Technical Evaluation Report
NATO Modelling & Simulation Group (NMSG) Conference MSG-111
"M&S Support to Transitioning Forces and Emerged/Emerging Disruptive Technologies

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OVERVIEW

The NATO Modelling and Simulation Group (NMSG) Conference (MSG-111) "M&S Support to Transitioning Forces and Emerged/Emerging Disruptive Technologies" was conducted in Sydney, Australia on 17 & 18 October 2013. All sessions of the Conference were unclassified. The Conference audience included participants from NATO countries, Partners-for-Peace (PfP) nations, and invited nations.

At the Conference, 21 papers were presented. A keynote presentation was given at the beginning of the first day, and Conference contributions were presented in four topic Sessions, with each of the four Sessions preceded by a session Focus Speaker. This Technical Evaluation Report summarizes the core ideas and results presented in this Conference. The report also provides an overview of discussions conducted during the Conference and concludes with a summary and recommendations section.

1.0 INTRODUCTION

The source of the 2013 NATO Modelling and Simulation Conference (MSG-111) stems from NATO Secretary General, Anders Fogh Rasmussen's Smart Defence Concept. The Smart Defence Concept revolves around nations collaborating, using existing defence capabilities, and deploying new capabilities during financially constrained times. Specifically the MSG-111 'Call for Papers' stated:

"The Multi-Workshop will look to share the latest thinking on smarter ways to exploit M&S in areas that NATO has prioritised. These areas include Missile Defence, Cyber Defence, Future Mission Networks, Counter IED operations, and others."

This Technical Evaluation Report contains a synopsis of the keynote talk, session focus speakers, and the paper presentations. Also included are significant technical and thematic aspects of the Conference concluding with recommendations for consideration by the organizers. While this Technical Evaluation Report serves as a record of the Conference's activities, the best source of the information presented are the original papers and the related presentation materials.

The organization of the Technical Evaluation Report includes an encapsulation of the Keynote Address and Session Focus Speakers and the 21 papers given during the four Sessions that comprised the MSG-111 Conference.

2.0 DAY 1 (THURSDAY, 17 OCTOBER 2013)

2.1 KEYNOTE - *MORE EFFECTIVE USE OF SCARCE SIMULATION TECHNOLOGIES*

Air Vice-Marshal Neil Hart from Australia gave the Keynote Address on *More Effective Use of Scarce Simulation Technologies*. He is Head Joint Capability Coordination Division and Vice Chief of Defence Force Group. He made the point that recently cyber has been a huge player in defence, cutting across all domains. He talked about M&S for both training and experimentation. Regarding training his main point was that simulation is a large issue, but not just doing the right thing at the basic level, also doing things right in a larger context. And he stated his key points for M&S in experimentation, which were testing the force design during concept development, stressing force structure in repeatable scenarios, and establishing the needs for force design research objectives. Near the end of his talk, he mentioned the Australian Force Integration Innovation Centre and exercises with some of the NATO nations represented in the room. Overall he said that simulation has an important part in Australian defence and in finishing his talk stressed the role of M&S in contingency preparedness.

2.2 SESSION 1 – C4ISR & CYBER

Session 1 Chair – Ms. Jie Hou

2.2.1 Session Focus Speaker – Commodore Charles McHardie from the Australia Defense Training and Simulation Centre was the Session 1 Focus Speaker and spoke about *M&S support to C4ISR and cyber*. He stated that the challenge was balancing protecting access with availability. He stressed the importance of M&S, because it is sometimes the only way to deal with issues such as assessing vulnerability, redesigning procedures and architectures, honing tactics, training/fighting in a denied environment, and assessing our denial capabilities. He stated that we face many challenges, because of the multitude of adversary capabilities and posed key questions we face such as: what to model against?, what contingencies to train for?, and how to develop exercises with the right balance of service denial/ sensor disruption? In his final slide he addressed the audience directly and said: He is looking for Solutions!

2.2.2 Paper #1 – *C3 Stress Relief: A New Methodology for Identifying Operational C3 Stress Points and Emerging Technology Solutions*, Webb, et al.

Military operations place demands on command support systems and communications infrastructure that vary according to the phase of the operation. Presented here is a methodology for the analysis of operational architecture products that enables the ready identification of stress points in the command, control and communications (C3) systems supporting operations. In addition to specific information and communications requirements, the assessment framework also considers a range of factors critical to the successful uptake of new technologies into existing contexts. These factors include technology type, scope of applicability, technology maturity, and operational impact.

