Perspectives on the Analysis Modeling & Simulation Business Plan

Dr. Thomas Allen, Institute for Defense Analyses; e-mail: Tallen@ida.org

Mr. James Bexfield, Office of the Secretary of Defense (Program Analysis & Evaluation); e-mail: james.bexfield@osd.mil

Dr. Stuart Starr, Institute for Defense Analyses; e-mail: Sstarr@ida.org

ABSTRACT

During the past year, the Department of Defense (DoD) has taken major steps to enhance its management of modeling and simulation (M&S) activities. As one facet of that change, it has focused on six functional communities of interest: experimentation, analysis, planning, acquisition, testing, and training. It has charged each functional community with the development of a M&S business plan.

The initial result for the analysis community is an Analysis M&S Business Plan designed to support the development, fielding, and application of appropriate M&S capabilities to address national security strategic-level assessment issues. The plan articulates the community's vision and objectives, compares current capabilities to these objectives to identify gaps, draws on the results of surveys to prioritize those gaps, and formulates initiatives to address the highest priority gaps. These initiatives are aggregated into the categories of focused warfare activities to include redressing deficiencies in M&S of Irregular Warfare; cross-cutting activities that address specific aspects of warfare arenas, such as net-centric operations; and analysis M&S management activities such as proposed changes to M&S governance. The product is intended to be a living document that will be updated on a periodic basis to expand its scope and respond to the evolving needs of the broader analysis community.

A. Introduction

During the past year, the Department of Defense (DoD) has taken major steps to enhance its management of modeling and simulation (M&S) activities. As one facet of that change, it has focused on six functional communities of interest: acquisition, analysis, planning, testing, training, and experimentation. As can be seen in Figure 1, it has charged each functional community with the development of an M&S business plan. Ultimately, once the first editions of these business plans are completed, the intent is to develop a corporate and cross-cutting plan to enhance cross-community M&S efficiency and effectiveness with respect to tools, data, and services.

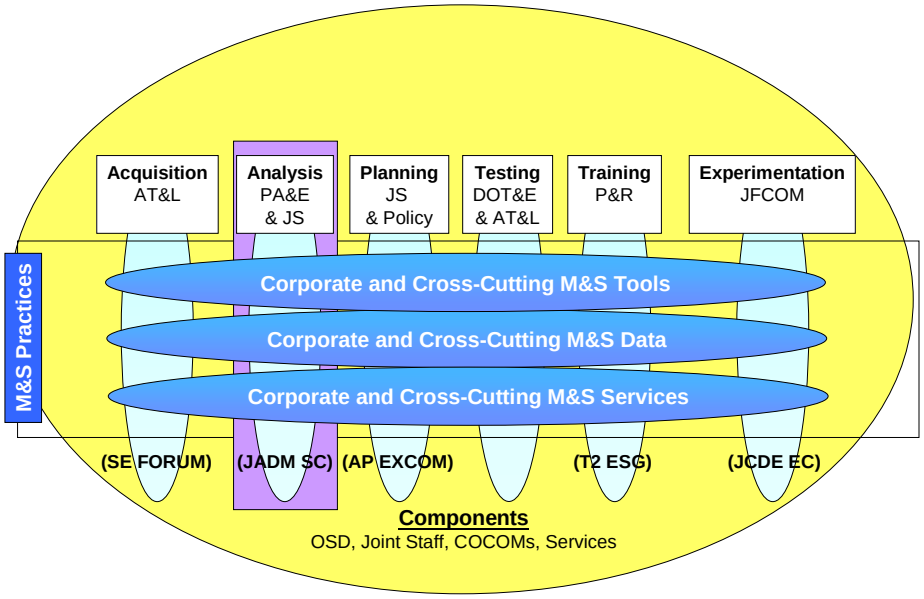

Figure 1. New DoD M&S Management Approach

This paper summarizes the process that created a DoD Analysis M&S Plan and the major insights that were developed through that process. The paper consists of six sections. Following this Introduction, Section B briefly summarizes the process employed to generate the Plan. Section C presents a vision for strategic analysis and articulates objectives for six key components of strategic analysis: methodology, tools, data, intellectual capital, research, and cross-community activities. Section D identifies significant gaps in each of the component areas and prioritizes those gaps. Section E summarizes proposed actions to address the high priority gaps. Section F concludes with a proposed way ahead for future activities.

This paper is supported by several appendices. Appendix A identifies a representative set of strategic issues that analysis M&S must be able to address. Appendix B characterizes a prioritized set of gaps that were developed through the use of a survey tool. Appendix C summarizes the abbreviations and acronyms that are employed in this paper.

B. Process

Figure 2 characterizes the process employed to identify and characterize proposed solutions to analysis M&S shortfalls. At the outset, the community agreed to focus the initial iteration of the Analysis M&S Business Plan on strategic analysis. Thus, attention was limited to those strategic issues that are relevant to major Department research and study processes such as the Quadrennial Defense Review (QDR) (Reference 1).

