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CDR Craig T. Schauppner, USN

Paper Advisor (if Any): Prof. George Oliver

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14. ABSTRACT

One of the most difficult questions the Combatant Commander must answer while executing Stability, Security, Transition, and Reconstruction (SSTR) operations is, “How do we know if our efforts are succeeding?” Indeed, DoD Directive 3000.05, “Military Support for Stability, Security, Transition, and Reconstruction (SSTR) Operations” specifically tasks the Combatant Commanders to develop measures of effectiveness (MOEs) that evaluate the progress in achieving the goals set forth in the SSTR directive. Yet, given little guidance from senior civilian policy makers and the immense uncertainty surrounding SSTR operations, Combatant Commanders typically rely upon traditional military focused MOEs, which are easily quantifiable and militarily comprehensible. However, these traditional military MOEs fail to accurately assess the progress in SSTR operations because they attempt to answer a fundamentally systemic problem through a systematic approach. Hierarchical Holographic Modeling (HHM) is a risk-based methodology that “decomposes a large-scale system into a hierarchy of subsystems” and shows “a multidimensional, holistic view of [the] system” (Dombroski et al. 2002). This paper will

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Measuring the Immeasurable: Applying Hierarchical Holographic Modeling to Developing Measures of Effectiveness for Stability, Security, Transition, and Reconstruction Operations

by

Craig T. Schauppner

CDR USN

A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

Signature: ______________________

16 May 2006

ABSTRACT

One of the most difficult questions the Combatant Commander must answer while executing Stability, Security, Transition, and Reconstruction (SSTR) operations is, "How do we know if our efforts are succeeding?" Indeed, DoD Directive 3000.05, "Military Support for Stability, Security, Transition, and Reconstruction (SSTR) Operations" specifically tasks the Combatant Commanders to develop measures of effectiveness (MOEs) that evaluate the progress in achieving the goals set forth in the SSTR directive. Yet, given little guidance from senior civilian policy makers and the immense uncertainty surrounding SSTR operations, Combatant Commanders typically rely upon traditional military focused MOEs, which are easily quantifiable and militarily comprehensible. However, these traditional military MOEs fail to accurately assess the progress in SSTR operations because they attempt to answer a fundamentally systemic problem through a systematic approach. Hierarchical Holographic Modeling (HHM) is a risk-based methodology that "decomposes a large-scale system into a hierarchy of subsystems" and shows "a multidimensional, holistic view of [the] system" (Dombroski et al. 2002). This paper will demonstrate how HHM can be applied by the Combatant Commander's staff to develop a more accurate assessment of how well our efforts in SSTR operations are succeeding.

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Introduction

"To win victory is easy; to preserve its fruits, difficult."
- Sun Tzu[1]

The use of the term Stability, Security, Transition, and Reconstruction (SSTR) operations, as the latest in a series of monikers attempting to describe those operations that fall outside the category of major combat, serves to highlight the nebulous nature of such operations. Closely akin to Stability and Security Operations (SASO), military support to SSTR operations falls within the Range of Military Operations (ROMO) in the spectrum most familiarly known as Military Operations Other Than War (MOOTW). However, SSTR operations are not merely a subset of MOOTW. As the word "reconstruction" implies, SSTR operations must follow some type of "deconstruction" which usually results from the use of the military "to compel our enemy to do our will."[2] This subtle distinction, while seemingly minor, adds a level of complexity to planning SSTR operations and complicates the metrics with saliency and subjectivity issues. The complex, multifarious nature of Stability, Security, Transition, and Reconstruction (SSTR) operations requires a holistic approach, such as Hierarchical Holographic Modeling (HHM), to determine appropriate Measures of Effectiveness (MOEs).

One of the most difficult questions the Combatant Commander must answer while executing SSTR operations is "How do we know if our efforts are succeeding?" Indeed, DoD Directive 3000.05, "Military Support for Stability, Security, Transition, and Reconstruction (SSTR) Operations," specifically tasks the Combatant Commanders to develop MOEs that evaluate the progress in achieving the goals set forth in the SSTR directive.[3] Yet, given little guidance from senior civilian policy makers and the immense uncertainty surrounding SSTR operations, Combatant Commanders typically rely upon traditional, military focused MOEs, that are easily quantifiable and militarily comprehensible. However, these traditional military MOEs fail to accurately assess the progress in SSTR operations because they attempt to answer a fundamentally systemic problem through a systematic approach. To overcome the deficiencies of these primarily one-dimensional measures, Hierarchical Holographic Modeling (HHM) provides a risk-based methodology that "decomposes a large-scale system into a hierarchy of subsystems" and shows "a multidimensional, holistic view of [the] system."[4]

This paper will demonstrate how HHM can be applied by the Combatant Commander's staff to develop a more accurate assessment of how well the efforts in a SSTR operation are succeeding. First, this paper will provide a precise definition of what encompasses SSTR operations in order to present the framework for which a risk-based approach to determining MOEs is appropriate. Next, a review of the current and proposed MOEs in effect for measuring SSTR operations will highlight the inherent inadequacy of these traditional approaches. Finally, an adaptation of a risk management planning aid will demonstrate the utility of applying HHM to developing risk-based MOEs for SSTR operations.