DISCUSSION: This paper provides an interesting and useful way to categorize C3 technologies in a number of different ways. The useful aspect comes from being able to ascertain where critical nodes are with regard to operations and where, in the system, are viable points for the insertion on newer technologies. Another area the authors might want to examine is how the information gained from this study would be useful for looking at interoperability between simulation systems and C3.

RECOMMENDATION: The authors use this framework in the context of M&S to C3 interoperability to see what insights can be gained.

2.2.3 Paper #2 - Modelling and Simulation Support for Cyber Defence, Patel & Huiskamp
This paper is a report on various activities having to do with Cyber Defence. The objective of the group was:

- Exchange information on current national and NATO activities and initiatives on the use of M&S in support of cyber defence
- Discuss ideas on how M&S might support certain still unaddressed aspects of cyber defence needs
- Support development of common definitions and characterisation of Cyber Defence for use by the M&S community

DISCUSSION: The various efforts of this group provide a good overview of the broad aspects this topic covers. As mentioned the focus areas were; 1) cyber education, 2) threat and risk, and 3) types of M&S environments. The group also put on a successful workshop at the 2013 Simulation Interoperability Standards Organization's Simulation Interoperability Workshop.

RECOMMENDATION: This is an area of M&S that will continue to grow in importance. The NMSG should consider follow-on activities that include using M&S to train cyber defence skills for military operators and M&S support to cyber operations.

2.2.4 Paper #3 – The scheduled paper 3 presenters were not at the Conference so a substitute presentation, *Exercise Control Information Services*, was put on the agenda. The authors of this presentation, Jacek Welz and Vladimir Manda from NLD did not submit a paper, but have one-pager to put on the Conference website. They were not present, but Hans Jense (NCIA) and Wolfhard Schmidt (JFTC) spoke for them. The talk first covered the operational perspective and discussed exercise control requirements and combining information from various sources. Then the talk covered the technical perspective where the work is very much still in progress. The benefits of the proposed solution included adaptable data mediation, the combining of multiple information sources, presenting information in user-defined views, and advanced information management.

2.2.5 Paper #4 – *Multi-Schema and Multi-Server Advances for C2-Simulation Interoperation in MSG-085,* J. Mark Pullen, *et al.*

This paper reports on significant steps forward in C2-simulation interoperation that have been developed and implemented by the authors in support of MSG-085: a coalition of simulation, C2, and web-enabled infrastructure systems that are capable of interoperating over a variety of syntactically different schemata, to the extent they are semantically compatible. Further, the system provides support for distributed, interoperating servers. This system enables interoperation among coalition partners who may be working with simulation and C2 systems developed with different schemata generations or versions. It also supports geographic and organizational scalability by enabling support from distributed servers.

The presentation by Dr. Pullen covered the major aspects of the paper. Of note is that the overall goal is interoperation of C2 systems with simulations using web services. With the assistance of Saab and the Fraunhofer Institute, two server configurations have been created that provide for the interface of various C2 and simulation systems. The current configuration is, however, problematic for more than two servers. A demonstration of the system is planned for December, 2013.

DISCUSSION: Key aspects of the work reported in this paper are the development of numerous open source tools and the ability to operate as a distributed service. Open source tools allow for members to make rapid low cost use of the tools in order to implement similar solutions at the national level and, if appropriate, add functionality that can be shared. The distributed aspect certainly fits the physical environment of coalition

operations and supports the growing demand for 'cloud services'. One constraint to note is the limited scalability of the network as pointed out in the paper.

RECOMMENDATION: The efforts under MSG-085 should be made known to the MSG-131, Modelling & Simulation as a Service (MSaaS) for situational awareness.

2.2.6 Paper #5 – *Human-in-the-Loop Analysis of Future Operational Scenarios using Network Emulation,* Matthew Britton

This topic covered the use of network emulations in support of operational scenarios. This paper includes examples of how various technologies like virtual machines are incorporated in representing network architectures. In addition, evidence of other advantages is offered. Those aspects include:

- Experimentation between existing systems and proposed systems;
- Cost effective way to realize complex networks;
- Repeatable and controllable test-environment.

The presentation included reference to human-in-the-loop analysis of future operational scenarios using network emulation. As a defense force needs to adapt to more complex environment that in turn drives cost of training and exercises higher. Emulation provides the 'sweet spot' between actually building equipment and simulation and thereby helping to control cost. Another advantage is that you can apply real software deployed in synthetic environment, emulation does not require additional equipment, and it provides a capability to augment training/analysis. A significant disadvantage is that you are limited to already developed software that limits experimentation. After the presentation the audience asked a number of questions regarding technical issues about scalability, propagation, and validation. There was also a question about future plans to use emulation for cyber research to which the author stated there were no current plans.