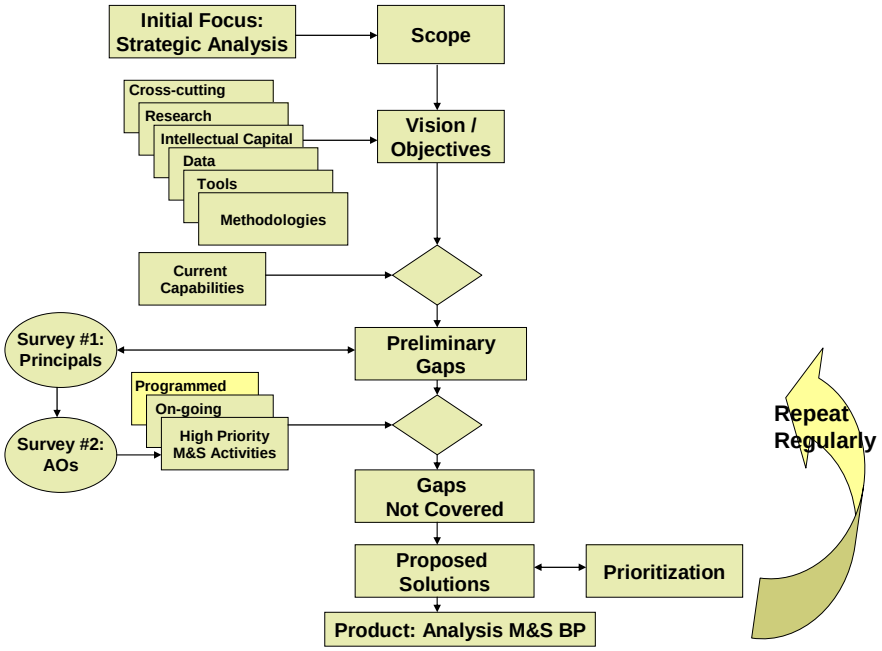

Figure 2. Analysis M&S Business Plan Process

Consistent with the selected scope, a Vision for analysis M&S was developed and associated objectives were articulated for six key areas: methodology, tools, data, intellectual capital, research, and cross-community activities. These objectives provided a standard against which to assess current activities.

Subsequently, a total of seventy-three preliminary gaps were identified, based on a comparison of current capabilities to the envisioned objectives. A survey was used to elicit the views of key members of the analysis M&S community to prioritize those gaps. The analysis of the responses to that survey achieved three objectives: it clarified the analysis community's priorities with respect to the initial set of gaps, it elicited an additional 33 gaps to consider, and it served to identify key M&S activities (and Actions Officers) that are addressing selected gaps. A second survey followed up with those identified Action Officers to characterize on-going efforts and to better ascertain progress in closing the gaps associated with their activities[1]. Based on these shortfalls, key subject matter experts identified potential solutions to address key high priority residual gaps.

The resulting Business Plan articulates the analysis community's vision and objectives, describes recommended processes for identifying gaps and priorities, and summarizes the major solutions that emerged from the overall process.

C. Vision and Objectives

In order to guide the development of the Analysis M&S Business Plan, the effort first focused on formulating a vision for strategic analysis. This top level vision was evolved through time with the help of analysis community members and is currently articulated as "**a**

[1] The results of the Action Officer Survey are not discussed in this paper.

robust and inter-connected analytical community which supports the formulation, discussion, and assessment of National Security Options across DoD through the use of M&S in an environment of evolving strategic issues." Achieving this high level vision will serve to improve the development and fielding of needed national security capabilities, as well as save resources and reduce risk.

To provide greater granularity for this vision, the business plan parses it into subordinate objectives for methodology, tools (subsuming models, simulations, and gaming), data, intellectual capital, research, and cross-community activities. These subordinate objectives provide the yardsticks against which the community can measure current capabilities and identify significant gaps between what is currently available and what is necessary to achieve the vision.

The **methodology objectives** endorse the development and employment of methodologies with several key attributes. First, the analysis community must develop and employ flexible, adaptable, and robust methodologies that are well suited to represent the strategic analysis issues as cited in the 2006 QDR. That product identified four major challenges: traditional, irregular, catastrophic, and disruptive (see Figure 3).

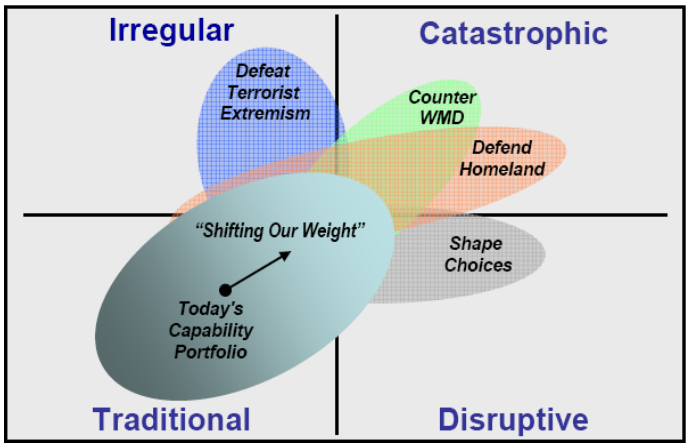

Figure 3. 2006 QDR Challenges

Second, the community must develop and employ methodologies to address additional strategic analysis issues as identified by senior leadership. A strawman set of those issues is identified Appendix A. These issues are expected to address a broad range of strategic challenges in the areas of shaping the force, deploying/employing forces, recovery/reconstruction, and performing Title X functions. The objective methodologies must also serve to illuminate the risks and uncertainties associated with recommendations provided to decision makers. As one facet of that illumination, the analysis community must communicate the level of uncertainty associated with an analytical effort both for the effort itself, and for the implications of various results. Finally, the analysis community must satisfy the demands of the decision makers by developing and employing methodologies that enable the analysis of the strategic environment from the perspective of both effects and capabilities.