SSTR Operations

"The beginning of wisdom is to call things their right name"
- Confucius[5]

SSTR operations pose a unique set of challenges for the Combatant Commander. The first and not least of which is defining those operations that comprise Stability, Security, Transition, and Reconstruction. Indeed, neither the Joint Pub 1-02, The DoD Dictionary of Military and Associated Terms,[6] nor the Joint Chiefs of Staff transformational white paper, An Evolving Joint Perspective: US Joint Warfare and Crisis Resolution In the 21st Century,[7] define the term SSTR. However, Joint Pub 3-0, The Doctrine for Joint Operations, defines the "transition phase" as that part of a major operation that immediately follows the "decisive operations phase" and is intended "to bring operations to a successful conclusion" while supporting the establishment of civil control and the rule of law.[8] Yet, to confine the definition of SSTR operations to such a narrow scope as merely a "transition phase" would disregard the preponderance of the military effort in SSTR operations which is Security and Stability Operations (SASO). In fact, DoD Directive 3000.05, "Military Support for Stability, Security, Transition, and Reconstruction (SSTR) Operations" focuses primarily on stability operations as "a core U.S. military mission" and defines those operations as "military and civilian activities conducted across the spectrum from peace to conflict to establish or maintain order in States and regions."[9] Yet, even this definition fails to encompass the totality of SSTR operations since it concentrates on only two aspects of the operation (i.e., stability and security) to the detriment and neglect of the others (i.e., transition and reconstruction).

The natural tendency for the military to focus on the SASO portion of SSTR stems from the kinetic characteristics of security and stability operations and how easily one can measure progress in such operations through traditional, military focused MOEs. However, such a tendency impedes the overall accomplishment of success in SSTR operations since efforts taken to assure security and stability often countervail those required for transition and reconstruction. For example, the use of force to quell an insurgency may provide an improved security environment in the short term but foster sectarian distrust and thus hinder the transition to a long term representative government. The difficulty arises in the attempt to measure the level of sectarian trust in a society; whereas, one can easily quantify the number of insurgent attacks and correlate that measure (presumably a negative correlation) to an increase in security patrols. However, while the latter measures attempt to capture one subtopic of SSTR operations, they fail to account for the interrelationships across the entire spectrum of SSTR objectives.

Therefore, any definition of SSTR operations must encompass more than simply a concatenation of the individual components of stability, security, transition, and reconstruction. The definition, just like SSTR operations themselves, must be regarded as more than just the sum of its parts; the definition must be considered from a holistic point of view. For the purpose of this study, SSTR operations occur across all the phases of a major operation with the preponderance of the effort following major combat or "decisive operations." This distinction is critical as it adds a level of complexity in measuring success that is not present in purely peacekeeping operations (PKO) or peace enforcement operations (PEO). As will be discussed later, measures that are applicable for determining success during major combat operations against a living, thinking enemy are inappropriate when assessing the effects of operations on an inanimate, intricate system of systems.

With the above distinction defining SSTR operations as following major combat, Joint Pub 3-0 provides some guidance for planning "Postconflict Operations." Specifically, The Doctrine for Joint Operations states: "To be effective, planning and conducting postconflict activities require a variety of perspectives and expertise and the cooperation and assistance of governmental agencies, other Services, and alliance or coalition partners."[10] The same argument applies equally to SSTR operations where the military plays a supporting role to other U.S. Government Departments and Agencies. Specifically, coordination must occur with the Department of State's Office of the Coordinator for Reconstruction and Stabilization (S/CRS), foreign governments (including the Host Nation (HN) and allied and coalition partners), International Organizations (IOs), Non Government Organizations (NGOs), and members of the private sector.[11] Each organization, including the military, brings a unique perspective to SSTR operations; a different vision for the desired end state; various strengths, weaknesses, capabilities, and requirements; and of course, alternate metrics for measuring success. In other words, the hierarchical structure of SSTR operations spans both vertically and horizontally with no clear command and control structure but rather a nebulous "unity" of effort across several, often disjoint entities.

