

## Effectiveness by Reusability, MSG-042 First Findings

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### **ABSTRACT**

*Many people think that experience is the best way to learn a skill. Unfortunately, it is not always possible to get practical training or perform real experiments due to economic, time, safety or resources constraints.*

*This kind of problems is the main reason why Modelling & Simulation is being used. In a few words, it saves a lot of money, it produces results faster, it is more flexible than real life and it makes possible to repeat the experiments as many times as you want. Furthermore, in the specific case of military operations, there is the additional advantage that simulation experiments and training are less dangerous for human beings.*

*In many cases the user's needs are urgent and Modelling and Simulation development work should be ready for 'yesterday'. The only way to solve this problem is to be 'ready in advance' and reuse components that were previously developed and simply reconfigure and assemble them according to the current needs. Therefore, effectiveness of M&S is directly related to the level of reusability of M&S resources.*

*MSG-042 is focused on fostering simulation resource reusability within NATO and PfP countries through the study and analysis of the factors that can enable a shared and common framework in which reuse of modelling and simulation assets will be supported.*

*This paper presents and discusses the first findings of the MSG-042 and the conclusions drawn from the workshop that has been held in The Hague (10-12 May 05) on "Simulation reusability challenge within NATO".*

### 1. INTRODUCTION

Simulation is considered an important business tool in modern society. It is widely used in organizations and companies, and NATO, of course, is not an exception. What is more, in recent years the use of simulation has grown inside NATO and this trend is expected to continue in the future.

In the military area, simulation can be used as an evaluation and decision aid tool for operations planning, Simulation Based Acquisition (SBA), training, mission rehearsal, equipment and tactical assessments, etc. The use of simulation allows saving time and money, preventing the risk for human lives and undesirable ecological impacts.

NATO awareness of the advantages of simulation has been the driving force behind the establishment of the NATO Modelling & Simulation Group (NMSG) under the Research Technology Organization (RTO). Besides, simulation is considered to be an essential tool for the Allied Command Transformation (ACT) to perform its tasks.

The uncontrolled increase of the use of simulation has produced dispersion and duplication of Simulation Resources (SR) and efforts, frustrating any possible reusability. NATO has taken a first step forward by adopting the High Level Architecture (HLA). HLA is a standard for interconnecting simulators and for improving simulation software reusability. However, the adoption of the HLA standard does not solve all problems related to simulation within NATO.

Conscious of this fact, in 2001, the NMSG commissioned the MSG-012 working group on "Recommendations on the Establishment of a NATO Simulation Resource Library". This task group studied the technical aspects related to the establishment of a NATO Simulation Resource Library as required by the NATO M&S Action Plan, considering it was clearly a first step to promote SR reusability within the alliance.

On the other hand, the Western European Union (WEU) has undertaken the SR reusability problem through several initiatives. The most recent and outstanding is the program EUCLID RTP 11.13 "Realizing the Potential of Networked Simulation in Europe". EUCLID stands for European Collaboration for the Long term In Defense and it is a memorandum of understanding among the WEU nations. EUCLID RTP 11.13 has produced a variety of prototype tools for developing simulations using the Synthetic Environment Development & Exploitation Process (SEDEP), similar to the HLA FEDEP (IEEE 1516.3 standard April 2003).

In spite of these excellent technical initiatives (from NATO and WEU), simulation reusability has not yet been established. This is because NATO/PfP countries have not yet defined a common framework to support SR sharing and spread simulation experiences and know-how within the simulation community to ensure that efforts will be neither duplicated nor wasted.

This common framework has to be created using a phased approach, to provide NATO/PfP with a greater capability in simulation by improving reusability with the development of new policies and tools.

The MSG-012 provided a specification document for the establishment of a Simulation Resource Library (SRL) for NATO/PfP. The RTA has already implemented a SRL at its facilities in Paris. The NATO SRL will be available for NATO/PfP use by the end of 2005.

The MSG-42 Model & Simulation Group has a different purpose and a more ambitious objective than MSG-012 and should not be considered as a follow-on of MSG-012. Nevertheless the MSG-012 final report provides a vision which is a useful input to the overall objective of this new working group.

