

**NEW M&S CHALLENGES DERIVED FROM THE
NATO RESEARCH & TECHNOLOGY ORGANIZATION (RTO) SYSTEMS ANALYSIS STUDIES (SAS-071)
TASK GROUP ON ANALYTICAL TOOLS FOR IRREGULAR WARFARE**

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ABSTRACT

The research conducted recently by NATO's RTO Systems Analysis Studies (SAS-071) Task Group on Analytical Tools for Irregular Warfare (IW) is of direct interest to the M&S community, as it formulates several new challenges that have to be met by the M&S community. IW comprises among others the following categories: insurgency/counter-insurgency, combating terrorism, unconventional warfare, strategic communications, transnational criminal activities, including narco-trafficking, illicit arms dealing, and illegal financial transactions, and more. Many of these domains are either not modeled or modeled as stand-alone solutions. The paper establishes a research agenda for M&S activities in support of IW.

1 INTRODUCTION

The North Atlantic Treaty Organization (NATO) supports research via its Research and Technology Organization (RTO). The mission of RTO is to conduct and promote co-operative research and information exchange within NATO and with its partners. As such, RTO directly supports two of the leading bodies of NATO, the Military Committee (MC), as well as the Conference of National Armament Directors (CNAD). RTO is organized in form of the Research and Technology Board (RTB) that provides leadership and guidance and the Research and Technology Agency (RTA) that provides the necessary administrative and organizational support. The research work is conducted under six panels and one group. The following list provides the names and missions of these panels and group:

- *System Analysis & Studies* (SAS) conducts studies and analyses of an operational and technological nature and promote the exchange and development of methods and tools for Operations Analysis (OA) as applied to defense problems;
- *Human Factors & Medicine* (HFM) provides the science and technology base for optimizing health, human protection, well being and performance of the human in operational environments with consideration of affordability;
- *Information Systems Technology* (IST) identifies and review areas of research of common interest and recommends the establishment of activities in these areas;
- *Applied Vehicle Technology* (AVT) improves the performance, affordability, and safety of vehicles;
- *Systems Concepts & Integration* (SCI) advances knowledge concerning advanced systems, concepts, integration, engineering techniques and technologies across the spectrum of platforms and operating environments to assure cost-effective mission area capabilities;
- *Sensors & Electronics Technology* (SET) advances technology in electronics and passive/active sensors and enhances sensor capabilities through multi-sensor integration/fusion in order to improve the operating capability and contribute to fulfilling strategic military results;
- *NATO Modeling and Simulation Group* (NMSG) promotes co-operation among NATO and its partners to maximize the effective utilization of Modeling and Simulation (M&S).

RTO provides Meeting Proceedings (MP) for symposia, workshops, specialists' meetings, Educational Notes (EN) for lecture series, technical courses, Technical Reports (TR), or Technical Memoranda (TM), which are TR of ephemeral value or restricted distribution, and "AGARDographs" (AG), which are monographs of long-lasting value, to the NATO research com-

munity. These documents capture results of expert based work within the Alliance and are often valuable sources. Most documents can be accessed via the RTA website: <http://www.rta.nato.int>.

The website of the SAS panel states that the panel conducts studies, analysis and information exchange activities that explore how operational capability can be provided and enhanced through the exploitation of new technologies, new forms of organization or new concepts of operation. In addition, the Panel undertakes activities to develop and promote improved analysis methods and techniques to support defense decision-making. This aspect of the work focuses particularly on the methods required to address the new issues thrown up by the evolving strategic environment and the responses that both individual nations and NATO as a whole are making to it. These activities may include information exchange on Operational Analysis (OA) modeling concepts and best practice, research into new methodological approaches and the development and exchange of models. Among the products produced by this panel is the NATO Code of Best Practice for C2 Assessment (NATO 2002).

