Technical Evaluation Report

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OVERVIEW

The NATO Modelling and Simulation Group (NMSG) Conference (MSG-056) on "Improving M&S Interoperability, Reuse and Efficiency in Support of Current and Future Forces" was held in Prague, Czech Republic on the 4th and 5th of October 2007. All sessions of the conference were unclassified. The conference audience included experts from NATO countries, Partners-for-Peace (PfP) nations, as well as invited nations.

The sessions consisted of two keynote speakers (host nation and NATO), three invited papers and 17 of 20 planned papers (three papers were cancelled shortly before the conference due to extenuating circumstances). This technical evaluation report summarises the principle ideas focussing on the recurring themes, issues and concerns, and offers a view to the future within the context of the subject at hand.

INTRODUCTION

The past decade has ushered in significant changes, on a global scale, which have resulted in equally significant consequences for the defence science and technology community. The ever-changing geo-political climate has imposed challenges on leadership and management, while rapid advances in technology present daily promises of improved effectiveness and efficiency. Both of these diverse realms operate and evolve in parallel, resulting in a highly complex environment that demands the utmost from the leaders in their respective fields.

During his keynote speech for this conference, Dr Greg Schneider, the Director of the NATO Research and Technology Agency (RTA), highlighted the growing importance of modelling and simulation (M&S) and its unique relationship with the operational realm. There is little doubt that members from both communities (operations and M&S) would fully support Dr Schneider's comments regarding the increased overlap between the M&S domain and the operational domain, particularly from the perspectives of representation and communications. One could argue that technological advancements have allowed the two realms to come ever closer together. Furthermore, casual observation reveals that the current pursuit of standards within the M&S realm is not dissimilar to operational and tactical standardisation agreements that have been around for decades.

There is no indication that the current inertia behind the operational and technological tempos will subside; consequently, one can rationalise that it is best to make the most of these dynamic systems and use that inertia to our benefit. As Dr Schneider points out, the communities must leverage the inherent power of M&S to speed the understanding of new systems and concepts, with the intent of improving the capability development process. Like most dynamic systems, however, any increase in positive effects is likely to require some significant effort at the input stage.

THEME

The theme of this year's annual conference addresses issues that are all too familiar to the realms of defence and simulation. Two of the three specific areas have been pursued by military forces world-wide

for many decades: *interoperability and efficiency*. The remaining item of interest has become increasingly important over the past 10 to 15 years: *reuse*. As technologies improve, operations become more complex and defence budgets come under tighter scrutiny, there has never been more pressure on the operational and scientific communities to make the most of the resources at their disposal. Thus, the theme of this year's conference: improving M&S interoperability, reuse and efficiency.

PURPOSE AND SCOPE

The MSG-056 Conference was structured along five distinct, yet interrelated sessions:

Standardisation of Military Language and Data

The primary focus of this session was on the generally accepted requirement to establish a common foundation upon which simulation practitioners would be able to interchange ideas and information. Not unlike the way in which communities and cultures world-wide have established methods to interact in a mutually beneficial manner, the diverse organisations within NATO, that make use of simulation systems, must establish mechanisms to facilitate the meaningful exchange of information. As Pullen et al point out in their paper on the proposed Coalition Battle Language Standard, there is a growing need to achieve semantic consistency, which, in turn, requires a shift from the current ambiguous situation to an unambiguous framework. Only through such a mechanism will all potential participants in any given federation be able to function in a constructive way.

Support to Military and Civil Operations

Defence organisations throughout the world have been leveraging the power of simulation for quite some time now; however, it is relatively recently wherein defence users have been able to interconnect their systems cross domain and cross discipline. Even more recently, the M&S community has witnessed a veritable explosion in the interest from the civil sector, particularly from the civil contingencies and emergency preparedness perspectives. Dr Faye points out the linkages and commonalities civil requirements have with existing defence systems and activities. This concept is supported by two concrete examples offered by Kreitmair & Norgaard, and Vallerand et al, whereby the utility of simulation from an exploratory perspective was demonstrated.