## 2. OBJECTIVES OF THE MSG-042

The principal goal of the MSG-042 is to foster simulation reusability within NATO and PFP countries. This group is studying organizational and technical issues and identifying the categories of sharable resources that might provide the **Framework for Simulation Resources Reusability (FSRR)**.

For the scope of this work, the term Simulation Resource includes conceptual models, data, simulation software, tools, individual know-how (in particular subjects or techniques) and any other kind of asset useful for the development, control, implementation and execution of simulation projects.

The current conception of the FSRR (**Figure 1**) includes:

- Recommendations for organizational changes and improvements including:
  - Identification of possible facilitators and management and coordination entities for Simulation Resources Reusability.
  - Description of procedures and processes necessary to be implemented to ensure SR reusability.
  - Identification of User communities with similar simulation needs (Communities of Interest – COI).
- Guidelines, based on lesson learned of previous efforts and national experiences, to:
  - Set the basic repository functional requirements

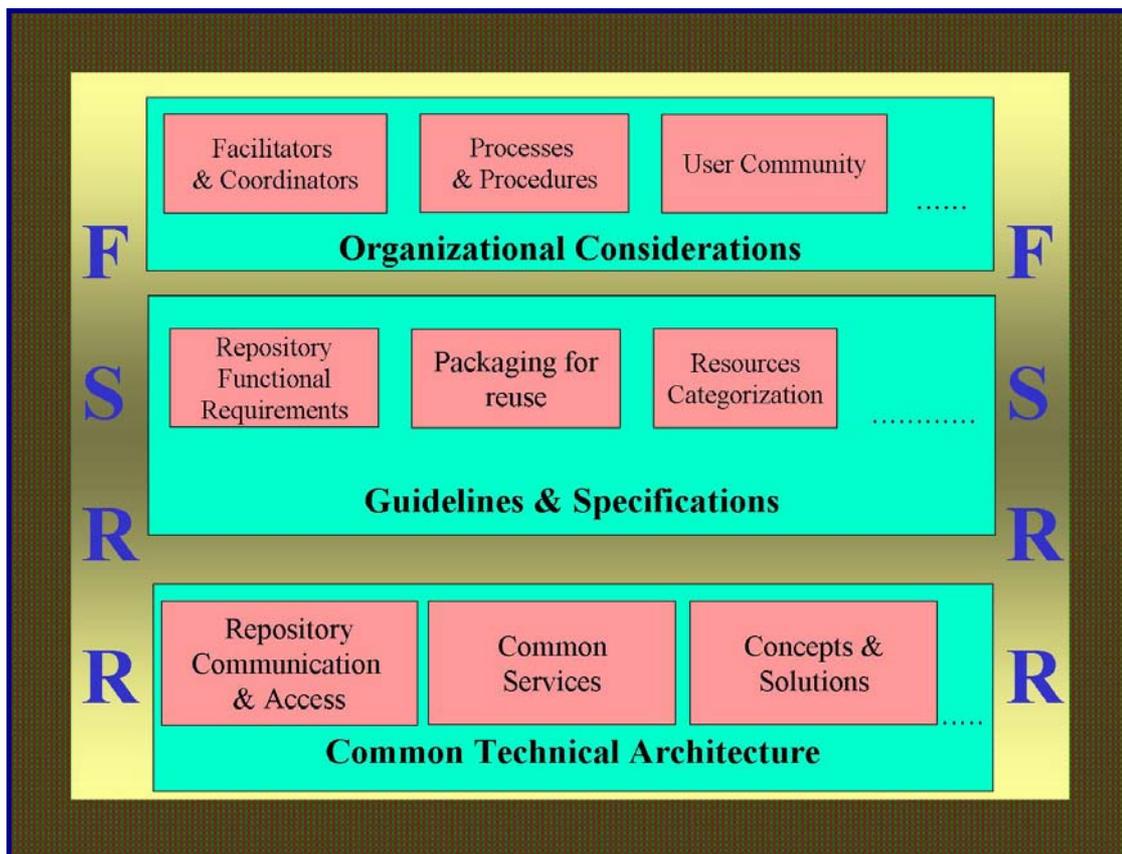


Figure 1 – Current implementation of the FSRR

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- Establish the mechanisms for packaging for future reuse.
- Define a common resource categorization to allow SRLs to interoperate and permit advanced resource searching.
- A Common Technical Architecture to ensure the interoperability between SRL and Tools, defining:
  - Mechanisms for repository communication and access.
  - Common services, such as application related common ontologies for resource identification.
  - New concepts and solutions for SR reusability.

