NORTH ATLANTIC TREATY ORGANISATION

RESEARCH AND TECHNOLOGY ORGANISATION

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RTO TECHNICAL REPORT TR-051 **MSG-012**

Recommendations on the Establishment of a NATO Simulation Resource Library

(Recommandations pour la création d'une bibliothèque de moyens de simulation)

Work performed by the RTO NATO Modelling and Simulation Group (NMSG) MSG-012/TG-009.

Published April 2003

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The Research and Technology Organisation (RTO) of NATO

RTO is the single focus in NATO for Defence Research and Technology activities. Its mission is to conduct and promote co-operative research and information exchange. The objective is to support the development and effective use of national defence research and technology and to meet the military needs of the Alliance, to maintain a technological lead, and to provide advice to NATO and national decision makers. The RTO performs its mission with the support of an extensive network of national experts. It also ensures effective co-ordination with other NATO bodies involved in R&T activities.

RTO reports both to the Military Committee of NATO and to the Conference of National Armament Directors. It comprises a Research and Technology Board (RTB) as the highest level of national representation and the Research and Technology Agency (RTA), a dedicated staff with its headquarters in Neuilly, near Paris, France. In order to facilitate contacts with the military users and other NATO activities, a small part of the RTA staff is located in NATO Headquarters in Brussels. The Brussels staff also co-ordinates RTO's co-operation with nations in Middle and Eastern Europe, to which RTO attaches particular importance especially as working together in the field of research is one of the more promising areas of co-operation.

The total spectrum of R&T activities is covered by the following 7 bodies:

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

These bodies are made up of national representatives as well as generally recognised 'world class' scientists. They also provide a communication link to military users and other NATO bodies. RTO's scientific and technological work is carried out by Technical Teams, created for specific activities and with a specific duration. Such Technical Teams can organise workshops, symposia, field trials, lecture series and training courses. An important function of these Technical Teams is to ensure the continuity of the expert networks.

RTO builds upon earlier co-operation in defence research and technology as set-up under the Advisory Group for Aerospace Research and Development (AGARD) and the Defence Research Group (DRG). AGARD and the DRG share common roots in that they were both established at the initiative of Dr Theodore von Kármán, a leading aerospace scientist, who early on recognised the importance of scientific support for the Allied Armed Forces. RTO is capitalising on these common roots in order to provide the Alliance and the NATO nations with a strong scientific and technological basis that will guarantee a solid base for the future.

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Recommendations on the Establishment of a NATO Simulation Resource Library

(RTO TR-051 / MSG-012)

Executive Summary

In 1998, the North Atlantic Council (NAC) approved the creation of a new organisation tasked with co-ordinating the modelling and simulation (M&S) activities of the Alliance. This Organisation, known as the NATO Modelling and Simulation Group (NMSG), was integrated into the Research and Technology Organisation (RTO). The activities of NMSG are set out in an M&S action plan (MSAP) which was approved by the RTO Board. This document stresses that the rapid establishment of a Simulation Resources Library (SRL) is an important objective as a key enabler for the NMSG.

Thus, to comply with this action plan, NMSG decided to form a working group tasked with comparing various possible implementations of a NATO SRL and specifying the best solution.

The Task Group (MSG-012, TG-009) met 5 times (in December 2001 and in February, April, October and December 2002) and produced this resultant report. The TG was chaired by the NATO M&S Co-ordination Office (MSCO) and the following nations were members:

- Canada,
- France,
- Germany,
- Norway,
- United Kingdom.

The United States has a large experience in this activity and provided valuable information despite not being a formal member of this Task Group. The information that was provided had a noticeable influence on the practical and economical aspects of the recommendations of the Task Group. Other factors influencing the TG conclusions in establishing simulation resources repositories were the finding of the European project EUCLID RTP 11.13 “Realising the potential of networked simulation in Europe”.

The first chapter of the final report describes briefly the background and the rationale for the establishment of a NATO SRL. The second chapter introduces national projects, current or in preparation. National requirements, wishes, opinions or visions are also expressed in this chapter. Chapter 3 analyses requirements and identifies priority contents for the SRL. Chapter 4 describes and assesses five possible options for the implementation of a NATO SRL:

- A fully *centralised* library,
- A fully *decentralised* library,
- Three variants of an “hybrid” solution.

The preferred solution is a SRL distributed between NATO and nations, sharing a common framework and presentation format.

After the introduction of the Task Group’s long term vision, chapter 5 proposes a technical solution for implementing the SRL solution, in coherency with the assessment of chapter 4. This implementation should essentially be based on standard Internet technology and tools. Security, Population and Maintenance aspects of the SRL are also analysed. Human resources and funding aspects are addressed and an implementation plan is proposed: If this proposal is accepted and sufficient resources are allocated a NATO SRL could be implemented by the end of 2005. Chapter 6 summarises the proposals of the Task Group and highlights the human resourcing and funding aspects.

Recommandations pour la création d'une bibliothèque de moyens de simulation

(RTO TR-051 / MSG-012)

Synthèse

En 1998, le Conseil de l'Atlantique Nord (NAC) a approuvé la création d'une nouvelle organisation chargée de coordonner les activités de modélisation et de simulation (M&S) de l'Alliance. Cette organisation, appelée « Le groupe OTAN sur la modélisation et la simulation » (NMSG), a été intégrée dans l'Organisation OTAN pour la recherche et la technologie (RTO). Les activités de NMSG sont définies dans le Plan d'action M&S (MSAP) approuvé par le Comité OTAN pour la recherche et la technologie (RTB). Ce document souligne l'importance de la constitution, dans les plus brefs délais, d'une bibliothèque sur les moyens de simulation (SRL), qui est considérée comme un outil clé pour le NMSG.

Ainsi, afin de se conformer aux indications de ce plan d'action, le NMSG a décidé de créer un groupe de travail ayant pour objectif de comparer les différentes possibilités de mise en œuvre d'une SRL OTAN, et de proposer la meilleure solution.

Le groupe de travail (MSG-012, TG-009) s'est réuni 5 fois (en décembre 2001 et en février, en avril, en octobre et en décembre 2002) et a rédigé le rapport TR-51. Ce groupe de travail a été présidé par le Bureau de coordination des activités M&S de l'OTAN (MSCO). Les pays membres suivants y ont participé :

- le Canada
- la France
- l'Allemagne
- la Norvège
- le Royaume-Uni

Les Etats-Unis ont acquis une grande expérience dans ce domaine et malgré le fait que ce pays n'était pas membre officiel du groupe de travail, il lui a fourni des informations très utiles. Ces informations ont influencé de façon considérable les aspects pratiques et économiques des recommandations faites par le groupe de travail. Parmi les autres facteurs ayant pu avoir une influence sur les conclusions du groupe de travail en ce qui concerne les sources d'informations sur la simulation, il y a lieu de citer les conclusions du projet européen EUCLID RTP 11.13 sur « La réalisation des possibilités de la simulation distribuée en Europe ».

Le premier chapitre du rapport final présente l'historique du projet et fournit la justification de la création d'une SRL OTAN. Le deuxième chapitre donne la description de divers projets nationaux en cours ou en préparation, et expose les différents souhaits, avis, opinions et aspirations des pays membres. Le chapitre trois fait l'analyse des besoins et identifie les éléments prioritaires à inclure. Le chapitre 4 présente et évalue cinq options possibles pour la mise en œuvre d'un SRL OTAN, à savoir :

- une bibliothèque entièrement *centralisée*
- une bibliothèque entièrement *décentralisée*
- trois variantes d'une solution « hybride »

La solution de choix consisterait en une SRL répartie entre l'OTAN et ses pays membres, avec un cadre et un format de présentation communs.

Après la présentation de la vision à long terme du groupe de travail, le chapitre 5 propose une solution technique permettant la mise en œuvre du SRL en conformité avec l'évaluation faite au chapitre 4. En principe, cette mise en œuvre ne devrait faire appel qu'à des technologies et qu'à des outils d'Internet. Les aspects sécurité, contenu et maintenance du SRL sont également analysés. Les ressources humaines et le financement sont examinés et un projet de mise en œuvre est proposé. Dans le cas où ce projet serait accepté et où des moyens suffisants seraient affectés à l'activité, un SRL OTAN pourrait être mis en place avant fin 2005. Enfin, le chapitre 6 résume les propositions formulées par le groupe de travail, en soulignant les aspects ressources humaines et financement.

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Chapter 1 - INTRODUCTION

1.1 ORIGIN OF THE TECHNICAL ACTIVITY

1.1.1 The NATO Modelling & Simulation (M&S) Organisation

In 1996 a temporary NATO working group was set-up to assess the possibility of establishing a permanent M&S organisation within the Alliance. This working group was named the Steering Group for M&S (SGMS) and reported to both the Conference of National Armament Directors (CNAD) and the Military Committee (MC), via the Research and Technology Organisation (RTO).

In 1998, the SGMS published two documents: a final report proposing a NATO M&S organisation and a NATO M&S Master Plan (MSMP). Both documents were approved by first the above-mentioned hierarchy (RTO, CNAD and MC) finally by the North Atlantic Council (NAC) in November 1998. Since then the M&S organisation has been set up under the auspices of the RTO, as shown on the following drawing.

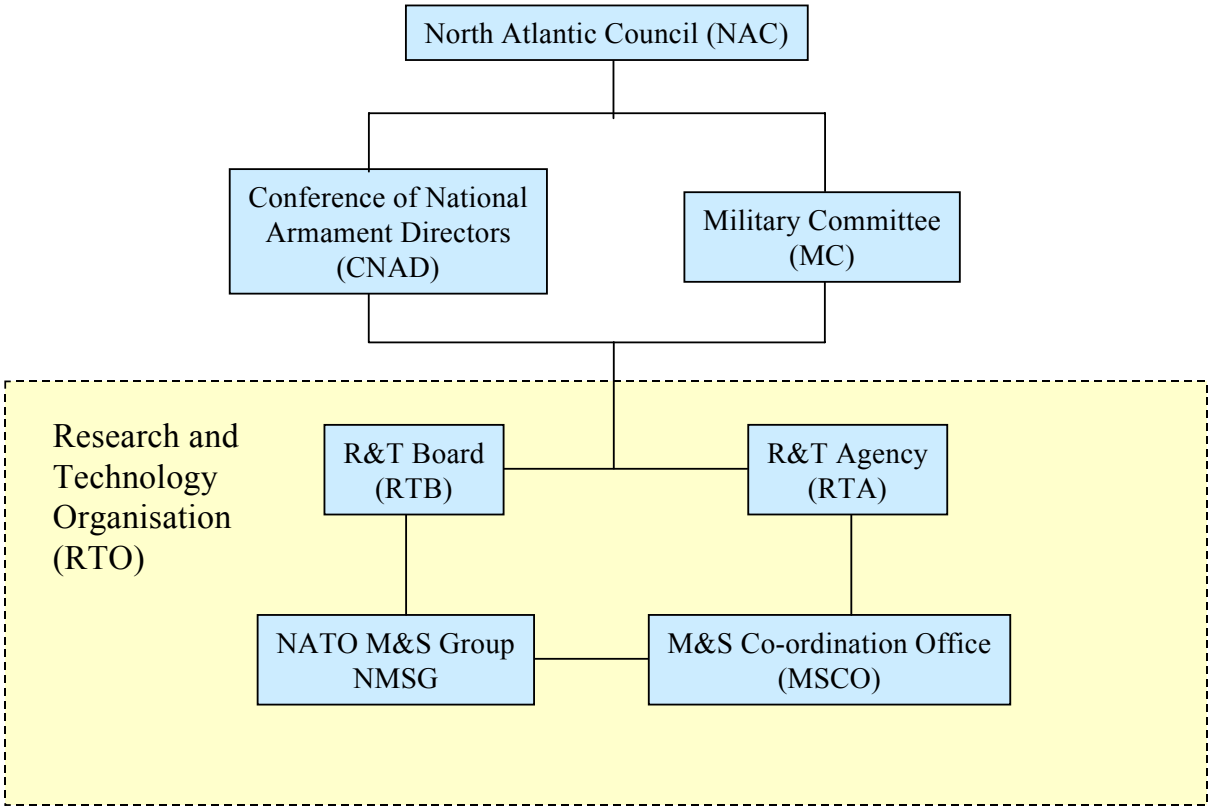

Figure 1: NATO M&S Organisation

This new organisation was actually set-up by the end of 2000 and the NATO M&S Group (NMSG) established its first programme of work in 2000. This programme of work was guided by a new document summarising the MSMP and called the M&S Action Plan (MSAP). The MSAP recognises the MSMP objectives as the leading objectives for NATO M&S activity.

1.1.2 The NATO M&S Action Plan Related Objectives

The five NATO MSAP objectives are.

Table 1: M&S Action Plan Objectives

Objective 1	Objective 2	Objective 3	Objective 4	Objective 5
Establish a Common Technical Framework	**Provide Common Services in NATO M&S**	**Develop Simulations**	**Employ Simulations**	**Incorporate Technological Advances**
1.1 Adopt HLA[1]	*2.1 Compile M&S Information*	3.1 **Identify & Prioritise Requirements**	4.1 **Plan Employment**	5.1 **Monitor M&S Related Advances**
1.2 **Establish Data Interchange Standards**	2.2 **Provide M&S Education**	3.2 **Identify Strategies**	4.2 **Provide Resources**	5.2 **Conduct R&D**[2]
	2.3 Establish a Simulation Resource Library	3.3 **Allocate Resources**	4.3 **Provide Databases**	*5.3 Share Information*
	2.4 Establish a Help Desk	3.4 **Execute Strategy**	4.4 **Operate Simulations**	5.4 **Implement Advances**
		3.5 Provide feedback	*4.5 Conduct Impact Assessment*	

As can be seen in the objective tables, the establishment of a Simulation Resources Library (SRL) is contained within objective 2 (sub-objective 2.3). The top-level objective 2 is the establishment of a set of services, which should be provided to the Alliance for the future development and use of models and simulation. Sub-objective 2.3 clearly relates to the establishment of a simulation resources library but some other sub-objectives are more or less closely linked to this activity such as: 1.1, 2.1, 2.4, 3.5, 4.5 and 5.3. These objectives will be more deeply discussed later in paragraph 3.1.

1.2 MAIN DEFINITIONS: LIBRARY, REPOSITORY AND CATALOGUE

According to the Harrap's Webster thesaurus (2000 edition) there is little difference between a "library" and a "repository":

- **A Library** is defined as "A collection of books, films, records, etc., […] a collection of programs that can be accessed by a computer programmer when required".
- **A Repository** is defined as "A place or a container where things may be stored especially a museum or warehouse […], a trusted person to whom one can confide secrets!"

[1] HLA stands for the "High Level Architecture" the US DoD 1.3 and IEEE 1516 interoperability standards.

[2] R&D: Research and Development

It seems that the concept of a library suggests some organisational and administrative capability: collected items should be classified in categories and can be accessed easily when needed. In the repository definition this notion of accessibility seems absent, the capability of storage is emphasised. It does not seem that existing dictionaries give the current meaning of a repository in reference to a SRL. Therefore it should be noted that a repository should inspire confidence in the usability of its contents.

Another word, which could be used in this report, is "**catalogue**". It normally refers to a list of ordered references that can be used to retrieve things to be acquired by some process. But a catalogue is only supposed to provide information on the referred objects and does not enable direct access to them.

In this report, both words "**library**" and "**repository**" are equally used for simplicity even if they are not exactly synonymous. They both define a place where resources are identified. In the best case, products can be directly accessed. When products are not directly available in the library, some relevant information should be given; a reference which allow users to acquire a better information about their nature, their capability, the constraints for accessing them and the best way to obtain them should be included. The term "catalogue" will not be used since producing a simple list of products without any relevant information attached to them seems to be of little utility.

In any case, the quality of products referenced in a library and the confidence that users can have in them should be a prerequisite before populating the library.

1.3 RATIONALE FOR DEVELOPING A NATO SRL

As can be seen in Chapter 2 of this report, many nations' M&S organisations have already established or have projects to create a Simulation Resource Library (SRL). This emphasises that everybody is convinced that an SRL is the fundamental tool for monitoring and co-ordinating the development of M&S in a structured organisation. It is not surprising that the NATO MSAP clearly identifies the establishment of an SRL as an important objective. The high-level funding objective of the MSAP and the NATO supporting M&S organisation is to promote *interoperability* and *reuse* of M&S. Reuse is not possible without a specific knowledge of available M&S assets.

More specifically the MSAP Sub-objective 2.3 documents that the "**NATO Simulation Resource Library**" **(NSRL)**, is a fundamental tool to promote interoperability and the sharing of M&S resources amongst Alliance Nations. In 2000 the NATO MSG-012 Task Group 009 was established for fulfilling this objective.

1.4 DESCRIPTION OF THE TECHNICAL ACTIVITY

This technical activity was undertaken under the hospices of the NMSG in accordance with the RTO procedures governing the RTO technical team activities. The terms of reference (TOR) of this SRL technical activity asked for *"improving the cost-effectiveness of NATO modelling and simulation (M&S) by satisfying common requirements by a common means"*. The Task Group (TG) TOR document explicitly refers to the NATO M&S Action Plan Sub-objective 2.3*, "Promote the sharing of M&S resources through a simulation resource library (SRL)*".