The **tool objectives** address four key attributes. First, the community needs to collaboratively develop and employ a *core set* of M&S that enhance joint, interagency, multinational (JIM)

analyses. This core set can only be achieved by coordinating efforts across the key stakeholders in the analysis community and working in concert with the training, acquisition, testing, experimentation, and planning communities within the DoD, as well as with those members of the analysis community supporting non-DoD members of the interagency process. Second, objective tools require capabilities to support the methods developed to analyze across the four QDR challenge areas and new innovative packages of Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, and Facilities (DOTMLPF). Third, given that this core set of M&S may not be able to address many of the emerging issues of interest, a tool objective is to develop the capability to rapidly create tailored M&S that are well suited to primary issues of interest as they evolve or are discovered through time.

A final tool objective is a tool development and employment process that ensures existing and newly developed tools can be employed credibly, consistently, and usefully.

The **objectives for data** demand that the community acquire and provide to analysts complete, accurate, consistent, and responsive data to support the methods and tools used by the community. These data bases should look out at least twenty years and satisfy three criteria. First, they should address the four QDR challenge areas. Second, they should characterize potential significant crises/operations, world-wide, to include the environment (natural, man-made) and key actors. These key actors should include US government (DoD and non-DoD); non-government (such as Non-Governmental Organizations (NGOs) and non-combatants); other nation states (coalition partners, non-friendly nations); and non-state actors (such as terrorist organizations, International Organizations, and host nation populations). Finally, the data should address in a comprehensive way all key political, military, economic, social, informational, and infrastructure (PMESII) factors. Ultimately, the data must be available, accessible (subject to security caveats), traceable (through appropriate metadata and an audit trail that documents pedigree), and trusted (through an appropriate established method of evaluation).

A primary **intellectual capital objective** is to enhance Education and Training for analysts and the decision-makers they support. For analysts, there are five elements of this objective. First, a community of analysts with diverse intellectual capabilities must be recruited, developed, and retained. Second, the community should implement a curriculum that provides these analysts with the competencies needed to generate exceptional strategic assessments for the initial scope of the business plan and then expands appropriately as the scope broadens. Third, the community should implement a program to keep civilian and military analysts' skills current, even when moving fluidly between analytic and non-analytic assignments. Fourth, and most significantly, the community should take steps to ensure that analysts embark on "life long learning" to keep pace with developments in methodologies, tools, and data. Finally, the community should provide analysts with ancillary knowledge. As an example, analysts require knowledge of Codes of Best Practice (COBPs) for assessment to inform them of community standards and processes (Reference 2). In addition, they need training on how best to convey uncertainty and risk to the recipients of analysis. Recipients of strategic analyses include commanders and senior decision makers on the staffs of OSD, the Joint Staff, and Service and Agency Headquarters. Part of the analysis community's development of intellectual capital should be to ensure the recipients of analysis are educated on the capabilities and limitations of analysis. Furthermore, they will require knowledge of a

tailored COBP of Analysis that will help them engage analysts in a meaningful dialogue and better understand the effects of uncertainty and risk.

Research M&S objectives can be represented by a taxonomy, depicted in Figure 4 as a jig saw puzzle with four interlinking pieces The first piece represents modeling methodology to include the theories, processes, algorithms, and information that support the conceptualization of a model. The second piece is development methodology, to include the tools, techniques, and software used in architecting, designing, and implementing a model. Computation and communications technology make up the third piece, subsuming the platform the M&S application is hosted on, how it connects to other M&S applications, and how M&S application developers and users connect to one another. The final piece is the data and information technology to include the array of processes and tools needed to acquire and convert data and information into the inputs required for future M&S.

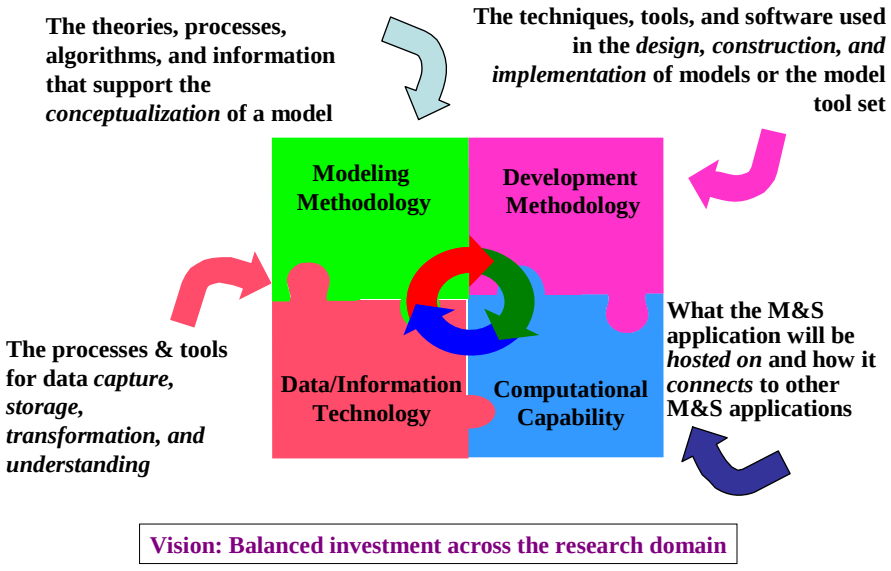

Figure 4. M&S Research Framework

Consistent with this research framework, the research objectives are to develop the means to perform the necessary research and to undertake specific initiatives to ameliorate issues that limit existing methods, tools, and data. At this time, computational capability does not appear to be a primary limiting factor to DoD analysis, given the commercial advances in computing and communications. However, in each of the other quadrants, the objective is to strengthen the analysis community's knowledge in key areas. In the area of conceptual modeling, it is vital that the analysis community develop methods and tools to enhance its ability to conduct analyses across the four QDR challenge areas. As a part of this activity, the community needs to improve relevant research in the areas of human, social, and cultural behavior (HSCB) modeling (Reference 3). In addition, in order to respond to key strategic issues, the objective is to enhance research in the representation of innovative concepts of warfare such as Net Centric Operations (NCO), Information Operations (IO), and Effects Based Operations (EBO). This also includes enhancing the community's ability to conceptualize the treatment of key strategic issues and missions including the specific areas of deterrence, Irregular

Warfare (IW), Global War on Terrorism (GWOT), Homeland Defense (HD), and Defense Support of Civil Authorities (DSCA). In the area of model instantiation, one facet of the objective is to take near-term actions to enhance the composability of M&S. Furthermore, there is a need to develop methods that transcend the current guidance on Verification, Validation and Accreditation (VV&A) to establish the credibility and usability of tools to support strategic analysis. Finally, in the area of data/information, the objective includes enhanced visualization capabilities to make M&S results more transparent to the analyst and decision maker.