Live, Virtual and Constructive

The number of simulation systems has grown significantly over the years, filling out the commonly used categories of live, virtual and constructive; notwithstanding the increased capability each new M&S system brings with it, the rapid growth and proliferation also brings inherent interoperability problems and issues. The papers presented in this session touched on three distinct interoperability challenges that have been at the forefront of this community for many years now: technical, operational and organisational.

In addressing technical level interoperability, the US Air Force (USAF) has taken the prescriptive approach and decreed that any prospective federates looking to join the Distributed Mission Operations Network (DMON) must abide by a rigid set of standards (namely DIS, HLA and TENA). Although this may be viewed by some as too restrictive, Mr Michael Aldinger presented evidence that the standards-based approach proved highly effective and efficient, and was suitably fit for the purpose of DMO within the USAF construct. Consequently, the USAF has achieved successful integration of live, virtual and constructive assets in a single federation; furthermore, it has implemented an architecture wherein the integration of new participants is accomplished with relative ease.

Notwithstanding the success highlighted above, bringing together distinctly different simulation assets from a variety of different domains and application areas is a non-trivial task. Most distributed simulation

managers and practitioners of today would argue that this is a statement all too familiar within their day-to-day activities, and that it is a hurdle that challenges even the most intelligent and resourceful minds in the business. However, one has only to revisit the basic definition of a model to reveal the fundamental source of this challenge: a model is an abstraction of something real for a stated purpose. These two key components of the notion of a model inherently lead to difficulties and challenges when one attempts to interoperate and integrate models from different realms. It is the opinion of the author that, until the community is able to conceive of a way in which disparate communities can represent the elements of their individual problem spaces in a common manner, there will always be interoperability challenges and issues to confront the M&S community.

New Concepts and Strategies

Despite the challenges and issues referred to above, the highly capable and brilliant minds within the M&S community continue to pursue new ways in which we can potentially achieve higher degrees of interoperability and reuse, leading ultimately to improved efficiency. The two papers presented in this session bear witness to a concept and a strategy that hold promise for higher levels of interoperability, reuse and composability amongst models, simulations and elements of the real world.

As information and networking technology continues to advance, defence forces continue to inch closer to realising the network enabled, network centric reality; however, as many experts have pointed out, it is not simply a matter of technology to achieve this vision. In his paper describing the Australian Defence Network Centric Warfare Simulation Support Plan, Mr Darren MacFarlane uses the ADF framework to draw out the relationships between the M&S realm and the envisioned network centric realm. The very nature of these two realms leads to significant areas of overlap when examining their characteristics and functions. The concept of a model (and thus simulation) hierarchy has long been an accepted view in the M&S community: models span a spectrum from the engineering/technical level through the platform level to the campaign/theatre command level. MacFarlane goes on to describe what has become an accepted view of the network centric realm wherein four domains span a spectrum similar to the simulation hierarchy: physical, information, cognitive and social. Viewing these two realms in a matrix fashion helps draw out the similarities between the two realms (i.e. each area deals with sharing information at varying levels amongst different source systems at varying degrees of resolution). Equally important is the fact that both realms draw upon and employ very similar concepts, mechanisms and processes for sharing and visualising the domain information.

The second paper of this session addressed an element of the simulation realm that has come to the fore over the past few years – that of developing and implementing a fully composable approach to simulation and synthetic environments. The realm of physical engineering encountered this issue many years ago, and in some cases, has been able to implement reasonable solutions to their problem spaces. One example is that of the automotive industry wherein many vehicle components and parts are available from a variety of vendors (third party vendors in many instances), yet able to be adapted to a specific vehicle based on common component views and standard *interfaces*. In their paper "An Innovative Approach to Weapon Performance Assessment", Cernis & Halsall demonstrate a similar approach within the realm of weapons modelling, by developing architecture they call the Unified Weapon Model (UWM). Notwithstanding the relatively narrow application area, the UWM architecture appears to have established and implemented something that has been discussed in concept for many years – a fully composable, generic framework within which weapon systems can be decomposed, defined, instantiated and recomposed for execution. The component-based approach is particularly suitable to experimentation and testing. Perhaps this approach holds promise for developing component-based strategies and frameworks for areas and disciplines beyond realm of weapon performance assessment.