Determining the initial components of the FSRR will be the main duty of the MSG-042, but this group will not provide all components of a closed and permanent framework; we consider FSRR as a living tool.

We think that populating this framework will be an iterative process that has to be addressed using a phased approach development cycle, MSG-042 is just fulfilling one of these phases. It also has to be noted, that this effort can be considered part of the NATO PATHFINDER concept.

The other key task of the MSG-42 will be to define and implement a demonstrator to show the value of the concept of adopting the proposed FSRR in NATO/PfP. For this task the MSG-042 is collaborating with other NMSG groups, such as the MSG-027 (“Integration Environment for Multi-Purpose Application of Distributed Network Simulations”) and MSG-024 (“M&S Support to Non-Article 5 Operations and COA”).

Specific topics to be covered by the MSG-42 are specified in the goal tree of **Figure 2**.

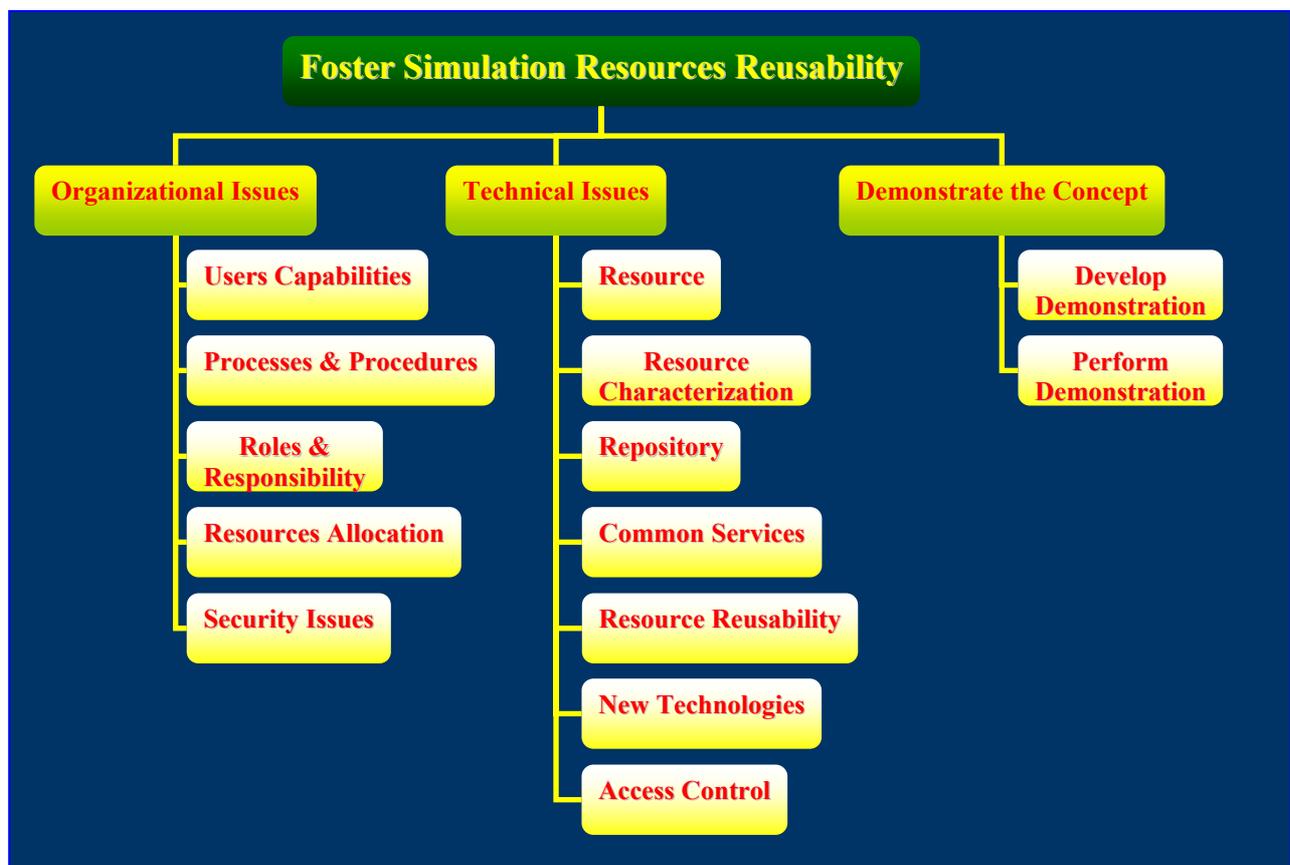


Figure 2 – MSG-042 Goal Tree

The expected end products and/or Deliverables are:

- Final report of the Task Group, including the FSRR initial components. As mentioned before, the FSRR is a living product that can be considered part of the NATO PATHFIDER concept. This group will only provide a first set of components for the FSRR.
- A set of simple demonstrations and presentations for concept exhibition.