Cross-community activity objectives are those which reach across the various M&S communities to better connect them and their M&S capabilities. The intent of these activities is to share developments and address common problems synergistically, improving the efficiency and effectiveness of M&S across the DoD and the larger community that uses M&S. To better support cross-community activities, the analysis community objective is the implementation of improved management, flow of information, and other collaborative processes to enhance synergism across DoD and the broader users of analysis. For example, this entails jointly developing and sharing appropriate methods, tools, data; cooperating in developing and implementing key processes to include VV&A of tools and data; and reducing unnecessary redundancy in M&S research.

D. Gap Analyses

During the course of the development of the Analysis M&S Business Plan, considerable effort was expended to identify current capabilities in the areas of methodologies, tools, data, intellectual capital, research, and cross-community activities. Subsequently, those current

Area	Traditional Challenges	Irregular, Catastrophic, & Disruptive (ICD) Challenges
Methodologies	Green-Amber	Red
Tools	Green-Amber	Red
Data	Green-Amber	Red
Intellectual Capital	Green-Amber	Red
Research	Amber	Red
Cross-community Activities	Amber	Red

Table 1. Overview of Broad Gaps in Capability

capabilities were compared to the objectives cited in Section C. The results of that comparison are summarized in Table 1.

As depicted in that Table, the analysis community has a reasonable capability to handle traditional challenges, although there are significant residual shortfalls. However, the

community faces pervasive and profound shortfalls in its ability to deal with all of the dimensions of irregular, catastrophic, and disruptive (ICD) challenges.

During the course of the development of the Analysis M&S Business Plan, seventy-three specific gaps were identified. As suggested by Table 1, while there are many problems with the methods, tools, data and other elements of M&S associated with traditional warfare challenges, there are even more significant gaps in all categories relating to the other challenge areas. The business plan summarizes the **methodological gaps** by cataloguing them in six key areas. These include gaps in available methodologies to address a number of cross-domain activities, as well as the absence of robust approaches to deal with specific missions, functions, or problem set areas. The list of methodological gaps includes:

- Adequate methodologies to address Command and Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR); IO and other "soft kill" systems; urban operations; special operations forces; weapons of mass destruction (WMD); logistics; adaptive adversaries; and deterrence
- Comprehensive, agreed-upon metrics and the ability to develop causal relationships for analyzing irregular, catastrophic and disruptive challenges
- Explicit treatment of risk and uncertainty in the M&S used to support analysis
- Capability Based Assessment that incorporates the generation of desired effects
- Efficient and credible exploratory/quick look analyses to identify interesting segments of a problem's solution space
- Strategic assessment processes that can meet quick-turn information needs within the decision cycle of senior decision makers.

As with methodologies, the business plan identifies the need to improve M&S related **tools.** This includes upgrading the tools where the associated methodologies already exist and to build new tools for the new methodologies being designed to represent domains of interest, particularly in key cross-cutting functional areas and for the irregular, catastrophic and disruptive challenges. The list of tool gaps includes:

- Adequate tools for analyzing C4ISR, IO, and urban operations
- Enhanced processes to employ M&S credibly, consistently, and usefully, to include an improved VV&A process to address M&S that represents systems and capabilities that have not yet been fielded
- Mature tools to address irregular, catastrophic and disruptive challenges.

Data gaps include:

- Production of comprehensive, long range traditional scenario as well as scenarios tailored to analyze irregular, catastrophic and disruptive challenges
- Full characterization of Blue C4ISR and CONOPs
- Reliable estimates of the impact of changes to C4ISR or results from specific Information or Urban Operations in traditional campaign models

- Red doctrine and ancillary data, particularly for irregular warfare asymmetric challenges
- Interagency, Coalition Partner, Civilian, Non-government Organizations, and International Organization characterizations, behaviors, and capabilities
- Natural and man-made environmental factors
- Identification, understanding, and collection of credible and useful data for irregular, catastrophic and disruptive challenge areas.

Research gaps are identified in several areas. First, in the analysis of traditional challenges, major gaps include: modeling of complex communications and sensor systems; ensuring that net-centric operations are addressed more credibly; and capturing the effects and trade space for C4ISR. In addition there are major gaps in our ability to represent HBSC factors (Reference 3). These gaps include improving the knowledge base of key factors characterizing individual and group behavior. In addition, the community is currently unable to understand and embed social science theory into M&S. As one manifestation, it does not understand civilian reactions to crises or the effects of those reactions on military requirements or operations.

Currently, the analysis community lacks the ability to fully leverage M&S opportunities across the various functional communities in DoD or across other US Government agencies. These **cross-community** gaps include the need for the total community to address issues associated with irregular, catastrophic, or disruptive challenges. As examples, there is no shared understanding of the appropriate metrics and there is very limited sharing of tools to address these challenge areas across the analytic, acquisition, experimentation, and planning communities. The emerging new approach to DoD M&S management provides significant potential to start addressing these gaps.