The TOR recommend that "NATO establish an SRL, automated if possible, to promote the sharing of M&S resources efficiently and cost-effectively across the Alliance. This effort managed by the Modelling and Simulation Co-ordination Office (MSCO) relied initially on national contributions".

The initial objectives of this technical activity were to:

- Identify the types of resources to be shared among the Alliance,
- Perform an investment appraisal/benefit analysis for the SRL as a prelude to obtaining central NATO funding for SRL.

Based on these terms of reference, the task group proposed a possible short-term implementation for a future NATO SRL, taking into account the budget constraints and human resources as they are currently available within NATO and member nations. A vision of the future SRL was developed as a starting point to propose a technical implementation that will be capable of future improvements in respect to what can be envisaged for the mid and long-term technology evolution.

1.5 TASK GROUP PARTICIPATION AND ORGANISATION

Participating nations were:

- Canada,
- France,
- Germany,
- Norway,
- UK.

The US M&S Resources Repository (MSRR) was explicitly named as the referent example of an actual implementation of SRL. Unfortunately it was not possible for this nation to participate in the TG. Nevertheless the US NMSG delegation provided information required to the group.

The group had 5 working meetings rotating between nations. The Internet capability was also extensively used to support the TG work.

Due to the short time allocated to the group, drafting the final report was the leading activity.

Chapter 2 of the report provides national input: describing current and future national projects, wishes and hopes of nations for a NATO SRL. Chapter 3 is the evaluation of SRL requirements from a NATO and a more general perspective. Chapter 4 discusses possible implementations (distributed versus centralised solutions). Chapter 5 elaborates on a preferred solution taking into account various implementation constraints, security, costs and human resources issues. Chapter 6 discusses main conclusions and recommendations to be provided to NATO and national authorities.

Chapter 2 - NATIONAL DEVELOPMENTS, FACILITIES AND REQUIREMENTS

2.1 CANADA

As the UK (see paragraph 2.5), Canada adopted the concept of "Synthetic Environment". For Canada, a Synthetic Environment (SE) is a ***"computer linkage of models, simulations, people (real or simulated), and equipment (real or simulated) into a common representation of the world"***.

Within the Canadian Department of National Defence (DND), the focal point for information on M&S and SE is the "SE Co-ordination Office" (SECO).

The present situation in the Department of National Defence (DND) and the Canadian Forces (CF) is rather difficult in relation to M&S/SE (Modelling & Simulation and Synthetic Environment): DND has no common M&S/SE database, no common repository, no common Resource Centre, no common SE, no common SE Development Environment or no common library. However, there is one M&S Catalogue (http://www.drdc-rddc.gc.ca/SECO/msrr_e.html). It has helped tremendously in the recent past to increase the awareness about M&S/SE in DND /CF. It was not designed for and was not able to push the yardstick with respect to enhancing interoperability since no assets were present in the first place thus no assets could be shared. However, if DND/CF want to make significant improvements in better system designs, faster acquisition schedules or cheaper total costs, the Catalogue has helped in focusing attention on the requirement to perform much more integrated activities in Concept Development and Experimentation (CDE), Material Acquisition and Support (MA&S), Training, Mission Rehearsal using M&S tools that are interoperable, common and reusable. This Catalogue has helped in crystallising the requirement for commonly shared assets, common use tools, common database, common SEs, particularly since Canada, like the US and NATO, has also adopted the HLA architecture. Without a repository of one or more likely several nodes in the country, it is clear that DND/CF will not be in a position to realise the potential of networked simulations. It would be a significant shortfall as a Distributed Mission Training capability for instance is starting to be required to be interoperable with our neighbours to the South. A Table describing the present catalogue entry template is shown in Annex A.

In addition to a larger catalogue of assets, DND/CF will require a large Repository of assets. Indeed, several project, like the Canadian Aerospace SE (CASE project) and several Technology Demonstrations (TD) projects like the Tactical Aviation Mission Simulation System (TAMSS TD), the Maritime Air Littoral Ops (MALO TD), Advanced Distributed Mission Training TD will all develop Federates, Federations and /or related resources or assets. Other Distributed Simulations efforts are planned to participate in various large CD&E activities (such as Joint Global Wargaming 2004). A SE Development Environment, the unclassified Joint Simulation Network (JSimNet) and a classified Experimentation Network, the Canadian Forces Experimentation Network (CFXNet, connected to the Common Federated BattleLab Net with the US and the NATO Consultation, Command and Control Agency (NC3A)) will be available to support these Distributed Simulations efforts.

Requirements:

It is understood that a lot more HLA/FEDEP-based[1] information than is currently available will be required to make greater use of the assets. Documents (under various formats such as .doc .pdf .ppt etc.) that support, illustrate and document the model or simulation or the asset ought to be included in the catalogue.

[1] FEDEP stands for HLA "Federation and Development Process", a guide for developing and running HLA federations approved by both the US DoD and IEEE (1516.3 standard).

1. It is also understood that if reusability is desired, one will have to ensure that some form of a Verification Validation and Accreditation Process (VV&A) process has been applied to the assets, before they can be life cycled and made available to the national community first in a user friendly (not user-hostile) Repository environment. Further, access to NATO Catalogues and Repositories would be also required. In some cases, either in internally in Canada or in NATO, user fees may be required and may still be cost effective both ways: for Canadians as well as for Allies.

2. If one requires several (repository) nodes in the same country, as well as several nodes for all the participating countries, then a common framework and infrastructure for the repository of the common data will have to be tabled, and framed by the MSG 012 task group along the lines of success stories, like the EUCLID[2] RTP[3] 11.13 (see paragraph 2.2.3. and 2.5.3) to guide participating nodes of the participating countries whenever they will be ready to build their nodes in conjunction with their own SE Development Environments (SEDE).

3. It is not clear whether NATO has the requirement, the resources or the capacity to life cycle the M&S/SE assets of several countries. However, if the NATO MSG 012 Task Group provides minimum requirements for connectivity and if we suggest recommended tools (software and hardware) and best repository practices, then many NATO SRL countries could quickly benefit from NATO SRL efforts.

2.2 FRANCE

In order to understand the current status of the simulation resource library in the French Ministry of Defence (MoD), a short review of its General Directorate for Armaments (DGA) organisation for the M&S activities is necessary. DGA is the French procurement agency.

2.2.1 Current Status

Within the DGA, the policy of M&S and Simulation Based Acquisition (SBA) activities are defined by the "Complex System Engineering" Department (SC) of the Technical Policies and Planning Directorate (DSP). The policy is approved on a yearly basis at the DGA directorate level. A Simulation Action Plan has been agreed by the DGA directorate and is under executive responsibility of the SC department.

The technical M&S activities are mainly carried out by:

- The technical centres of the Systems Evaluation and Test Directorate (DCE),
- The Defence Analysis Centre (CAD) of the Technical Policies and Planning Directorate (DSP).

Technical centres within the Armed Forces (Land CROSAT[4], Navy ANPROS[5], Air Force CASI[6]) carry out the operational research activities.

There is no common simulation resource library shared at the MoD level. However, current initiatives are set out below.

[2] EUCLID = EUropean Co-operation for the Long term In Defence

[3] RTP= EUCLID Research Technology Project

[4] CROSAT = Centre de Recherche Opérationnelle et de Simulation de l'Armée de Terre

[5] ANPROS = Antenne Plan, Recherche Opérationnelle et Simulation

[6] CASI = Cellule d'Analyse, de Simulation et d'Innovation

At the DGA level, the simulation resources are capitalised and managed locally within each centre. Most of the time, there is a basic storage (e.g. ASCII[7], Microsoft Excel files) of input/output data, simulation parameters, results, scenarios, etc. Only few centres have catalogues or databases of models and simulation tools. Configuration management is rarely considered.

2.2.2 National SRL in Development

2.2.2.1 Repository Activity in the ARCOSIM Project

A unified process is undertaken by the ARCOSIM (Architecture Commune de Simulation)[8] study whose purpose is to specify and develop a common simulation infrastructure named "Infrastructure Technique Commune de Simulation (ITCS)" for the simulation based acquisition of defence systems, promoting reuse and interoperability. This study started in March 2001. It is under the responsibility of a newly created project team EPSA (Equipe de Projet Simulation pour l'Acquisition). 14 of the 18 DCE's centres and the CAD are directly involved in this project. This large-scale project embodies one of the strategic directions decided by the Simulation Action Plan approved at DGA directorate level.

The first step of this project was to gather general information and technical characteristics about the legacy M&S tools used in those centres. The collected information can serve as input data for a national SRL. The present national vision of the repository is quite schematic, there will be common databases that include:

- Models,
- Simulations,
- Supporting tools,
- Scenarios,
- Results,
- Hardware/software configurations.

These databases will not only serve as catalogues. The users will have access to the specification documents related to models or simulations; the source code, possibly the executable components; the scenario files and the validation of repository resources, etc. The issues related to the information security and the proprietary rights will also be investigated.

The specification of the ITCS functional architecture is expected by end 2003. A prototype will be tested to validate the specification. The detailed requirement analysis is in progress. The development of the ITCS should be achieved by 2005.

2.2.2.2 Joint Simulation Database: BDSIM 2000 Project

Another initiative is the BDSIM[9] 2000 project. The CAD is in charge of the BDSIM 2000 project, which aims to develop a joint simulation database for Joint Staff M&S purposes (tactical, operation and strategic levels).

This database is mainly a catalogue which makes reference to M&S products (models, simulations) and to simulation tools (simulation frameworks and support environment, scenario preparation tools…).

[7] ASCII = American Standard Code for Information Interchange

[8] ARCOSIM = Architecture Commune de Simulation

[9] BDSIM = Base de Données de Simulation

The content of the BDSIM 2000 is organised with respect to the following categories:

- Product name (or acronym),
- Short description of the product (one sentence),
- Detailed description of the product,
- Simulation type (simulation application, war game…),
- Conformity to current or past standards (DIS, HLA, SEDRIS…),
- Simulation level (strategic, operation, tactical, weapon system, physical phenomenon…),
- Operational domain (air, sea, land, joint, NBC, EW…),
- Main purpose (operational analysis, acquisition, planning and rehearsal, training),
- Armed forces systems classification (Air, Land, Navy, Planning and Logistics, Projection,
- Deep Strike, Deterrence, C3I),
- Current status (in preparation, in use, obsolete…),
- Custodian organisation/owner,
- Point Of Contact (POC) name,
- Date and time of the last updated information,
- Keywords.

It is important to stress that associated documentation, such as model or simulation descriptions, could be attached to the related categories.

The database will be hosted on a single server but used in a distributed way (defence Intranet or Internet if the Intranet is unavailable) since its utilisation is based on standard web technologies: online fielding form and secured access to authorised users only (online identification, data encryption).

The BDSIM 2000 offers the following services: multi-criteria search engine, data creation with a validation process, notification for online modification, request for product file destruction, automatic report editing. It also offers useful services such as members' directory (automatically generated and updated), discussion forum, links to other MoD sites. A more detailed description of the BDSIM architecture is provided in Annex B.

The development of this database started in November 2001. The prototype version was delivered 4 months later. The final version is due October 2002. Data is currently under creation and validation. The evaluation and validation of the BDSIM 2000 is planned in early 2003.

BDSIM 2000 will be open to the M&S community within the French MoD. As an example, some of the collected information in the ARCOSIM project will be inserted into the BDSIM 2000.

2.2.3 Prototype of a European Repository in EUCLID 11.13

France is one of the 13 nations involved in the EUCLID RTP 11.13 project: "Realising the potential of networked simulation in Europe". As the UK chairs this project, a detailed description is given in the relevant section (see paragraph 2.5.1).

2.2.4 National Requirements on a NATO SRL

The French point of view about the requirements on a NATO SRL is mainly based on the experience drawn from existing projects: national SRLs (in development) and EUCLID 11.13 repository requirements.

Hence, the NATO SRL is expected to contain the following mandatory items:

- Product name (or acronym),
- Short description of the product (one sentence),
- Detailed description of the product,
- Simulation type (simulation application, war game…),
- Simulation level (strategic, operation, tactical, weapon system, physical phenomenon…),
- Operational domain (air, sea, land, joint, NBC, EW…),
- Main purpose (operational analysis, acquisition, planning and rehearsal, training),
- Current status (in preparation, in use, obsolete…),
- POC name,
- Date and time of the last updated information,
- Proprietary rights (free, industry, government),
- Current HLA compliance status (impossible, certified, under test).

In the best case, it would be noticeable to have an access to the following optional items:

- Description documents about models and simulations,
- Models (for executable software, the type of the operating system and the compiler version are needed),
- Simulations (for executable software, the type of the operating system and the compiler version are needed),
- VV&A information,
- Basic scenario template if the models and the simulations can be retrieved,
- Keywords.

2.3 GERMANY

The present day situation in the Bundeswehr (German Federal Armed Forces) concerning a simulation resource library is best understood by simply following the chronological order. We can identify basically 3 stages.

Stage 1 is characterised by a vast number of lists and catalogues that were produced independently from each other by different organisational units (OU) of the Bundeswehr.

Each of those activities was focused on the peculiarities of the OU: e.g. there were lists on the Operations Research tools, on training simulations, on simulations to support Rapid Prototyping. But there are also lists containing management data, like cost per training hour, etc.

Those lists were neither exhaustive nor correlated to each other. Furthermore, they are partially outdated and to the author's knowledge only one catalogue is dedicated to the potential of federated/distributed simulation available on the Bundeswehr Intranet.

That catalogue has led to stage 2, which began in approximately 1995, when the importance of distributed/federated simulation was recognised in Germany. Hence, this catalogue focused on the interfacing capabilities of simulation systems. However, the knowledge about M&S standards like HLA, or DIS was/is not widespread enough at that time, to have the database completed by the local simulator authorities.

Those lessons learned have finally led to stage 3, which is, where we are now (2002): it is recognised that the vital database entries have to reflect:

- a verbal description of the simulation (task, purpose, category);
- availability of the source code (programming language);
- support of Data Interchange Formats (DIFs);[10]
- connection to an external database (and if, underlying data structure/model);
- availability and quality of documentation;
- information about the vendor/developer;
- knowledge about internal interfaces (modularity);
- access to an API of the simulation application.

By reviewing, updating and merging the current catalogues and adding the above-mentioned information, the Bundeswehr is presently on the way to gather the relevant information about their simulation systems. The results are to be published in the Bundeswehr Intranet.

Although, stage 3 is doubtless a necessary pre-condition for a resource library, it suffers from a lack of practical relevance: when establishing a federated simulation, the potential federates should be documented according to the HLA 4603 NATO Standardisation Agreement (STANAG). Ideally, a repository will contain all of the above mentioned information plus the Simulation Object Model (SOM) plus a link to the simulation software (if appropriate).

Summarising:

The German requirements on a national and a NATO SRL are:

1. Establishing a national data collection as described as stage 3;

2. Access to a NATO data collection providing similar information as the national SRL;

3. Access to a NATO Simulation Resource Library that allows for access to the data model description (as far as relevant for a distributed simulation) and providing a link either to the simulation software itself, or at least to a point of contact (POC).

[10] DIF in this meaning applies to standardised formats like the OMDT (Object Model Development Tool) Data Interchange Format, as well as to "proprietary" formats exchanged by ASCII files, XML files or any other.

2.4 NORWAY

In Norway, simulation is used on many levels in the defence sector. Production simulation, operational and training simulation and technical simulation of new weapon systems are some examples. For instance, when new concepts for officer training are chosen, simulation plays an integral part of the analysis effort. Similarly, long-term costs are simulated when choosing among future force structures. At the other end of the spectrum, new C3I[11] solutions for ship-to-ship missiles also rely heavily upon such SE. Simulations reside in industry, within operational and training units as well as in the research establishments.

There presently exists no common database, repository or library that enables an overview of the plethora of simulation models used by different agencies of the Norwegian Armed Forces. However, at the Norwegian Defence Research Establishment (FFI) a model library has been established for the use of its defence analysts, mostly in support of long term defence planning. The library's models are mainly focused on operational and force production aspects. The library contains information relating to key aspects of each simulation model, including the model documentation and POCs. At present, the model library is a text-only overview of the different models, based on queries sent to POCs for each model. POC is defined as "the person with most knowledge of the model". The query process is quasi-yearly and consists of all POCs being asked to verify existing information – and all project leaders to provide documentation on new models. The results from the queries are presented on an internal web-site in HyperText Mark-up Language (HTML).

The model library contains data in the following format (the list is not exhaustive):

- Model name,
- Purpose of model,
- Joint/Army/Navy/Air/Logistics, etc.,
- Strategic level, operational level, tactical level, weapon systems level,
- Different versions,
- Programmers/developers,
- Year finished and year of last updated information,
- Current and previous projects using it, current POCs,
- Operating system,
- Programming language,
- Documentation,
- Comments on possibilities of re-programming/further development (including plan to make HLA compliant if any),
- Other models using output from the described model,
- Other models needed to give input to the described model.

Norway is a partner in EUCLID RTP 11.13 and stands behind the requirements developed in that effort. It is the Norwegian view that the NATO SRL only requires a small subset of EUCLID 11.13 to be fulfilled. As a minimum, the information in the FFI model database (see above) must be available in the NATO SRL.