### 3. WORKSHOP ON “SIMULATION REUSABILITY CHALLENGE WITHIN NATO”

The workshop on “Simulation reusability challenge within NATO” was held at TNO Defence, Security and Safety, The Hague, The Netherlands (10<sup>th</sup> – 12<sup>th</sup> May 2005).

The goals for this workshop were:

- Present the objectives and activities of the MSG – 042 to other organizations (NATO agencies, Military Staff, Industry, Academy...),
- Identify required capabilities for simulation reusability within NATO,
- Obtain input from participants on the requirements, possible solutions, implementation and usage of the FSRR,
- Discuss, with experts outside the group, the state-of-the-art tendencies in resource reusability, from different points of view: Organizational aspects, Technical aspects and Users’ view.

Participants from seven different countries (Canada, France, Germany, Spain, The Netherlands, The United Kingdom and The United States of America) provided presentations. All of them introduced new ideas and had a very high quality level. These presentations generated much interest and discussion.

There were a total of 36 attendees from eight different countries, those listed before plus Sweden. These attendees work for industry, government and academia. The NC3A (the NATO Consultation, Command and Control Agency) was also represented.

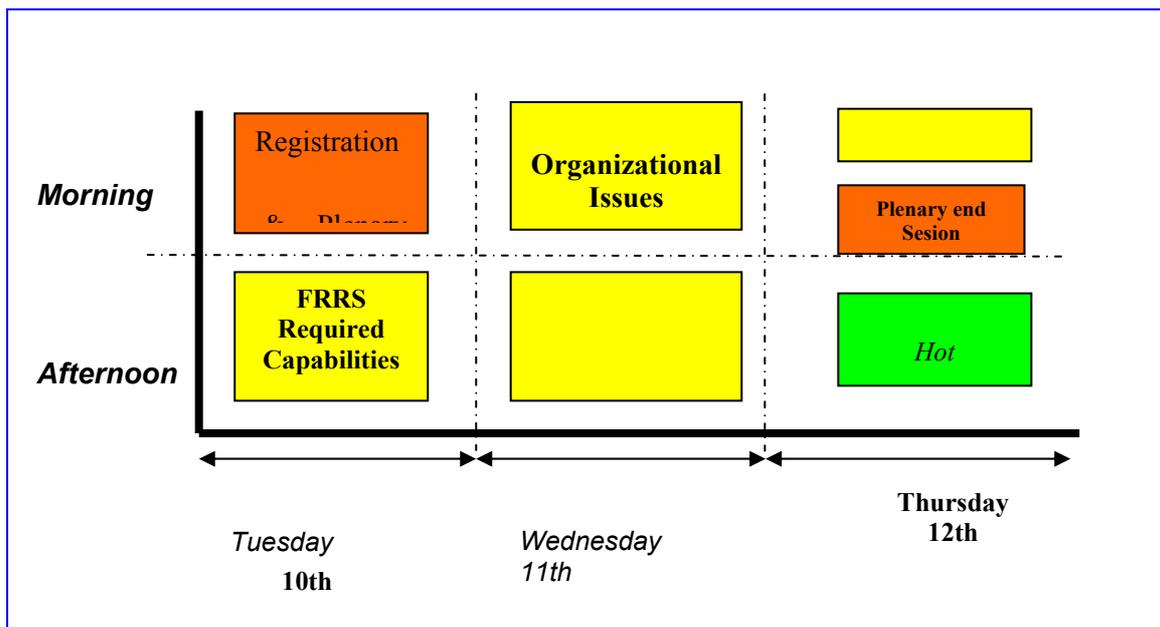


Figure 3 – Organization of the Workshop

As a general remark, we concluded that the Model & Simulation community is greatly concerned about the reusability issue.