Regardless of the domain and level of application, it is vital that the M&S community continues to strive for novel ways to improve interoperability and facilitate wider reuse of existing component models. Only

through exploration of yet undiscovered concepts and strategies will modelling and simulation achieve the levels of efficiency it has pursued for so long.

Acquisition, Education and Training

This final session saw five of the six originally planned papers presented, the contents of which covered a fairly broad spectrum of application. The areas of acquisition, education and training encompass a significant portion of all activities within the realm of defence business. Not surprisingly, three of the papers addressed the topics of interoperability and reuse from a high level, while two of the papers provided a more focussed view on simulation in acquisition and training. Regardless of the level of focus amongst the papers and the specific application domain (acquisition, education or training), all papers addressed the issue of interoperability at one or more levels.

EVALUATION

The theme of this year's conference covers significant ground within the realm of M&S; nonetheless, the areas of interoperability, resuse and efficiency are closely related and offer plenty of opportunity for examination and evaluation. All papers presented during the conference served their purpose well by focusing on the main theme. Some papers took a broad approach, addressing the issues from a high level, while others opted for a more focussed approach, dealing with specific issues within the theme; this provided for an excellent mix of material thus facilitating much in the way of information and knowledge sharing.

By way of evaluation, this section of the report will aim to draw out the main points from all of the papers presented. This will be accomplished by discussion in the following three areas: recurring themes; issues and concerns; and the future.

Recurring Themes

Notwithstanding the overall conference theme, and the individual session focus areas, there were other, more generic themes that were noted amongst the various paper presentations and associated discussions throughout the conference. Although all ideas and issues expressed during the conference are worthy of attention at some time, two themes were referred to many times and are of particular importance to the overall efforts of the NMSG and the M&S community. Oddly enough, within a highly technical subject area, the two noteworthy topics are of a non-technical nature.

First of all, many presentations and discussions addressed the issue of cultural and organisational philosophies as they relate to the M&S community and associated activities. Although this is not a new topic in the realm of M&S, it was evident that there is growing emphasis on the impact of cultural and organisational characteristics on the efforts towards, and eventual achievement of higher levels of interoperability, reuse and efficiency. A number of experts in the field of interoperability analysis have long since identified the fact that there are multiple layers (or levels) at which one can strive to be interoperable; the two extremes are generally accepted as technical interoperability (at the *lower* level) and organisational or conceptual (at the *higher* level). These levels, and associated challenges, have existed within the military operational realm for many years; the relatively recent expansion of networked and distributed simulation into all defence activities has seen a logical (not unexpected) translation of similar levels and challenges across to the M&S realm. Nonetheless, the majority of the focus to date has been on achieving technical and syntactic interoperability, with reasonable levels of success. It is now time for the community to join forces and confront the challenge of higher level interoperability with the intent of developing and implementing usable solutions that can be fielded in short order. To achieve this goal, researchers, practitioners and users alike, will need to examine and establish constructs within which they

can assure a common view of the operating space is shared by all participants. This will require a view to aligning the sometimes diverse cultural and organisational views of the mission space.

The second recurring theme is a logical extension of the first: only through dedicated leadership and consistent, committed action, will the user community be afforded the opportunity to achieve the necessary levels of interoperability, reuse and efficiency. In the author's opinion, a key prerequisite to realising the needed level of leadership is the identification of an appropriate *champion* at an appropriate level, to sponsor and take ownership of efforts aimed at confronting the challenges identified in the preceding paragraph. It is vital that senior military officers and defence civil servants fully comprehend the wealth of potential benefits that can be achieved given realisation of the conference theme; it is equally vital that they understand the challenges and associated levels of effort and resources required to achieve some of the visions articulated in the conference papers. There is no doubt that the senior leadership is aware of these issues; it is now a matter of allocating the appropriate priorities and resources to the necessary efforts. As Dr Stephen Covey discusses in his works on highly effective people[1], one must seek a balance between production and production capability; now is the time for leadership to step forth and take care of our production capability by investing in the research and development necessary to support the production of the years to come.