[11] C3I stands for Command Control Communications and Intelligence.

2.5 UNITED KINGDOM

The UK has a number of initiatives examining the sharing of SE, modelling and simulation assets, the ability to interoperate and the creation of resource directories or repositories.

The working UK definition of an SE is 'A computer based representation of the real world, usually a current or future battle space, within which any combination of 'players' may interact. The players may be computer models, simulations, people or instrumented real equipment'. As part of the Infrastructure and Services initiative the UK Synthetic Environment Co-ordination Office (SECO), is carrying out a project to improve the availability, value and economy of SE Assets within the Ministry of Defence (MoD). Project SAVE will look at the sharing of SE and simulation assets.

a) The UK MoD research community has a database of models.

b) The UK chairs EUCLID RTP 11.13, 'Realising the potential of networked simulation in Europe'.

Further information on these initiatives is set out below.

2.5.1 Project SAVE

Project SAVE is an initiative to promote Synthetic Environment AVailability and Economy. The original objective was to identify the requirement for and options to deliver a common set of SE components to UK MoD users. The first major part of the project was a stakeholder survey to determine the current SE and simulation assets held across MoD, the commonality and overlap of existing components and capture any best practice in the sharing of components. The survey addressed Interoperability, Ownership, Intellectual Property Rights (IPR) and User Rights and the current and future aspirations for sharing SE components within the UK MoD and elsewhere. At the beginning of the project UK SECO did not have a comprehensive list of SE, modelling and simulation assets.

The stakeholder survey will be carried out in a number of stages; currently it has created a simple database of in service training simulation assets. As the survey continues it will identify assets from research projects, academia, synthetic environment based acquisition projects etc. The aspiration is that this information [obtained through the stakeholder survey] will serve as the baseline data set for population of any future national or international SE and simulation repositories. It should be noted that the stakeholder survey confirmed that Intellectual Property Rights, MoD use and re-user rights will be significant factors in the consideration of sharing SE components.

2.5.2 The Defence Scientific and Technology Laboratory (Dstl)/QinetiQ Models Database

2.5.2.1 The DERA Public Private Partnership

In July 2001, under a public private partnership arrangement the UK MoD scientific research base, the Defence Evaluation and Research Agency (DERA) was split into two distinct organisations: QinetiQ and the Defence Scientific and Technology Laboratory (Dstl). Whilst QinetiQ is a commercial company, Dstl remains an integral part of the UK MoD.

The previous DERA models database contains approximately 800 models, of which probably more than half have since been vested in QinetiQ The database does not contain information at component level – it is designed as a catalogue rather than a repository. The quantity and quality of information is variable. A number of the models held are now obsolete. A review of the information held is currently underway.

2.5.2.2 Industry Assets

Alenia Marconi Systems (AMS), BAE Systems and Matra BAe have established a SE Advanced Technology Group (SE-ATG). It is hoped that UK MoD will have visibility of their SE Assets Repository.

2.5.3 EUCLID RTP 11.13

The UK chairs the EUCLID RTP 11.13 programme 'Realising the potential of networked simulation in Europe'. This is a jointly funded activity involving both national MODs and Industrial Entities (IEs) across Europe. The lead industrial entity (i.e. prime contractor) is Thales Training & Simulation (TT&S) and the overall project consists of 23 European companies across 13 Nations. The programme started in November 2000 and will finish in October 2003, with a final demonstration scheduled for November 2003.

The aim of the project is to "overcome the obstacles that prevent SEs being exploited in Europe" by developing a process and an integrated set of prototype tools, which will reduce the cost and time-scale of specifying, creating and utilising SEs for collective training, mission rehearsal and simulation based acquisition".

An essential part of this programme is the characterisation of assets and the development of prototype repository architecture software that aims to provide a repository server based solution, independent of any COTS software products, e.g. ORACLE DBMS. This will be used to develop a prototype 'pan European' Repository that will store all information relative to building and utilising SEs.

The EUCLID RTP 11.13 Management Group (MG) has agreed that those deliverables relevant to the repository architecture, including "asset" characterisation, can be shared with NATO MSG-012 TG 009. The word "asset" is used in the RTP 11.13 to represent any information item or resources such as models, simulations, tools, databases, etc. which are of interest for designing, developing or exploiting SE modelling and simulations. In relation to this report, NATO Simulation Resource Library, the word "Asset" is interchangeable with "Resource".

2.5.3.1 Repository Architecture Requirements

The prime function of the repository software is to provide a mechanism for storing and transferring data between the different phases of the EUCLID RTP 11.13 SE development process. Therefore the repository has to be flexible, scaleable, distributed and content specific. The latter meaning that the repository will contain information about a variety of assets that can be used in the design of an SE including documentation, information on entities, simulations, and previously constructed federations.

The repository software will:

- Support the EUCLID 11.13 SEDEP[12] by enabling the tools that support the SEDEP to access and manipulate information,
- Support the implementation of a set of local repository databases across Europe which can be linked together using standard networking technology,
- Provide the ability to be configurable so that the data can be split into private and public areas,
- Support a single point of access using tools that support the SEDEP,
- Be independent of any vendor operating system and Data Base Management Systems,
- Support control of the content so that it remains with the owner of the local repository,

[12] SEDEP = SE Development and Execution Process which should be considered as a specialisation of or an extension to the HLA FEDEP (Federation Development and Execution Process).

- Allow for annotation so that owners of assets can add additional text in a repository Entry,
- Provide an access interface so that tools developed during the Euclid 11.13 project or COTS tools can access it,
- Provide off-line capabilities, to allow tools supporting the SEDEP to run off-line (i.e. without connection to the repository),
- Scaleable, so that there is no limit as to how much data is stored,
- Not restrict the type and size of an Entry,
- Provide easy maintenance of entries by ensuring that the software helps the users modify or remove information from the database.

2.5.3.2 Data Storage

The repository may contain types of data such as:

- Information about SE assets that could be used in an SE (e.g. simulators, simulations, etc.),
- Information about databases (visual, natural environment, etc.)
- Information about support tools (Input Output Systems (IOS), data loggers, stealth viewers, User Requirements tools, SE development tools, Execution Management, etc)
- Federation definition and development materials, tested Federations
- Project parameters (cost, time, schedule etc.)
- Executable code (or links to executable code) that can be downloaded and run during the execution phase of the process,
- Data components for the requirements, design, execution and results for a particular SE experiment.

2.5.3.3 Repository Usage

The repository can be used at a number of different levels:

Individual libraries (Usage 1)
In its simplest form, users can adopt the Database and Characterisation of assets structure to store information on their assets (e.g. simulators, simulations, stealth viewers, data loggers etc.) to build their own library.

SE construction (Usage 2)
The repository can support the construction and execution of an SE as an internal project. In this form of usage, the repository is part of the user Intranet that is protected by its own firewall. Examples 1 and 2 of repository usage are shown in the Figure 2. The private repository isolated from the network by an ‘air gap’ ensures that individual access rights and IPR are controlled by the user.

Internet visualisation of other organisations’ assets (Usage 3)
In this the public Internet is used to connect many local repositories. If requested, the owner of the assets could either licence the asset to another organisation or run it remotely at their own site.

SE consortia (Usage 4)
An SE user can participate in an SE project as part of a consortium. In this case the participants’ repositories are connected to an “Internet type” network. This is a more complex usage of the repository

where companies will want to protect their IPR and military sensitive information from either competing companies or potential hackers.

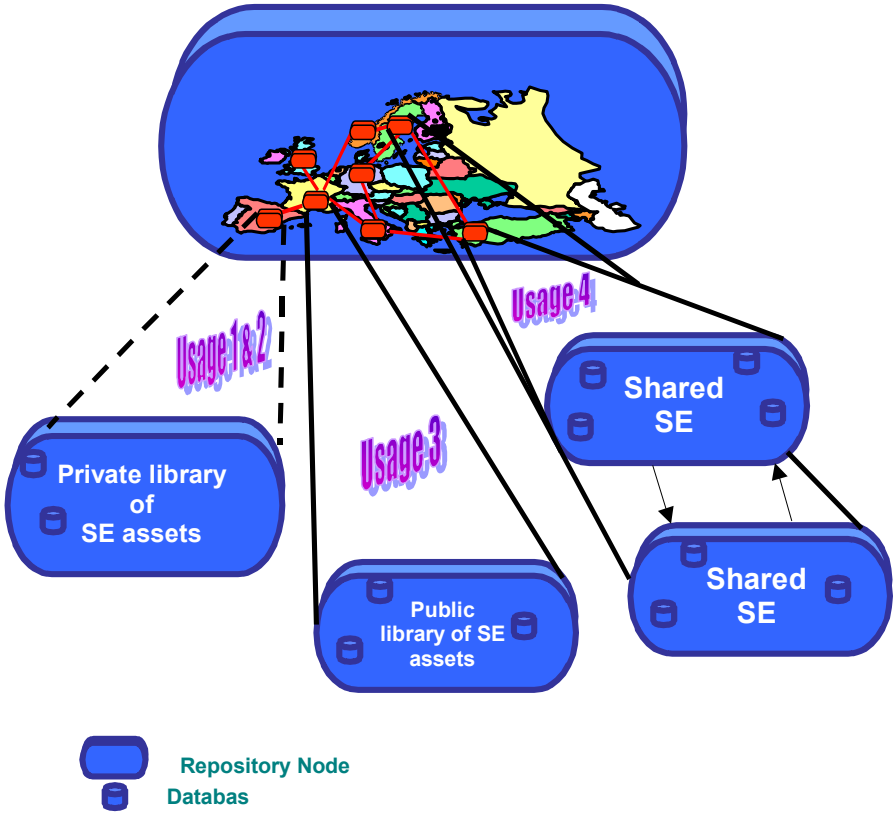

Figure 2: EUCLID RTP 11.13 Repository Usage

2.5.4 UK Requirements

The UK requires that the NATO SRL should be a linked set of Simulation/SE repositories or libraries. The EUCLID 11.13 repository could be a node on the NATO SRL. In addition, the EUCLID 11.13 methods for asset characterisation including the repository architecture software could provide a basis for developing NATO SRL and National SRL nodes. In terms of access to information on Simulation and SE assets, as a minimum, top level information on the assets and relevant points of contact details should be available to all NATO participants. The information should be organised to allow information to be abstracted to the requirements of a variety of user types.

2.6 THE UNITED STATES MSRR

The MSG 012 task group members drafted this section according to information provided by the US Department of Defense (DoD) Defense M&S Office (DMSO). The task group established a questionnaire during its second meeting, sent it to the US and received a detailed answer.

The US "Modeling and Simulations Resource Library" (MSRR) was established in the mid-90' as a DoD-level effort. It is a fully distributed repository with a central node operated by the US DoD M&S Information Analysis Centre (MSIAC) under the leadership of DMSO. In fact, there are multiple

"MSRRs": DMSO, each Service, and the Missile Defense Agency (MDA) operate independent systems, which can conduct mutual searches of each other. While content is intended to be exclusive, in practice there are exceptions.

2.6.1 Access Conditions

In the MSRR there is a public part that can be accessed by everybody via the Internet and a private part. This private part is not accessible by non-US citizens. Account holders for the DMSO MSRR must be U.S. citizens, active duty military or civilian employees of the U.S. Department of Defense. Contractors under current contract to the U.S. DoD may also receive accounts.

The current number of account holders in the DMSO MSRR was 1549 in mid-2002. Searches (not web hits) conducted on the DMSO MSRR varied between 928 and 1453 per month.

2.6.2 MSRR Contents and their Origin

Most resources are only catalogued, however, the system can and does contain resources, which can be distributed to users.

Typical resources that can be found in the US MSRR are:

- Functional descriptions of the Mission Space,
- Data Interchange Formats,
- Data sources,
- Databases,
- Documentation,
- High Level Architecture documentation,
- High Level Architecture Federation Object Models (FOMs),
- High Level Architecture Simulation Object Models (SOMs),
- Lessons learned/successful practices,
- Models,
- Points of Contact,
- Simulations,
- Subject Matter Experts,
- Tools and utilities.

In addition some sites can provide additional types of information on :

- Facilities,
- Organisations,
- Related Sites,
- Simulators,
- Studies,
- Technology Research.

The sources of information are too numerous to list.

About mid-2002 there were 1333 different resources items in the DMSO MSRR.

2.6.3 Ownership, Property, Rights on available Tools, Models, Algorithms

Ownership rights vary. All DoD owned or funded software is subject to DoD distribution restrictions; distribution restrictions may also apply to information about the resources. The MSRR supports enforcement of these restrictions. The commercial resources are governed by copyright. Information on how to obtain resources and any use restrictions are available for all resources. At this time, the MSRR does not distribute any item that is commercially owned.

Entries are validated, however, the nature of the validation varies. Some systems automatically validate URLs[13], others check resource related web pages for changes. The DMSO MSRR also validates resources manually, on a cyclical basis, as this is the only way to validate content. Unfortunately, it is labour intensive. Upgraded MSRR software will partially automate this by generating e-mails to sponsor and technical points of contact on a cyclical basis.

2.6.4 Implementation

The Service sites use nearly identical software but each Service has different management methods.

The front end is written entirely in JAVA; the authentication system is mostly in C. The back end is an Oracle database. All Services can use different commercial software. The current system is running on Microsoft Windows based platforms, however as most of the system is server side JAVA it would port to other platforms.

The system relies on certain security features within the Oracle database.

2.6.5 Cost Aspects

All the MSRR systems have gone through multiple software releases over the course of six years. Given that, the overall cost of development is more than $2.5 million (U.S.), but difficult to pin down.

The annual cost of software maintenance is dependent on the extent of modifications required. DMSO found through system use that significant improvements were necessary. Additionally, new COTS software releases, required modifications to the MSRR code. The workload justifies 1-2 people. The system operates on two Windows compatible servers, one hosting the database, and the other the front end. Hardware costs would vary, depending on the server capability.

There is no cost sharing between DoD nodes; each node is fully independent.

2.6.6 Human Resources

The DMSO node requires about 1/2 staff-year for resource administration, and about 1/4 staff year or less for software systems administration. This assumes that the resource administrator does minimal resource acquisition. All of the MSRR nodes have some type of multi-layer transaction based system for incorporating resources. Various subordinate organisations can play the role of “resource co-ordinator,” screening resource nominations before they receive final approval for incorporation. Annual level of effort does not include this role, as it will vary significantly.

[13] URL stands for Uniform Resource Locator (Internet)

2.6.7 Weak Points Identified

Development of a sufficiently robust administrative back end is critical to maintaining content. Originally, it was assumed that many back end functions would be performed only occasionally. As a result, they were not well implemented within the administration back end. Some of these functions are:

- Account administration,
- Access control by groups,
- Keyword administration,
- System resets based on external attacks or repeated entering of incorrect passwords by authorized users,
- Creation of new resource types, domains, and data fields.

2.7 NATO NC3A ASSETS

From 1996 to 1998, NC3A was an active participant of the former Steering Group for Modelling and Simulation (SGMS, see paragraph 1.1). The SGMS organised a survey among NATO and SGMS participating nations to know what models and simulations were available for application in the NATO context. The result of this survey was made available on the NC3A web site. It appears that the database has not been maintained and is no longer available.

NC3A has developed a paper catalogue in 1999 describing tools developed or acquired by the agency. This document would be highly useful to task group and in the development of a NATO SRL, however, the current working status of this document is not known (unfortunately no information was available on the NC3A website. (www.nc3a.nato.int). It would be useful if this document could be made available to the NMSG in advance of NATO SRL implementation.

2.8 COMMON POINTS ON NATIONAL PROJECTS AND IMPACTS ON A NATO SRL

The individual statements of participating nations positions in regard to the development of SRLs show that many different approaches are planned and that countries are at different stages of implementation. The US is the only nation to have a fully working SRL. However, nations agree on the pressing requirement for a M&S/SE catalogue, listing and describing current assets owned or accessible to each country, developer, user or operator across all domains, (CDE, MA&S, Training or Mission Rehearsal activities). In addition, participating countries are converging on the common concept that their catalogues must also lead to a “common look and feel”. The task group was very interested to assess and potentially exploit repository activities undertaken by the EUCLID RTP 11.13 programme.

The task group recognised that the long-term goal would be a repository of actual validated assets, with “one degree of separation”, i.e.: a double click of a mouse away form the asset. However this vision is not feasible at this time.

Chapter 3 - SRL REQUIREMENTS ANALYSIS

3.1 NEEDS EXPRESSED IN THE NATO MSAP AND MSMP

As mentioned in paragraph 1.1.2, the NATO MSAP objectives show clearly the need for a NATO SRL. More specifically, the sub-objective 2.3 (see table 1, page 3) is attached to this activity: "Establish a Simulation Resource Library". The description of this sub-objective provides some details on the contents of the simulation library, but this content list should be considered as a minimum requirement for the work of this task group.

Sub-objective 1.1 (Adopt HLA) mentions that no benefit could be provided by a common technical architecture without putting models and simulations into a library if they have to be reused instead of being continuously re-developed.

Sub-objective 2.1 (Compile M&S Information) is the first sub-objective explicitly mentioning the existence of a SRL as a repository of information needed by the NATO M&S community for its future activity. It also recommends assessing what type of information would be suited to NATO and PfP[1] activity and it is the main topic treated in this Chapter 3.

