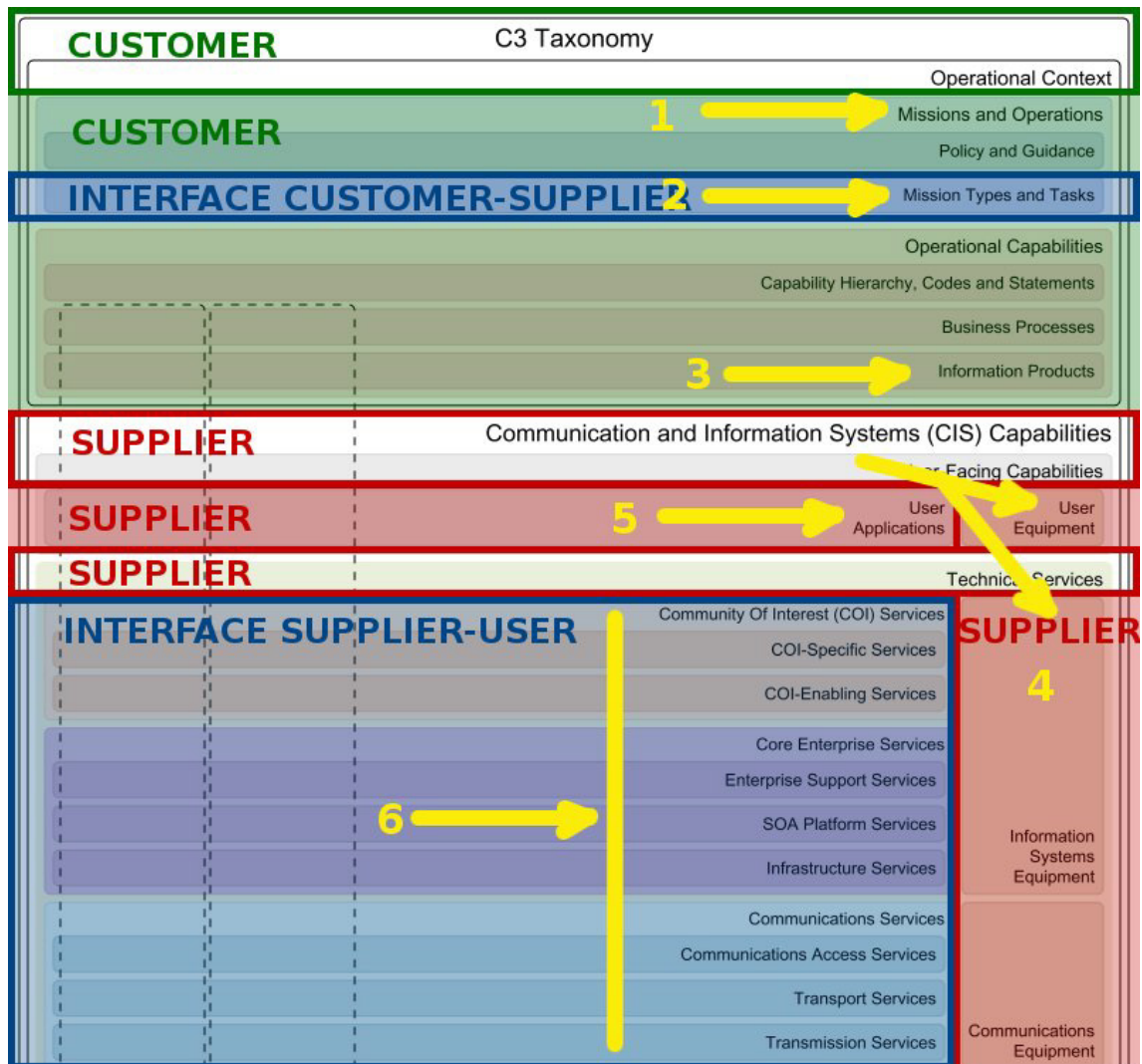


Figure B-2: Relationship Between NATO C3 and SPHINX Taxonomies.

Thus, C3 taxonomy provides lists and data for:

- 1) Missions and operations.

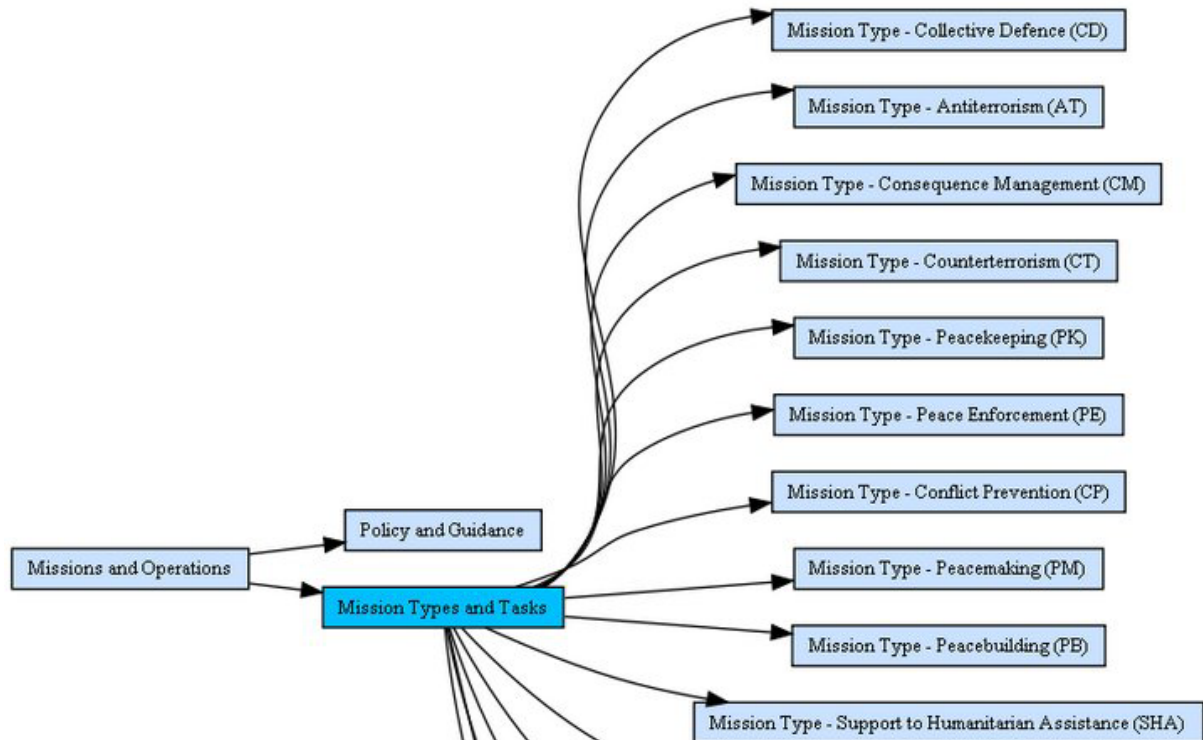


Figure B-3: Missions and Operations.

