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NATIONAL DEFENSE RESEARCH INSTITUTE

# Modeling, Simulation, and Operations Analysis in Afghanistan and Iraq

Operational Vignettes, Lessons Learned,  
and a Survey of Selected Efforts

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## Summary

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This report surveys and provides lessons learned on modeling and operations analysis (OA) in Operations Enduring Freedom (OEF) and Iraqi Freedom (OIF). Operations and environmental complexities in Iraq and Afghanistan placed heavy demands on U.S. military commanders, requiring them to make critical, time-sensitive decisions with limited information. Modelers and analysts provided both direct and indirect, or “reach-back,” support to commanders in both theaters to help them make well-informed decisions across the full spectrum of counterinsurgency and irregular warfare (COIN and IW) operations. Based on our analysis of both the literature and interviews with commanders and analysts, we identified four general categories that encompassed most decision support: (1) force protection; (2) logistics; (3) campaign assessment; and (4) force structure.

We assess that modelers and analysts were able to successfully inform many force protection and logistics decisions, but they were less effective in supporting campaign assessment and force-structuring decisions (each category is described in greater detail below). Scope, scale, complexity, and the opacity of the operational environment were critical variables: Modeling and analysis were effective at addressing difficult but relatively concrete tactical and operational problems, but less useful in addressing complex strategic problems that required detailed analysis of the operational environment. This finding was perhaps unsurprising given the complexity of the environments and operations in both theaters, but it does help refine understanding of the ways in which modeling, simulation, and analysis might be used most effectively in IW. It also informs decisions on current and future investment in modeling and analytic capabilities. The theory and practical methods for force protection and logistics decision support are generally sound and warrant continued investment, while the theory and methods that support campaign assessment and force employment would benefit from additional investment in theoretical research rather than in applications.

Our research focused on four tasks: (1) identify decisions in campaigns such as OEF and OIF that could benefit from modeling, simulation, and analysis; (2) review and assess the ways in which analysts have attempted to address these decisions; (3) develop insight into the challenges they faced; and (4) find ways in which modeling, simulation, and analysis might be improved. To accomplish these tasks, we con-

ducted a detailed analysis of existing literature on modeling, simulation, and analysis for COIN specifically, and for IW more broadly. We also interviewed 115 commanders and analysts who had experience in Afghanistan, Iraq, or in both theaters.

## Lessons Across Four Categories of COIN and IW Decision Support

Four chapters in the main report are devoted to discussing examples (in the form of vignettes in some cases) of how modeling and simulation (M&S) or analysis helped support commanders' decisions. Each chapter describes commanders' insights into decisions within each category, and each contains vignettes describing modeling and analytic support to those decisions.

1. **Force Protection** encompasses all efforts to reduce casualties and damage to friendly forces—including armor improvements, electronic countermeasures, and active efforts to eliminate enemy forces before they can attack. Most commanders interviewed stated that they most needed and most benefited from counter-improvised explosive device (C-IED) decision support in Afghanistan and Iraq. Countering direct and indirect fire mattered, but these were rarely cited as a major concern. Modeling and OA techniques modified from previous work, as well as those developed specifically for C-IED analysis, saved countless lives, preserved millions of dollars in material, and played a significant role in increasing the freedom of movement of U.S. forces in Afghanistan and Iraq.
2. **Logistics** decision support occurred at all levels and ranged from simple tactical calculations to theater-level modeling. Commanders and analysts described a broad range of logistics-related efforts, including those designed to control the movement of supplies, to find efficiencies in aerial transport deployments, and to optimize the location of specialty surgical teams. The tactical, operational, and strategic cases we examined were far more amenable to traditional operational analysis techniques (including modeling) than campaign assessment or force structuring. This stems in great part from the fact that analysts supporting logistics decisions relied primarily on readily available Blue force data and less on complex and often inaccurate and incomplete environmental data such as the number of insurgents or the true character of popular sentiment. The problems that logistics analysts faced were difficult but often straightforward. We identify specific cases in which logistics modeling and analysis saved money and directly reduced threat of injury or death to U.S. military personnel.
3. **Campaign Assessment** is the commander's effort to determine progress against mission objectives in order to optimize planning and resource allocation. Assessments are tools that support a range of decisions, such as how to allocate forces, when to change strategy, and when to request additional support. Yet campaign

assessment offers few opportunities to link analytic effort with operational outcomes. Interviewees reported frustration associated with a poorly defined problem, inadequate data, and a lack of common, validated methods. Commanders had a hard time articulating their requirements, and analysts had a difficult time trying to support decisionmaking. Further, confusion over the definitions and purposes of *analysis* and *assessment*—an issue we address in the report—further undermined analytic support to campaign assessment efforts. Our review of the literature and our interviews did not reveal any clear campaign assessment successes for OEF or OIF.