DISCUSSION: The use of network emulation has particular significance for planning, testing, and experimentation. The ability to quickly replicate various networks in different scenarios in a controlled environment provides planners with information on how to best use equipment for different types of operations. A constraining factor is using estimates for propagation. Possibilities exist for combining detailed geospatial data with the propagation models to provide increased accuracy in those estimates. As for cyber capabilities, the US National Cyber Range makes extensive use of emulation to establish networks which are used to replicate cyber events and note their effects.

RECOMMENDATION: NMSG continue to follow this effort and consider undertaking a project to determine the potential of providing documentation to member nations in order apply network emulation for their own projects/training events.

2.2.7 Session Panel Discussion – The Session 1 panel members consisted of the speakers from the papers in the session. Ms. Jie Hou led the panel session and began by asking everyone to think about convergences. The first questioner asked how do we extract data and use it in a cyber-context, e.g. denial of service. One response was that BML reports will do extraction, but we don't know the answer if the level of classification rises. Another panel member said we are trying to model the level of challenge rather that connect it to a higher level. Another person said he saw lots of examples of using simulation tools as planning tools and asked where do you see this going in support of planning? One panel member said we will head in the direction of mission preparation and planning and in doing so we have to run simulations faster than real time, not with stochastic simulation, but faster than real time for planning. Another panel member stated that we need to train people to use networks and if you have it emulated, we should say something constructive about how it performs. And his plan is to explore these issues.

2.3 SESSION 2 – INNOVATION AND INTEGRATION OF SIMULATION OF TRAINING

Session 2 Chair – Mr. Bharat Patel

2.3.1 Session Focus Speaker – The Session 2 Focus Speaker was Commodore Michael Noonan, Commodore Training, RAN, who presented *A New Strategy for RAN Simulation support to Training*. He presented a "strategy on a page" where the goal was that all training that CAN be conducted effectively, efficiently, and economically by simulation IS conducted by simulation. He stated the drivers of simulation in this strategy were to deliver simulation based training for the future fleet, reduce the training burden on operational assets, improve the efficiency of the current simulation suite, improve the effectiveness of simulation-based training, and increase the cultural acceptance of simulation as a training assessment, qualification and certification methodology. To achieve the goal, he emphasized education, work tools, and collaboration.

2.3.2 Paper #6 – *Interactive Simulation to Support the Transition of Forces,* Hoff, et al.

After a long period of deployments and ongoing operations, and in the wake of the financial crisis, NATO now stands before new challenges reforming its forces and maintaining interoperability in an austere economic environment. This paper suggests a methodology for using interactive simulations to support the transition of military forces through experimentation with alternative future concepts. Interactive simulation experiments, where military officers plan and lead the operations, are central in our method to evaluate potential military structures in relevant scenarios. A big advantage of using interactive simulations compared to traditional war-gaming has been that the analysis has become more robust and traceable.

The presentation reiterated the main points in the paper to include; experimentation with new technologies and concepts, interdisciplinary cooperation between subject matter experts, and use of an interactive constructive simulation. These bring in to play human creativity, decision-making, and ability to find new solutions. In order to introduce consistency in the study, the force structures were tested against a fixed adversary in a variety of situations.

DISCUSSION: The planning community has long sought ways to bring more modelling and simulation to bear on questions revolving around course-of-action analysis, force structure, and effects of military hardware on force structure. Use of training simulations has always been suspect because of questionable models that make up those simulations. The processes and criteria of application outlined in this paper certainly is a step in the right direction. Emphasizing the use of military operations expertise (human in the loop) and the need to use simulations with well documented models addresses some of the validity issues. One question of interest is scalability. Will what was done at the Brigade level hold for larger forces used in theater level operations?

RECOMMENDATION: Identify other simulations that meet the authors' criteria for use and make experiments with coalition forces in larger scale campaigns.

2.3.3 Paper #7 – *Effective and Efficient Training Capabilities through Next Generation Distributed Simulation Environments,* Siegfried, et al.

Current distributed simulation environments suffer from time- and cost-intensive development and initialization procedures. Furthermore, limited credibility resulting from unknown validity and ad-hoc processes is a serious problem. To overcome these problems, MSG-086 "Simulation Interoperability" analyzed 46 currently prevailing issues that limit true interoperability and discussed possible solution approaches for these issues. Based on these findings and results from national research and development projects of the German Armed Forces, we present requirements and recommendations for next generation distributed simulation environments. The impact of these recommendations on providing effective and efficient training capabilities to NATO forces is illustrated and potential benefits are highlighted.