- 2) Vignettes and tasks.

Mission to Task Decomposition

The **Mission Type - Extraction Operation (EOP)** is decomposed via *Military Strategic Objectives and Operational Objectives* to **Key Tasks - Extraction Operation (EOP)**.

- 1 Description
- 2 Mission to Task Decomposition
- 3 Forces postured for regional strategic deterrence
 - 3.1 Conduct show of force operations
- 4 PK force extracted and international civilian personnel evacuated
 - 4.1 Identify and prepare for attack of JOA strategic targets / target systems
 - 4.2 Control of the air environment in the JOA established
 - 4.3 Control of the maritime environment within the JOA established
 - 4.4 Control of the space environment established
 - 4.5 Entry points to the JOA secured
 - 4.6 NATO-led forces inserted
 - 4.7 Extraction points and routes secured
 - 4.8 PK force extracted
 - 4.9 International civilian personnel evacuated
 - 4.10 NATO-led force withdrawn safely
- 5 WMD threat to the extraction operation neutralised

Figure B-4: Mission to Task Decomposition.

3) Information products.

Tasking & Orders

- Air Coordination Order (ACO)
- Air Operations Directive (AOD)
- Air Tasking Order (ATO)
- Air To Air Refuelling Combined Task Message (AARCTM)
- Airspace Control Order (ACO)
- Airspace Coordination Order (ACO)
- Bridge Demolition Order
- Collection Task List (CTL)
- Coverage Mission Order (CMO)
- Electronic Warfare Stop Jamming Message (EWSTOPJAM)
- Emission Control (EMCON) Order
- Engineer Annex To The Operation Order
- Engineer Materiel Request Release Order
- Engineer Recce Order
- Evaluation task

Figure B-5: Tasking and Orders.

4) Technical equipment.

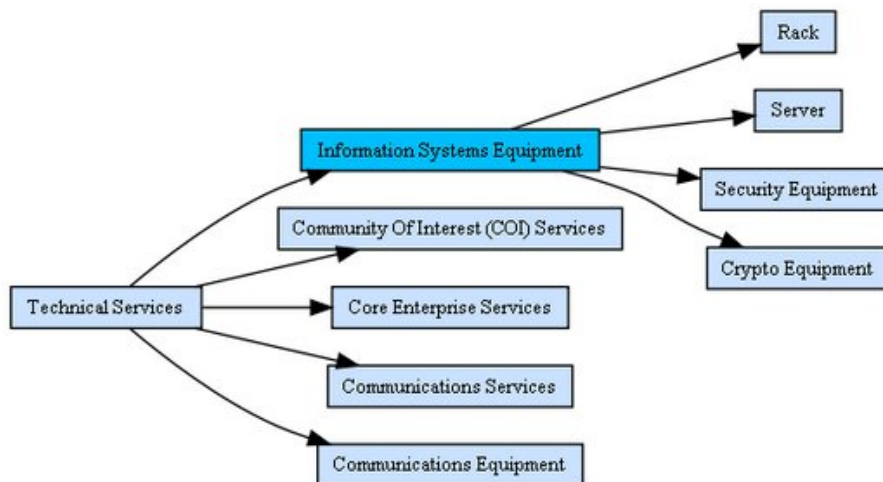


Figure B-6: Technical Services and Equipment.

5) Software applications.

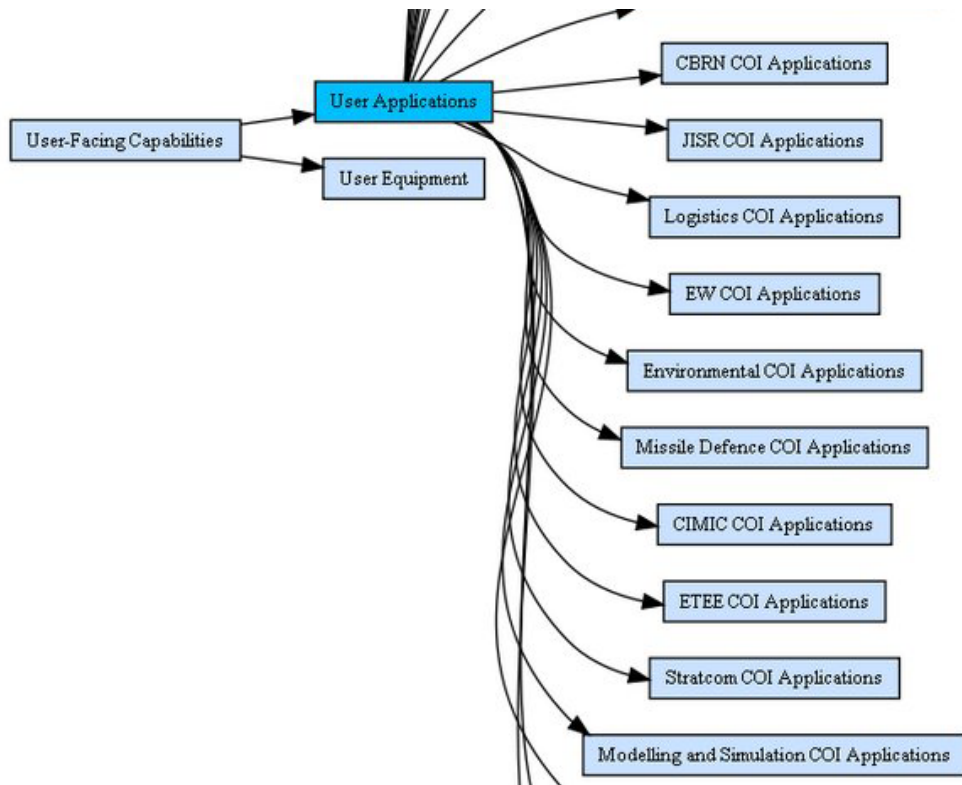


Figure B-7: Software Applications.

6) Services.