E. Prioritization of Gaps

In order to elicit community attitudes about the prioritization of the seventy-three gaps identified, the business plan development team created and disseminated a survey to the analytic leaders of the Combatant Commands (i.e., JFCOM, PACOM, STRATCOM, TRANSCOM, USFK), Service/Joint Staff organizations (i.e., USAF/A9, AMSAA, Army G-3/5/7; Center for Army Analysis, CNO (N81), USMC, Joint Staff (J8)), and selected OSD organizations (i.e., ASD(NII), OSD(PA&E), OUSD(P)).

The following section summarizes the views of the respondents on gap prioritization. In addition, Appendix B provides the rank ordering of the seventy-three gaps based on the survey responses.

The survey employed a Lickert scale, equating a very high priority for a selected gap to the numerical result 5; high priority was a 4; moderate was rated as 3; low equaled 2; and very low was a 1. The numerical results were then used to determine community priorities among the seventy-three gaps.

Several techniques and Measures of Merit (MoMs) were employed to analyze the survey responses. These include calculations of the average and median response for each question.

In addition, the team employed supplemental measures to identify those questions for which high consensus was observed.

There was no simple, accurate metric available to characterize the degree of agreement among responders. For this survey, a surrogate measure was employed to indicate the spread of the responses across the five levels of the Lickert scale for each question. In the following table (and in Appendix B), the following notation is used for differing levels of responses across the Principals Lickert levels:

- For a spread of responses across three (3) numerical answers: **bold**
- For a spread of responses across four (4) numerical answers: *italics*
- For a spread of responses that included all five (5) possibilities: standard print

In no case did the 16 respondents to this survey ever provide fewer than three unique contiguous Lickert scale answers.

Table 2 identifies the top nine gaps that were identified by the respondents to the survey. As a MoM, the table cites the average response from all of the respondents, Substantively, the highest priority gaps focused on methodology, tools, and data issues associated with IW/GWOT and Stability, Security, Transition, and Reconstruction (SSTR) operations. The rank ordering of the complete list of seventy-three gaps is provided in Appendix B.

An analysis of the **median** responses to the survey provided additional insight. First, four gaps received the highest priority responses -- MoM: War on Terror; Tools: Irregular

Gap Area	Sub-Category	Gap	Average Response (All)
Data	Scenarios	**Defeating terrorist networks**	4.38
Methodology	MoMs	*War on Terror/Irregular Warfare*	4.31
Tools	QDR Challenges	*Defeating terrorist networks*	4.13
Tools	Domains	**Irregular Challenges**	4.13
Data	Data Gaps	**Non-State Actors**	4.13
Methodology	Developing	**Meet QUICK-TURN information needs of decision makers**	4.00
Methodology	Domains	**Irregular Challenges**	3.94
Methodology	Developing	*Explicitly address RISK & UNCERTAINTY*	3.94
Methodology	Domains	**Stability, Security, Transition, & Reconstruction (SSTR)**	3.88

Table 2. Selected Survey Results

Challenges; Scenarios: Defeating Terror Networks; and Research: HSCB Representation. Conversely, the median responses gave the following six gaps the lowest priority responses -- Data: Natural and man-made terrain; Tools: Proprietary issues; Scenarios: Traditional; Research: Validation; Intellectual Capital: COBP; and MoM: Traditional Campaigns.

In all of the responses to the survey, seven items were cited that were rated "moderate importance" or higher (i.e., greater than, or equal to, 3 out of 5). These items included:

- Methodology (i.e., Irregular Challenges; SSTR; and Quick turn responsiveness);
- Tools: Irregular Challenges;
- Scenarios: Defeating terrorist networks;
- Data (i.e., Red actors; Non-state actors).

The respondents' assessment of the importance of research gaps is relatively low. Nevertheless, several of the research gaps received higher emphasis (with respect to response average). These include:

- HSCB Representation (3.63)
- Representation of Complex Adaptive Systems (3.5)
- Information Operations (3.31)
- Visualization of data/information (3.25)
- Modeling Net-Centric Warfare (3.25)
- Modeling of Complex Systems (e.g., mobile, *ad hoc* networks (MANET)) (3.25)

F. Proposed Solutions

Given the prioritization of the identified gaps, the study team, in concert with the analysis community, formulated an initial array of potential solutions. These solutions included ideas outlined in the literature, the results of meetings and conferences, and the efforts of a focused workshop involving a number of subject matter experts.

The first set of solutions addresses focused warfare solutions (see Table 3). These include options to address high priority gaps in the areas of IW/GWOT, SSTR operations, disruptive challenges (e.g., attack against C4ISR assets), HD/DSCA, and traditional challenges.