In general, SAS studies reflect operational requirements as well as technical constraints and possibilities. The M&S community may be interested to know that until recently the panel name stood for Studies, Analyses, and Simulation, as the application of simulation methods is well established in the OA community. Furthermore, the operational use of M&S has been the topic of SAS studies as well. Several reports are now used and co-developed with other panels, in particular HFM and NMSG. The topic of this paper has the potential to become another collaboration domain requiring cross-disciplinary approaches involving several panels of NATO's RTO (Tolk 2009).

2 THE NATO RTO TASK GROUP SAS-071

At the time this paper was written, SAS-071 did not yet provide a formal report. This paper was developed based on interviews with participants as well as two official summary briefs (Bexfield 2009, Coulter 2009). In addition, this paper comprises additional interpretations and recommendations of the authors. To refer to the outcome of the task group, the reader is referred to the official documents.

2.1 Overview

The main objective of SAS-071 was to set up and conduct an expert meeting on *Analytical Tools for Irregular Warfare* (IW). The goals for this meeting are presented by Bexfield (2008, 2009) and Coulter (2009) to be "a specialist meeting that will allow national programs to showcase their irregular warfare analytical capabilities. This process will allow the alliance members to identify areas for collaboration and approaches to build on for further analysis."

The idea can be summarized that participants can learn from one another by sharing success stories and failures, but also by identifying gaps as well as controversies. Besides networking, the efforts should also identify current capabilities in NATO and identify leverage points and potential value of emerging analytic tools and methods.

Under a chair from the United States, experts from Canada, the Czech Republic, France, Germany, the Netherlands, the United Kingdom, and NATO's Headquarter for Allied Command Transformation organized this week-long meeting, which hosted 118 experts from the aforementioned countries and Denmark, Greece, Norway, Slovenia, Sweden, and Turkey. 85 papers originating from seven nations were presented in six parallel working group sessions framed by plenary sessions on IW concepts and lexicon, validation, verification, and accreditation (VV&A), modeling and analysis, and model demonstrations.

The six working group topics were

1. Models, methods, and frameworks for IW analysis (unclassified),
2. Data and validation for IW tools (unclassified),
3. Analysis support to current operations (confidential),
4. IW analyses to inform future capabilities (secret),
5. Social science and historical perspectives of IW (unclassified), and
6. Strategic analyses, assessments, and metrics for IW (unclassified).

As some of the working groups were classified, only the publicly released references could be used in preparation of this paper. However, the original reports can be obtained via the national distribution centers by eligible interested readers with the appropriate clearances. In the context of this paper, deriving new M&S challenges from the results of this workshop, the access of classified information is not needed.

2.2 Contributions to SAS-071

The plenary session presentations dealt with the operational perspective and the utilization of social sciences in IW analysis tools. The operational perspective was driven by the insight that many past operational art tenets are no longer relevant. Re-

cent operations have shown that even extensive intelligence, surveillance, and reconnaissance did not prevent surprises. In part, the thread blends, conventional as well as terrorist threads, are responsible for this, as they posed obstacles for intelligence and analyses. Overall, the joint and combined arms operational competence showed to be essential for success. However, alignment is a challenge and the development of analytic frameworks is necessary. Such a framework could adapt operational processes and products to human and environmental dimensions constraining the operation. It could also facilitate to incorporate interagency and international elements and capabilities. Overall, better support for leader-centric, network-enabled operations is needed. This objective requires that NATO operations utilize the social sciences more efficiently than it is done today. Such an inter-disciplinary approach shall include at least OA, social science, and historical analysis. While OA aims to establish a common picture, social sciences tend to focus on one factor at a time, often applying different world views than those used by military decision makers in their research. The pedigree of social data is therefore essential to determine its reuse and usability in a current operational context. However, as social science research is not yet perceived to be an essential enabler, these challenges have to be overcome.

The national contributions could be roughly categorized into IW definition and lexicon efforts, identifying important issues in IW, and identifying IW analytic capabilities. As such, they were well connected with the plenary presentations. The need for a common set of terms to facilitate discussion, operational employment, and assessment was addressed repeatedly. The central role of human behavior, as it is governed by social and cultural factors, was identified as an important issue. These factors need to be taken into consideration to balance between conventional activities and new capabilities, merging war-fighting culture and human-social culture in support of an agreed strategy in IW. Currently, IW analytic capabilities are not mature enough to achieve this balance (hence the SAS-071 activity was launched).