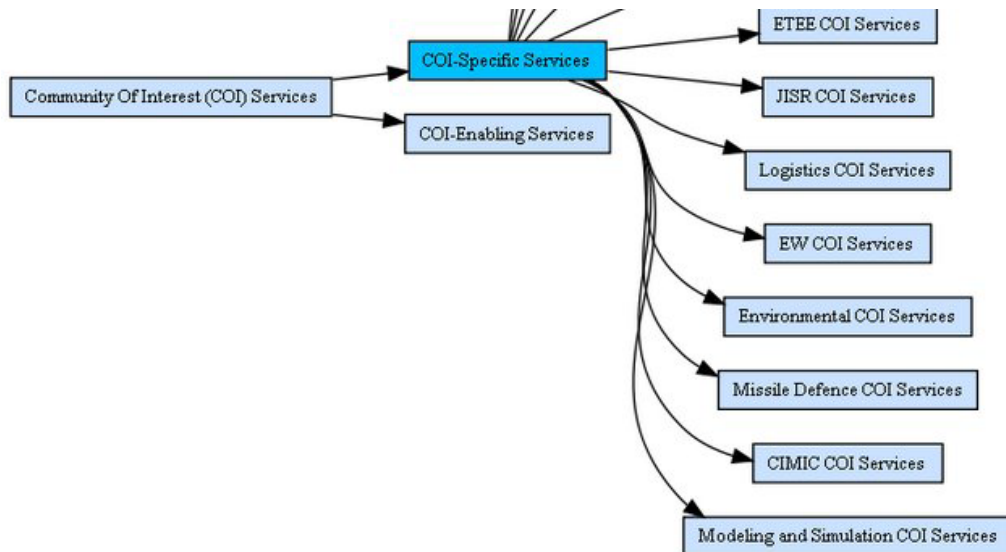


Figure B-8: Services.

The Bi-SC 75-3 provides other taxonomies:

- 7) Training centres:
 - Joint Warfare Centre (JWC).
 - Joint Force Training Centre (JFTC).
 - Joint Analysis and Lessons Learned Centre (JALLC).
 - Austrian Armed Forces International Training Centre (AUTINT / AUT).
 - Peace Support Operations Training Centre (PSOTC / BIH).
 - Bulgarian National Military University / Department of Foreign Languages (BGR).
 - Cairo Regional Centre for Training on Conflict Resolution and Peacekeeping in Africa (CCCPA / EGY).
 - Finnish Defence Forces International Centre (FINCENT / FIN).
 - German Armed Forces United Nations Training Centre (DEU).
 - Etc.
- 8) Training audiences according to level.

Level	Strategic		Operational/Joint Command		Tactical/Component		Tactical/Unit	
Form	Command Post Exercise (CPX)		Live Exercise (LIVEX)		Exercise Study			
Type (examples)	CAX	CFX	SYNEX	FTX	MAPEX	INVITEX	DISTEX	COMMEX
		SACEX	LOGEX	NCSEX	MOVEX	GUNEX	EWEX	MEDEX

Figure B-9: Training Audiences According to Level.

- 9) Control cells.

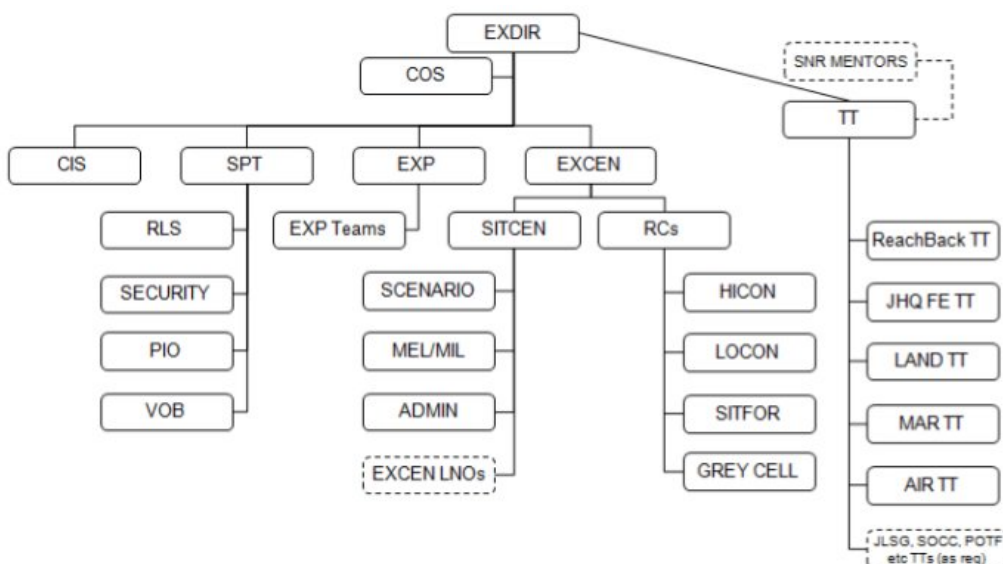


Figure B-10: Control Cells.

10) Country books according to realism.

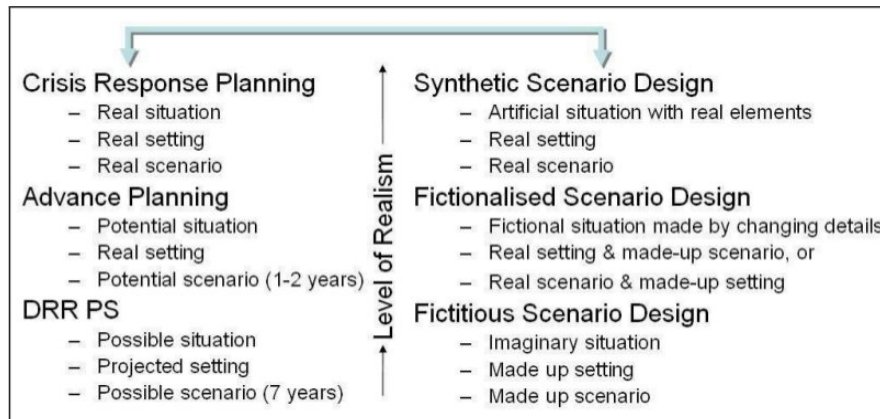


Figure B-11: Country Books According to Realism.

11) Data exercise: terrain data, description of military units, modelling parameters, description of targets, logistics parameters, prototype definitions, force command and logistics structures, lethality data, etc.

Data Category	Description (Partial Only)
Low level data	
Modelling Parameters	Random number streams Altitude and depth zone definitions Combat system definitions Supply category definitions Weather conditions and fronts
Terrain Data	Playing surface size in hexes Hexagon conversion factors Barrier and hex trafficability data
Target Category Data	Target class definitions Aircraft classes, SSM types, etc.
Prototype Data	Force side definitions Tactical unit prototypes Ship unit prototypes High resolution unit prototypes Faction prototypes
Lethality Data	Targetable weapon definitions Target type Group Aircraft loads Load assignments Weapon type lethality Mine field lethality data Lanchester data
High level data	
Unit Data	Faction definitions Individual unit data Command and support hierarchies Naval formation data Individual high resolution unit data
Target Data	Individual target data networks Pipeline and railroad Bridge and tunnel target networks IADS networks Supply movement assets
TPFDD Data	Unit arrival times Arrival data
Strategic Re-supply Data	LOGIN times Receiving units Supplies lists
External Event Data	Types and times of events Event-specific data

Figure B-12: Data Exercise.