Sub-objective 3.5 (Provide feedback) is the establishment of a process to "provide information to the larger NATO community regarding simulations and any lessons-learned during development". This sub-objective suggests to record results of the activity within the SRL and the accomplishment of the objective is clearly based on the existence of such a capability.

Sub-objective 4.5 (Conduct Impact Assessment) is complementary to sub-objective 3.5: even if it does not explicitly refer to the SRL, it refers to the collection of lessons-learned and their availability to future developers/users via the MSCO-provided services.

Similarly **sub-objective 5.3 (Share Information)** underlines the importance of "providing easy, cost-effective access to M&S related technology information".

3.2 IDENTIFIED RESOURCE LIBRARY CONTENTS

The MSMP provides a very short and not so detailed list of products to be included in the NATO SRL. The sub-objective 2.3 suggests providing:

- End products: models and simulations,
- Raw materials (knowledge, data and algorithms termed as "representational resources").

As recalled in the paragraph 3.1, some other contents are suggested exploring along the MSMP. This is the purpose of the next paragraph to be more explicit on all possible contents.

3.2.1 Contents Categories

According to experiences collected in different nations and organisations such as the US Modelling and Simulation Resources Repository (MSRR), it appears that contents of a SRL can be very numerous and diverse. As an illustration, the task group established the following list. This list should be exhaustive even

[1] PfP : Partner for Peace

if not too detailed. Pertinent information was classified in 8 different categories. The accessibility of information provided in each category can be very different.

1. **General documents**: glossaries, master/action plans, M&S orientation courses and other tutorials, etc.

2. **Information on M&S projects**: names, participating nation(s), purpose, schedule, point of contact, etc.

3. **Links and references to other specific sources of information or education materials:** other repositories, related standard organisations (like IEEE[2], SISO[3], OMG[4]), other communities (like CIS community).

4. **NATO and national facilities, their capabilities and skills:** technical M&S centres, training facilities, battle-labs, etc.

5. **Information about M&S end-products:**
   - high-level description (M&S use domain e. g. training or SBA, level e. g. tactical or technical, concerned service e.g. Navy or Air Force, HLA compliance status, etc.),
   - access to detailed documentation on products or tools,
   - assessment information (final reports, lessons learned, reusable products),
   - VV&A status,
   - access to HLA compliance certification documents/reports and statistics,
   - HLA object models (e. g. certified SOMs, FOMs, reference FOMs),
   - list of M&S supporting means (such as used methodology and tools) and their high level descriptions,
   - point of contact,
   - etc.

6. **Data sources** (scenarios, doctrines, tactics, performances, etc.).

7. **Tools: help to development and run-time tools** (e.g. FEDEP tools database), specific APIs[5] (e.g. SEDRIS).

8. **M&S Products and raw materials:** simulations, models, technical documents, algorithms, conceptual models, etc.

3.2.2 Contents Preferences among User Types

All types of information are not useful or equally important for every type of SRL user. The task group has identified 5 different types of users:

[2] IEEE : Institute of Electrical and Electronic Engineers

[3] SISO : Simulation Interoperability Standards Organization

[4] OMG : Object Management Group

[5] API : Application Programming Interface

- "**Beginners**": this term is related to newcomers to the "M&S activity" just discovering the M&S world and the capabilities it offers. They can come from any NATO nation, but they can also come from those PfP nations not having already developed a significant activity in M&S.
- "**Final users of M&S**": this generic term refers to people who will run or be in direct contact with simulators, simulation applications, models, etc.; they could be students, analysts, trainees or trainers; they should have some specific background about the simulation technology.
- "**Developers**": people in charge of designing, developing and testing simulations/models; they are the real technical people supporting the other categories, they should normally have a good general M&S culture and additionally some specific knowledge on one or more speciality such as software engineering, human behaviour modelling, etc.
- "**M&S co-ordinators**": they can be administrative, political or technical people; they should have a good background in military affairs. They should have a good understanding in M&S; their role could be to establish M&S policy, to develop, co-ordinate and run action plans, to advice high authorities on M&S subjects, etc.
- **"Sponsors / decisions makers"**: in many cases, people from the previous categories have no power to decide on their own M&S budget. Decisions on investment are made at higher level and requirement of "deciders" are not usually expressed in terms of M&S. They are rather expressed in terms of functional capability such as armament acquisition, training/exercising or decision support. They should have some technology basis to be able to decide on investments.

For every type of user the importance of every kind of information was rated from "**low**" to "**HIGH**" with "**Medium**" as an intermediate stage.

Table 2: Contents preferences according to user types

	Beginners	**Final M&S users**	**Developers**	**M&S Co-ordinators**	**Sponsors/ Decision makers**
General documents	***HIGH***	Medium	Medium	***HIGH***	***HIGH***
Information on M&S projects	***Medium***	Medium	Medium	***HIGH***	***HIGH***
Information on M&S products	***Medium***	HIGH	HIGH	***HIGH***	***HIGH***
Facilities	***Medium***	Medium	Medium	***HIGH***	***HIGH***
Links & References	***HIGH***	Medium	Medium	***HIGH***	***Medium***
Data sources	low	HIGH	HIGH	Medium	Low
Tools	low	HIGH	HIGH	Medium	Low
M&S products and raw materials	low	Medium	HIGH	Medium	Low

This preliminary assessment shows the different kinds of information required by different type of users of a simulation resource library. It shows that an SRL should give access to the first five types of information to “Beginners”, M&S co-ordinators and sponsors/decision makers within NATO.

3.3 CONTENTS PRIORITISATION

The prioritisation may directly be derived from a thorough analysis of the boundary conditions under which the TG was established:

- The mission of NMSG;
- National concern;
- The identified customers.

As the superior task of NMSG is to promote and co-ordinate the M&S activities within NATO, NATO members and PfP nations, the main requirement for the NMSG and the M&S community is to have access to the higher level of information. More detailed or technical information should interest developers and end users that are technical people of government agencies/organisations and industry companies or national experts.

Therefore a NATO SRL should in a first step rather concentrate on providing this kind of information rather than supporting detailed technical information.

This is in accordance with the demands of the following customers:

- **Beginners,**
- **M&S co-ordinators,**
- **Sponsors/ Decision makers,**

who are mainly interested in high level information (as can be seen from the previous table their interest is never low for the five first categories of information. Those categories are rated frequently “HIGH” and in some rare cases “Medium”.)

Consequently, the Task Group suggests the NATO SRL to be populated with information corresponding to the first five categories at highest priority.

Furthermore, technical and security feasibility, availability and/or limitations in funding, required time frames and human resources issues also need consideration.

The development of simulation systems is regularly governed by national responsibility rather than by the Alliance. This is reflected by the current [technological] push for distributed simulation and the creation of federations of simulations, such as the NATO Pathfinder project.

Summarising, the task group recommends as a first step to concentrate on building a capability giving access to a large amount of information instead of designing a repository providing M&S products and software tools. These kinds of products are recognised as keys for interoperability and reusability, though their availability might raise some additional concerns, which should be discussed later in some detail (see Chapter 4).

Chapter 4 - DESCRIPTION AND ASSESSMENT OF DIFFERENT ORGANISATIONAL SOLUTIONS

In this chapter, organisational solutions are described and compared. They form a range from a totally centralised approach to a totally decentralised solution.

In the centralised approach, NATO or some other authority maintains and owns the SRL. The entries in the SRL do not have to be owned by the central authority, but the ownership should be clear and if possible all contents should be accessible and available to everyone within reasonable security and cost limits.

At the other end of the spectrum is a totally decentralised solution where the central authority only owns and maintains a "portal" with links to various national and NATO resources.

Between these extreme approaches, one finds various hybrid solutions involving format (see paragraph 4.1.3) and quality process controls. The format control means how the information regarding the resources should be presented in the SRL. The quality process is related to frequency and procedures for supplying and updating information.

4.1 SOLUTIONS DESCRIPTION

4.1.1 Completely Centralised

In this section, the centralised approach corresponds to the completely centralised solution. In other words, a single centralised server such as that described in the BDSIM 2000 project (see § 2.2.2.2.) hosts the data. Hence the implemented solution will bring about a centralised organisation which will require political, organisational and financial issues as pointed out below.

NATO would need resources to govern the capacity to manage such a solution. It is clear that today it does not. It is however less clear if the Nations and their Industries have the appetite to relinquish sufficient local control of their assets to a central authority. Nations would, if such a solution were to be chosen, have to implement costly bandwidth requirements to access their own assets now life cycled overseas.

A centralised solution would also have to comply with the NATO requirement of both languages French and English.

4.1.2 Completely Distributed

This is the least costly solution. Basically, the Distributed Libraries (DL's) can be accessed through a "portal" that is a hub and only keeps track of, and keeps updated links to, local Libraries. The "portal" would also contain simple search algorithms. The DL itself does not govern in any way the local DL. This means that these DL's are likely to be inconsistent – and an user would not have any guarantee that the library information is valid, reliable or of high quality.

4.1.3 Hybrid Type 1: Common Framework and Presentation Format

An user who wants to access information via the "portal" mentioned above, would be much helped if the various DL's are designed within a common format – and that there is a requirement that this format is followed by everyone. The easiest way to perform this is by making benefit from the international XML[1]

[1] XML : eXtended Marked up Language

standard, inasmuch as an XML schema for the SRL contents structure is offered. An example of the potential asset "Simulation Tool" is presented in Annex C.

The user would then be able to compare various resources in order to choose a resource that suits his/her needs. A key issue of this format would be the list of searchable key words. An example illustrates the limits of having only framework and format requirements. There can be a format requirement that all information is dated – but no requirement as to how often information shall be updated. So with this approach, much information may soon be out of date.

4.1.4 Hybrid Type 2: Common Quality Assurance Procedures

Here, all DL's are accredited. The accreditation requires that the library follows a detailed sequence of how the information is updated and other quality process issues are followed. In particular the updating frequency requirement solves the problem of type 1 – but certainly at a significant cost.

4.1.5 Hybrid Type 3: Common Framework, Presentation Format and Quality Assurance Procedures

This is the solution that is closest to a centralised solution. It differs, however, in that the central authority delegates information creation and information updating to a localised authority. Also, technically there is decentralisation; there are local databases where information resides with a link to a central "home page". Other procedures are similar to 2 above. But again, instead of only requiring the DL's to conform to a quality process, now the process itself is run by a central authority. It combines the requirements of solution 1 and 2 above.

4.2 COMPARISON OF SOLUTIONS

All of the above mentioned solutions come along with advantages and disadvantages, which are discussed further below. From experiences gained within the United States[2], a hybrid solution seems favourable.

Three main categories of criteria are considered:

a) Funding issues:
   - NATO costs,
   - National costs,

b) Labour issues:
   - NATO human resources,
   - NATO training effort,
   - National human resources,
   - National training effort,

c) Practicability issues:
   - Initial Development effort,
   - National requirements,
   - Consistency management,
   - Controllability by nations,

[2] For a discussion of the US efforts on a SRL, see section 2.6.

- National security guarantee,
- Intellectual Property Rights,
- Organisational effort.

Table 3: Solutions assessment according to the detailed criteria.

	Completely decentralised	Hybrid Type 1 Common framework & format	Hybrid Type 2 Quality assurance	Hybrid Type 3 (1 plus 2)	Completely centralised
Funding issues					
NATO costs	++	+	0	-	--
National costs	--	-	0	+	++
Labour issues					
NATO human resources	+	0	-	-	--
NATO training effort	++	+	-	-	--
National human resources	--	--	-	0	+
National training effort	--	--	--	--	++
Practicability issues					
NATO Initial Development effort	0	+	0	-	--
Satisfaction of national requirements	++	+	0	+	--
Consistency management effort	-	0	+	++	-
Controllability by nations	++	+	++	++	--
National security guarantee	++	+	0	0	--
Intellectual Property Rights	++	+	0	0	-
Organisational effort	0	+	-	-	--

This table should be interpreted as an approximate assessment. The symbol represents:

+ / ++ means that this solution seems **good/very good** according to this criterion,

- / - - means that this solution seems **bad/very bad** according to this criterion,

0 means that this solution seems **neutral** according to this criterion.

4.3 RECOMMENDED SOLUTION

As discussed above, there are basically three options to establish a NATO SRL:

- A fully centralised SRL: all information is owned and managed by one central authority, and all queries and entries are to be directed to this authority and its database. Accordingly, the required staff to maintain the SRL is therefore significant at this central authority.
- A fully decentralised SRL: One central portal provides links to a plethora (or not) of local resources. Preferably through the Internet, information can be accessed and/or up- and downloaded from those local databases. Accordingly, the required staff is decentralised.
- Hybrid solutions: there is one single server to provide an access portal to the SRL; the SRL itself comprises various decentralised servers. In this case the responsibility for maintaining the servers is with the particular organisations, which run the servers and only a small staff is required to maintain the access portal.

From the NATO point of view, the following table yields the comparison assessment of the different solutions according to the main issues:

Table 4: Solution comparison according to the main issues

	Completely decentralised	Hybrid Type 1 Common framework & format	Hybrid Type 2 Quality assurance	Hybrid Type 3 (1 plus 2)	Completely centralised
Funding issues	+	+	0	-	--
Labour issues	+	+	+	0	--
Practicability issues	0	++	+	0	--

It appears reasonable to start with a hybrid approach, preferably of type 1. The details of what the common format control and quality assurance should be will have to be decided in the SRL design and implementation phase. The additional cost of that solution compared to the cheaper solutions seems to be more than overcome by its obvious higher quality and suitability to the users.

Chapter 5 - PROPOSAL FOR THE ESTABLISHMENT OF A NATO SRL

Starting from the word "Resource Library", one would expect a repository, in which resources, e.g. directly useable pieces of software or reference documents, are also integrated. From this point of view a programming environment, like the J2EE[1] may serve as guideline: J2EE provides services and modules, which can be directly used in a (distributed) environment. The developer of an application is provided with a brief description of the capabilities of the service/module and its API[2]. The internal structure, however, is hidden from the developer.

This, of course, is a vision of a SRL, where the simulation systems are equipped with APIs expressed in a standardised way, but one should keep in mind, that a simulation system which has been part of an HLA-federation is already documented (at least in terms of a SOM).

This chapter will develop the task group proposal for the implementation of a NATO SRL.

5.1 VISION AND SCOPE

Presently, operational or projected implementations of simulation libraries are mainly catalogues of resources. They provide a very useful amount of information, are often largely distributed and can (or will) be accessed via public or private networks. They demonstrate the availability of M&S resources but they rarely provide a direct access to the referenced resources.

In parallel, a large effort has been undertaken on interoperability and re-use supported either by internationally open efforts such as the DIS and SISO communities or by national government-founded initiatives. All those efforts mainly started in the 90s. One of the obvious results is the development of military interoperability standards (such as HLA and SEDRIS) and the large adoption of industry standards such as Java, XML UML[3], CORBA[4], etc. by the M&S community. At first glance, it would seem that a large amount of technology is currently available to interoperate resources. Nevertheless, the current effect of this technology does not seem to provide the expected benefit. Considering financial and technological constraints, the current development of a catalogue is the only possible and sensible implementation in the short term.

In contrast, what is really required by final users is very similar to what is already operational within the Advanced Distributed Learning (ADL) domain: a distant, direct and flexible access to simulation capabilities via a WAN[5]. In the future, whatever the simulation purpose (for example, training or analysis), an end-user could access and tailor an application for it's own purpose on a SRL, run it and obtain secure results within a short delay. This implies that models and simulations should be made available under a dedicated framework, that any property or copyright issues be solved, that an interoperability level must be achieved that is beyond what is currently available. If this vision could be achieved, users would only require to develop new components that are clearly not available to satisfy their full requirements and a significant amount of money would potentially be saved.

[1] J2EE ≡ JAVA 2 Enterprise Edition

[2] API ≡ Application Programming Interface

[3] UML : Unified Modelling Language

[4] CORBA : Common Object Request Broker Architecture

[5] WAN : Wide Area Network

In 2002 a follow on effort was initiated on new interoperability issues and "component based simulation" willing to go well far beyond what was proposed by the HLA paradigm. The idea is to examine how the current industry standards could be used in conjunction with HLA and SCORM (Shareable Courseware Object Reference Model) ADL standard to establish distributed M&S/SE which would be made available on WANs in a more flexible manner than the current very rigid HLA federation concept. Prototyping developments and various studies are emerging. They should provide an interesting view on what should be possible in the medium term to provide this rapid and convenient resource use and re-use, which constitute the future SRL vision. But, for the time being, there is no evidence that this vision is close to becoming realistic. A lot of issues have to be solved: they are mainly related to security, database availability, verification and validation issues, resolution of property and copyright issues in addition to the selection of the technical framework to use. The continuous evolution of the technology, technological and methodological gaps to fill, constrained military budgets are not driving to a close solution to those issues. Nevertheless the final output of those efforts should be kept in mind: ready availability, flexible access to a distributed capability for the end-users. This vision shall lead the current standardisation efforts, the adoption of existing industry standards by the M&S community and the specification of future SRL development.