The multitude of terms used to refer to IW became obvious in these discussions: Irregular Warfare, Irregular Conflict, 4th Generation Warfare, Asymmetric Warfare, Complex Operations, Hybrid Warfare, Security and Stability Operations, Military Assistance to Stabilization and Development (MASD), and Whole of Government Operations (WGO) are among these terms. IW was applied in the categories of insurgency/counter-insurgency, combating terrorism, unconventional warfare, strategic communications, transnational criminal activities, including narco-trafficking, illicit arms dealing, and illegal financial transactions, and more. Despite this variety of applications, no common definition for IW could be officially provided by NATO so far. SAS-071 used the following working definition: *"IW is a struggle among state and non-state actors for legitimacy and influence over the relevant population(s). It favors indirect and asymmetric approaches, concealment amongst civilians and is unlikely to adhere to recognized conventions and treaties. It may employ the full range of military and other capacities, in order to coerce or erode an adversary's power, influence, and will."*

Using these foundations, the six working groups mentioned in the overview met to work on recommendations to enable support for better leader-centric, network-enabled operations, based on the following scopes and objectives:

- **Models, Methods, and Frameworks for IW Analysis:**
In order to explore the different models, methods and frameworks used by attending nations in the analysis of IW, and to identify benefits or limitations of different approaches while highlighting any observed analytical capability gaps and promising areas for further research and collaboration, this working group evaluated general models, methods, and framework requirements for IW, looked for trends in models, methods, and frameworks, and conducted a tentative high level identification of capability gaps and common problems and issues.
- **Data and Validation for IW Tools:**
The objectives were to explore data and validation of IW tools by examining the current ability to identify, collect, and share data needed to support IW tools and analysis and by determining a sense of how good NATO is in validating the data and tools. The scope was the validation of data and tools for analysis supporting IW activities, including models and simulations and the validation across the life cycle of the tools and data for development and use. This included the analysis associated with supporting training, testing, experimentation operations, planning, and acquisition across all domains covered by *Diplomatic, Information Operations, Military, or Economic (DIME)* domains.
- **Analysis Support to Current Operations:**
Sharing analytical support experiences pertaining to current IW operations, and to identify key enablers, limitations, and promising research and collaboration areas were the objectives of this working group. Key questions included:
 - Is irregular warfare a new thing?
 - Are definitions an obstacle?
 - How can the gap between the analysts in the field and the analysts remaining back home be bridged?
 - How can effectiveness be measured?
 - How can the problem be described concisely?
- **IW Analyses to Inform Future Capabilities:**
Reviewing and assessing the analytical methods and tools needed by or used in recent IW analyses intended to inform future IW force structure decisions were in the scope of this classified session. While traditional M&S applica-

tions for the armed forces focus on military challenges, the new operational environment has been defined by *Political, Military, Economic, Social, Information, and Infrastructure (PMESII)* categories coping with all aspects of military operations as they emerged in the post cold war world era. However, the non-military categories are still insufficiently represented in current IW analysis capabilities, and they were rarely validated in real operations. This issue needed to be addressed.

- Social Science and Historical Perspectives of IW:

In order to close these gaps, it is necessary to increase the understanding of the human, social, cultural, and economic dimensions of IW and determine how this understanding can contribute to IW analysis. The scope of this working group was therefore to highlight applicable historical methods, social science methods, and interdisciplinary approaches. Qualitative and quantitative methods were evaluated and first implications for modeling and simulation were included in the discussion.

- Strategic Analyses, Assessments, and Metrics for IW:

The objective of the final working group was to create a better understanding of IW and the strategic level of war, including metrics of success. This shall be accomplished among others by conducting a comparative analysis of contemporary IW conflicts and an examination of ends and means coherence. The scope of such efforts is shaped by determining how to adopt a strategic perspective for analyses, assessments, and metrics for IW and by providing a focus on a research agenda for Operations Research and Analysis (OR&A).