The former NMSG-131 about MsaaS provided a taxonomy about:

12) Reference architectures.

Reference architecture	<p>Architectures which are used as a reference for a large set of applications.</p> <p>The following qualifiers may be used to distinguish domain-specific and domain-independent architectures:</p> <ul style="list-style-type: none"> • Domain-specific: architectures that target a very specific application domain, e.g. land-based entity level simulation. • Domain-independent: architectures that are (at least to some degree) independent of a specific application domain. <p>Additionally, architectures may be qualified as “comprehensive” if they define additional services, service agreements, and/or service components.</p>	<p>Domain-independent reference architectures:</p> <ul style="list-style-type: none"> • HLA <p>Domain-specific reference architectures:</p> <ul style="list-style-type: none"> • DIS • TENA <p>Comprehensive domain-specific reference architectures:</p> <ul style="list-style-type: none"> • VIntEL (= HLA + VIntEL-FOM + services + ...), see Chapter 4.5. • NETN (= HLA + NETN-FOM + ...), see Chapter 4.6. • MTDS (= HLA + NETN-FOM + accreditation requirements + ..., see Chapter 4.7.
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Figure B-13: Reference Architectures.

B.7 CONCLUSIONS

Each data of the SPHINX conceptual model can be associated to a taxonomy. A data shall be composed of a type and an identification name (example: HQ-XXX_operational-level).

Reference taxonomies are useful for interoperability but it may be a long time before NATO and Nations coordinate their taxonomy or choose a single set of taxonomies.

Using the SPHINX conceptual model may be the first step in this direction because, once applied, the step after is to exchange CAX implemented according to the SPHINX conceptual model.

The SPHINX conceptual model consists of 12 data objects, 3 scenario types (operational, conceptual, executable) and documents related to each stakeholder like the FAFD, the AMSP-03 and the guideline for non-CAX experts.



Annex C – EXPERIMENTATION AND DEMONSTRATION

C.1 BACKGROUND

There is a requirement to experiment with, “validate”, and demonstrate the Guidance (GOV) and Technical Approaches (TEK) for the development of distributed simulation federations with a representative scenario context (OPS) to:

- Evaluate Guidance recommendations against a use case.
- Evaluate technical developments within a limited use case and gain increased confidence that they will work when integrated together.
- Provide a mechanism to evaluate (demonstrate?) the operational value of the technical developments.
- Demonstrate the outputs from NATO MSG-106 (e.g. at I/ITSEC).

C.2 OBJECTIVES

C.2.1 Strategic

- “Validate” the ability to undertake distributed simulation in an agile manner using emerging NATO standards.
- Demonstrate the ability for Nations to engage in distributed simulations using national capabilities from their home sites.

C.2.2 Operational

- Demonstrate and validate the AMSP-03 recommendation for use of standards for NATO CAX with distributed simulations.
- Demonstrate and validate the benefit of integrating virtual and constructive simulations to stimulate C2 systems using coherent modular architectures.
- Demonstrate and validate the value of automated initiation methods to reduce simulation set-up efforts using coherent modular architectures.
- Demonstrate and validate how the technical approach enables the agile integration of multiple simulation services.

C.2.3 Technical

- Demonstrate and validate within a complex vignette the use of recommended M&S interoperability standards (HLA-e).
- Demonstrate and validate use of reference implementation of information exchange data model for HLA 1516-2010 standard (NETN).
- Demonstrate and validate within a complex vignette the use of recommended Executable Scenario Standards for scenario initialization (MSDL).
- Demonstrate and validate the use of recommended C2-Sim interoperability standards (CBML) within a modular M&S architecture.

ANNEX C – EXPERIMENTATION AND DEMONSTRATION

- Demonstrate benefits of modular approach to NETN FOM development to enable the M&S as a service vision (benefits of FEDEX, MRM, TMR, SimC2 and CBRN FOM Modules) [ET-35].

C.3 DELIVERABLES

The ultimate deliverable is to carry out a successful demonstration of the technical work done within MSG-106 at I/ITSEC, Orlando, FL, USA, in early December 2014. The ambition for this is to demonstrate the use of as many of the FOMs that have been developed as possible.

The other significant deliverable is to carry out experimentation work to prove that individual FOMs are fit for purpose and are able to inter-operate with each other, across local, wide area and international networks. This work will be carried out by producing a scenario that incorporates the use of as many FOMs as possible, involving a significant number of Nations. An OneSAF-compatible MSDL version of this scenario will be produced as a deliverable.

Detail of the scenario is being recorded in the following “experimentation plan”, including specific contributions from Nations and products. In addition, it contains pseudo UML sequence diagrams detailing interactions and ownership responsibility.

C.4 ACTIVITIES

C.4.1 Scenario Definition

This task is being carried out by all participants. Discussions and work is being carried out held ad Completed work should be recorded within the “experimentation plan”.

C.4.2 Federate Development

There are quite a lot of federates being used at different stages of experimentation within the EXDEM Task Team. The table below lists those that have been or are expected to be used.

Table C-1: Simulation Tools Involved in the Experiment.

Federate	Contact	NETN FOMs	Role	Expr Site	Demo Site
CBR VB	Nathan Newton	CBR, MRM	CBR Virtual Battlespace	GBR	Orlando, FL, USA
LowRes UAV	Simon Morris	TMR	Low-resolution UAV CGF	GBR	GBR
HighRes UAV (VBS2)	Simon Morris	TMR	High-resolution UAV CGF	GBR	GBR
OneSAF	Michael Mifsud	MRM	Land-centric unit level CGF	GBR	GBR
MRM SP	Lennart Olsson	MRM, TMR	MRM Service Provider	SWE	SWE/Orlando

Federate	Contact	NETN FOMs	Role	Expr Site	Demo Site
(Pitch Actors)	Lennart Olsson	<ALL>	Aggregate and unit level CGF	SWE	SWE/Orlando
SWORD	Antony Hubervic	MRM, TMR	Aggregate CGF	FRA	Orlando
ORQUE	Xavier Cuneo	TMR, NETN Logistics	Aggregate CGF	FRA	Orlando
Booster	Lennart Olsson	–	Booster	SWE	SWE/Orlando
Viewer (FRA)	Xavier Cuneo	–	Viewer	–	Orlando
C2 System	José Ruiz	–	CBML + FR SICF C2 system	FRA	Video
Google Earth / GE-Adapter	Lennart Olsson	–	Viewer	SWE	Video
Pitch Recorder	Lennart Olsson			SWE	SWE/Orlando

C.4.3 Significant Dates

Date	Event
W/S 28 Aug	First distributed testing event with CBR VB, SWORD, MRM SP and Pitch Actors. Ambition to carry out a complete run through of our scenario (without OneSAF).
W/S 15 Sep	Second distributed testing event with CBR VB, SWORD, MRM SP and Pitch Actors. It is hoped that OneSAF could be included as well as or in place of Pitch Actors.
23-25 Sep	11 th MSG-106 Meeting. Opportunity to test face-to-face with all players.
22-24 Oct	Experimentation event.
1-5 Dec	I/ITSEC Demonstration.