DISCUSSION: The work of MSG-086 aligns with the DoD M&SCO High level Task (HLT) Live, Virtual, Constructive, Architecture Roadmap-Implementation (LVCAR-I) project which is focused on distributed simulation interoperability. It is interesting to note that the Federation Engineering Agreement Standard (FEAT), an LVCAR-I product distributed by SISO, is referenced. One item noted is that the discussion seems to concentrate on single architecture design whereas multi-architecture is common in LVC events. To that end the LVCAR-I team developed a multi-architecture overlay as an update to the DSEEP also covered in this paper.

The presentation followed the outline of the paper. The presenter's key points included distributed simulation problem areas (e.g. high effort for preparation in terms of time, cost, V&V, etc.). There was also mention of the newly formed MSG-131 working on Modelling & Simulation as a Service that has the potential to address some of the distributed simulation cost drivers.

RECOMMENDATION: This paper is well done and the authors should consider other venues for distributing this paper; for instance as a submission to the Fall 2014 SISO SIW or the US DoD M&S Journal.

2.3.4 Paper #8 *Public Order Management in a Virtual World*, Buiel, et al.

The Royal Netherlands Military Police and TNO initiated the development of a dedicated Public Order Management (POM) training system for commander staff. This system included simulations of POM units (formations, stances and dress) and crowds (movements, formations and aggression). Virtual Battlespace (VBS2) provided the system's simulation engine. As VBS2 is not meant primarily for staff training or for crowd control, a fair amount of functionality had to be added. During development, multiple trials were organized with students from the NLD school for Public Order Management with results provided.

DISCUSSION: There are a number of interesting aspects to this paper. The first is that the training design was not purely a machine-to-student interface but rather there were instructor/controllers in the loop. From an instructional design paradigm this provides for adaptability to the student and in turn should enrich the learning experience. The second is that VBS2 provides the capability to adapt the software for the instructional need. This is an aspect of future design simulation that needs attention. The ability to adapt legacy systems is typically limited and causes the users to employ workarounds making the training more artificial and thus less effective. The last item of note is the discussion on V&V and the data collected. This is an example that demonstrates the utility of V&V and that the process need not be cumbersome. The presentation reflected the main points of the paper and the discussion brought up the topic of negative training. The author stated that there are some indications of negative training that would also merit further investigation.

RECOMMENDATION: This paper provides an excellent example of how a virtual simulation can be an integral part of a training environment with real time adaption by instructor personnel which is a scenario that deserves broader recognition.

2.3.5 Paper #9 *Augmented Reality and Mixed Reality Technologies: Enhancing Training and Mission Preparation with Simulations*, Amorim, et al.

As a way to enhance training and mission preparation with simulations, this research focus on augmented reality (AR) supported by head-mounted displays (HMDs). HMDs may have many shapes, which include pairs of glasses with lenses that present AR with superposed images, enabling its wearer a total immersion in the simulation. The method used in this work involves a literature review on AR and HMDs, assessment of training needs at the Brazilian Army and an evaluation of emerging technologies from the ICT sector. The main contribution of this work is the comparative study of the main solutions for HDM. The research presented suggests that the approach is effective and that future work should be on both development of new

applications and its evaluation in real training sets in Brazil. The presentation also covered areas of future work.

DISCUSSION: To date the application of augmented reality in training is in its infancy. This stems from the fact that the available technology is still limited and the most advantageous way to apply AR technology in the training environment. This paper does establish the potential of the technology as well as a good list of criteria for evaluating the capabilities of head-mounted displays. This brings to the fore the concept of form following function. In too many cases we alter training to fit the available technology that has a tendency to degrade the quality and effectiveness of the training when we should only apply technologies that enhance training.

RECOMMENDATION: The 2012 NMSG Conference had an interesting presentation on using augmented reality to enhance sniper training. That effort and the evidence from this paper would seem to indicate that the area is ripe for exploitation through an MSG on the topic.

2.3.6 Paper #10 *Immersive Technology Supporting Individual and Collective Training*, Biagini, et al.

The foundation precept of this paper is the NATO pillar, "train as we partner". The concept proposed is based on state-of-the-art immersive devices coupled with web-based virtual simulators, serious games and virtual worlds making them accessible through social learning technology to support individual and collective training for Commanders, staff and dismounted soldiers. The framework is suitable to be used to conduct remote distributed training and rapid prototyping activities in a web-based networked environment. Furthermore, the concept could be implemented in a Joint Enterprise Information environment like the NATO Training and Education Network (NTEN) fitting the NATO Future Mission Network initiative.

