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RTG on Conceptual Modelling for M&S MSG-058, RTG-038

I. ORIGIN

A. Background

The NMSG was established within the Research and Technology Organisation (RTO) in 1999, with an objective to favour re-use and interoperability of M&S within the Alliance, and NATO/PfP Nations. So far, within NATO, like in the international M&S community, the interoperability objective was mainly addressed at the “technical level” using open standards developed by SISO (Simulation Interoperability Standards Organization), IEEE (Institute of Electrical and Electronics Engineers) or ISO (International Organisation for Standardisation) such as the HLA that was adopted by NATO as early as 1998. Those standards have provided a first step to interoperability and a state-of-the-art way to interconnect simulations and tools to build distributed systems of simulation but it is recognized that existing standards are not meant for exchange of semantics and concepts.

Since the beginning of the NMSG activity it was recognized that HLA was only a preliminary step to satisfy the M&S technical interoperability concern and that the final objective was still to achieve a more ambitious M&S “interoperability level”. This final objective should be to achieve a common understanding and use of information exchanged between simulations for better satisfying military requirements for education, training and operational support.

In the mean time SISO recognized the importance of better defining and advising the M&S community on the importance of Conceptual Models not only for the interoperability issue but also to form a basis for simulation development, foster re-use, and to support V&V activities. A SISO Task Group was created in 2003 to address the topic of Conceptual Models with the potential objective of developing a new standard, or more precisely a “guide”, to help practitioners building Conceptual Models. For various reasons this SISO Task Group did not fully achieve its goals. Nevertheless it produced some interesting and valuable output that can be exploited to produce a recommended practice guide for the elaboration of Conceptual Models.

The purpose of this NMSG Task Group is to develop a guidance document on Conceptual Models, which can be used in the future by NATO to support its M&S requirements.

B. Military Benefit

Conceptual models are key to the transformation of user needs and requirements to M&S design, and eventually implementation. Conceptual models form the bridge of understanding between the users of M&S, the military domain experts that have the necessary knowledge that must be represented in M&S, and the software and simulation engineers that implement simulations. Without Conceptual Models, history has shown that simulation developers often do not sufficiently understand the military domain to be modelled and implement M&S that do not reflect the intended reality, and thus do not satisfy the user’s needs. Further, Conceptual Models form the basis of an important step in Verification and Validation – determining that the

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application domain has been described sufficiently to meet users' needs while accurately incorporating subject-matter expert knowledge.

In addition to playing a key role in the development of individual simulations, Conceptual Models are also a key to facilitating the valid and effective composition of M&S into federations. While technical interoperability of simulations has been thoroughly researched and solutions have been implemented (for example, the High Level Architecture for M&S), these do not address higher levels of interoperability (semantic, pragmatic, and conceptual).

Neither a standard practice for Conceptual Model development nor consensus definition of Conceptual Model content currently exists. Where conceptual modelling is practiced, it is typically defined on a project-to-project basis. A NATO Task Group (TG), working in conjunction with SISO, is in the unique position to develop a standard that will be used by multiple Nations, thus meeting the reusability and interoperability goals. A recommended practice including specification of the content of Conceptual Models for M&S will further increase user understanding of the capabilities of those M&S, thus increasing their reusability.

II. OBJECTIVE

Major objectives of this Task Group are:

- Clarify the “Conceptual Model” concepts, discuss the terminology, and emphasize the utility to better formalize Conceptual Models, understand the relationship between conceptual modelling and related concepts (scenario definition, etc.);
- Investigate methodologies, simulation and software engineering processes, initiatives and technologies useful for the establishment and content of Conceptual Models;
- Draft a guidance document on conceptual modelling that can be used by different stakeholders (sponsor/user, project manager, subject-matter experts, V&V agents, developers, etc.); and
- Foster the establishment of the guidance document as a SISO standard.

The TG's first objective will be to clarify what a Conceptual Model for Military M&S is and what it represents. A common understanding at this starting moment is that the Conceptual Model should serve as a frame of reference for simulation development by documenting important entities/concepts, their properties, and their key actions and interactions. That is a Conceptual Model should bridge between the requirements and simulation design.

The TG will clarify and rigorously define the core terminology associated with conceptual models and conceptual modelling, and the relationship among those terms. The TG will identify the key stakeholders in conceptual modelling and their requirements with respect to conceptual modelling. Stakeholders will include those that are involved in the production of conceptual models and those that rely on conceptual models to perform their jobs. Among the issues the TG will address what key concepts each of these stakeholders needs in a conceptual model and the level of abstraction at which conceptual models should be expressed to meet various stakeholders' needs.

Conceptual modelling is one of key concepts in the development and employment lifecycle of M&S. As such it is related to other concepts such as scenario development, simulation software requirements development, and test plan development. As part of the first objective, the TG will define the relationships among conceptual modelling and these other activities. The second objective of this Task Group is to investigate

methodologies, simulation and software engineering processes, initiatives and technologies useful for the establishment and content of Conceptual Models. While the objective of this TG is not to develop or identify a single standard for the representation of conceptual model content, this TG will identify a range of such solutions that can be employed in conceptual modelling.