Further, it is expected that a large portion of this NATO SRL will be composed of legacy models or simulations that are stand-alone tools. However, NATO has recently adopted the HLA architecture and individual nations have already started to build their own HLA –based architecture, their own synthetic environments and their own applications. As a result, a second key and crucial SRL task will be for a subsequent group to this MSG-12 Task Group 009 to outline a strategy that describes how to enable not just awareness but true sharing of M&S through an "On-Line NATO M&S Portal" (or distributed controlled-access servers) to some of the HLA-compliant tools already available in NATO nations. The clear intent is to figure out a strategy of facilitating or enabling M&S use, re-use as well as the user-friendly interoperability within the Alliance.

5.2 PROPOSAL FOR THE IMPLEMENTATION OF THE SRL

The establishment of a distributed resource library has already been tasked by several organisations and programmes. Hence, this task group goes back to the experiences made there to yield a benefit for NATO.

In particular, two European wide programmes were investigated for this report in order to benefit from their lessons noted: the EUCLID RTP11.13 ("Realising the potential of Synthetic Environments in Europe") and the ESPRIT[6] project OPERA (Operators Training Distributed Real-Time Simulations).

Both programmes have suggested the use of architectures and technologies that rely on distributed object technologies like CORBA or J2EE. Furthermore, XML was chosen[7] as the format for document[8] archiving and exchange.

5.2.1 Information Content of the SRL

Prior to drafting a possible architecture of the SRL, some light needs to be shed on the information that is to be stored. It is recommended that the SRL should contain following information:

- Meta-Data: information about an asset. In as much as simulation systems are described here, this information is described in section 2.3 plus indication of the sponsoring nation and references about projects, where this system has already been used and lessons learned (if applicable).

[6] ESPRIT : the EU information technology program

[7] In RTP11.13 only, the ESPRIT project was performed prior to the acceptance of XML as a standard.

[8] The term "document" is used in a broader sense and comprises textual documents as well as any other piece of information.

If reference material is included in the meta data an option is required to link the reference document or at least to a point of contact.

- Model Data: information about the data structure as far as relevant for communication, expressed in an agreed standard format, e.g. XML (with a specified scheme/DTD[9]) or HLA OMT[10].
- Supporting Tools: it is recommended to include the FEDEP Tools list, as prepared by MSG-005 into the SRL.
- Linkage either to the simulation system itself (ideal case) or at least to a point of contact. In the first case the link should provide the signature of the simulation system[11] and the API.

A suggestion of the information content is given in the Annex C as an example of an XML Schema. This schema corresponds to the format as mentioned in section 4.1.3.

5.2.2 Architecture of the SRL

Following the references given further above, the task group proposes a 3-tier architecture for the SRL. Although, more recent developments on distributed databases allow even for more tiers, it is recommend to exploit a regular 3-tier architecture following experiences from the RTP 11.13 project.

In the presentation tier the client gets access to the repository services by using SOAP (Simple Object Access Protocol) messages over HTTPS (Secure HTTP[12]). The use of these technologies enables access over the Internet as well as via a local web server. The Web-Server and/or SOAP Handler need to be embedded into a transaction administration layer: it is responsible for granting the parallel access of various users. More importantly, it has to take care that changes in the database are either performed completely, or are totally neglected (an all-or-nothing principle). This is to guarantee consistency of objects.

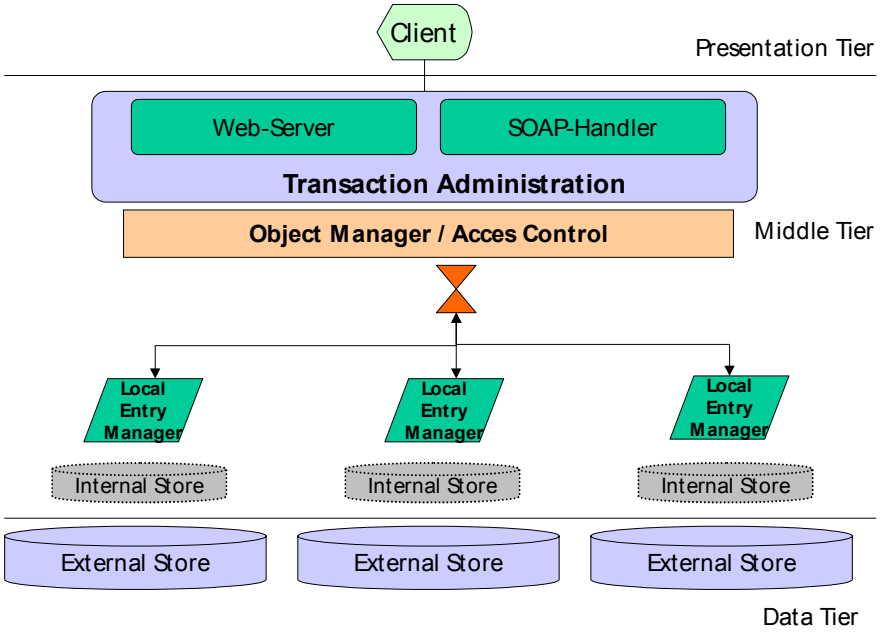

Figure 3: Proposal of a 3-tier architecture for the SRL

[9] DTD : Document Type Definition

[10] HLA OMT : HLA Object Model Template

[11] Signature ≡ required/accepted input and output data

[12] HTTP : Hyper Text Transfer Protocol

The middle tier comprises an Object Manager or Access Control and a Local Entry Manager. The first should enable a consistent object-view upon the data. It is responsible for the object and class structure administration. Finally, an Entry Manager is responsible for accessing the data storage; it exposes an API to the clients to provide functions to them like storing, deleting, retrieving, etc. It has the ability to create inputs on behalf of the client most preferably as updateable XML DOM[13] objects.

The data tier finally, comprises a Data Store Manager responsible for converting the objects resident in the local store (connected through pointers) into persistent data structures.

Summarising:

The presentation tier allows the user to access the SRL e.g. via a Web server; the middle tier is responsible for decoding the incoming messages and routing. Additionally, the middle tier could also comprise further service units, e.g. security devices, query managers etc.. The implementation of deeper layers in the middle tier (everything after the Object Manager) is left to the national responsibility and authority.

5.2.3 Recommended Technologies

In order to guarantee platform- and language independence, the use of products complying to OMG standards is recommended.

In particular:

- SOAP/HTTPS as the interaction and transmission protocol between Client and Server modules;
- XML as the document archiving and exchange format with e.g. using the SAX[14] API parser for searching XML documents;
- Java Integrated Development Environment (IDE) for developing the client/server architecture.

5.2.4 Conclusions and Recommendations

The focus of the architectural description of the SRL is to enable a generic, distributed, multi-user application which allows for searching, retrieving and uploading of information from different locations spread over interested NATO/PfP nations.

From a technical point-of-view, a 3-tier architecture is proposed; after thorough discussion, the group's view of the repository is mostly that of an information and storage service.

As opposed to true object servers such as COM[15] and CORBA, this repository will not have the ability to install a user (i.e. tool) specific function on the server. However, the repository should provide a generic XML DOM-like API for server-side entry manipulation.

In future extensions of the SRL, one might think of implementing/accessing tool's functionality directly through the server.

5.3 SECURITY ASPECTS

It is commonly agreed that the complexity of providing an adequate level of security increases with the number of users and the wider information is shared. From the original idea to share information as wide

[13] XML DOM : XML Document Object Model

[14] SAX : Simple API for XML

[15] COM : Component Object Model

as possible among NATO/PfP Nations it is apparent that the initial version of the SRL will not contain any protectively marked information as it is designed to be accessible from the Internet.

There are various protective measures commercially available. Since the SRL in its first demonstration should not contain classified information, the use of such measures seems adequate and sufficient. If, in future extensions, more sophisticated measures become necessary the architecture proposed here is simple enough to allow for adjustments. Technologies readily available for protecting data over the public telecommunication network include secure Internet Protocol (IPSec), Virtual Private Networks (VPN), encryption devices and Public Key Infrastructure (PKI), among others.

The task group -- following recommendation given within the RTP11.13 programme -- refers to an UK initiative[16]. There, the concept of "Common Criteria" is defined. This is a standard that can be used as a basis for evaluating security products (called as Target of Evaluation, ToE) by permitting comparability between the results of independent security evaluations.

The Common Criteria defines the following framework:

- Security environment: Laws, regulations, organisational security policies etc. which define the context in which the ToE is to be used. Threats present in the environment are also included.
- Security objectives: This is simply a statement of intent to counter the identified threats by IT[17] measures.
- Security requirements for the ToE: The refinement of the IT security objectives into a set of technical requirements for security functions and assurance.
- Security Specifications for the ToE: Define an actual or proposed implementation for the ToE.
- Implementation of the ToE: The realisation of a ToE in accordance with its specification.

The Common Criteria are currently recognised by Canada, France, Germany, the Netherlands, Norway UK and US. They are being considered for use by the EUCLID RTP 11.13 consortium.

5.4 POPULATION AND MAINTENANCE OF THE SRL

Although technically feasible, for the sake of consistency as well as security, it is recommended to follow a population process as outlined further below rather than a decentralised population.

5.4.1 Population Process

As well as the initial or future population of the NATO SRL, the list of imperative tasks is:

- creation,
- modification,
- destruction,
- verification,
- validation.

The terms "verification" and "validation" refer to the SRL information and not to the VV&A of models and simulations referenced in the database. The task "verification" has the purpose to verify that the

[16] www.cesg.gov.uk.

[17] IT : Information Technology

information is produced in the adequate *format* and is complete. The validation is supposed to check that the information is *semantically* correct.

Each agent in charge of the SRL population process must be able to carry out these actions through an appropriate network. A Web-based end-user interface appears as a good candidate for processing these actions.

Before describing an SRL population process including the verification and the validation processes, let us define the minimum stakeholders involved in the population process:

- **Authorised National Organisations** (ANO): National organisations, which are authorised to have an access to the SRL. Because of the peculiarity of the national M&S organisations, each nation has to manage directly the access rights of their ANO.
- **NATO SRL Verification Agent** (NSVeA): National - or MSCO staff if the verification is centralised at the NATO level - whose task is to check the format and the completeness of the information according to the defined population interface.
- **NATO SRL Validation Agent** (NSVaA): National - or MSCO staff if the validation is centralised at the NATO level - whose task is to validate the verified information, insert them into the NATO SRL and send a notification to the ANOs.

The above stakeholders can be a unique person or different agents, depending on the final decision made by NATO authorities.

Let us now give a description to the population process. When an ANO fills out the population form, he or she should send a request to the NSVeA for creation, modification or destruction. It is considered that the information given by the ANO have been verified and validated at the national level according to an appropriate organisation.

The NSVeA verifies the completeness of the information according to the data specifications. If this step fails, the NSVeA sends back the request to the ANO for revision, otherwise the NSVaA validates the information and sends a notification to the ANO. Then related data are allowed to be published.

In case of a modification or a destruction request, the previous versions should be stored into an archive for the configuration management.

The following figure 4 shows the population mechanism described above.

In the case of a product developed in co-operation or shared by nations the item should be referenced in only one SRL for configuration control. In that case a nation should be designated as the custodian of the related information. For example, in a typical EUCLID project, the lead nation should be in charge of this task.

Some products are developed by NATO agencies and are not typically used by nations. This justifies the requirement of a specific NATO node. This node could be set up in the RTA or the NC3A. This second possibility has not been considered due to the absence of a NC3A representative in the task group.

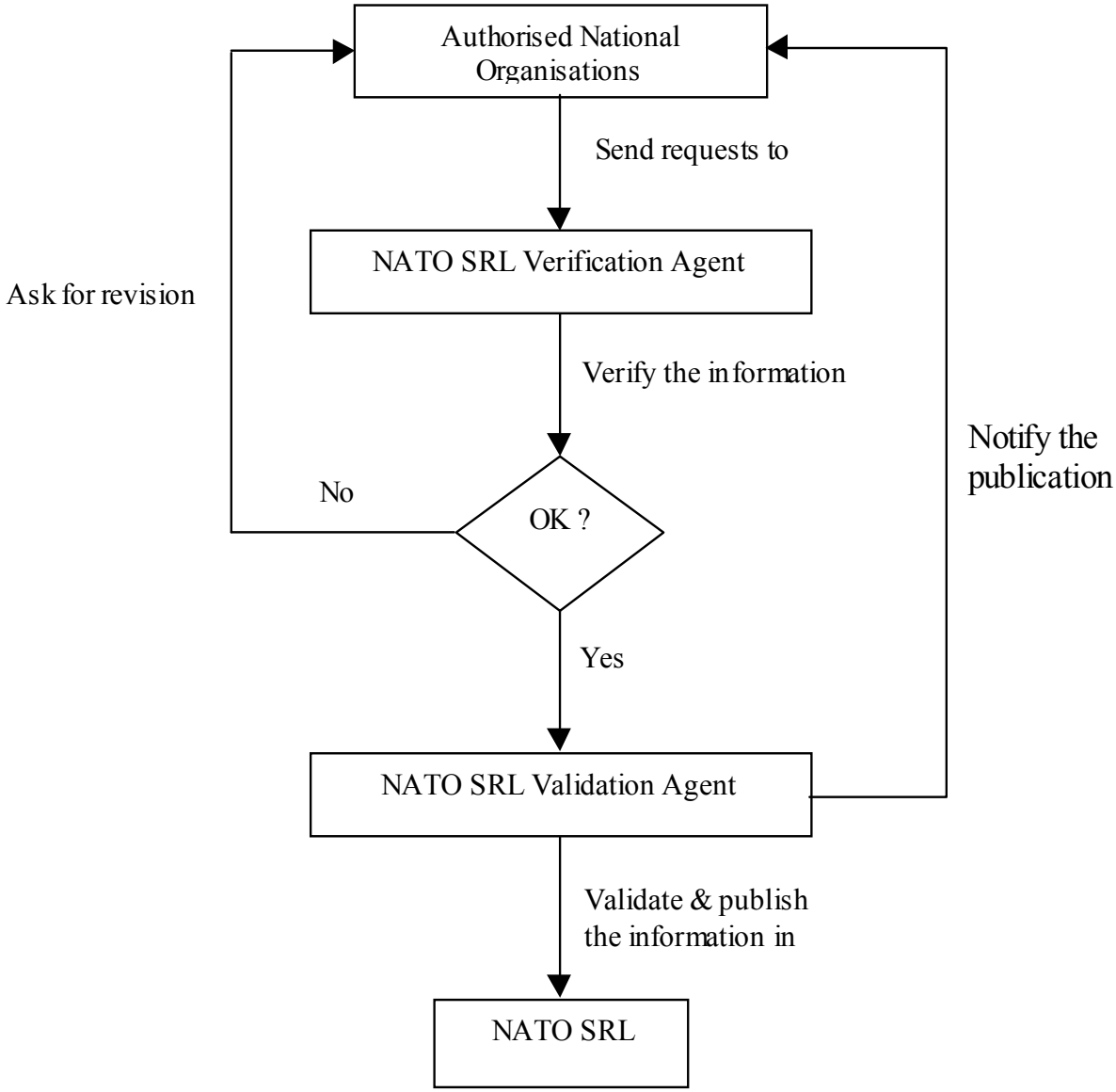

Figure 4: Population mechanism

5.4.2 Maintenance Process

The maintenance of the information is under the responsibility of the national M&S organisations. As expressed in the previous paragraph, a national verification and validation process should achieve it. Whatever the final solution selected, it has should be emphasised that backup hardware systems are required for the storage, the configuration management and the safety of the NATO SRL.

Besides this aspect, it is also important to pay attention to the NATO SRL access availability, the software and the hardware maintenance. Then a central administrator is necessary. It should be the responsibility of the RTA/MSCO or the NC3A.

5.4.3 Authority for Asset Population

The population and maintenance process will require significant human and funding resource. The likely level of human resources to manage the SRL are set out in paragraphs 5.4.1 and 2. There will be additional resource requirements for the initial population stages. Development of a process is required to capture the assets; in the past this has often been achieved by the form of questionnaire, however more benefit would be obtained by use of personal communication between the stakeholder and the persons populating the SRL. Senior levels of NATO need to agree and authorise the asset capture process and subsequent accessibility to assets that are contained within the SRL. It is unlikely that the NMSG is the responsible body to issue this authorisation; NMSG do not own or manage the data or assets. The NMSG should approach the RTB to determine who can authorise the asset capture process. Co-operative working with NC3A should be encouraged.

In addition, Terms of Reference for National or NATO individuals who partake in asset capture should be drafted, reflecting their given authority. A senior NATO body should endorse the TORs.

To be effective the SRL would require access to assets from existing projects and to new assets as they become available. A senior NATO body should mandate that information on all assets that are developed in support of new programmes should be delivered to the SRL.

NATO needs to identify the key assets it would like to store in the SRL. There are reference papers on asset characterisations available from the EUCLID 11.13 work package 3 deliverables[18]. As a follow on activity NATO should work with the EUCLID 11.13 consortia on the creation of NATO specific DTDs or schema for population of the SRL.