C.4.4 Team Members

Name	Organization	Sponsor Organization	Country	Role	A/I	Email
Laurent Tard	EMA/CPI	EMA	FRA	Chair	A	laurent.tard@soprasteria.com
José Ruiz	DGA/DS/CATOD	DGA	FRA	TEK	A	jose.ruiz@intradef.gouv.fr

ANNEX C – EXPERIMENTATION AND DEMONSTRATION

Name	Organization	Sponsor Organization	Country	Role	A/I	Email
Lubomir Chylik	JCBRN Defence COE	JCBRN Defence COE	Multi-national	TEK	A	chylikl@jcbrncoe.cz
Michael Mifsud	Dstl	Dstl	GBR	TEK	A	MVMIFSUD@dstl.gov.uk
Simon Morris	Thales UK	Dstl	GBR	TEK	A	simon.morris@thalesgroup.com
Ceri Pritchard	BAE Systems	Dstl	GBR	TEK	A	ceri.pritchard@baesystems.com
Stuart Robin	SEA Ltd	Dstl	GBR	TEK	A	stuart.robin@sea.co.uk
Thierry Lamodiere	STAT	EMA	FRA	OPS	A	thierry.lamodiere@intrade.gov.fr
Xavier Cuneo	AIRBUS D&S	DGA	FRA	TEK	A	xavier.cuneo@airbus.com
Anthony Hubervic	MASA GROUP		FRA	TEK	A	antony.hubervic@masagroup.net
Lennart Olsson	Pitch Technologies AB		SWE	TEK	A	lennart.olsson@pitch.se

C.5 EXPERIMENTATION PLAN

Where possible, the scenario has been developed following the DSEEP process.

C.5.1 Exercise Objectives

C.5.1.1 Requirements

- 1) To create an environment for force training process and using modeling and simulations as support tools.
- 2) To give training audience the set of information about Area of Operation to help them to understand the situation in region.
- 3) Created based on OPLAN for potential deployment of NIMFOR into the “SHIPWRECK COAST” Crises Response Theatre of operation. It is based in a fictitious land, but uses a real area of Germany, along with its towns and infrastructure to reduce cost of producing visualisation.

C.5.1.2 Strategic

- 1) “Validate” the ability to undertake distributed simulation in an agile manner using emerging NATO standards.
- 2) Demonstrate the ability for Nations to engage in distributed simulations using national capabilities from their home sites.

C.5.1.3 Operational

- 1) Demonstrate and validate the AMSP-03 recommendation for use of standards for NATO CAX with distributed simulations.

- 2) Demonstrate and validate the benefit of integrating virtual and constructive simulations to stimulate C2 systems using coherent modular architectures.
- 3) Demonstrate and validate the value of automated initiation methods to reduce simulation set-up efforts using coherent modular architectures.
- 4) Demonstrate and validate how the technical approach enables the agile integration of multiple simulation services.

C.5.1.4 Technical

- 1) Demonstrate and validate within a complex vignette the use of recommended M&S interoperability standards (HLA-e).
- 2) Demonstrate and validate use of reference implementation of information exchange data model for HLA 1516-2010 standard (NETN).
- 3) Demonstrate and validate within a complex vignette the use of recommended Executable Scenario Standards for scenario initialisation (MSDL).
- 4) Demonstrate and validate the use of recommended C2-Sim interoperability standards (CBML) within a modular M&S architecture.
- 5) Demonstrate benefits of modular approach to NETN FOM development to enable the M&S as a service vision (benefits of FEDEX, MRM, TMR, SimC2 and CBRN FOM Modules) [ET-35].

C.5.1.5 Exercise Scenario

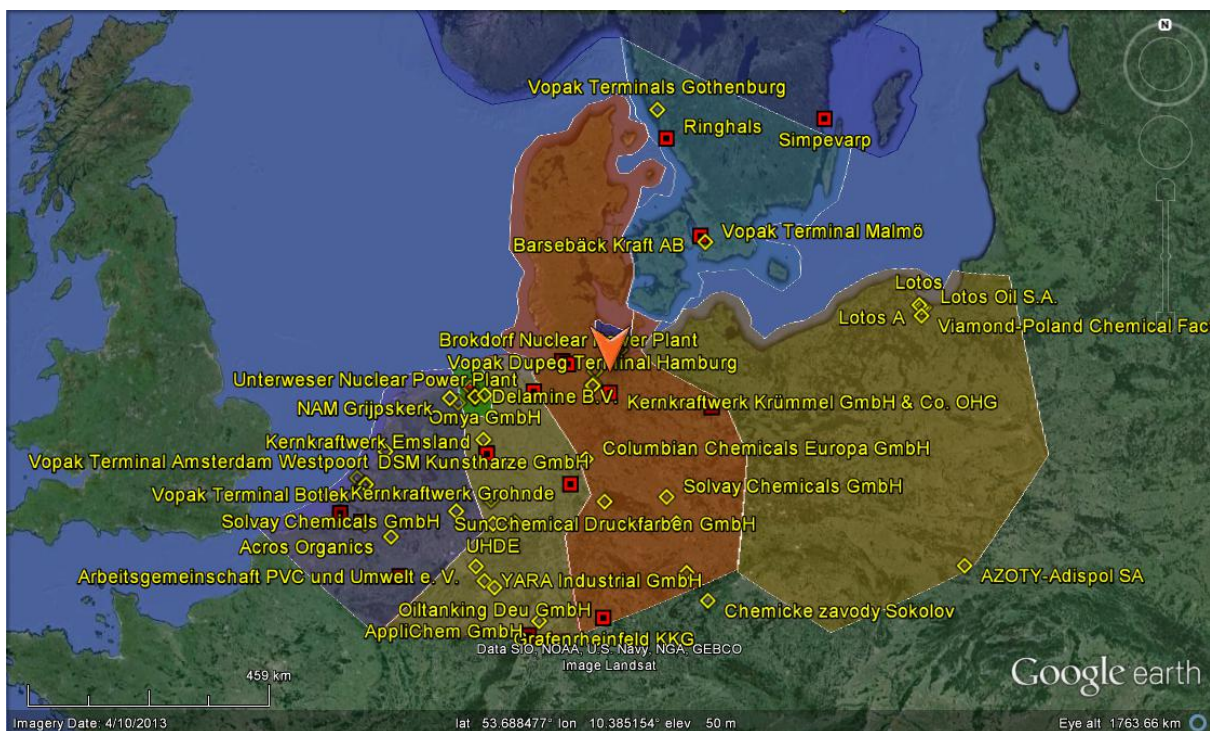


Figure C-1: Scenario Countries.