DISCUSSION: This paper provides insight into various available technologies that could be used to provide some form of virtual environment with the goal of providing mission pre-deployment training. While the coverage of the technologies along with criteria for use is sound, the paper seems to be missing a critical aspect – command and control (C2) systems. The guiding precept should be "train as we fight' meaning the interface to available C2 systems is critical to training in an environment that replicates what will be found in the operational theater. Learning how to function in a situation where coalition command and control systems constrain freedom of action is as important as learning the functions of effective staff work.

RECOMMENDATION: The authors indicated that their next steps are a proof-of-concept and architecture for on-line command post and dismounted soldier training systems. It should be suggested that those efforts provide for a system that includes existing C2 systems.

2.3.7 Paper #11 Learning Priorities and the Role of Computer-Based Training and Simulation on Military Supply Chain Logistics, Gustavsson, et al.

This paper describes a research project with the objective to identify training priorities for considering the implications of all variables that respond for these four factors, this work carried out a qualitative research with in depth interviews with military personal with expertise on making decisions about military logistics. Results from this research shows the skills that are most important to follow for developing expertise on military supply chain logistics and the technology that should best be applied to enhance the training experience. Conclusions from this work shows that training on military logistics involve decisions that are mostly unique, though the current computer-based technology has an important role for training and simulating field situations, thus enhancing the required expertise for making decisions on real military supply chain operations.

DISCUSSION: The research design and rigor in conducting the research are well described. The key point to observe is that there are many areas of military operations that have not had the benefit of modeling and simulation has to offer in support of training. Given this circumstance it is important to consider ways in

which the NMSG can reach out to a broader user community so that they can have the opportunity to have the advantages of applying technology like computer based training.

RECOMMENDATION: Use the research design covered in the authors' paper as a model to ascertain areas of operations where computer based training is limited and has the potential for advantageous application.

2.3.8 Session Panel Discussion – The Session 2 panel members consisted of the speakers from the 6 papers in the session. Dr. Bharat Patel led the panel session and began by noting the panel members came from quite varied countries and perspectives. The first questioner noted that innovation was in the title of the session and asked panel members to expand upon what they considered to be innovative. One panel member mentioned head mounted displays. Another said to do the research first, then determine requirements, and then look for COTS fits. Another questioner asked how to do V&V on human behavior. The first answer was that it is a real issue and so far we really only have SMEs saying TLAR (that looks about right). Then a discussion ensued where the point was made that teaching perhaps doesn't take into account cultural difference and realities of real ops. Also said was that you have to be aware of what you are doing V&V on – human behavior theory or appropriateness of simulation. The session leader then gave a quick summary stating that human behavior has many issues and is a very difficult area and that all of the papers in the session addressed issues appropriately.

3.0 DAY 2 (FRIDAY, 18 OCTOBER 2013)

3.1 SESSION 3 – ACQUIRING AND SUSTAINING SIMULATIONS IN THE 21ST CENTURY

Session 3 Chair – Mr. Greg Akhurst

3.1.1 Session Focus Speaker – The Session 3 Focus Speaker was Dr. Mike Brennan, Director General Capability & Materiel Science, DSTO and he spoke on *Acquiring Simulations in the 21st Century.* He started by saying that now the supporting hardware is in obsolescence when acquired and obsolete when you buy it. This situation is new, because we used to have monolithic hardware and monolithic software. But now we have plug and play hardware and service oriented software. And in the past the idea of simulation has been sold as "cheap" and people are expecting it to be cheap. But P&P hardware and SOS require strong configuration management and costly people. Regarding people, the US has done a lot of work in developing simulation professionals. In summary, simulation acquisition is not what it is used to be and to move forward we need to design and build a minimum governance framework, develop a comprehensive strategy and roadmap, think of investment benefit, not cost benefit, and remember it is no longer about just hardware and software, but about people.

3.1.2 Paper #12 – *An Agile Revolution in Acquisition of Defense Simulation* (presentation given by Adrian Webb)

The main idea of the presentation was agile development. Up until recently the status quo, the waterfall engineering processes, has provided discipline. The agile method allows for iteration and adaptation to change without having to perform complete redesign of the original product. It focuses on collaboration throughout the life of the product and encourages the use of prototypes and constant iteration. It allows for a rapid product redesign.

The presenter gave the name "scrum" for the day-to-day activity of the process and presented an "agile manifesto" under which many things could be accomplished including counter IED training, capturing training from coalition partners, and avoiding the boredom factor. The presenter summarized by recommending that where we go from here is to get out of the waterfall method.