Each working group presented its findings in detail. A synthesis group captured and highlighted the results focusing on recurrent themes, capabilities needed for current and future operations, perceived strengths of the community as well as current capability gaps, possible approaches to address these gaps, interesting divergences, and debates between experts and nations to be aware of and to resolve misunderstandings, and general recommendations for the way ahead. The following section summarizes the main recommendations of all six working groups as agreed to in the plenary meeting in which the individual recommendations were presented. The detailed recommendations of each working group are summarized in (Bexfield 2009).

2.3 Topics, Findings, and Recommendations

The topics identified by the synthesis group were

- NATO definitions and lexicon,
- Defining progress and success,
- Effective integration by multidisciplinary analytic teams ,
- Quality and credibility of methods, tools and data,
- Analysis at appropriate level: relation between macro, micro/tactical, and strategic levels, and
- Suite of methods fit for purpose.

By evaluating the contributions and views of the expert groups from the various working groups, SAS-071 was able to establish a consistent method from the working group results towards general recommendations.

One challenge every working group experienced was the missing of common terms to discuss IW. While arguing definitions is boring, it is necessary to understand that differences in terms may mask major issues. As an operational example, the early post combat activities during operation Iraqi Freedom did not focus sufficiently on the security of the population partly because that was not defined as a primary aspect of the mission. Academically, a common terminology enhances the discourse between analysts and operators of different nations by clarifying objectives and providing an agreed-upon starting point for assessment. The challenge is that narrow definitions are useful for deciding what to do in specific cases, but can leave out important functions, such as counter-terror, stabilization, etc. Broad definitions avoid mission creep, clarify longer-term actions and objectives, but make agreement and prioritization more difficult. In addition, terms are often perceived in a context. For example, the term “warfare” in IW may not be an acceptable way to describe this type of endeavor in NATO for political and structural reasons; or the term “complexity” captures the dynamic nature of IW and its multiple variables, non-linearity and adaptivity, but using this term may suggest the primacy of a specific solution set.

Evaluating a process without appropriate metrics is not possible, as progress and success definitions rely on comparisons of solutions and developments. SAS-071 distinguished between strategic, operational, and tactical level considerations. At strategic level, decision makers need clear, traceable basis for reasoning. At the operational level, military commanders and organizations need structured mechanisms for thinking through planning problems, like suitable games or simulations supported exercises. Success of conducting military tasks on the operational level requires collaboration of operators and interdisciplinary teams to address a complex environment with many stakeholders. In addition, some non-military areas are not just a civilian concern: in many cases the military may be the only one who can act effectively to ensure stability, e.g., in the

absence of local police forces. Furthermore, success ultimately depends on the relevant populations and influencing their human, social, and cultural behavior at the individual and group level. At the tactical level, successful operations imply the need for preparing for adaptiveness and better understanding of what is a complex and non-linear phenomenology. Tactical operations require proper education as well as tools that help prepare for flexibility, adaptiveness, and robustness. These objectives require on all levels identifying key variables to monitor or effect is an important aspect of the required analytic support, as already defined in the Code of Best Practice (NATO 2002). Leveraging lessons learned and historical studies will contribute to this task.

The experts of SAS-071 agreed that multidisciplinary teams are needed to meet these challenges. One of the challenges to do this is overcoming cultural differences between the potential contributors and focusing on the similarities instead. One major step is participating in common research or product teams. Also, a common case study methodology can help. Tolk (2009) recommends more cross-panel alignment. Another way could be to use peer review teams from other panels, as recommended in (NATO 2002) for operational studies: SAS studies with strong information system implications could be reviewed by IST, HFM studies looking at agent-based technologies could be reviewed by NMSG, etc. This would be one to show respect and leverage each other's perspectives and contributions. As mentioned earlier, operational research tends to see a connectivity of physics-based activity and research, to tactical, to operational, to strategic. Some social scientists, such as behavioral psychologists, prefer dealing only at the individual level while others, such as some political scientists, deal predominately at the strategic level. A common framework allowing the deconfliction and integration of all relevant efforts is needed. Harmonizing approaches to data availability and use can be a first step into this direction.