ANNEX C – EXPERIMENTATION AND DEMONSTRATION

Reason/Environment (brief summary of locations, history, political status, etc.) – all defined in CBRN Scenario.

C.5.1.6 Road to Crisis

- The Gomophia supports of FARM/Frisia clan (Escambian Shahida faith devotees) at overthrowing Asteria and Asterland's democratic governments.
- The overall situation in the Shipwreck Coast region has again begun to deteriorate.
- The increasing Gomophian sponsorship of insurgent and terrorist organizations to spread the Escambian Shahida faith as a rule of government in Asteria and Asterland.
- The UN is concerned that Asteria and Asterland are plagued by insurgent activity.
- The UN established a Weapons Restricted Zone (WRZ) in western Gomophia along the border with Asteria.
- The Asteria government requested for international military help.
- The FARM/Frisia clan insurgents assail the Asteria and Asterland governmental centers, police stations and military forces.
- UN Council approved NATO to send in Asteria International stabilization force (NIMFOR).
- The NIMFOR were deployed and Ground Buffer Zone has been established alongside the Weapons Restricted Zone (WRZ).
- Maritime harassment of fishing vessels.
- The Gomophia EX LIGHT STORM 14 (planned).
- Submarine movements from ports.
- The FARM/Frisia insurgents' attacks governmental centers.
- Gomophia special and land forces has deployed in the northern part along the border with Asteria.
- The Gomophian government conveyed support all Escambian Shahida faith devotees outside of Gomophia.
- UN Council approved NATO to send in Asteria International stabilization force (NIMFOR).
- The NIMFOR were deployed and Ground Buffer Zone has been established alongside the WRZ.

C.5.1.7 Desired UN End-State

- A NATO offer of an interim force to act in the region while the UN force is being generated has been accepted by the UN Secretary General.
- Stability and security restored in the region together with full implementation of the CFA and relevant UNSCRs such that it forms the basis for a stable, well-balanced, long-term and effective political solution to regional issues and allows NATO to handover the mission to a UN-approved Follow on Force (FoF).

C.5.1.8 Com NIMFOR's Military Strategic Objectives

- Provide a secure environment in the region through the implementation/enforcement of the conditions set out in the UNSCRs.
- Provide effective deterrence to prevent further regional escalation and widening of the crisis.
- Allow UN and other agencies to provide humanitarian assistance.
- Conditions set for sustainable political, economic and social development.
- To maintain ground buffer zone established alongside the WRZ.

C.5.1.9 Land Component Command Key Military Actions

- Provide a secure environment in the region through the implementation/enforcement of the conditions set out in the UNSCRs.
- Provide security to key area APOD/DOB1 Lemwerder, Mariensiel, Bremen, Norden airports.
- Provide security to LLOC Oldenburg – Aurich – Moormerland.
- Provide effective deterrence to prevent further regional escalation and widening of the crisis.
- Permit and facilitate UN and other agencies to provide humanitarian assistance.
- Conditions set for sustainable political, economic and social development.
- To maintain ground buffer zone established alongside the WRZ and northern coast ASTERIA.

C.5.1.10 1st Mech Bde Mission and Tasks

- The 1st Mechanized Bde has been deployed in Asteria area:
 - The 1st Mechanized Bde HQ has been deployed in Westerstede.
 - The 1st Mechanized Bde area of responsibility has been demarked as follows: Friedeburg, Varel, Oldenburg, Wardenburg, Friesoythe, Rhaderfehn, Uplengen, Wiesmoor.
- 1st Brigade Mission/Tasks:
 - To create and maintain ground buffer zone established alongside Asteria/Gomophia border line in own AOR.
 - To provide security to key area DOB.
 - Conduct military operations/actions inside the 1st Bde AOO to control MSR (LLOCs) enabling the delivery of HA as main effort.
 - To reinforce 2nd Mech. Bde units by 13th Mech. Bn in Norden area.

C.5.1.11 11th Mech. Battalion

- To redeploy from current position in the SE ZETEL industry area, take and secure it. Establish and provide regular guarding.

C.5.1.12 12th Mech. Battalion

- To secure Vreschen-Bokel city and provide regular patrolling there.

ANNEX C – EXPERIMENTATION AND DEMONSTRATION

- To secure L821.
- To create and provide regular road check points on L821 in Detern, Vreschen-Bokel, Apen.

C.5.1.13 13th Mech. Battalion

- To secure governmental and autonomy centers against insurgents.
- To maintain the ceasefire line on stage from Oldenburg to Edelwecht.
- To start movement to Norden area to secure this coast area.
- To fulfil this preparing Advanced Guard 1Mech Plt, enlarged by 1 CBRN Recce Squad, route intersection Grundschule Kampe – Harkebrügge – Lohe – Barßel – Tange – Detern – Filsum – Hesel – Mittegrossefehn – Aurich – Moordorf – Marienhaf – Osteel – Süderneuland – Norden.

C.5.1.14 CBRN Defence Mission

- To conduct CBRN defence operations within the Joint Operations Area in order to minimize the effect of the use of CBRN Weapons / TIM on deployed forces.

The key CBRN tasks are:

- To protect FF and LN, deter the use of CBRN.
- To establish CBRN Warning and Reporting System.
- To collect and secure evidence of the use of WMD or EOD/IED equipped by CBRN agents.