3.1.3 Paper #13 *Dynamic Decision Support – A War Winning Edge*, Dave O'Connor

The paper purports the use of Dynamic Decision Support (DDS) as a desirable skill for military operators. The DDS described can be achieved by utilising advances in real artificial intelligence simulation as a technology that can manage forces and plans. The paper goes on to claim that incorporating this capability into the military appreciation process we can enable operational commanders to make quicker and better decisions and thus to gain and retain the initiative on the battlefield.

DISCUSSION: The paper advocates the use of various simulation technologies to help military personnel learn a stylized decision making process. There is however no evidence provided that shows the proposed system is effective at teaching DDS. Prior to making any significant investment it would be desirable to conduct a case study or some other form of evaluation that demonstrates that effectiveness.

RECOMMENDATION: See Discussion

3.1.4 Paper #14 *Data Farming Support to NATO: A Summary of MSG-088 Work*, Horne and Seichter

This paper describes the cumulative efforts of MSG-088 on data farming which is a process that has been developed to support decision-makers by answering questions that are not currently addressed. Data farming uses an inter-disciplinary approach that includes modelling and simulation, high performance computing, and statistical analysis to examine questions of interest with large number of alternatives. Using a case study approach, operational military questions were examined in a joint NATO environment.

DISCUSSION: the paper summarizes the processes developed as part of MSG-088 project on data farming. The paper goes on to provide examples of data farming, model development to support gaining insight to questions, and the application of high performance computing capabilities to run the models. The paper demonstrates the comprehensive effort by the members of MSG-088. Users of this information would benefit from the groups experience in the area of data discovery (i.e. resources used, time involved, etc.) and data manipulation required to get the data in the format required by the model and then load the data. Both of these items tend to be significant cost drivers of the simulation process. The presentation generated interest from the audience in recommendations for follow-on efforts.

RECOMMENDATIONS: The MSG-088 report should include processes for data discovery, data manipulation, and give an accounting for the resources required to conduct the case studies.

3.1.5 Paper #15 - *A methodology for the Generation, Storage, Verification and Validation of Performance data for Modelling and Simulation*, Shine et al.

The Defence Science and Technology Organisation (DSTO) have developed an approach to mitigate this problem which is built around three concepts:

- A database, called the Simulation Repository (SimR) that contains simple, verifiable, fundamental attributes for systems including weapons, ammunitions, platforms and sensors.
- A set of algorithms and techniques based on physics to calculate more complex data required by Combat Simulations from the simple formats stored in SimR.
- The use of available empirical data as a verification tool at all stages of the data generation process, but not necessarily as a direct input to SimR

The data generation algorithms allow for the rapid generation of rough order of magnitude performance data - sufficient to distinguish between classes of systems - which is an appropriate level of detail for our purposes. This reduces the data storage burden on SimR, which in turn minimises the amount of verification and validation required.

DISCUSSION: Sources of data, data formats, and validity of data have been long standing issues with models and simulations that have only been exacerbated with the advent of combining multiple simulations in to large federations. The concepts expressed in this paper show a set of solutions that address those problems. The idea presented of filling 'data gaps' with various models is unique and certainly seems to provide a useful solution for DSTO and the Australian forces. Using a single repository certainly makes the data source issue more manageable. In countries that have developed numerous repositories over time, consolidation is not practical because of differing service interests. In lieu of this consolidation, the US DOD (MSCO) is looking at this problem set from the idea of vetting various data sets and providing tools to access that data for the population of simulations. The Rapid Data Generation project is an ongoing effort that is working with data domains (e.g. order of battle, geospatial) in different repositories.

RECOMMENDATION: That the NMSG invite US MSCO to present an overview of the Rapid Data Generation high level task at the 2014 Conference.

3.1.6 Paper #16 *Air Force Synthetic Training Effectiveness Research in the Australian Context,* Best et al.

This paper describes the tools and methods of synthetic collective training (SCT; i.e., networked simulators and associated support systems) to provide a potential means by which to address some of the shortcomings of live training. Discussion of the Black Skies series of exercises (EBS) provided an empirical basis for understanding how best to design, manage, and support SCT for air combat. The outcomes presented suggest that the systems and methods used during EBS constitute a solid baseline for development. In addition several areas requiring further research are also identified.

DISCUSSION: This topic of this paper is of increasing importance as cost constraints on live training elevate the use of M&S to augment training opportunities. A key aspect of this paper that is often lacking in the application of M&S is empirical evidence of its effectiveness. It is not uncommon for leadership to question the credibility of M&S support to training and rightfully so as we, as a community, have been remiss in providing the data that demonstrates M&S based training is effective.