Quality and credibility of methods, tools, and data being applied for OA has been emphasized in many publications. The best practice for solution strategies documented in (NATO 2002) emphasis the need to understand the phenomenology as the first step and to select or design models, methods, and tools for analysis accordingly in the second step. In the context of SAS-071, based on the current understanding of IW a substantive review and iteration of social science modules was perceived to be feasible as well as critical. However, the need to adapt VV&A from the rigor of physical modeling to the realities of human, social, and cultural data and modeling and ensure it is integrated throughout the development process. NATO's NMSG produced a report on their view on VV&A that needs to be evaluated in this context (NATO 2008). In addition, MSG-054 is currently working on a standard overlay for VV&A. However, within SAS-071 the need to use models to frame a problem efficiently was a central topic of many discussions, focusing on the need that VV&A should not be a bureaucratic exercise that makes no difference or a method to kill promising new models or methodologies, but a tool helping in reducing and mitigating problems and identifying residual risks. One particular challenge is to identify and agree upon meta-data allowing the appropriate reuse of methods, tools, and data to avoid that the right model is applied in the wrong context.

To allow the analysis of IW on the right levels requires that all potential contributors "will come out of their comfort zone" and collaborate. Traditional operations analysts have faith in a pyramid structure of model connectivity between levels, such as engineering models, tactical models, operational models, and strategic models. Traditional social scientists, such as economists, have a similar theoretic structure in which macroeconomics for national and international analysis resting on microeconomics, such as theories of companies and firms. The preference of some other human and social science disciplines to focus on one level has been already mentioned. However, commanders need help in determining what operational activities or approaches will best generate individual and overall support, so a community view is needed. To this end, the analysts need to be prepared and educated in an interdisciplinary way, so they can address all levels of activity and effects.

Finally, the necessity for an orchestrated set of tools, as generally recommended in (NATO 2002), was envisioned for IW as well. Generally, the tool value varies with level of analysis, type analysis, and social science and other knowledge required. While strategic planners need frameworks and conceptual models reducible to memos and viewgraphs, operational planners need simple, fast tools to meet decision timelines. Some task may be supported by substantial simulations or even games with structures reflecting real-world considerations, processes, and dilemmas, but the VV&A challenges needs to be addressed. Over the longer run, high-end simulations for research can broaden understanding of possibility space and opportunities for effective interventions, but these models need not be reliably predictive to be useful. Furthermore, method development should include classic social-science approaches, rather than exclusively rely computer modeling.

Based on theses topics and findings, SAS-071 prepared six recommendations describing activities that NATO RTO should consider sponsoring:

- A joint technical team to create a plan to collect data from NATO and national operations in Afghanistan and make the data available to member nations to support tool building and analysis shall be established.
- A joint technical team to develop a plan that would create a group to provide joint support and training to analysts deploying to Afghanistan shall be established.
- A Social Science Community of Interest to foster the comparisons of social science theories and data is required to address the human-social challenges.

- An IW M&S Community of Interest to foster the sharing of IW M&S techniques, data and lessons learned is required to address M&S challenges.
- A joint research team to develop an IW framework that could be used to assess M&S and establish requirements is needed to address integration issues.
- A joint research team to develop a code of best practices (COBP) for IW M&S and data V&V is needed to support this broadened community with common methods and procedures.

It is furthermore recommended that Allied Joint Operational Doctrine (AJOD) Working Group and/or AAP-6 Working Group sponsor a joint technical team to create a lexicon for IW-related activities for use by all the member countries. In the next section, these recommendations will be evaluated regarding their implications for new M&S challenges.