CBRN Incidents

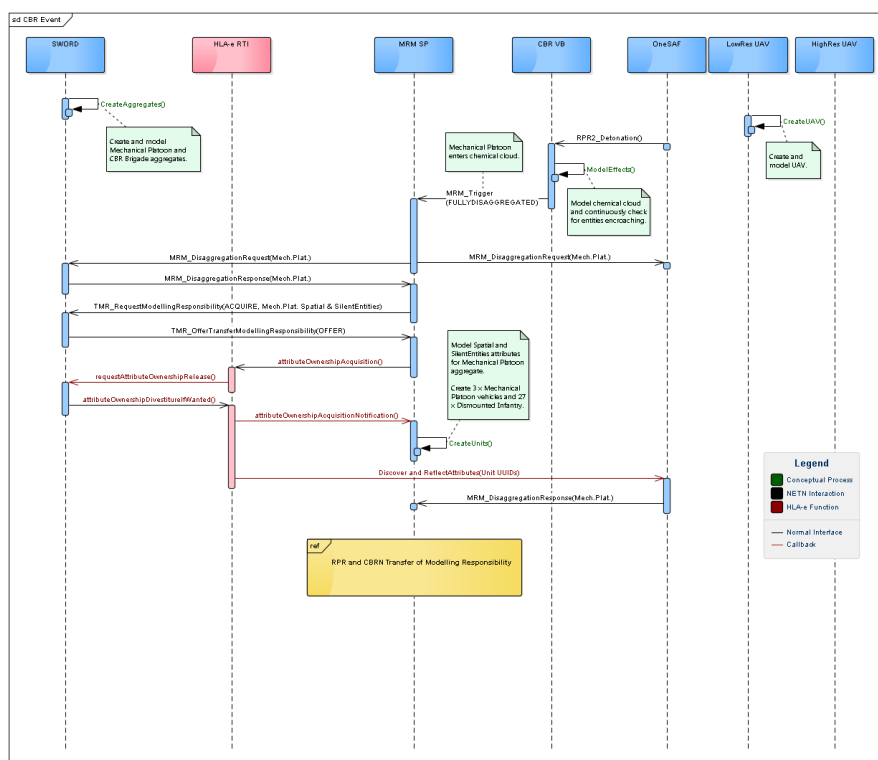


Figure C-2: CBRN Incidents.

Minor Incident

A tanker leaves the carriageway and ruptures, resulting in an Ammonia leak.

Location: On the road to the west of Neuemoor

Latitude: 53°19'47.65"N

Longitude: 7°36'9.12"E

Main Incident

Detonation and release of chlorine, resulting in an expanding cloud that travels on a north easterly direction.

Location: Omya GmbH Emden

Latitude: 53°21'03.00"N

Longitude: 7°21'32.00"E

The Facility Address: Eichstraße 1, 26725 Emden.

The Main Economic Activity: Storage and distribution of chemicals.

Industrial Hazard: Chemical.

The Hazard Specification: Nitrogen liq., Ammonia, Ammonia aqua, Sulphuric acid, Chlorine, Nitric acid.

The Maximal Amount of Stored Toxic Material: Chlorine amount declared up to 1 t, other unknown.

*Main Players***Gomophia:**

- Gomophia is a state-sponsor of terrorism.
- Supports the Asterland-based Frisian Aboriginal Resistance Movement (FARM, the armed wing of the ethnic Frisia clan).
- The strongest military power in the Shipwreck Coast region.
- The Gomophian enclave north of Asterland provides Gomophia with potential ground facilities, airfields, and naval ports that can be used for forward-deployed operations.
- Gomophia is planning for military presence in the enclave for security purposes with a battalion-sized force and a small naval base with an attached airstrip.

Asteria:

- Republic governed by weak centralized government.
- Asteria is supported by Bilateria and maintains diplomatic relations with every country except Gomophia, due to that country's strong support of Asterland.
- Asteria's economy has experienced long-term recession and deterioration.
- Land forces divided into two divisions.

Asterland:

- An independent state formed in Northern part of Asteria after months of intense fighting of three clans Frisia, Hamina and Paldiski, recognized by the international community.

ANNEX C – EXPERIMENTATION AND DEMONSTRATION

- Religiously devout government and society independent of Asteria and Western influence.
- FARM/ Frisia clans continue with its operations against the pro-Western government of Asteria, strongly supported by Gomophia.
- An active sabotage and harassment campaign throughout Asteria and along the Asterland/Asteria border.

Enclave:

- The Gomophian enclave north of Asterland, leased to Gomophia by Asterland in return for Gomophia's support during its fight for independence from Asteria.
- A potential ground facilities, airfields, and naval ports that can be used for forward-deployed operations.
- Gomophia is planning for a permanent military presence in the enclave with battalion-sized force and a small naval base with an attached airstrip.

Situation Forces

FARM/Frisia clan:

- The main goal is to spread the Escambian Shahida faith as a rule of government in the neighbouring countries of Asteria and Asterland.
- Using violence against security force as military and police.
- Interesting about Chem or Bio agents for more pressure to citizen.
- FARM/Frisia clan in Asteria supported by Gomophian government, using terrorist action for enforcement their goals.
- Using IED/EOD against military supply convoys.
- Operating area – Asterland region, Asteria.

NIMFOR:

- The NATO Interim Multi-national Force based on NRF.
- Well trained and good equipped force for peacekeeping operation.
- Entering IAW UN resolution as a peacekeeping force.

Meteorological Information

Prevailing weather:

- T_a : 16 – 20 °C.
- T_g : 8 – 14 °C.
- Isotherm / Convection.
- Somewhat cloudy and sometimes drizzling.
- Wind direction 230 – 270°
- Wind speed 5 – 16 ms⁻¹

Modelled Entities

Table C-2: Modelled Entities.

Entity	Enumeration	Number	Aggregate
BMP-2	1 1 222 2 2 0 0	3	1.11.NIMFOR
BRDM-2	1 1 222 2 4 0 0	1	1.11.NIMFOR
Basic Rifleman	3 1 222 1 205 1 0	4	1.11.NIMFOR
Tanker	TBD	1	N/A
Civilian Lifeforms	TBD	TBD	N/A
Civilian Vehicles	TBD	TBD	N/A
Watchkeeper	1 2 224 50 2 0 0	1	N/A

All forces are considered friendly.

NETN/RPR2 Use

The experimentation will be carried out on HLA-Evolved 1516-2010. The table below defines the versions of the HLA-e FOMs to be used.

Table C-3: Versions of the HLA-e FOMs Used.

FOM	Version	Comment
RPR2	Draft 19.10	Real-time Platform Reference
CBRN	1.1.6	Chemical, Biological, Radioactive and Nuclear
MRM	1.1.1	Multi-Resolution Modelling
TMR	1.1.1	Transfer of Modelling Responsibility

Vignette

Start Date: 30 July 2014 10:00 hrs CET.

- 1) Scenario loading.
- 2) Movement to the gathering point, start reconnaissance:
 - Mech Plt moves to gathering point (Kampe) from ...
 - Recce Sq moves to gathering point (Kampe) from ...
 - Advance Guard change formation and starts reconnaissance on route to Norden:
 - FOM – SimC2.
 - Video – blue force tracking.