4. **Force Structuring** decisions encompass the determination of force requirements, force shaping, and force employment. In other words, how many and what kind of troops are needed, and how should they be used? Commanders are responsible for providing policymakers with a clear rationale for their force-structuring requirements, but the analytic community has not yet provided them with a methodology that provides a clear rationale for COIN and IW force-structuring requirements. In general, commanders and analysts have taken one or more of three approaches in an attempt to determine strategic force requirements for COIN: (1) troop or force ration calculations; (2) troop density calculations; and (3) troop-to-task calculations. However, none of these approaches were considered generally sound and effective by policymakers, commanders, or the analytic community. This leaves a critical gap in IW decisionmaking.

## Resource Allocation

Where should the Department of Defense (DoD) invest to close the M&S gaps? In this report, we show that modeling, simulation, and analysis have proven clearly useful to support two of the four categories we addressed: force protection and logistics (Chapters Three and Four). We were unable to identify any clear successes from among the various efforts to support campaign assessment and force structuring presented in Chapters Five and Six. Hundreds of military personnel and civilians have worked to develop and improve modeling, simulations, and analytic tools and methods to support decisions across all four categories between 2001 and 2012. It is likely that DoD has invested considerable sums in these developmental efforts over the past 11 years. We are not aware of any cost-benefit analyses conducted to determine which of these specific efforts bore fruit and therefore represented good investments. Based on the information provided to the authors for this report, it appears that DoD would more likely achieve immediate, practical success by investing in force protection and logistics methods and tools rather than in IW campaign assessment and IW force-structuring employment methods and tools.

This apparent difference in opportunity presents a dilemma for those considering future investment: Should DoD weight its investment toward those models, simulations, and analytic tools and methods that have already proven to be useful; should it attempt to address what appears to be a capabilities gap by focusing investment toward these gaps; or should it spread its assets to achieve some kind of parity? We do not weight the value of the various decisions that commanders face in COIN and IW—there is no evidence to show that campaign assessment or force structuring are more or less important than force protection or logistics in any one campaign or across recent COIN and IW cases. Failing to invest in any one category might be equated to a failure to support a selected range of commanders' COIN and IW decisions. However, given that the latter two are least amenable to the kinds of quantitative models and tools typically associated with M&S and operational analysis, we argue that further investment in structured techniques of similar purpose and type—*without a reconsideration of assessment and force-structuring theory*—is putting good money after bad.

We make the following resource allocation recommendations:

- **Leverage existing gap identification to help allocate investment.** DoD should reexamine the gaps in decision support identified in this report in order to better allocate M&S investment.
- **Invest selectively in campaign and strategic assessment and in force structuring.** DoD should continue to diversify investment across all four categories of support covered in this report. However, it should invest more selectively in the development of campaign assessment and force-structuring methods. More is not necessarily better for these two problem sets, at least not until the analytic community resolves the issues with theory, methods, and data described in this report.
- **Invest in efforts to help identify promising methods.** In the near term, the best investment in campaign assessment and force-structuring support is to help the community of experts—military staffs and commanders, operations research systems analysts (ORSAs), social scientists, modelers, intelligence professionals, and general researchers—discriminate between the broad categories of approaches and methods that are likely to provide effective decision support and those that are not. Once these issues have been resolved, investment can be directed to address individual methods and tools with greater confidence.

Each investment in modeling, simulation, and analysis should be predicated on the understanding that the COIN and IW mission and environment places restraints on applicability of many commonly used methods, particularly on those that require large quantities of data.



## Additional Findings

In addition to identifying issues associated with supporting different types of decisions, we also identified a range of other findings.

1. **Most decision support derives from simple analyses, not complex modeling.** This is true even while DoD and the supporting community strive to develop models and simulations in support of IW.
2. **Reachback support for COIN and IW is useful, but its role is limited.** Many commanders and analysts praised the role of reachback support for OEF and OIF, but most also noted that this support is bounded by the timeliness and remoteness of operations.
3. **Data quality for many types of data in COIN and IW is generally poor and inconsistent.** In OEF and OIF, data were generally incomplete, inaccurate, and inconsistent. Data-quality issues were sometimes manageable at the tactical level, but rarely at the strategic level.
4. **There is no clear understanding of what is meant by analysis or assessment in COIN and IW.** DoD provides a range of complex, overlapping, and sometimes-contradictory definitions for these terms, and the lack of clear delineation between the two often led to confusion and sometimes to misallocated resources in OEF and OIF.
5. **Some commanders were insufficiently prepared to use analysts or read analyses.** In many cases, OEF and OIF presented commanders with their first introduction to analysts and analyses. Many commanders were not prepared to optimize the use of their trained analysts, and could not read their analyses with a sufficiently informed and critical eye.
6. **Simulation, or wargaming, is useful for decision support in COIN and IW but has limits.** Simulation has helped analysts think through complex problems and helped prepare commanders and staffs for deployment to OIF and OEF. However, the complexity of the IW environment and the lack of good, consistent data preclude the use of simulation as an effective real-world, real-time decision support tool at the operational level (e.g., regiment or brigade) and above.