3 NEW M&S CHALLENGES

That IW is of emerging interest in the OA and research community is reflected by presentations of related workshops in articles like (Bexfield 2008) and (Carlucci and Timian 2009). All of the recommendations made by SAS-071 should be of interest to the M&S community to. To initiate a discussion and generate input from the audience of this Winter Simulation Conference (WSC), the focus of this section will be on four topics of immediate interest, as similar observations have been made in WSC papers as well. As recommended by SAS-071, the discussion starts with similarities of SAS-071 and WSC observations and recommendations. These four sections can become the hub of a research agenda for M&S activities in support of IW focusing on common interests and merging complementary expertise.

3.1 Creating a Common Terminology

The NATO Code of Best Practice (NATO 2002) emphasizes the need for a glossary of terms used within a study and furthermore recommends to gradually building a common glossary of key data elements, metadata, information, and terms to create a common understanding within in study team as well as enabling the reuse of study data and results.

SAS-071 observed this necessity in several working groups as well and recommended to create a lexicon for IW-related activities for use by all the member countries. It was also observed that data collection cannot be generally reused, but that the context in which these data were collected needs to be known, which is directly connected to the requirement for appropriate metadata explaining the data, which required well defined terms.

The request to establish a “common language” enabling the merger of the world of domain experts and model developers has been documented in several fields within WSC papers and on other conferences, for the military domain in particular in the Command and Control Research and Technology Symposia (CCRTS).

As Carlucci and Timian, (2009), point out, it is not possible to simply revive military definitions and terms, as some of the current definitions are not acceptable to coalition and interagency partners.

Disagreements are not limited to domain terms but are even observable down to technical terms such as aggregation and composition that have different interpretations in different communities. While the US Department of Defense defines aggregation as “the ability to group entities while preserving the effects of entity behavior and interaction while grouped” (US DoD 1995), and this definition is widely used in the M&S community, many computer scientists use exactly this definition for the term composition, which often creates confusion.

A common terminology that facilitates the effective and efficient communication is therefore necessary as a first step. To what degree such a common controlled vocabulary can and should be extended into a taxonomy (such as initiated by SAS-50 (NATO 2007) for Command and Control) or by adding axioms and constraints into a common ontology is the subject of ongoing research and discussions.

3.2 Operational Data and M&S Data

The case for early integration of data efforts of OA, real world operation, and M&S has been made in (NATO 2002): “As the data being used today by the analysts will be the data needed tomorrow by systems engineers, decision makers, and commanders for their operations, alignment of the standardization processes ... as early as possible with the command and control systems community is good practice.”

With the current operations increasingly becoming data providers for future operation analysts, the inverse role – using operational data to feed into operational analyses – needs to be supported as well. However, SAS-071 observed that there are often blocks. For example, although there is currently considerable data being collected by the individual member countries participating in operations in Afghanistan, most of these data are not being shared. One reason is that no common data collection plans exists. In addition, some of these data are not captured by the information system being used in the operation, so that data collection becomes time consuming and expensive.

M&S data must benefit from the recommended data initiatives of SAS-071. As M&S based analysis and decision support is only as good as the combination of model and data allows, the M&S needs for data to feed their systems should not be neglected. In order to use models and methods, the right data is required. It is therefore necessary to formulate the data needs in terms understandable to the operational community, which can make use the common terminology. Furthermore, the definitions of the data identified to be relevant here should become part of the common terminology as well.

3.3 Social Science and Irregular Warfare Communities of Interest

Tolk (2009) reports on current US JFCOM activities in support of Community of Interest developments for human, social, and cultural behavior modeling challenges that are interwoven with the challenges documented in this paper. SAS-071 explicitly addresses social sciences and IW modeling as topics and includes experts for technical integration challenges while implicitly requesting a common framework. These communities should create research agendas and provide a forum for bringing social scientists, modelers, and analysts together. Furthermore, they should produce a guide for IW analysis methods and metrics and focus on the comparison and contrast of alternative social science research approaches.