RECOMMENDATION: As we have developed processes and procedures for validation and verification of models we should embark on a similar strategy to make instruments available for users of M&S to evaluate the effectiveness of the tools they are using.

3.1.7 Paper #17 *MSG-088 Data Farming in Support of NATO: Case Study Force Protection*, Kalfass et al.

This paper describes in detail the DEU lead case Study "Force Protection". Operational questions in the context of an effective protection of a Combat Outpost (COP) in a joint NATO environment, such as; "Which COP configurations perform consistently well against a large variety of threats?" are examined by applying the Data Farming methodology. The paper also describes the analysis approach, the development of the scenario, the used Design of Experiment (DOE) and presents parts of the analysis results. In summarizing the paper also discusses the merits and cautions to be considered when applying Data Farming in order to obtain valid results to support our decision makers in the future in more and more complex and uncertain operational environments.

DISCUSSION: This paper is actually an extension of the MSG-088 work described in Paper #14. The addition here is the description of an actual application of the data farming principles in a case study scenario. This provides a good example of the benefits that can be realized from the data farming process. The reader would benefit if the paper had provided some information regarding resources expended in data collection, data transformation, and data quality assessment. The reason being is that any benefit derived is mitigated by cost and the previous three items are all cost drivers.

RECOMMENDATION: That MSG-088 include lesson learned in cost (time, effort, etc.) regarding the areas of data collection, data transformation, and data quality assessment in their reports.

3.1.8 Session Panel Discussion – The Session 3 panel discussion members consisted of the speakers from the 6 papers in the session. Mr. Greg Akhurst led the panel session and began by asking how do we solve some of the issues that have surfaced. Focus Speaker Mike Brennan stated that it was a good set of presentations and two phrases struck him as important: Dave O'Conner with his discussion of fully automated forces and Gary Horne with his discussion of data farming data analysis and visualisation. One response was that the data farming loop of loops allows us to go about it in a more agile way and we should use it. Another person responded that we need to develop data mining and other methods. One comment was that with small numbers of customers, it means we don't always have the resources to do what we need. Another questioner asked about the use of biological based computational experimentation and the short answer was no, but in the past genetic algorithms had been used and complex adaptive modelling was a promising area.

3.2 SESSION 4 – GAMIFICATION AND EDUCATION IN MILITARY M&S

Session 4 Chair – Dr. Hans Jense

3.2.1 Session Focus Speaker – The Session 4 Focus Speaker was John Welsh who spoke about Gamification and Education in Military M&S. He showed a short film clip and started with the quote: "It's not what it is, it's what you do with it that counts." He then played a bit of a game with the audience, dividing them up into 4 teams and asked what the terms tabbing (opening multiple links) and yomping (your own marching pace) meant. In the process of having fun with the game he introduced ideas such as that gamification is simply introducing game-like aspects to anything and serious games were actual games to achieve some insight. So gamification and serious games are sometimes the same, but they are different. He mentioned a taxonomy of serious games which shows there is a lot out there. He said the two questions to ask are: "do you know what you want to achieve?" and "do all of the stakeholders speak the same language?" So gamification/serious games is not technology, technology is simply a tool. Also gamification/serious games is not a silver bullet, but as a solution it is part of a whole.

3.2.2 Paper #18 *Gamified Training for Cyber Defence: Methods and Automated Tools for Situation and Threat Assessment*, Amorim, et al.

This work considers training needs for cyber defence and discusses the gamification of training. The use of game play mechanics is considered with a special emphasis on strategies to encourage users to engage in desired secure behaviours. The use of games and game play mechanics has been shown to be able to make the training more engaging. Serious games may well help increase motivation amongst learners. A possible design of a gamified training system for cyber security that complies with these requirements is introduced. Based on these analyses, the paper concludes that the approach overall is feasible.

DISCUSSION: This paper brings two significant points regarding Cyber training to the fore. The first point is the requirement to train personnel for operations in a cyber-environment. In the US M&SCO lead Cyber Technical Working Group we concentrate on two areas which are known as 'cyber for cyber' which are those activities for cyber operations and then 'cyber for everyone else' which includes the training described in this paper. The second area is gamification which has gaining momentum as a training tool across many areas of military operations.

RECOMMENDATION: With the growing interest in Gamification or Serious Games the NMSG should consider having this a special panel area for the 2014 Conference.