ANNEX C – EXPERIMENTATION AND DEMONSTRATION

- 3) Main CBRN event occurs:
 - Detonation and release of chlorine from the Chemical facility, in close vicinity of Emden:
 - FOM – CBRN, SimC2.
 - Video – detonation and initial stages of release.
- 4) Minor CBRN event occurs:
 - Vehicle crashes and releases Ammonia, in close vicinity to Neuemoor:
 - FOM – CBRN, SimC2.
 - Video – Crash site.
- 5) Minor CBRN event – Advanced Guard at risk:
 - Near Neuemoor the Advanced Guard is exposed to a CBRN hazard (Ammonia):
 - FOM – MRM, TMR, CBRN, METOC.
 - Video – showing health status of aggregated entities, disaggregation, CBRN effects caused to single entities, leaving the contaminated area, aggregation, showing updated health status of aggregated entity.
- 6) Main CBRN event – Advanced Guard at risk:
 - Between Hesel and Aurich the Advanced Guard is exposed to a CBRN hazard (chlorine):
 - FOM – MRM, TMR, CBRN, METOC.
 - Video – showing health status of aggregated entities, disaggregation, CBRN effects caused to single entities, leaving the contaminated area, aggregation, showing updated health status of aggregated entity.
- 7) Reinforcement/logistic and medical support to affected Advanced Guard, decontamination at completion of movement:
 - Decontamination required when reconnaissance finished:
 - FOM – MRM, TMR, CBRN, METOC.
 - Video – Embarkation.

Minor CBRN Incident

Step	Action	Owner
1	The Advance Guard vehicles are moving in a convoy along the road. They are initially aggregated and consists of 3 BMP-2's and 1 BRDM. Formation BMP-2, BRDM, BMP-2 and BMP-2 with a 20 meter separation.	SWORD
2	CBRN event is triggered, caused by a crashed tanker leaking Ammonia.	SWORD
3	The moving convoy reaches approximately 50 meters before the CBRN Ammonia cloud and are disaggregated; soldiers remain mounted within the vehicles.	MRM

Step	Action	Owner
4	The vehicles come to a stop, following identification of vehicles blocking the road.	OneSAF
5	A single BMP vehicle moves forward to investigate the blockage.	OneSAF
6	Four soldiers of the forward BMP dismount, from the vehicle.	OneSAF
7	The dismounted soldiers are affected by the Ammonia cloud and report chemical smell, eye irritation and breathing problems.	CBR VB
8	The soldiers return to the vehicle and retreat to re-join the stationary vehicles.	OneSAF
9	The CBRN vehicle, BRDM, moves forward and investigates the CBRN Ammonia cloud. An alternative BMP-2 vehicle moves forward to provide cover for the CBRN vehicle. The CBRN vehicle team identifies the cloud as low concentration of Ammonia report (ATP-45) and layout markers.	OneSAF
10	The forward BMP-2 vehicle moves through the blockage, followed by the BRDM vehicle and the remaining BMP-2 vehicles. Formation BMP-2, BRDM, BMP-2 and BMP-2 with a 20 meter separation.	OneSAF
11	The convoy moves forward and exits the CBRN Ammonia cloud.	OneSAF
12	The vehicles are aggregated.	MRM
13	The convoy continues to move forward on the original route.	SWORD

Major CBRN Incident

Step	Action	Owner
1	The Advance Guard vehicles are moving in a convoy along the road. They are initially aggregated and consists of 3 BMP-2's and 1 BRDM. Formation BMP-2, BRDM, BMP-2 and BMP-2 with a 20 meter separation.	SWORD
2	CBRN event is triggered, caused by detonation and release of Chlorine from a Chemical facility, in close vicinity of Emden.	SWORD
3	The expanding Chlorine cloud reaches the Advance Guard route between Marienhaf and Aurich.	CBR VB
4	The vehicles reach the CBRN Chlorine cloud and are disaggregated; soldiers remain mounted within the vehicles.	MRM
5	The front vehicle reports smelling chemicals, eye irritation and breathing issues.	OneSAF
6	The CBRN vehicle team identifies and report (ATP-45) the cloud as Chlorine. The CBRN vehicle team leaves markers for the detected contaminated area.	OneSAF

ANNEX C – EXPERIMENTATION AND DEMONSTRATION

Step	Action	Owner
7	The convoy increases its speed until it exits the CBRN Chlorine cloud and the CBRN vehicle leaves a marker.	OneSAF
8	The vehicles are aggregated.	MRM
9	The convoy continues to move forward on the original route.	SWORD

Components

Table C-4: Simulation Tools Managers.

Component	People/Organisation
CBR VB	Nathan Newton, Dstl
SWORD	Antony Hubervic, MASA
OneSAF	Neil Smith, QinetiQ Russell Mills, RiskAware
High-Res UAV	Simon Morris, Thales
Low-Res UAV	Simon Morris, Thales

DSEEP

The Distributed Simulation Engineering and Execution Process (DSEEP) is a generalized systems engineering process for building and executing distributed simulation applications. It incorporates fundamental concepts from existing process models within the HLA, DIS, and TENA communities, and reflects a broad consensus as to the key activities and tasks needed to build distributed simulation environments. The DSEEP is designed as a high-level process framework into which the lower-level systems engineering practices native to any distributed simulation user can be easily integrated. The DSEEP was approved as an IEEE Recommended Practice (IEEE 1730) in January 2011.

Step 1 – Define Simulation Environment Objectives

The user, the sponsor, and the development/integration team define and agree on a set of objectives and document what must be accomplished to achieve those objectives.

Step 2 – Perform Conceptual Analysis

The development/integration team performs scenario development and conceptual modeling, and develops the simulation environment requirements based upon the characteristics of the problem space.

Step 3 – Design Simulation Environment

Existing member applications that are suitable for reuse are identified, design activities for member application modifications and/or new member applications are performed, required functionalities are allocated to the member application representatives, and a plan is developed for the development and implementation of the simulation environment.

Step 4 – Develop Simulation Environment

The Simulation Data Exchange Model (SDEM) is developed, simulation environment agreements are established, and new member applications and/or modifications to existing member applications are implemented.

Step 5 – Integrate and Test Simulation Environment

Integration activities are performed, and testing is conducted to verify that interoperability requirements are being met.

Step 6 – Execute Simulation

The simulation is executed and the output data from the execution is pre-processed.

Step 7 – Analyze Data and Evaluate Results

The output data from the execution is analyzed and evaluated, and results are reported back to the user/sponsor.



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14. Abstract	<p>Computer-Assisted Exercises (CAXs) have existed for some years. They are either distributed where participants remain in their home bases and are linked by high capacity communications or non-distributed where all those taking part are collocated.</p> <p>The use of distributed CAXs has grown significantly for the following reasons: a) Operational complexity: multi-national and joint level training needed; b) To reduce costs of exercises by increasing distributed solutions which enable troops to remain within their own barracks; c) Technical advances have enabled far more effective simulation systems; and d) Simulation interoperability is there.</p> <p>To meet with this operational demand, twenty countries and 7 NATO bodies formed a working group also nicknamed SPHINX and delivered several NMSG reference documents:</p> <ul style="list-style-type: none"> • AMSP-03: M&S standard profile for NATO and multi-national computer exercises with distributed simulation; • AMSP-04: NETN Federation Architecture and FOM Design; • AMSP-05: Guideline for non-CAX experts; and • The SPHINX conceptual model describing a Computer-Assisted eExercise (CAX). 		





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