The research agendas for social science and IW modeling are of immediate interest to the target audience of WSC, as these agendas have the potential to directly influence IW M&S research. However, current new ideas can be used to support respective NATO and JFCOM activities as well. As documented in (Garrett et al. 2009), the US JFCOM is exploring effective methods for modeling a comprehensive approach to Political, Military, Economic, Social, Information, and Infrastructure (PMESII) / Human, Cultural, Social, and Behavioral (HSCB) modeling by building a virtual network of subject matter experts and practitioners that can share expertise, tool sets, and technologies. This effort is supported by a web-based infrastructure and includes innovative approaches, such as the use of collaboration via Second Life (<http://secondlife.com>).

Several activities discussed in recent WSC can directly contribute to these discussions, such as the role of M&S in education, including but not limited to serious gaming topics, or the integration of M&S applications into web-based environment or even a virtual collaborative environment like Second Life.

3.4 A Framework for Irregular Warfare

The IW framework envisioned by SAS-071 should be useful at all three levels of war, as identified earlier in this paper. On the strategic level, decision makers need clear and traceable basis for reasoning that can be supported by this framework. On the operational level, military commanders and organizations need structured mechanisms for thinking through planning problems, including but not limited to suitable games and simulations. On the tactical level, training and operational support to prepare users for adaptiveness and allow for a better understanding of the social/cultural effects, in particular where a complex and non-linear phenomenology can be observed. The framework will furthermore support consistency between all views. Most promising models should be integrated into this framework as services providing their functionality. Furthermore, the operational data – and potentially M&S data as well – needs to become part of this approach.

The IW framework integrates the other approaches and is of immense importance to M&S providers, as their solutions must fit into this framework. The framework must support the recommended communities of interest, must be open for new members, and support the collection and distribution of relevant models, methods, tools, and data. It is worth mentioning that the controlled vocabulary of common terms could be among the first services to be provided, which would ensure consistent use of terms among all users of this framework. Similar ideas are currently discussed for net-centric and net-enabled operations, where a common dictionary for each community of interest should be provided to ensure consistent terms within the operations, using *Enterprise Lexicon Services* as recommended in (Durham et al. 2009).

This framework is very ambitious, as concepts like multilevel security and role-based access control are needed for technical integration. On higher levels, the composability of models and methods and the interoperability of tools must be ensured, which requires annotation of services with metadata supporting these objectives (Davis and Tolk 2007). While it is obvious that such a project cannot be implemented immediately, the architecture can be chosen to be open for additionally required solution in a way that overarching orchestration of otherwise independent development efforts is possible. This requires a close collaboration of experts from all domains as well.

4 SUMMARY

The paper contains some insights and results from the SAS-071 NATO Specialist Meeting that demonstrate that a significant overlap exists with the interested domain covered by WSC experts. It is necessary to open the potential of WSC experts in support of IW support. The research item enumerated in section 3, which are derived from recommendations of SAS-071 and target the expertise of WSC expert, can be the initial elements of a commonly supported research agenda.

The cultural gaps between WSC experts and operational analysts are not perceived to be too deep to be overcome. Particularly regarding questions on using M&S applications in support of IW, WSC subject matter experts belong to the interna-

tional leaders of the field and need to contribute to new solutions. The attractiveness of WSC to the broader academic M&S community can serve as a facilitator to open doors to new collaboration opportunities and the beginning of a fruitful, constructive discussion to improve security and safety of all contributors and affected third parties.

Setting up the envisioned IW framework for integration of knowledge and application requires an even broader engagement of experts, as observed in (Garrett et al. 2009). However, WSC can become a hub for all these experts and a common ground for expert discussions and evaluations of options and opinions. Tolk (2009) recommends addressing these challenges by establishing a *Body of Knowledge* for HSCB modeling. In other words, a comprehensive and concise representation of concepts, terms, and activities is needed that make up a professional HSCB modeling domain. This shall represent the common understanding of relevant professionals and professional associations. The experts represented at the Winter Simulation Conference must be included in such endeavors.

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