In addition to this elaborate hierarchical structure, the Major Mission Elements (MMEs) and Essential Tasks (ETs) that comprise the "necessary and sufficient" requirements for success in SSTR operations also span a diverse spectrum of governmental services, military tasks, and professional responsibilities.[12] Table 1 below delineates some of the representative tasks from the S/CRS Post-Conflict Reconstruction Essential Tasks document. A close examination of the Essential Tasks Matrix reveals that not only are the sub-tasks nested under their particular "technical sector," but also the success or failure in one area can have profound effects in others. For example, a critical failure in the "Telecommunications" sub-area of the "Infrastructure" technical sector will certainly have adverse effects on, among others, the "Public Order and Safety" sub-area nested under "Security" as well as to the "Public Information and Communication" sub-area under "Governance and Participation." Conversely, success in one area may improve the chances for success in others; or as demonstrated previously, success in one area may actually hinder success in another. The challenge is in evaluating the effects of each sub-area and their corresponding contribution to the system as a whole.

SECURITY	***ECONOMIC STABILIZATION and INFRASTRUCTURE***
Disposition of Armed and Other Security Forces	***Economic Stabilization***
Territorial Security	Employment Generation
Public Order and Safety	Monetary Policy
Protection of Indigenous Individuals and Infrastructure	Fiscal Policy and Governance
Protection of Reconstruction and Stabilization Personnel	General Economic Policy
Security Coordination	Financial Sector
Public Information and Communications	Debt
GOVERNANCE and PARTICIPATION	Trade
Governance	Market Economy
National Constituting Processes	Legal and Regulatory Reform
Transitional Governance	Agricultural Development
Executive Authority	Social Safety Net
Legislative Strengthening	***Infrastructure***
Local Governance	Transportation
Transparency and Anti-Corruption	Telecommunications
Participation	Energy
Elections	General Infrastructure
Political Parties	Public Information and Communications
Civil Society and Media	***JUSTICE and RECONCILIATION***
Public Information and Communications	Interim Criminal Justice System
HUMANITARIAN ASSISTANCE and SOCIAL WELL-BEING	Indigenous Police
Refugees and Internally Displaced Persons (IDPs)	Judicial Personnel and Infrastructure
Trafficking in Persons	Property
Food Security	Legal System Reform
Shelter and Non-Food Relief	Human Rights
Humanitarian Demining	Corrections
Public Health	War Crime Courts and Tribunals
Education	Truth Commissions and Remembrance
Social Protection	Community Rebuilding
Assessment, Analysis and Reporting	Public Information and Communications
Public Information and Communications	

Table 1. Essential Tasks Matrix. Lists Major Mission Elements, Essential Tasks, and Sub-Tasks.[13]

During SSTR operations, Combatant Commanders often find themselves in control of a multifarious system with minimum control over all the subsystems. To complicate matters further, not only do the various hierarchies and agencies contribute to the operation differently, but also the capabilities and resources that they bring to the effort fluctuate across the spectrum of time. Figure 1 below provides a notional example of how the capabilities and resources provided by the various organizations involved in SSTR operations evolve over time.[14] Of note, while the military provides the majority of the resources immediately following a crisis, the ultimate goal is the increase in the capabilities of the local institutions.

The Combatant Commander must be keenly aware of the intersections and inflection points where there is a change in the capacity and resources dynamics. It is at these points, where there is a change in the status quo that the greatest risk for failure exists.