Key Gaps	Proposed Solutions
Irregular Warfare/ Global War on Terrorism (IW/GWOT)	▪ Create a Community of Interest for analysts formulating Measures of Merit for IW/GWOT ▪ Review data exchange agreements with other nations to encourage greater collaboration on IW/GWOT solutions ▪ Develop a framework for IW/GWOT issues and populate with key academic and defense agency initiatives ▪ Create enhanced tool sets, leveraging existing efforts ▪ Enhance visibility of the Joint Data System (JDS) Counter Insurgency Forum ▪ Enhance DoD-Intelligence Community collaboration ▪ Create a Center of Excellence for Irregular Warfare/War on Terrorism
Stability, Security, Transition, & Reconstruction (SSTR)	▪ Build upon emerging tools (e.g., the Defense Advanced Research Projects Agency's Conflict Modeling, Planning and Outcomes Experimentation) to develop a mature tool set ▪ Build on and sustain SSTR data collection efforts (e.g., Human Terrain System) ▪ Enhance collaboration with Training Community ▪ Create a Center of Excellence for SSTR (perhaps building on the Center for Complex Operations)
Disruptive Challenges	▪ Initiate a comprehensive study to investigate the disruptive efforts that would follow an attack against Blue Command and Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance (C4ISR) assets ▪ Address key data issues ▪ Enhance collaboration with Experimentation and Training Communities
Homeland Defense/ Defense Support of Civil Authority (HD/DSCA)	▪ Develop an evolutionary plan for an HD/DSCA M&S environment that can be tailored to support the needs of the Analysis, Experimentation, Training, and Planning Communities. This should leverage the current Experimentation alliance being created by JFCOM, NORTHCOM, National Guard Bureau, and DHS. ▪ Collaborate with the DHS to address high priority research needs in the areas of M&S for chemical and biological defense, cybersecurity, incident management, and infrastructure protection.
Traditional Challenges	▪ Upgrade the Synthetic Theater Operations Research Model (STORM) to create a more balanced, joint Service strategic assessment tool ▪ Develop and implement methods and tools to enhance analyses of risk and uncertainty ▪ Implement exploratory analysis techniques where appropriate

Table 3. Proposed Solutions to Address Focused Warfare Activities

The second set of solutions addresses cross-cutting activities (see Table 4). These include options to address capability based assessment, shaping choices of entities at strategic

crossroads, complex adaptive systems, quick turn solutions, C4ISR, and Information Operations.

Key Gaps	Proposed Solutions
Capability Based Assessment (CBA)	▪ Develop and implement a CBA framework with other key stakeholders that builds on the Missions and Means Framework
Shaping Choices of Entities at Strategic Crossroads	▪ Undertake a prototype activity (by a Combatant Command) to assess the Theater Security Cooperation Program and SSTR operations
Complex Adaptive Systems (CAS)	▪ Conduct a CAS-based analysis initiative to inform an ongoing DoD decision process
Quick Turn Solutions	▪ Work in concert with the Planning Community on the Adaptive Planning program ▪ Expand the Analytic Baseline activity ▪ Exploit lessons learned from the Services' Quick Turn activities ▪ Prototype a portfolio approach to address Quick Turn Solutions
C4ISR	▪ Build on the NATO Code of Best Practice for Command and Control (C2) Assessment to develop a holistic approach to assess the mix of warfare processes and C4ISR that are commensurate with mission needs
Information Operations (IO)	▪ Address communications-related issues (e.g., Computer Network Operations) by building on IO Joint Munitions Effectiveness Manual activities and tasking and funding solutions through the Services, Defense Agencies, and Program Executive Offices ▪ Leverage the Director, Defense Research and Engineering's investment in HSCB research to develop the needed scientific foundation and associated analytic methods and tools

Table 4. Proposed Solutions to Address Cross-Cutting Activities

In addition to providing initial solutions for prioritized gap areas, the Analysis M&S Business Plan also identifies a number of management issues in the analysis community's governance, visibility of information, outreach, intellectual capital, and data. Those proposed solutions are summarized in Table 5

Key Issue	Proposed Solutions
Analysis M&S Governance	▪ Evolve JADM Steering Committee into a Joint Coordinating Authority (JCA) to lead and coordinate all Analysis Community-specific M&S matters ▪ Evaluate, implement, and monitor key metrics to track progress in addressing key gaps (JCA responsibility)
Enhance the Visibility of Information	▪ Formulate and improve the JDS M&S tool registry ▪ Build on the current JDS portal initiatives to create a vibrant body of knowledge (e.g., establish a "M&S-pedia") ▪ Complete documentation of widely used tools (e.g., Joint Integrated Contingency Model (JICM))
Outreach	▪ Leverage the Information Analysis Centers and the M&S Resource Repositories to help shape information ▪ Enhance M&S outreach to the Interagency ▪ Enhance outreach through key professional associations (e.g., Military Operations Research Society (MORS) and Institute for Operations Research and the Management Sciences (INFORMS))
Intellectual Capital	▪ Develop and promulgate Codes of Best Practice for key analyst and decision-maker M&S stakeholders ▪ Augment the US Government's intellectual capital in social sciences, gaming, and applying agent-based modeling ▪ Expand curricula at military academies and graduate schools to include appropriate courses in social science, advanced M&S ▪ Add analysis and M&S curricula to professional military education and senior leader courses ▪ Create one or more Centers of Excellence to address major challenges cited in the 2006 QDR
Data	▪ Develop metadata standards for the Analysis Community to use ▪ Better define and enforce data set sponsorship and proponency ▪ Undertake initiatives to overcome existing data barriers (e.g., Special Access Program/Special Access Required/Sensitive Compartmented Information)

Table 5. Proposed Solutions to Address Analysis M&S Management Issues

G. Summary

Although an initial version of the Analysis M&S Business Plan has been disseminated (Reference 4), it will be revisited on a periodic basis. Because the nature of the problems that must be addressed by the analysis community will change through time, it is vital to track those changes and their implications for any analysis and associated M&S gaps. Second, as the processes established gain traction and potentially improve the coordination of analysis M&S development and application for the strategic analysis community, it will be beneficial to broaden the scope of the Analysis M&S Business Plan to reach more of the analysis

community. Such broadening would transcend strategic analysis to treat an appropriate range of operational and tactical analysis issues.

Based upon recent developments, it has been decided to focus the next version of the Analysis M&S Business Plan on 20 key challenge areas. As can be seen in Table 6, these challenge areas build upon and extend the key areas identified in the first edition of the Business Plan.