Issues and Concerns

In addition to recurring themes, there were a few issues and concerns raised during the course of the conference that are worthy of mention. Notwithstanding the fact that many issues and concerns were identified during the course of the two days, the items mentioned in this section are, in the opinion of the author, worthy of noting.

- First is the issue of contractual barriers. It is understood that contracting agencies and companies must support the running of their businesses by turning a profit in the work that they do. They must also have the mechanisms and ability to protect their intellectual property. That said, all too often many programs encounter delays due to *heavy* processes and procedures. Industry needs to spend time on creating streamlined contracting processes and teaming arrangements to facilitate expeditious execution of programs.

- A second issue that was not addressed directly, but was present in the background amongst a number of presentations, is the debate concerning reuse and fit-for-purpose. Being a part of the central conference theme, this issue is definitely worthy of continued discussion. In the first instance, one can argue that the fundamental definition of a model[2] does not fully support the concept of greater reuse. The other side of this debate is equally sound, especially from an economic perspective. This, however, is not the sole argument for reuse. From a developer and user perspective, the reuse of verifies and validated models, simulations or components is an attractive prospect since there is likely less chance of encountering errors or anomalies when compared to developing something from scratch. That said, one must approach reuse with caution, and ensure that the original purpose of a model is taken fully into account along with the new intended purpose. Any discrepancies need to be critically assessed to determine if any necessary modifications to facilitate reuse are feasible and economically viable. Efforts must continue towards the concept of communities of interest wherein model reuse is more likely to be a feasible and acceptable practice. It is the opinion of the author that a *blanket* policy of reuse is not necessarily the optimum approach in many instances.

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[1] *The 7 Habits of Highly Effective People* ®, Stephen R. Covey,

[2] The M&S community generally accepts the notion that a model is a representation of some element of the real world for a stated purpose.

The Future

Finally, as the M&S community continues to make progress on technical through to conceptual fronts (i.e. in depth), it is important to keep a view to the other dimension and look for opportunities in expanding the breadth of application of the M&S realm. Specifically, as has already begun, application in, and collaboration with the agencies involved in public security and civil contingencies is a logical and fitting expansion of the use of M&S technologies and processes. There are many similarities between defence activities and public security activities; this <u>will</u> support the notion of reuse at many levels (conceptual, practical and technical). Furthermore, as the boundary between defence and security becomes more blurred, there is strong potential that both domains will be able to make use of the exact same architectures, systems and tools in certain cases. However, as discussed above, the concept of communities of interest in the context of reuse, applies equally in the domain of security, and any other domain for that matter.

CONCLUSIONS & RECOMMENDATIONS

The challenges that confront the practitioners and users of modelling and simulation technology are numerous, and span the spectrum from the technical through to the conceptual. Never have these challenges been so great given the rapid advances in, and equally rapid proliferation of the technologies and techniques that support the M&S communities.

As the world in which we live and work becomes more sophisticated, it also becomes more complex and difficult to understand at first glance. The appropriate and informed application of modelling and simulation in these highly complex environments can prove to be very beneficial from an understanding perspective. As more and more communities realise the advantages simulation has to offer, we see continued growth and spread in the use of M&S technologies and techniques. Additionally, as the realm of networking continues to touch an increasing portion of our daily activities, the desire (and in some cases necessity) to connect capabilities brings with it both new and familiar challenges.

Those individuals and organisations responsible for addressing interoperability issues and challenges must continue to examine the entire spectrum of associated with collaborative processes and activities. Although technical interoperability is not a closed issue, it has received significant attention over the past two decades; consequently it is significantly more mature than our ability to interoperate at higher levels. Therefore, it is appropriate for our community to expend more effort now on tackling the (not-so-new) challenge of higher level interoperability; this will require a closer look at how the various participants and organisations perceive the operating space and the myriad of items contained therein. We must strive to conceptualise and capture common representations and understandings of the various environments for the (yet-to-be fully defined) communities of interest that have materialised, and will continue to form. Failing this, we run the risk of failing to facilitate more effective interoperability and reuse, and thus higher degrees of efficiency in all that we do.