The workshop was organized in four sessions (**Figure 3**): FSRR Required Capabilities Session, Organizational Issues Session, Technical Issues Session and Way Ahead Session. Each session began with an introduction by the session leader in which he expose a brief explanation of the session and the objectives to achieve. We will detail the objectives and conclusions of each session in the next paragraphs.

### **3.1. FSRR Required Capabilities Session**

#### **3.1.1. Objectives**

The objective pursued in this session was to analyze which capabilities users require from the FSRR. The different kinds of users considered were simulation developers or simulation consumers involved in military procurement, experimentation or training.

The following presentations were provided:

- Framework for Simulation. Resources Reusability. Analysis of REQUIREMENTS  
Presented by: Lt Col. Xavier Lecinq (SAIS/IOS – DGA) – France
- PATHFINDER MSG – 027 Integration Environment for Multi-Purpose Application of Distributed Networked Simulations  
Presented by: Dieter Steinkamp (IABG mbH) – GERMANY
- GIMO Simulation Needed Capabilities  
Presented by: CN José Fernando Meifrén – SPAIN

#### **3.1.2. Conclusions**

The modeling & simulation community is demanding reusability. It was made clear by the users that if a resource is available and it is suitable to be reused they do not want to waste time and money to produce it again.

Resources may require upgrading, but it was considered that time employed to update resources could be shorter than the time needed to develop new ones, provided that a series of initiatives were taken to develop simulation resources in a way that made them more suitable for reuse. These initiatives should be defined in the FSRR component “Packaging for Reuse” of **Figure 1**.

User identification was considered an important first step in the process. This also implies the problem definition for different users who have different requirements. This classification of users and capabilities required has to be included in the “User Community” element of the FSRR (**Figure 1**).

Also, the possible risks for reuse have to be tackled. This could include problems associated with the intellectual property or with finding a resource good-enough to reach a particular user need.

Organizations and individuals should initiate a change of attitude to face reusability issues during development. They need to evaluate the possible benefits obtained by reusability and sharing of their resources, decide if they want to undertake the necessary changes in organization and other areas needed to foster reusability.

Particularly, in the NATO context, reusability seems to be difficult at short-medium term due to the wide spectrum of applications to be covered. A solution may be to focus in particular areas and on small teams. However, in many cases, technology-based solutions suffice only for local initiatives; the perspective of the mutual advantage is hidden by the need to obtain short-term results. Communities of interest can help to break down the problem. The FSRR components “Facilitators and Coordinators” and “Process and Procedures” should tackle these problems.

For reusability and sharing purposes it is essential to speak a common language. To achieve this, semantic uniqueness is an important tool. Ontologies may be used to obtain this semantic uniqueness. The FSRR will cover this capability in the “Common Services” element. These common services should be agreed by the community and cannot be property of an isolated nation to ensure resources sharing among nations and organizations.

Other remarks were:

- It is necessary to standardize a flexible resource characterisation. It should be implemented at high level and suitable of continuous changes.
- When budget is not the problem, the key motivation for reuse is to speed up the development. For this, it could be necessary to integrate different simulators and applications; standards help to obtain the necessary interoperability.

As a general remark, it was noted that the FSRR should be agreed by the NATO/PfP community so it has to be developed by members of different countries and communities of interest in the context of a NATO organization. The MSG-042, a RTO task group, fulfils these requirements.

## **3.2. Organizational Issues Session**

### **3.2.1 Objectives**

The objective was to identify and analyze which organizational issues prevent simulation resources reusability.

The session focused on:

- Current situation within the NATO/PfP structure and within National organizations
- Identification of NATO/PfP agencies or offices that have responsibilities in the simulation reusability cycle.
- Identification of processes, procedures and other organizational factors that can impede the reuse cycle.
- Analysis of the kinds of procedures needed within the NATO organization to ensure that resources are controlled, reusability opportunities are not wasted and efforts are coordinated.
- The impacts of the intellectual property rights or the Security Issues with respect to resources reusability.