Operational Areas	**Cross-cutting Missions/ Functions**
Conventional Operations (e.g. MCOs)	Deterrence
Irregular Warfare (e.g., COIN, Counter Terrorism)	Representation of ISR
Stability, Security, Transition and Reconstruction	C4 and Net-centric Operations
Homeland Defense/Defense Support for Civil Authority	Human Social, Cultural, Behavior (HSCB) Aspects
Management Issues	Information Operations including Cyber Warfare
Education and Training (analysts, decision makers)	CBRNE Activities
Ensuring Credibility of M&S (e.g., VV&A)	Space Operations
M&S Governance and Best Practices (e.g., Policies for use of proprietary tools)	Logistics
	Joint, Interagency, Multi-national (JIM) Analysis
Outreach	**Hot Topics**
Configuration Management (e.g., data, tools, standards)	Portfolio Management
	Representation of Complex Adaptive Systems

Table 6. Twenty Challenge Areas

To enhance community participation in the next version of the plan, PA&E has established two new collaborative web sites: a forum and a wiki. The intent is to eventually host these sites on servers available to the broad community engaged in analysis for the DoD. Currently, these sites can be accessed through the following URLs, restricted to the US defense community:

- Forum url: https://jdsforums.pae.osd.smil.mil
- Wiki url: https://jdstest.pae.osd.smil.mil/jdswiki.

By making the plan accessible via the web in a living format and encouraging near real time updates to the information, the plan will more effectively capture and reflect the changing needs of the analysis community through time.

References

1. 2006 Quadrennial Defense Review (QDR), Secretary of Defense, February 2006
2. NATO Code of Best Practice on C2 Assessment, NATO SAS-026, 2002
3. Report on Human, Social, and Cultural Behavior (HSCB) Modeling in Response to Strategic Planning Guidance (Fiscal Years 2008 – 2013), DDR&E, August 2006
4. T. Allen, et al, “Analysis Modeling and Simulation Business Plan”, IDA Paper P-4250, 2007

Appendix A Key Strategic Issues

To provide a context for characterizing the current state of analysis M&S, this appendix briefly identifies representative issues that confront the strategic analysis community. These issues are subdivided into the categories of traditional and non-traditional analyses. Broadly speaking, the non-traditional issues are relevant to the quadrants associated with irregular, catastrophic, and disruptive (ICD) challenges.

The following examples illustrate the types of traditional strategic issues that confront the analysis community:

- What is the ability of the forces to execute the national defense strategy in the mid-term?
- How should our basing, strategic lift, and pre-positioned materiel evolve in support of the Defense strategy?
- How should the Department address specific "traditional challenges" such as the value of net-centric capabilities to joint warfighting or the provision of foreign humanitarian assistance as part of planning and execution in joint campaign representation?
- What are our preferred alternatives for forces, equipment, and concepts of operation (CONOPs) across a broad range of scenarios?

Many of the strategic issues confronting the analysis community are Service-oriented. Thus, the community needs methods, tools, and data to address the following issues:

- What is the appropriate ground force mix?
- What is the appropriate long-range strike force, including the possible role of a new medium bomber?
- What is the appropriate investment for seabasing?

Because key strategic issues in the areas of non-traditional conflict are only just emerging, the analysis community has less understanding either of the issues or of their potential solution space. However, an initial set of questions have been posed by senior decision makers:

- What effects must be achieved to execute the Defense Strategy across all elements?
- What non-traditional capabilities are needed to achieve these effects?
- How can these non-traditional capabilities be integrated with the traditional warfare capabilities?

While these strategic issues exist today, the future will bring an even more complex set of questions. The business plan associates issues with the key mission areas that comprise non-traditional challenges. For each of those non-traditional challenge areas, the business plan cites strawman strategic issues developed in prior analyses:

<u>Homeland Defense (HD)/Defense Support to Civil Authority (DSCA)</u>

- What is our ability to interdict infiltration of weapons of mass destruction (WMD) into the US?

- What is our ability to respond to large consequence management events?

Global War on Terror (GWOT)/Irregular Warfare (IW)

- What is the sufficiency/effectiveness of GWOT capabilities?
- What is the contribution of Diplomatic, Intelligence, Military, Economic, Financial, Informational, Law Enforcement (DIMEFIL) levers of power to GWOT?

Counter Insurgency (COIN)

- What is the effectiveness of capabilities against insurgencies that utilize irregular warfare and psychological operations?

Stability, Security, Transition, and Reconstruction (SSTR)

- What is the sufficiency/effectiveness of US forces to conduct large, long range stability operations?

Appendix B Rank-Order Responses to the Survey

Legend: Average Response

Average Score Less Than	Average Score Greater Than, or Equal to	Color
5.0	4.0	Green
4.0	3.5	Yellow
3.5	3.0	Purple
3.0	2.5	Blue
2.5	1.0	Red

Principals Lickert Scale – Very High: 5
High: 4
Moderate: 3
Low: 2
Very Low: 1

Rank-Order of Responses (1 of 8)

#	Gap Area	Sub-Category	Gap	Average Response
1	Data	Scenarios	**Defeating terrorist networks**	4.38
2	Methodology	MoMs	*War on Terror/Irregular Warfare*	4.31
3	Tools	Domains	**Irregular Challenges**	4.13
3	Tools	QDR Challenges	*Defeating terrorist networks*	4.13
3	Data	Data Gaps	**Non-State Actors**	4.13
4	Methodology	Developing	**Meet QUICK-TURN information needs of decision makers**	4.00
5	Methodology	Domains	**Irregular Challenges**	3.94
5	Methodology	Developing	*Explicitly address RISK & UNCERTAINTY*	3.94
6	Methodology	Domains	**Stability, Security, Transition, & Reconstruction (SSTR)**	3.88