5.5 HUMAN AND FUNDING RESOURCES

Collecting statements from various places within this report, this paragraph summarises the recommendations. As mentioned earlier in this report, the establishments of a SRL needs 1 – 2 persons and a budget of approximately 500 k€ for acquisition of hard- and software and logistic support[19]. After the SRL is established, only a minor budget is necessary. It is assumed that one full-time position and an annual budget of 50 k€ is sufficient within the centralised part. As far as the decentralised parts is concerned, an exact cost estimation depends upon national regulations. As a rough number, one can estimate a quarter-time position with an annual budget of 10 k€ for each participating nation.

5.6 PROPOSAL FOR A SRL DEVELOPMENT PLAN

The key milestones to develop a NATO SRL are set out below.

The milestone dates are based on the assumption that this report (NMSG 012 – TG 009) is finished by February 2003. (This recognises that the document may not be in print at that time.)

In addition the NMSG needs to consider and decide whether there is a requirement to link to other repositories, for example, the US MSRR and EUCLID 11.13 repositories.

[18] See references to EUCLID documents in Annex D.

[19] Logistic support comprises collecting assets to populate the SRL; it is assumed that this requires having bespoke meetings with the potential stakeholders; thus logistic budget means travelling and communication cost (e.g. video-conferencing, etc.).

	Approval of report and development plan by NMSG	April 2003
	Approval of report and development plan by the RTB	Sept 2003
	Draft of budget levels and requirements documents distributed to nations	Sept 2003
	Funding secured by MSCO	Oct 2003
	Development plan agreed and funding secured by NMSG	May 2003
	Secure involvement of NATO and 4 nations	Oct 2003
	Endorsement of policies by NATO senior level committee(s)	Nov 2003
	Agreement on detailed technical implementation architecture	Dec 2003
	Identification of suitable project staff	Dec 2003
	Start of SRL project work	Jan 2004
	Prototype implementation presented at the NMSG meeting	May 2004
	Requirements reviewed by NATO and Nations	June 2004
	First “official” implementation	Sep 2004
	Stamp of approval by NMSG	Oct 2004
	Official launch	Jan 2005
	SRL implemented	Jan 2005

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Chapter 6 - CONCLUSIONS AND RECOMMENDATIONS

6.1 PROPOSAL FOR A NATO SRL

The task group recommends the development of a NATO SRL. The proposed architecture for the SRL is a distributed library with a common framework and presentation format. The SRL should be composed of national nodes and at least one NATO node. The NATO node(s) could be managed either by RTA/MSCO or NC3A. It is however the task group's suggestion that the central node is managed by the MSCO in accordance with the NATO MSAP. Consequently a sufficient level of annual funding and human resources must be established to set up and maintain a quality service.

The group noted that the longer-term vision is to have a repository with a common framework, presentation format and quality assurance process. However from the practical point of view it is advisable to start to develop an SRL with only the common framework and presentation format. The degree of centralisation of the above options is solely through the use of a central web portal. The distinction between a library and repository in this context is that a repository could contain downloadable assets, which is a part of the task group's long-term vision.

Chapter 3 discusses the potential assets that can be stored in an SRL. These include general documents, information on M&S projects and products, facilities, links and references. The minimum inputs to the SRL should include a description of the assets, that is "meta-data", and include a point of contact.

The key criteria used in choosing the suggested technical solution were the need to minimise costs and human resources and to capitalise on existing architectures and/or achievements. The group recognised however that under-funding of the SRL, especially in the development phase, will severely hinder the implementation of an essential requirement for the nations and NATO.

The suggested technical solution is closely related to the achievements of EUCLID RTP 11.13, ("Realising the potential of networked simulation in Europe") and is based on the use of current Internet technologies. The proposed solution is the establishment of a distributed network of nodes, each of which is under the authority of Nations or NATO organisations. The group developed an XML schema as a starting point for the recommended solution with a common framework and presentation format (see Annex C). The task group recommends that strong links are maintained with the EUCLID 11.13 consortium in the establishment of the SRL and that possible sharing and exploitation of existing achievements are considered.

The recommendations for security are in line with work on "Common criteria" developed by the Communications-Electronics Security Group (CESG).

It is estimated that the cost to NATO for the development phase for the establishment of the SRL will be 1 – 2 persons and a budget of approximately 500 k€. This includes acquisition of hardware and software and logistic support. Nations will have similar overall costs depending upon their current status of SRL activities. After the SRL is established, a lesser budget should be required. It is proposed that one full-time position and an annual budget of 50 k€ will be sufficient to manage and maintain the centralised part. As far as the decentralised parts (National nodes) are concerned, an exact cost estimation depends upon national regulations. As a rough number, one can estimate a quarter-time position with an annual budget of 10 k€ for each participating nation.

The task group recommends that the SRL should be implemented by January 2005. The schedule will of course be dependent upon securing approval, authority and finance from the NMSG and the RTB.

6.2 RECOMMENDATIONS TO THE NMSG AND THE RTO

The task group recommends that the NMSG approves this report and reports the main conclusions and recommendations to the RTB. Through the RTO the necessary funding and human resources should be secured to implement the SRL in line with the proposed development plan (Section 5.6); this proposes a launch date of January 2005 for the NATO distributed SRL. The financial requirements and human resource requirements are set out above. The RTA has already requested the creation of two new positions for implementing and managing the MSCO help-desk and the SRL. Population and maintenance of the SRL will require the agreement and authority of the NMSG (see Section 5.4.3).

The main NATO M&S assets are developed or acquired by NC3A, therefore strong involvement of NC3A is required for the establishment, population and maintenance of the NATO node(s). It is recommended that the NMSG and above authorities request the support of NC3A.

Annex A - CANADIAN CATALOGUE FORM

Name:

Acronym:

Type:

Description:

Purpose or Domain

Analysis:

Acquisition & Support:

Training Operations:

Other:

Details

Model Type:

Simulation Type:

Network:

Supported Capability Components: xxxx

Other User:

Ease of Use:

Release Date:

Lifespan:

Contact

POC:

Organization:

Mailing Address:

Phone:

Fax:

Email:

URL:

Additional Information

Other Info:

Keywords:

Projects

Case Studies

- Make Comments
- Add Project
- Add Case Study
- Add New Resource

Annex B - DESCRIPTION OF THE BDSIM 2000

USER PROFILES

The different user profiles identified in the database are described in the following table:

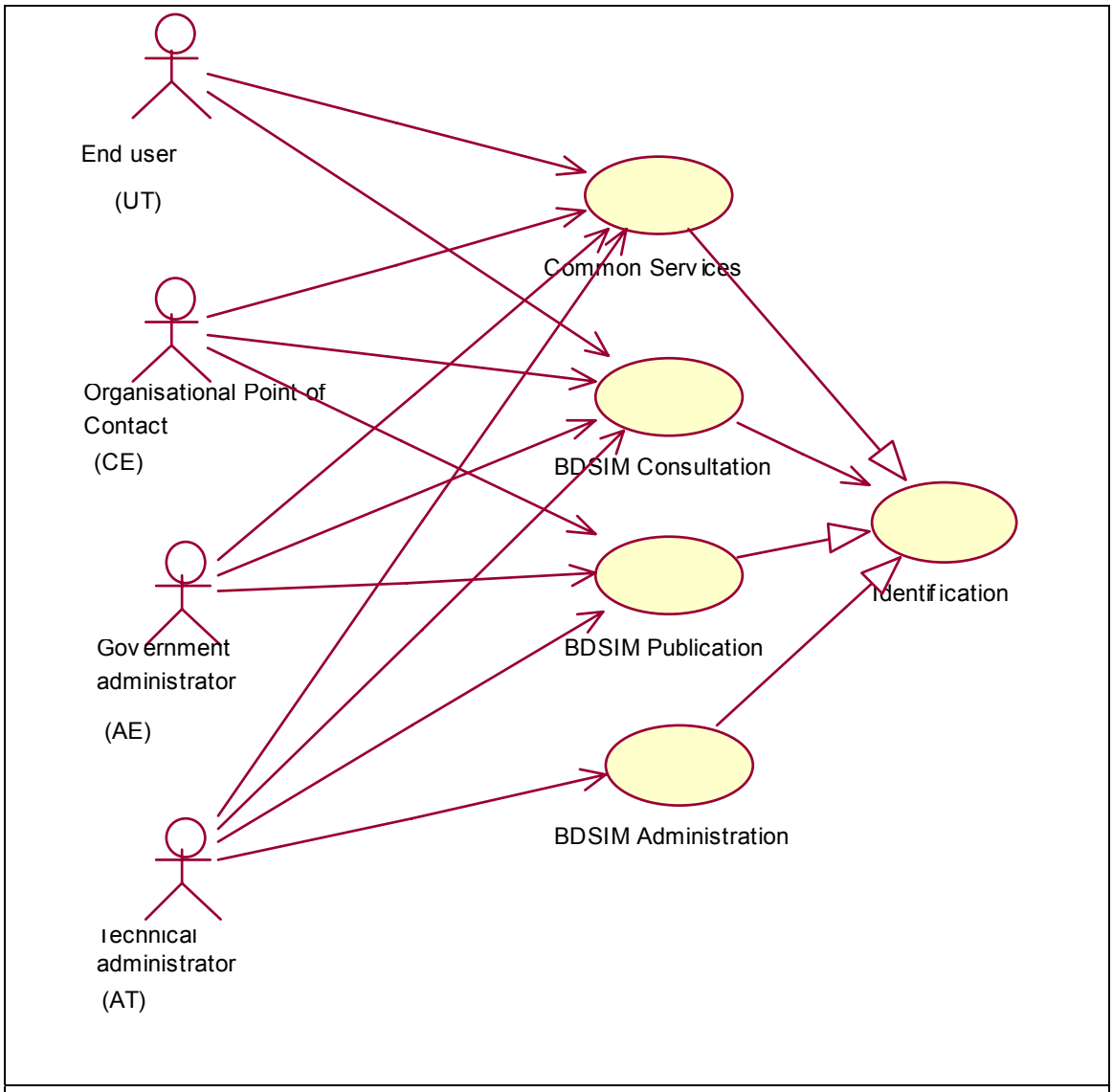
User	Profile	Rights	How they are identified?
UT	Utilisateur final (End user)	Read	Subscription
CE	Correspondant d'Entité (Organisational point of contact)	Creation, modification, suggestion to delete data	Designated by the competent authority
AE	Administrateur Etatique (Government Administrator)	Validation and deletion of data Creation of user accounts	Designated by the competent authority
AT	Administrateur Technique (Technical administrator)	Data base administration Creation of user accounts	Designated by the competent authority

ORGANISATION

The figure below is a diagram of a high level user. It shows BDSIM and its environment and shows how it works.

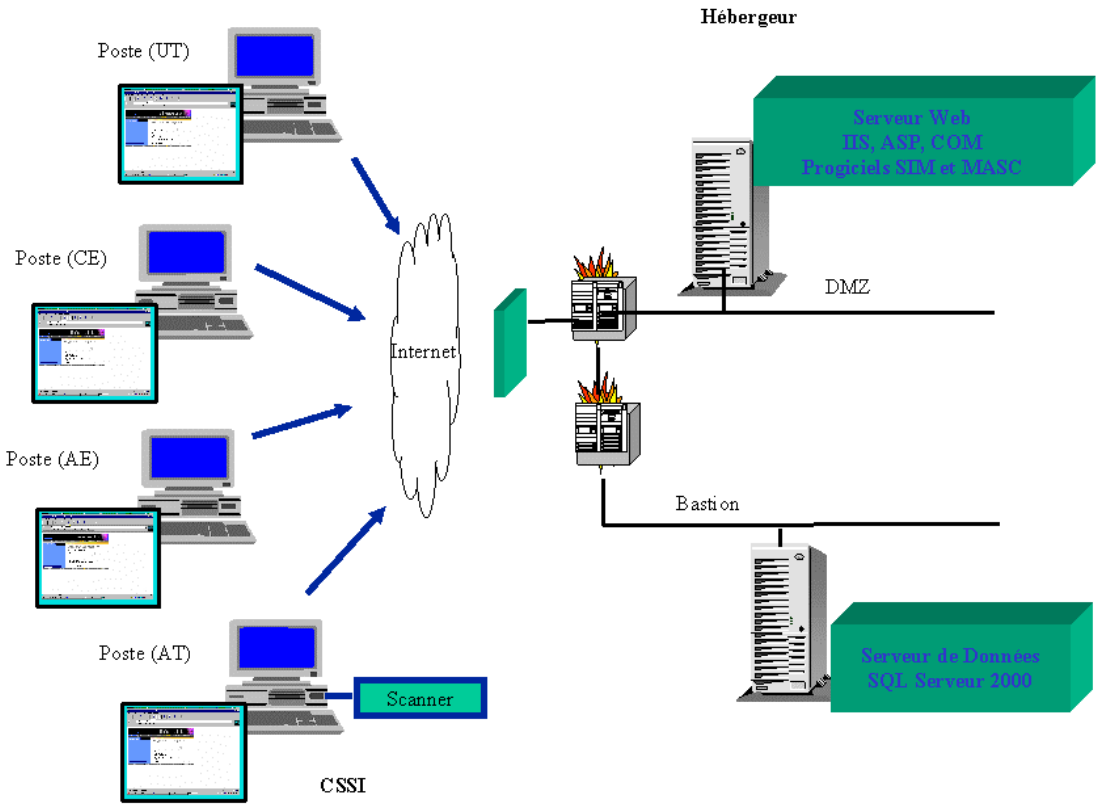
Please notice that:

- The participants (User groups) with whom the system interacts (UT), (CE), (AE) and (AT),
- When in use, as shown by the oval, one may translate here as a subset of the functionality of the system,
- Participants' use (solid arrow).



Description of the organisation (use cases)

ARCHITECTURE OF BDSIM 2000



Architecture

HARDWARE AND SOFTWARE CONFIGURATIONS

	Hardware Configuration	Software Configuration
HTTP Server	• Dell Power Edge 2500 • Pentium III 1Ghz • 256 Ko de cache • 1 Go RAM • 18 Go	• Operating system: Windows 2000 Server (5 access) • Server HTTP IIS 5.0 (MS), environment ASP et COM (MS) • COTS software MASC & SIM (company ARCHIMED SA): one licence server and one hundred licences for the access • Module server for PDF conversion • Backup software : ArcServe 2000
Data server	• Dell Power Edge 4400 • Pentium III 1Ghz • 256 Ko Full Speed • 512 Mo RAM • RAID 5 * 18 Go	• Operating system: Windows 2000 Server (five access) • SQL Server 2000 (Microsoft, licence Web) • Backup software: ArcServe 2000.

SECURITY

Making the Hardware Secure

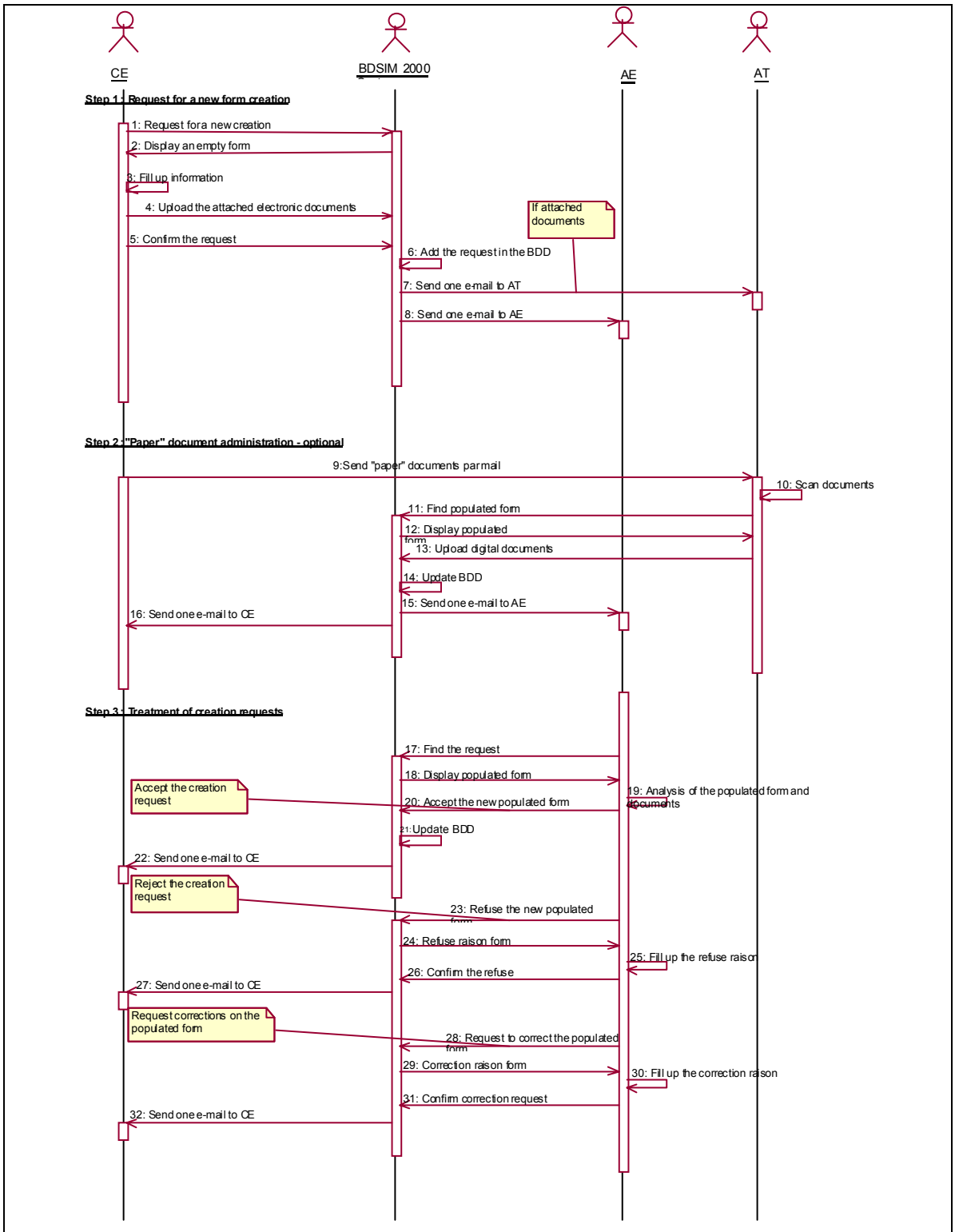
Hardware security is founded upon the following points:

The technical architecture provided by the host ensures security through various means (DMZ, protected area, firewall); in particular, only the DMZ Web server may access the protected area, which is not accessible from the Internet.