The following presentations were provided:

- NL Simulation Reuse. Organizational issues.

Presented by: Rombout Karelse (Matlogco/IV&C/STS/SEC) – THE NETHERLANDS

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- SICSEI Task 2 Simulation Component Reuse (SCR)  
Presented by: Kelvin Martin (MBDA) – THE UNITED KINGDOM

### 3.2.2. Conclusions

Some salient points from the discussion and presentations were:

- Reusability could be enforced through organizational policy. To induce organizations to utilize these aggressive policies they have to see real benefits. Organizations need the culture and mentality to ride the initial costs, but see the long-term benefits. A valid argument could be “Do once, sell many times”.
- Client involvement in resources design is very valuable in order to guarantee a good understanding of the requirements.
- The strategy for reuse should be based on a reliable repository. Complete reuse without a repository is unobtainable.
- The obsolescence of the resources has to be managed by the organizations involved establishing who pays for maintenance.
- The use of standards regarding Process, Interoperability and Portability improves the quality of components.
- Adequate documentation must accompany a reusable component. This way it will be possible to know whether a resource fits or not.
- It has to be taken into account that any legal or intellectual property rights associated with the resource would limit its potential reuse.
- Although organizations could be willing to share their knowledge on M&S, intellectual and industrial property rights related problems can prevent them from doing so. It is necessary to analyze how to cover and assure the confidentiality, intellectual property and other organizational issues.
- Industry is also an actor to take into account. At commercial level, there are other issues and different laws that are not considered in the NATO environment.
- The resource reusability business process should be defined. This is linked with the User identification and the User Community FSRR component.

As a last concluded statement all participants agreed that “while organizational issues are not solved, technical solutions will not be successful”. This is the reason why the block of Organization Considerations of the FSRR is considered so important.

## 3.3. Technical Issues Session

### 3.3.1. Objectives

This session studied the technical issues that can affect reusability and how new technologies could help to foster reusability. The speakers identified and presented the current tools that can support development for reusability.

NATO or National programs related to reusability were presented with the intention of ‘cross-fertilize’ with MSG-042.

Existing repositories were analyzed. Functions and guidelines for the new repositories were also presented along with architectures and interconnection issues.

Finally, the Technical Issues session tried to identify risks and impacts of each technology.

The following presentations were provided:

- SICSEI Task 2 Asset Characterisation for Simulation Components  
Presented by: Colin Petford (BAE Systems Integrated System Technologies) – THE UNITED KINGDOM
- The German Simulation Resource Library (SRL) A customization of the content management system WebGenesis  
Presented by: Reinhard Herzog (Fraunhofer-IITB) – GERMANY
- Spanish HLA Testbed  
Presented by: Patricio Jiménez (Spain MoD R&T Organization – ISDEFE) – SPAIN
- Modellers’ Role in Simulation Reusabilit  
Presented by: Nathalie Harrison (Defence R&D Canada - Valcartier Seekers and Countermeasures Group. Electro-optical Warfare Section) – CANADA
- NATO Simulation Reuse Case. Joint Terminal Attack Controller (JTAC) Simulator  
Presented by: Major David Laflam (Warrior Preparation Center Einsiedlerhof, Germany) – UNITED STATES OF AMERICA
- STANAG for Virtual Ships. Promoting interoperability and reuse.  
Presented by: Klaas Jan de Kraker (TNO Defence, Security and Safety) – THE NETHERLANDS
- Ptolemy, MDA for simulation reusability  
Presented by: Vincent Arnould (Thales) – FRANCE
- Requirements Reusability  
Presented by: Almudena Díez (TCP Sistemas e Ingeniería) – SPAIN
- From Escadre To Sacod The MDE applied to simulation for defense analysis  
Presented by: Olivier Defour (French MoD/DGA/Center for Defense Analysis) – FRANCE

### **3.3.2. Conclusions**

The following points were drawn from the session:

- It is necessary to reach an agreed definition and scope of Simulation Resource.
- Repositories should act as a catalyst to store resources.
- A resource characterization is essential to identify, search and find resources easily. A common understanding among the simulation community through common meta-data and formats will help to obtain better and faster outputs.
- Modularity and composability should be considered as enablers to reusability. XML-based configuration is a technological support to modularity. From a developer’s perspective Maximum reuse can be obtained by building smaller, less complex components. It is easier to fit small pieces to your model because their reconfiguration is easier. However, from an integrator’s view configurable components at the federate level are ideal for reuse.