Rank-Order of Responses (3 of 8)

#	Gap Area	Sub-Category	Gap	Average Response
11	Data	Non-military	*Cultural*	3.63
12	Methodology	Domains	Information Operations	3.56
12	Methodology	Domains	*Disruptive Challenges*	3.56
12	Methodology	Developing	*Perform CAPABILITY BASED ASSESSMENTS*	3.56
12	Methodology	MoMs	*Homeland Defense*	3.56
12	Data	Non-military	*Informational*	3.56
13	Data	Gaps	*Interagency partners*	3.53
14	Tools	QDR Challenges	*Shaping the choices of countries at strategic crossroads*	3.50
14	Data	Scenarios	*Shaping the choices of countries at strategic crossroads*	3.50
14	Research	Modeling	Representation of CAS	3.50

Rank-Order of Responses (4 of 8)

#	Gap Area	Sub-Category	Gap	Average Response
14	Intellectual Capital	E&T	Decision makers	3.50
15	Data	Gaps	*Allies, coalition partners*	3.47
16	Data	Scenarios	**Defending the homeland in depth**	3.44
17	Methodology	Domains	**Catastrophic Challenges**	3.38
17	Data	Non-Military	*Political*	3.38
18	Tools	Domains	**Disruptive Challenges**	3.31
18	Tools	QDR Challenges	Preventing hostile states and non-state actors from acquiring or using WMD	3.31
18	Research	Modeling	Information Operations	3.31
19	Data	Non-Military	*Diplomatic*	3.25

Rank-Order of Responses (5 of 8)

#	Gap Area	Sub-Category	Gap	Average Response
19	Research	Modeling	Net-Centric Warfare	3.25
19	Research	Modeling	Modeling of Complex Systems (e.g., mobile, ad hoc networks)	3.25
19	Research	Data/Info	Visualization of data/information	3.25
19	Intellectual Capital	Issues	*Existence of a "warm/hot intellectual base" for key QDR challenges*	3.25
20	Tools	Domains	**Catastrophic Challenges**	3.19
20	Tools	Domains	Information Operations	3.19
20	Tools	QDR Challenges	**Defending the homeland in depth**	3.19
20	Data	Non-Military	**Economic**	3.19
20	Intellectual Capital	E&T	ANALYSTS	3.19

Rank-Order of Responses (6 of 8)

#	Gap Area	Sub-Category	Gap	Average Response
21	Research	Data/Info	Data acquisition, conversion, and storage	3.13
22	Methodology	Domains	Soft factors	3.06
22	Intellectual Capital	Issues	*Aging of the analyst workforce*	3.06
22	Research	Development	*Composability/integration of simulations*	3.06
23	Methodology	Developing	*VV&A*	3.00
23	Methodology	Developing	Exploratory Analyses	3.00
23	Research	Development	Agent Based Models	3.00
24	Tools	Gaps	**Ameliorating shortfalls in TRADITIONAL STRATEGIC ASSESSMENT TOOLS**	2.94
25	Tools	Gaps	**Developing PROGRAMMATIC ESTIMATION TOOLS for portfolio options**	2.88

Appendix C Abbreviations and Acronyms

AMSAA	Army Materiel Systems Analysis Agency
AP	Adaptive Planning
AT&L	Acquisition, Technology, and Logistics
C4ISR	Command and Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
CBRNE	Chemical, biological, radiological, nuclear, and high yield explosives
COBP	Code of Best Practice
COCOM	Combatant Commander
COIN	Counter Insurgency
CONOPs	Concepts of Operations
DHS	Department of Homeland Security
DIMEFIL	Diplomatic, Intelligence, Military, Economic, Financial, Informational, Law Enforcement
DoD	Department of Defense
DOT&E	Director of Operational Test & Evaluation
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, Facilities
DSCA	Defense Support of Civil Authorities
E&T	Education and Training
EBO	Effects Based Operations
GWOT	Global War on Terrorism
HD	Homeland Defense
HSCB	Human, Social, and Cultural Behavior
ICD	Irregular, Catastrophic, Disruptive
INFORMS	The Institute for Operations Research and the Management Sciences
IO	Information Operations
IW	Irregular Warfare
JADM	Joint Analytic Data Management
JCA	Joint Coordinating Authority
JCDE	Joint Concept Development & Experimentation
JDS	Joint Data System
JFCOM	Joint Forces Command
JICM	Joint Integrated Contingency Model
JIM	Joint, Interagency, Multinational
JS	Joint Staff
M&S	Modeling & Simulation
MANET	Mobile, Ad Hoc Networking
MoM	Measure of Merit
MORS	Military Operations Research Society
NCO	Net-centric Operations
NGO	Non-Governmental Organization
NORTHCOM	Northern Command

OSD	Office of the Secretary of Defense
OUSD(P)	Office of the Under Secretary of Defense (Policy)
PA&E	Program Analysis & Evaluation
P&R	Personnel and Readiness
PME	Professional Military education
PMESII	Political, Military, Economic, Social, Informational, Infrastructure
QDR	Quadrennial Defense Review
SE	Systems Engineering
SSTR	Stability, Security, Transition, & Reconstruction
STORM	Synthetic Theater Operations Research Model
STRATCOM	Strategic Command
TRANSCOM	Transportation Command
USAF	United States Air Force
USFK	US Forces Korea
USMC	US Marine Corps
VV&A	Verification, Validation, and Accreditation
WMD	Weapons of Mass Destruction