In order to take advantage of the work covered by others regarding to this issue, it will be very important to collect and analyze as much as possible of the documentation available on conceptual modelling, specially those related to the M&S field. Lesson learnt by them can help to avoid some recurrent problems, to reduce the risk of developing simulation not adapted to the requirements and to get a better profit of this TG.

The TG will explore the potential of a variety of processes and knowledge representation approaches to examine their potential for conceptual modelling. Among these will be simulation-specific methodologies as the HLA FEDEP general software engineering processes; prior conceptual modelling initiatives as the CMMS – Conceptual Models of the Mission Space, and emerging technologies such as ontology languages. Through this objective, the TG will synthesize existing practices to identify the state of the art of conceptual modelling. By doing this, the TG will maximize the reuse of previous effort in the development of a recommended practice.

The third objective is to provide a tailorable set of guidance to the M&S community on conceptual modelling. This will guide users through the conceptual modelling effort by explaining how to apply it in practice. The process will be tailorable in that it is intended to be extended and modified by individual programs that apply it. Rather than being a one-size-fits-all rigid, single approach to conceptual modelling, the guidance will provide a starting point that individual programs can apply given their specific needs and resources. The guidance on the Conceptual Model content will state what should be in the Conceptual Model, and not mandate a specific format but suggestions for the selection and use of format, methodology, techniques and tools will be provided.

The guidance will encompass the conceptual modelling process, Conceptual Model content and describe appropriate views on a Conceptual Model for different stakeholders. For example, the conceptual modelling process will describe the transformation from the users view, concerned with the problem domain, to the developers view, focused on the M&S domain.

The TG's fourth objective is to foster the establishment of the guidance document as a SISO standard. The current policy of NATO for standardization is to use civil standards where appropriate ones exist and to develop its own standards only when no civil standard exists. In the case of conceptual modelling for M&S or conceptual modelling in general, no civil standard exists. The requirement for M&S Conceptual Modelling is not specific to NATO or to the military domain. Thus it should be helpful to extend this work to a larger M&S community. With respect to this proposal, the TG will open its guidance document to an M&S standard product, developed through an open consensus-based standards body. The SISO is the best suited organization for this standardization, since it has a strong background and current focus on military M&S, but also includes M&S practitioners from outside the military domain. Thus, the TG will propose to SISO the creation of a standard development group (a PDG, Product Development Group) in charge of developing a balloted standard.

Two models of interaction between this NMSG TG and the SISO PDG are possible:

- 1) The TG guidance document can provide the first draft of the future SISO product which can benefit from the input of a larger M&S community; or
- 2) The TG will work along with a SISO PDG to develop the product.

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The decision rests with the SISO membership and the SISO Standards Activity Committee on whether they wish to apply the resources immediately to exercise the second option. In either case, the TG will be involved in the SISO PDG activity and could provide a part of the leadership of the group thus protecting its own interests. This working mode between NATO Task Groups and SISO Product Development Groups has already been employed in the VV&A (Verification, Validation and Accreditation) and Coalition Battle Management Language (C-BML) activities. Even if the first cooperative approach is used, and SISO does not choose to take the product forward as a SISO product, NATO will be provided with a guidance document as proposed in the third objective at the end of the TG activity.

Main deliverables of the Task Group will be:

- A draft guidance document;
- Interim publications at some conferences (when required); and
- A final report.

III. RESOURCES

A. Membership

Co-Chair: Mr. William F. Waite, United States.

B. Nations Willing/Invited to Participate

Canada, France, Netherlands, Norway, Romania, Spain, Sweden, Turkey, United Kingdom, United States.

Task Group members must have a working knowledge of the simulation design and development. An initial list of Nations, which have expressed a willingness to participate, is given above.

Other Nations can express willingness to participate in this activity. It is recommended that USA and Romania co-chair this activity.

National and/or NATO resources needed:

- Member Nations will supply manpower (including travelling expenses) resources. It is important that the group be supported by the NATO Modelling and Simulation Coordination Office (MSCO).

RTA resources needed:

- Technical report publication services.
- RTO Web Space via the RTO Wise.

IV. SECURITY LEVEL

The security level will be Unclassified/Unlimited.

V. PARTICIPATION BY PARTNER NATIONS AND OTHER NATIONS

This activity is open to PfP.

VI. LIAISON

Liaison should be established with the following organisations:

- MSG-054 Task Group on “An Overlay Standard for Verification, Validation, and Accreditation (VV&A) of Federations”;
- MSG-052 Task Group on “Establishment of a Knowledge Network for Federation Architecture and Design”;
- The coming Task Group IST-075/RTG-034 on “Semantic Interoperability” (Continuation of the IST group ET-040 on “Ontology fusion”);
- Simulation Interoperability Standards Organisation (SISO); and
- Other RTO Task Groups as required.

VII. REFERENCE

The deliverables should be “Unclassified – Approved for Public Release (unlimited distribution)”.