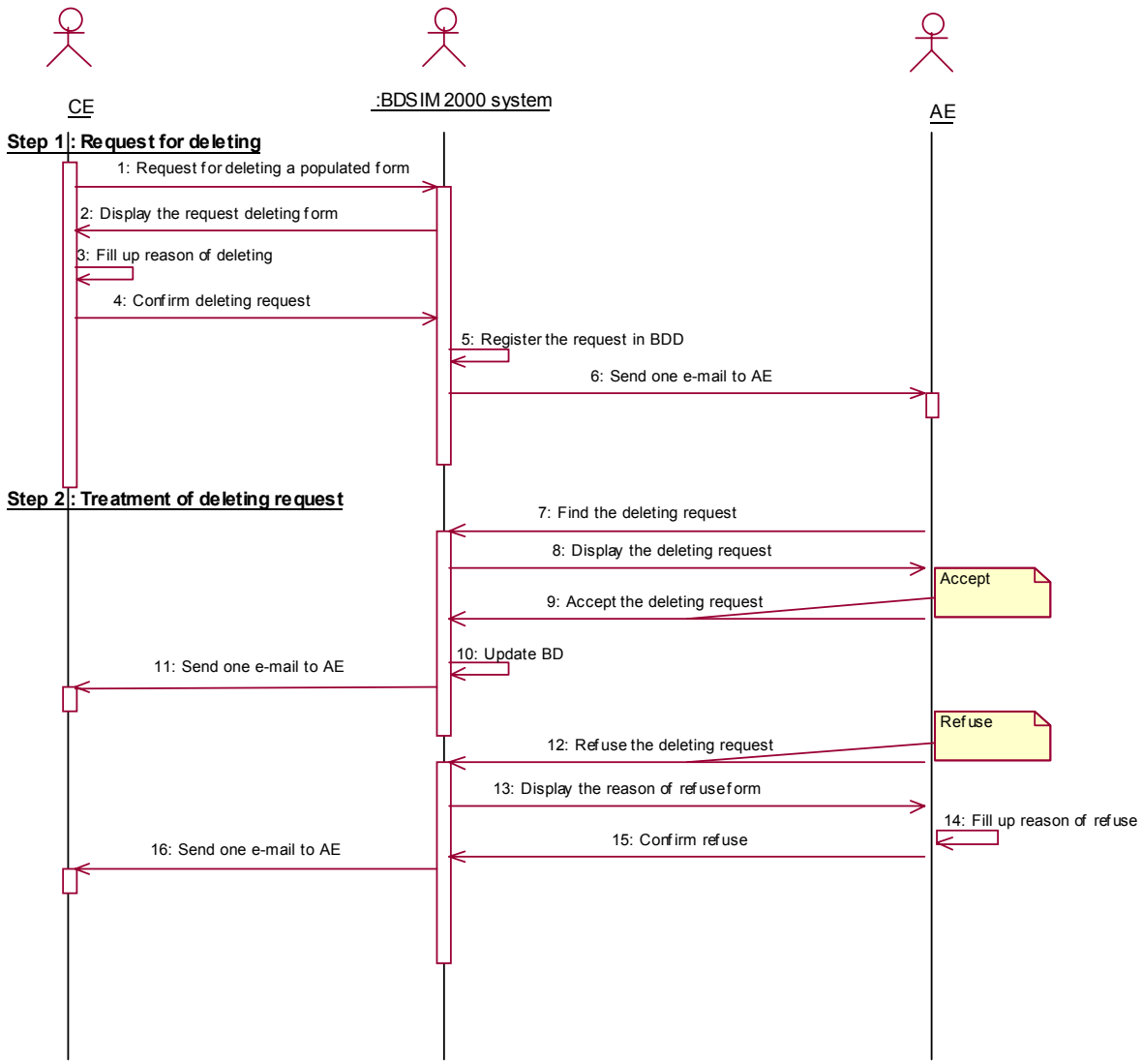
Site access is controlled by a login/password mechanism (according to the standard SSL V2) and from the management of the user profiles (UT; CE; AE and AT).

In addition a filtering of the IP address is put in place and controlled by the AE and the AT users.

PUBLICATION PROCESS



Process of Populated Form Creation

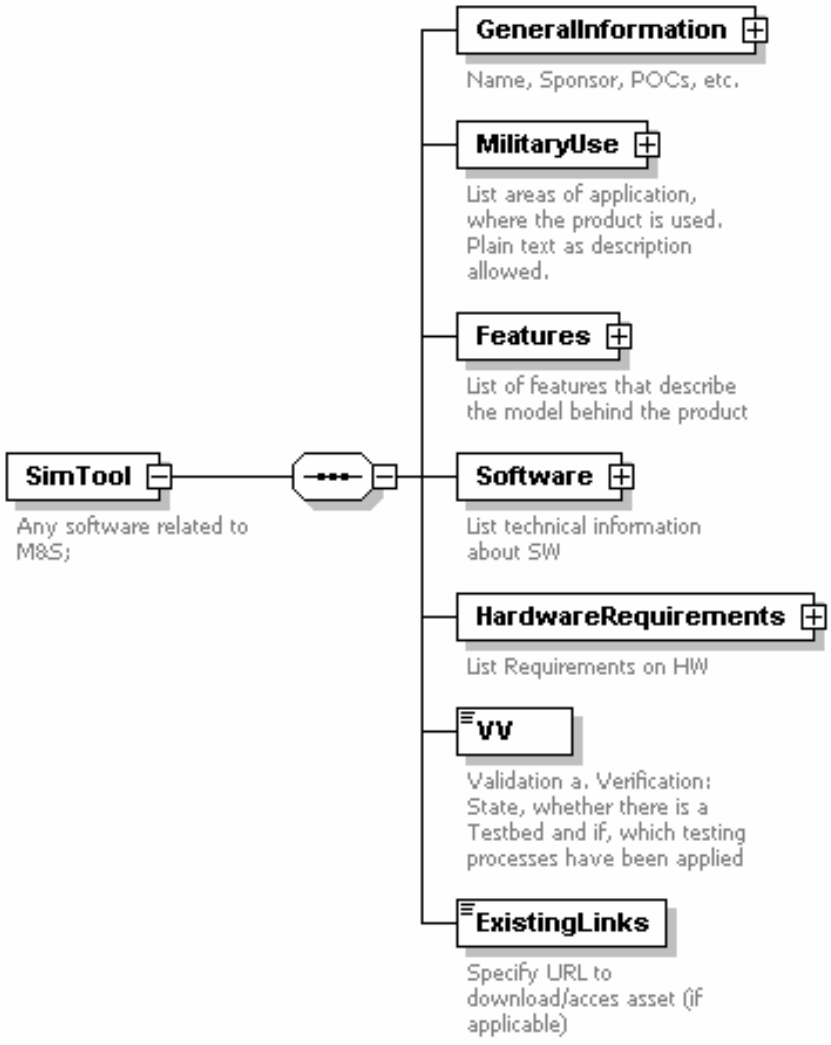


Process of populated form deleting

Annex C - EXAMPLE OF AN INFORMATION DESCRIPTION USING XML SCHEMA

The following figures depict the content structure of the SRL asset "Simulation Tool". The figures are generated by use of an XML tool and represent excerpts from a XML schema. This is a hierarchical structure of categories used to classify an arbitrary simulation tool.

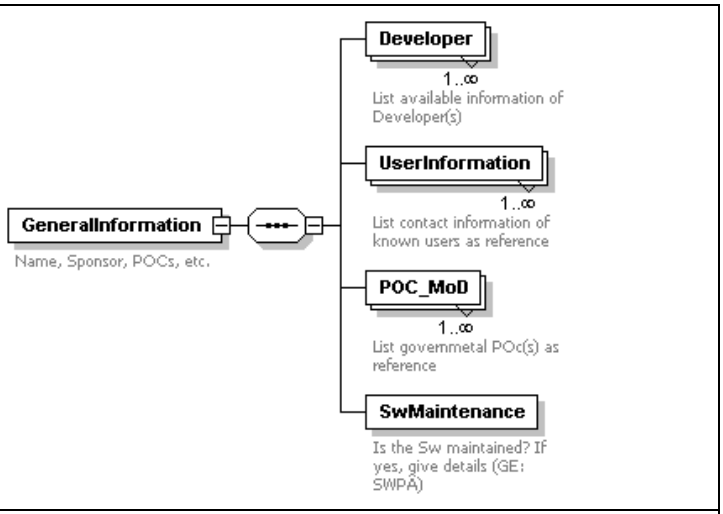
The top-level information categories are depicted below.



Top level information of SimTool

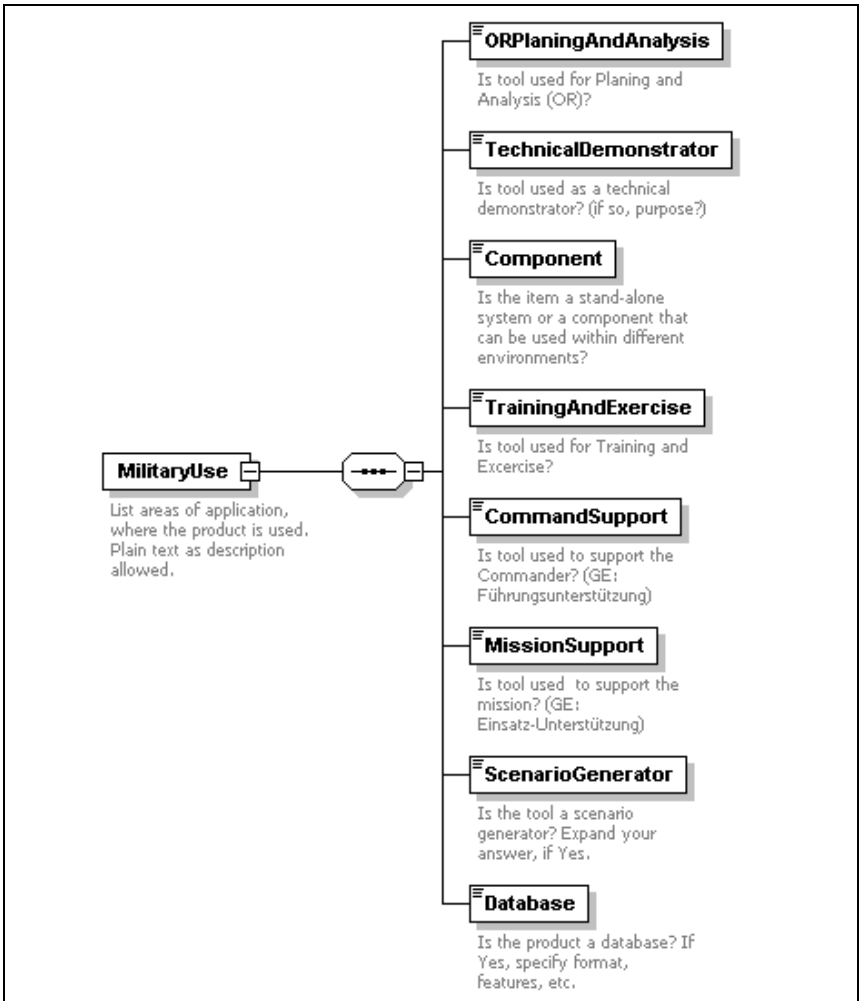
If a connection to existing nodes is required (for example a link to the U.S. MSSR, the link can be easily added within the XML file as indicated by the entry filed "ExistingLinks".

For practical reasons it is desirable to have general information, to enable contacting the developer and/or user to get some practical advice.



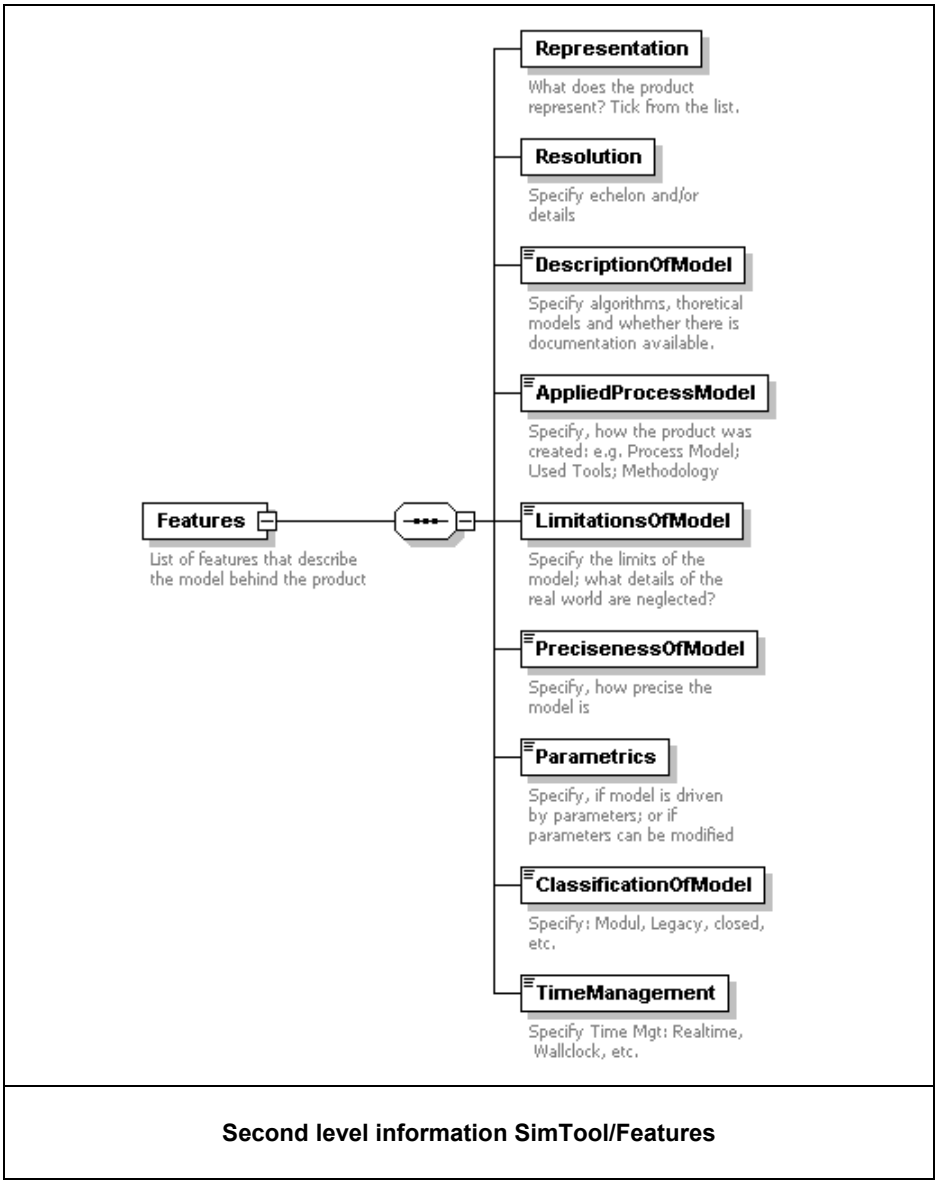
Second level information SimTool/General Information

For the use within a particular project, information of the military domain in which the tool could be used is relevant.