3.2.3 Paper #19 *The Potential of Serious Games for Training of Urban Operation,* Hulst et al.

With the push of civilian commercial technology development and the emergence of a vast military gaming community, military gaming technology undergoes an extremely rapid evolution. At present US Marines, US Army, GBR, NLD, Canadian, and Australian Armies have adopted Serious Games (SG) as essential training platforms for small infantry units and combined arms training. This Dutch study reports on extensive field testing combined with a broad literature analysis to reveal what presently does and does not work in training with military gaming technology for urban warfare. Besides kinetic operations, the paper explores the lower spectrum of force, considering tasks such as reconnaissance, social patrol, road blocking, knock, talk and search.

DISCUSSION: The paper makes a case for the limitations of using serious gaming for training of kinetic operations in urban warfare. The paper makes its points within the context of a limited set of virtual environments like VBS2. There are, however, other specially developed virtual battle spaces that provide more adequate training of the type discussed in this paper. An example is the US Army Live, Virtual, Constructive – Integrated Architecture (LVC-IA) program and 'single shooter' virtual simulations used by various special operation forces.

RECOMMENDATION: That the readers understand that the conclusions drawn in this paper are valid within the limitations of the simulations used in the study but not necessarily true for serious games in general.

3.2.4 Paper #20 *On the Need for White Force Multipliers*, Simpkin, et al.

Synthetic training exercises, not unlike live exercises, require extensive planning, preparation and management in order to provide trainees with effective training experiences. These activities are performed by training facilitators, commonly known as the White Force. For many exercises, White Force personnel far outnumber the training audience, and the limited availability of White Force personnel places an upper limit on exercise size, scope and fidelity. This paper examines the White Force activities in previous Australian synthetic training exercises, and builds the case for further development of White Force technologies and techniques.

DISCUSSION: The paper does a good job of itemizing the requirements for preparing a simulation training event and the important role of white players in those events to include the cost in resources for those players. This is certainly a recognized cost driver that needs attention. The important contribution is that the authors went on to nominate technologies that might be what they refer to as a white force multiplier which, in turn, provides good direction for further investigation.

RECOMMENDATION: The technologies mentioned be the source of a follow on study to determine what technologies are available and do they provide the hoped for multiplier effect.

3.2.5 Paper #21 – Withdrawn

3.2.6 Paper #22 *Human Behaviour Modelling as an Emerging Disruptive M&S Technology*, Dekker

This paper surveys some of the successes of simple human behaviour models, and outline the key factors in making more complex simulations epistemologically valid (e.g. valid theoretical constructs and justified selection of model parameters). The paper summary includes some necessary steps for developing a true science of modelling and simulation for human systems, and mentions some recent progress in this vein, such as work in the modelling of emotion.

DISCUSSION: As noted in other papers and well summarized in this work is that human behavior modelling is an area that needs more work done. This is especially important if the military wants to realize significant gains in the value of using serious games for training. When we consider the number of years spent on

researching artificial intelligence and the practical applications available today it is easy to see that research in this area will require extensive effort if we expect to see useful progress.

RECOMMENDATION: Instead of trying to replicate a wide spectrum of human behavior, there may be merit in looking at optimizing certain aspects of human behavior for use in simulations. For instance, optimizing on small unit tactical capability for a squad leader and limit the emotional considerations.

4.0 SUMMARY AND RECOMMENDATIONS

The following is a summary of the presentation by the TER at the end of MSG-111. The items contained here are solely the opinions of the technical evaluators and are not intended to reflect any form of official position.

The general observation was that it was a stimulating couple of days with excellent participation from around the world especially from the host country. Thus, a recommendation is to continue such activity and with more discussion time. Also, either a longer Conference or fewer papers would allow for more focus and more interaction. And overall, increasing participation would be warranted by the quality of the Conference.

A brief summary of the Sessions was presented and then the observation of three common threads via quotes:

1)“If it was easy, it would already be done!” We have a lot of good traditional methods and have solved a lot of questions but to get at the really tough ones, the important ones as we move to the future we need the innovation/disruptive technologies that might not fit the mold of the past.

2) “Effectiveness” and “Support” A quick word count check showed these words to be prevalent and indeed the efforts described in the Conference showed a common theme of providing effective support to our military through M&S.

3) “If we knew what we were doing, it would not be called research, would it?” With deference to Albert Einstein who is purported to have said these words, there are indications that we are beginning to know what we are doing with regard to M&S support to transitioning forces.

Overall, the Conference and associated papers were very encouraging from a technical point of view. Furthermore, as M&S professionals and simply as citizens of the world where we are all connected, the Conference, in a word, should be “heartening” to us as we look to the future of ttransitioning forces and emerged/emerging disruptive technologies.