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- An M&S development process inspired in MDA (Model Driven Architecture) will foster reusability. MDA can be useful in order to develop Platform Independent Models (PIM) that are, by definition, highly reusable.
- Some view M&S development as nothing more than regular SW engineering. But it was noted that, in simulation, we are not only worried about development; composing simulations for training or experimentation is also part of the problem.

As a final statement, it was agreed that “Technology is not the issue”.

### 3.4. Way Ahead Session

#### 3.4.1. Objectives

Short, medium and long-term topics in simulation resources reusability were analyzed. The principal points to consider were:

- List of problems to be avoided in the future to help to focus where we want to go.
- Give a realistic view of what can be achieved.
- Explore the current national or international strategies or plans to foster reusability in the future.
- Examine new concepts and solutions under research nowadays (e.g. XMSF, Web semantic, Ontology, Agents...) and how they can affect reusability.

These studies should be part of the “Concept and Solutions” component of the FSRR.

The following presentations were provided:

- Industry Initiatives to Improve Simulation Reusability  
Presented by: Jean Genest (Engenuity Technologies) – CANADA
- Models and meta-models in a Semantic Network  
Presented by: Ronald Poell (TNO) – THE NETHERLANDS
- Technology based on Ontologies applied to Synthetic Environment  
Presented by: M<sup>a</sup> del Carmen Suárez-Figueroa (Artificial Intelligence Laboratory, School of Computer Science – UPM) – SPAIN
- MSG-042 Resource Characterization Semantic Portal Prototype  
Presented by: Bernardo Martínez Reif (ISDEFE – GIMO) - SPAIN

#### 3.4.2. Conclusions

Salient points from this session were:

- It will be desirable to achieve a high interoperability level among simulation development tools. An enabler for this is the use of standards to interchange data between them. Thus, a better and easier integration between Simulation Resources Libraries and development components and tools needs to be accomplished. This will give the opportunity to use the resources produced elsewhere.

- Ontologies are built to represent the application domain. They are an alternative to Data Base or Conceptual Model representation. Ontologies are a set of agreed concepts or terms that can be associated by relationships which could be constrained by axioms that permit to inferred knowledge.
- For building SRLs in the future or for implementing user interfaces to distributed SRLs three technologies were identified:
- Semantic Networks should be considered when dynamic information data models are necessary.
- Knowledge Portals can easily built when an ontology is provided.
- The Semantic-Web is the future technology to build more effective and user-friendly interfaces to obtain information about reusable resources.

At this moment, the simulation community needs time to study and adapt to this emerging technologies because they will allow easier and cheaper solutions.

#### **4. CONCLUSIONS AND FUTURE WORK**

We claim that reusability could increase the effectiveness of simulation by shortening the development time, effort and cost and providing better solutions composed of proven resources. We also assert that reusability can be a key factor for different kinds of simulation users, such as, developers, operation research analysts, trainers, procurement staff, and so on.

Of course, we are aware of the difficulties involved in the reusability cycle. This is why NMSG started the MSG-042 activity.

So far the MSG-042 has more questions than answers but we think we are on our way to contributing to the creation of a common framework to foster reusability in the international arena and at home.

The phased approach we are following allows us to start populating the FSRR with components we have at hand and to permit that future efforts produce other components or even refine the ones we have proposed.

From the workshop, a very important event for our study, we get the following general conclusions:

- It is still necessary to identify the different users and their needs
- Organizational issues are paramount
- Technology is already good enough to provide partial solutions
- Emerging technologies could enable new solutions in the future to problems like resource characterization or smart resource search
- To get reusability we should change the current simulation development and exploitation business model

This task group is planned to end its works in 2006. Our intention is to disseminate the information and conclusions gathered as widely as we can. It is for this reason that we wrote this paper, we hope we have succeeded.

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