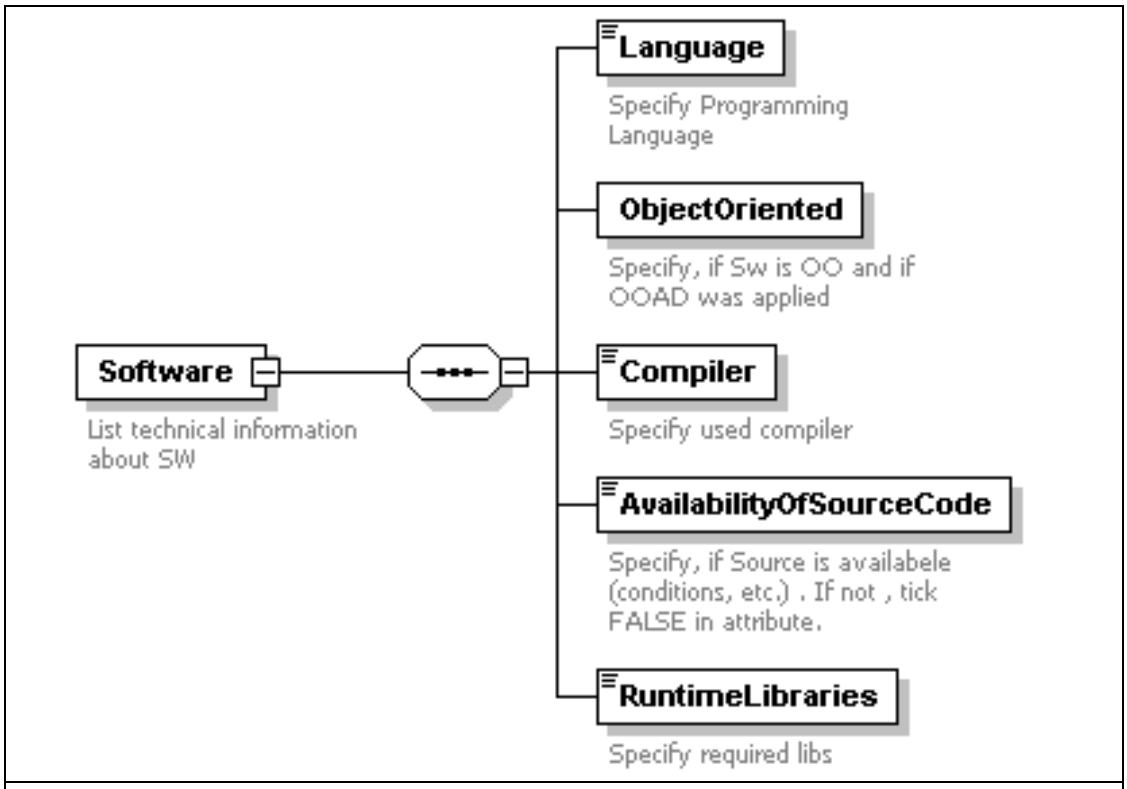
Second level information SimTool/ Military Use

Especially, for issues concerned with validation and verification, knowledge of certain “features” is required.

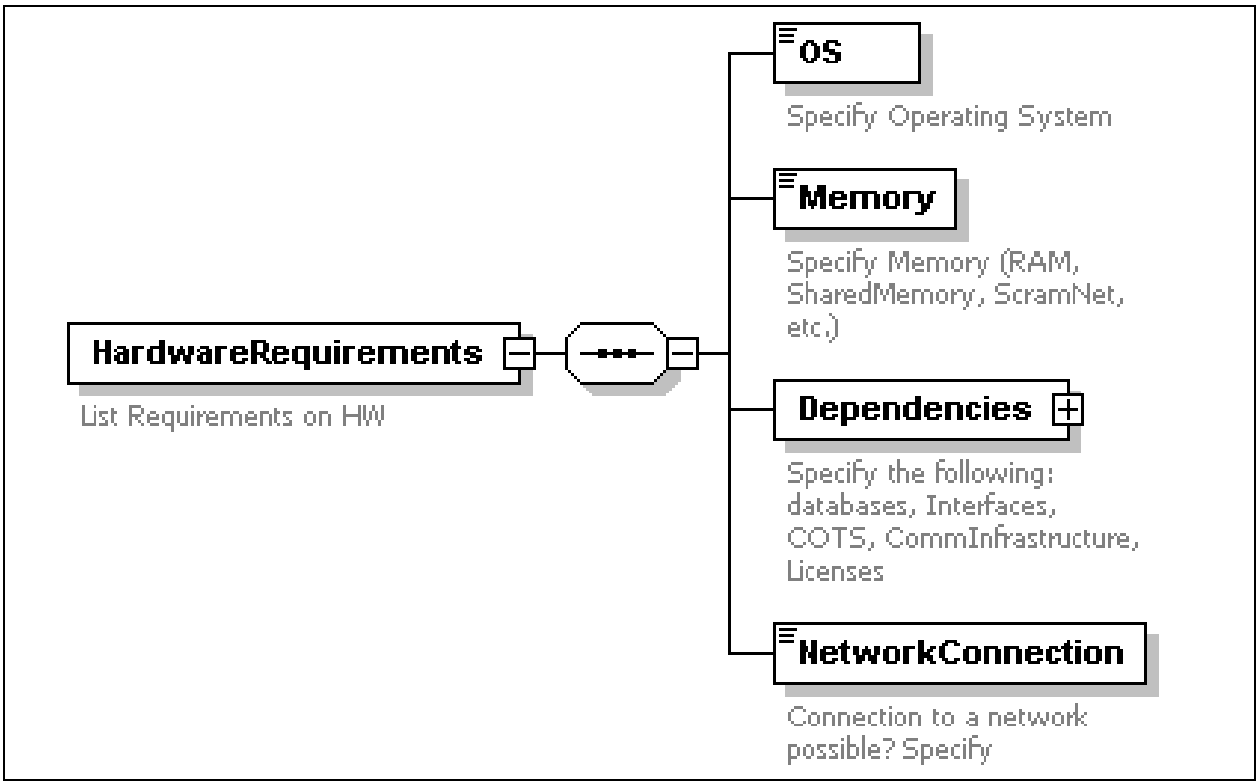


Second level information SimTool/Features

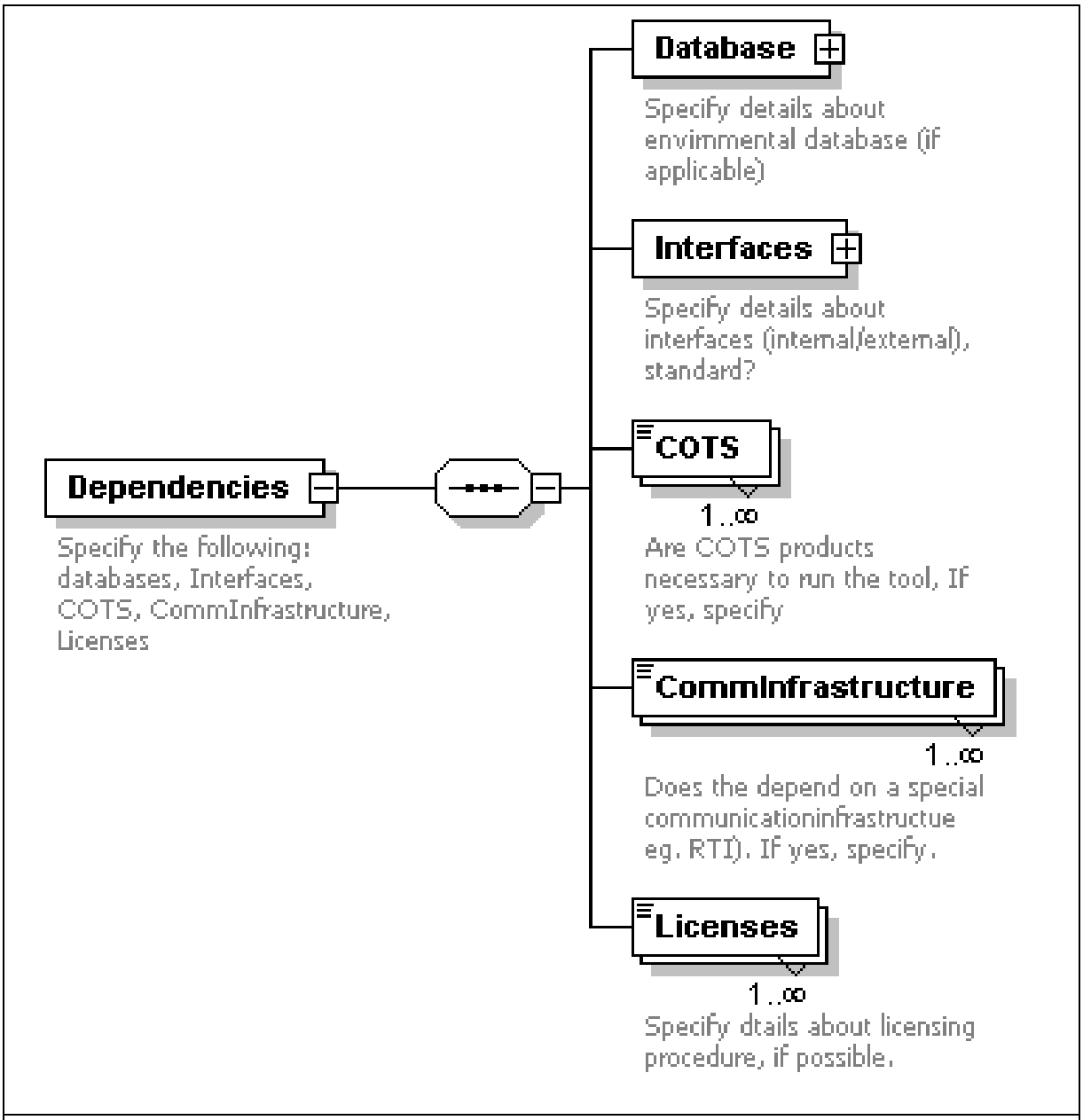
When entering a stage on a more technical level, finally, information related to soft- and hardware requirements becomes valuable.



Second level information SimTool/Software



Second level information SimTool/Hardware Requirements



Third level information SimTool/HardwareRequirements/Dependencies

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Annex D - REFERENCES

(Many relevant references can be found on some key web-site)

CESG (Communications-Electronics Security Group)	http://www.cesg.gov.uk
OMG (Object Management Group)	http://www.omg.org
US DoD Defense M&S Office (DMSO)	http://www.dmso.mil/public
EUCLID RTP 11.13 Web site	http://www.euclid1113.com
EUCLID RTP 11.13 Ref #1: **"Method for Characterising Repository Assets",** **(**Technical Note 3.1.c), dated 2 May 2002	
EUCLID RTP 11.13 Ref #2: **"Repository Architecture"** (Technical Report 8.1) dated 13 December 2001.	
ESPRIT : "European Strategic Programme for Research and Development in Information Technology"	http://www.cordis.lu/esprit/home.html/
NATO M&S Action Plan	http://www.rta.nato.int/msg.htm
NC3A Operations Research Division **"Models and Planning Tools Descriptions**"	Compilation document by R.J. Goad, NC3A ORD in July 1998

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Annex E - LIST OF ACRONYMS

ADL	Advanced Distributed Learning
AMS	Alenia Marconi Systems
ANO	Authorised National Organisations
ANPROS	*ANtenne Plan, Recherche Opérationnelle et Simulation* (operational research and simulation center of the Navy, France)
API	Application Programming Interface
ARCOSIM	*ARchitecture COMmune de SIMulation* (France)
ASCII	American Standard Code for Information Interchange
BDSIM	*Base de Données de SIMulation du ministère de la défense française* (simulation database)
CA	Canada
CAD	*Centre d'Analyse de Défense* (Center of Defense Analysis)
CASE	Canadian Aerospace SE
CASI	*Cellule d'Analyse, de Simulation et d'Innovation* (analysis, simulation and innovations department of the Air Force France)
CDE	Concept Development & Experimentation
CESG	Communications-Electronics Security Group
CF	Canadian Forces
CFXNet	Canadian Forces Experimentation Network
CNAD	Conference of National Armament Directors
COM	Component Object Model (MS product)
CORBA	Common Object Request Broker Architecture
COTS	Commercial Off The Shelf
CROSAT	*Centre de Recherche Opérationnelle et de Simulation de l'Armée de Terre* (operational research and simulation center of the Army France)
C3I	Command, Control, Communications and Intelligence

DBMS	Data Base Management System
DCE	*Direction des Centres d'Essais* (Systems valuation and Test Directorate)
DERA	Defence Evaluation and Research Agency
DGA	*Délégation Générale pour l'Armement* (French procurement agency)
DIF	Data Interchange Format
DIS	Distributed Interactive Simulation (IEEE standard 1278)
DL	Distributed Library
DMSO	Defense Modelling & Simulation Office (US DoD)
DND	Department of National Defence (of Canada)
DoD	U.S. Department of Defense
DOM	Document Object Model (XML)
DSP	*Direction des Systèmes de forces et de la Prospective* (Technical Policies and Planning Directorate of the French DGA)
Dstl	Defence Science & Technology Laboratory (UK)
DTD	Document Type Definition (XML)
EPSA	*Equipe de Projet Simulation pour l'Acquisition*
ESPRIT	European Strategic Programme for Research and Development in Information Technology
EUCLID	EUropean Co-operation for the Long-term In Defence
EW	Electronic Warfare
FFI	*Forsvarets forskningsinstitutt* (Norwegian Defence Research Establishment)
FEDEP	Federation Development and Execution Process (HLA)
FOM	Federation Object Model (HLA)
FR	France
GE	Germany

HLA	High Level Architecture (US DoD standard 1.3, IEEE standard 1516)
HLA OMT	HLA Object Model Template
HTML	Hyper Text Marked up Language
HTTP	Hyper Text Transfer Protocol
HTTPS	HTTP Secure
IDE	Integrated Development Environment
IE	Industry Entity
IEEE	Institute of Electrical and Electronic Engineers
IOS	Input Output System
IP	Internet Protocol
IPSec	Secure Internet Protocol
IPR	Intellectual Property Rights
IT	Information Technology
ITCS	*Infrastructure Technique Commune de Simulation*
JSimNet	Joint Simulation Network
J2EE	JAVA 2 Enterprise Edition
MALO	Maritime Air Littoral Ops
MA&S	Material Acquisition and Support
MC	NATO Military Committee
MDA	Missile Defense Agency (US)
MG	Management Group (*EUCLID RTP11.13*)
MoD	Ministry of Defence
MS	Microsoft
M&S	Modelling & Simulation
M&S/SE	Modelling & Simulation and Synthetic Environment

MSAP	Modelling & Simulation Action Plan
MSCO	Modelling & Simulation Co-ordination Office (NATO)
MSG	Modelling & Simulation Group
MSIAC	Modeling and Simulation Information Analysis Center (U.S.)
MSMP	Modelling and Simulation Master Plan
MSRR	Modeling & Simulation Resource Repository
NAC	North-Atlantic Council
NATO	North Atlantic Treaty Organization
NC3A	NATO Consultation, Command and Control Agency
NBC	Nuclear Biologic Chemical
NO	Norway
NMSG	NATO Modelling and Simulation Group
NSRL	NATO Simulation Resource Library
NSVaA	NATO SRL Validation Agent
NSVeA	NATO SRL Verification Agent
OMG	Object Management Group
OPERA	Operators Training Distributed Real-Time Simulations
OU	Organisational Unit (Bundeswehr)
PfP	Partnership (or Partners) for Peace
PKI	Public Key Infrastructure
POC	Point Of Contact
R&D	Research and Development
RTA	Research and Technology Agency (NATO)
RTB	Research and Technology Board (NATO)

RTO	Research and Technology Organisation (NATO)
RTP	Research Technology Project
SAVE	Synthetic environment AVailability and Economy
SAX	Simple API for XML
SBA	Simulation Based Acquisition
SC	*Département "Ingénierie des Systèmes Complexes"* ("Complex Systems Engineering" Department (SC) of the DGA/ DSP)
SCORM	Sharable Courseware Object Reference Model
SE	Synthetic Environment
SECO	Synthetic Environments Coordination Office (UK and Canada)
SEDE	SE Development Environment
SEDEP	SE Development and Execution Process
SEDRIS	SE Data Representation Interchange Specification
SE-ATG	Synthetic Environment Advanced Technology Group
SGMS	Steering Group for M&S
SISO	Simulation Interoperability Standards Organization
SOAP	Simple Object Access Protocol
SOM	Simulation Object Model(HLA)
SRL	Simulation Resource Library
STANAG	Standardisation Agreement (NATO)
TAMSS	Tactical Aviation Mission Simulation System
TD	Technology Demonstrations
TG	Task Group
ToE	Target of Evaluation
TOR	Terms Of Reference
TT&S	Thales Training & Simulation

UK	United Kingdom
UML	Unified Modelling Language
URL	Uniform Resource Locator (Internet)
US	United States of America
VPN	Virtual Private Network
VV&A	Verification Validation and Accreditation
WAN	Wide Area Network
XML	eXtended Marked up Language
XML DOM	XML Document Object Model
XML DTD	XML Document Type Definition

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7. Presented at/Sponsored by

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Modelling and Simulation (M&S)
M&S Catalogue
M&S Library
M&S Repository
Reuse of M&S Resources

14. Abstract

The NATO Modelling & Simulation Action Plan (MSAP) was approved by the Research and Technology Board (RTB) and recognised "reusability and interoperability" of M&S as the two fundamental objectives for establishing an efficient NATO M&S capability in support of Training, Exercising and Operational Support within the Alliance. In support of these primary objectives, the establishment of a Simulation Resources Library (SRL) was recognised as a key enabler: the MSAP document identifies this SRL activity as sub-objective 2.3.

This report investigates national and NATO requirements for the establishment of a NATO SRL. Priority contents has been identified and a proposal for future implementation is described. It appears that a SRL distributed between nations and NATO is the preferred solution. The main recommendation is to select a supporting software based on the current commercial Internet technology.

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