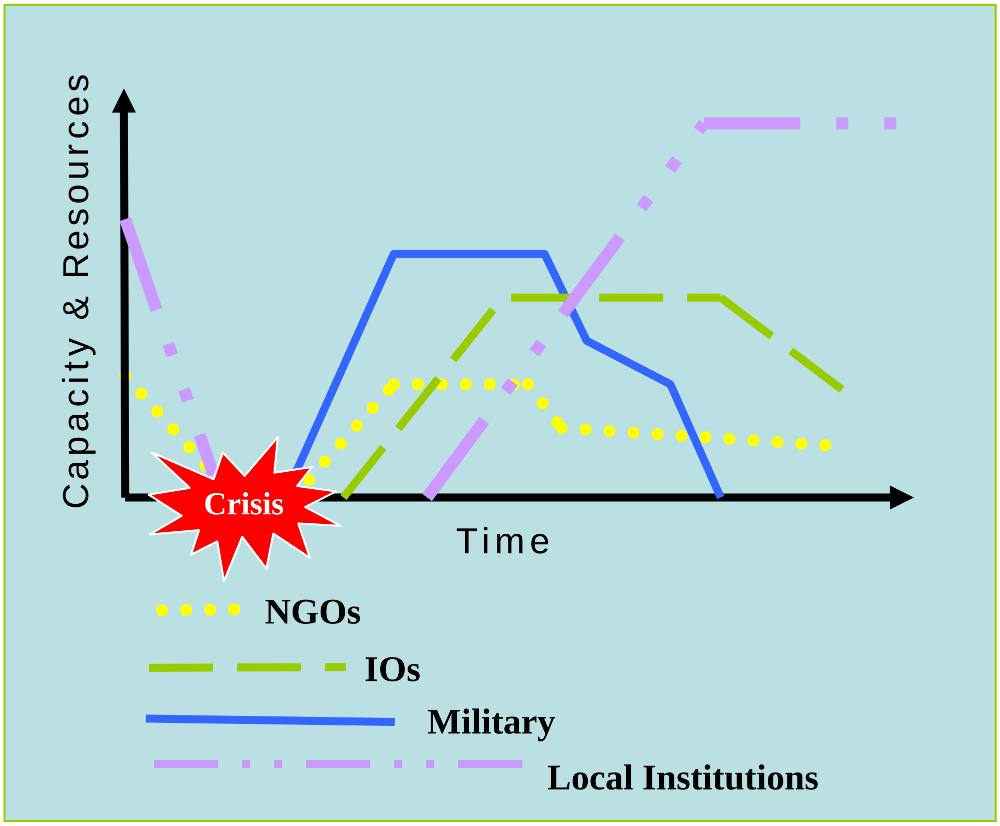


Figure 1. Capacity vs. Time. Chart depicts the level of capacity and resources contributed by the various organizations involved in SSTR operations over time.[15]

Traditional and Effects-Based Approach Measures of Effectiveness

> *"Since war is not an act of senseless passion but is controlled by the political object, the value of this object must determine the sacrifices made for it in magnitude and also in duration. Once the expenditure of effort exceeds the value of the political object, the object must be renounced and peace must follow."*
>
> *- Carl von Clausewitz*[16]

Traditionally, the military relies upon readily quantifiable and easily enumerable measures when determining success or failure in a major operation. With an objective in mind, one can begin to callously calculate the value of that object in terms of lives, equipment, effort, space and time. More importantly, in order to determine the most effective strategy, the

Combatant Commander, accepting some level of uncertainty, attempts to assess the value the enemy places on the object. Ultimately, the goal in warfare is to force the enemy to an expenditure of effort that exceeds the value of the object in terms of "the sacrifices made for it in magnitude and also in duration."[17]

With the value of the political objective as a benchmark, the Combatant Commander traditionally measures success in attaining that objective in terms of friendly resources expended and enemy resources taken or destroyed. These measures typically take the form of territory gained or loss; equipment destroyed disabled or captured; missions executed; casualties, prisoners and other changes in the order of battle on either side. These measures are attractive to the Combatant Commander because they are easily quantifiable, militarily comprehensible and behave well in mathematical modeling constructs. Through experimentation, lessons learned, test and evaluation, war gaming and exercises, a plethora of data exists that supports the planning and use of these measures when conducting major combat operations. For example, at the very micro level, a mission planner knows the probability of kill (P_k) of any given weapon delivered by a particular platform against a hardened or soft target. Post mission analysis (e.g., bomb damage assessment) determines if the mission was successful in meeting its objective (i.e., destroying the target).

However, while these measures are appropriate and necessary during the decisive phase of an operation when the enemy has a direct and opposite impact on the outcome, the same category of metrics ineffectually measures success of SSTR operations. During SSTR operations, the enemy, in a traditional sense, has already been defeated and the "opponent" becomes a complex system of systems that has no rational comprehension of value. Indeed, postconflict saliency becomes an issue when the force transitions from measuring destruction to measuring reconstruction. Furthermore, the Combatant Commander must shift the focus from what is best for his forces to fight and win, to what is best for a safe, secure, stable and self-sustaining, independent State.

In an attempt to capture the nuances of measuring success from a systems perspective, the U.S. Joint Forces Command developed an Effects-Based Approach (EBA) to Joint Operations. Table 2 below provides some pertinent definitions as they apply to measuring success in changing the behavior of a complex system.[18] This paradigm shift, from measuring physical attributes of the individual components to measuring "changes in system behavior," recognizes the inherent inanimate nature of the problem. Rather than influencing a living, thinking enemy as in the case of major combat operations, an EBA to Joint Operations "connects strategic and operational objectives with operational and tactical tasks by identifying desired and undesired effects within the operational environment (OE)."[19] In other words, an EBA attempts to control the outcome of an operation by addressing processes of a system as a whole in order to achieve the desired effect.

Measure. The degree to which an effect, action, system, node or link possesses a given attribute. (USJFCOM)

Measure of Effectiveness. A criterion used to assess changes in system behavior or capability that is tied to measuring the attainment of an end state, achievement of an objective, or creation of an effect. (JP 3-0, RFC)

Measure of Performance. A criterion used to assess friendly actions that is tied to measuring task accomplishment. (JP 3-0, Rev, 2)

Metric. A portrayal of an attribute based on two or more measures. (USJFCOM)

Table 2. Definitions from the Commander's Handbook for an Effects-Based Approach to Joint Operations.[20]

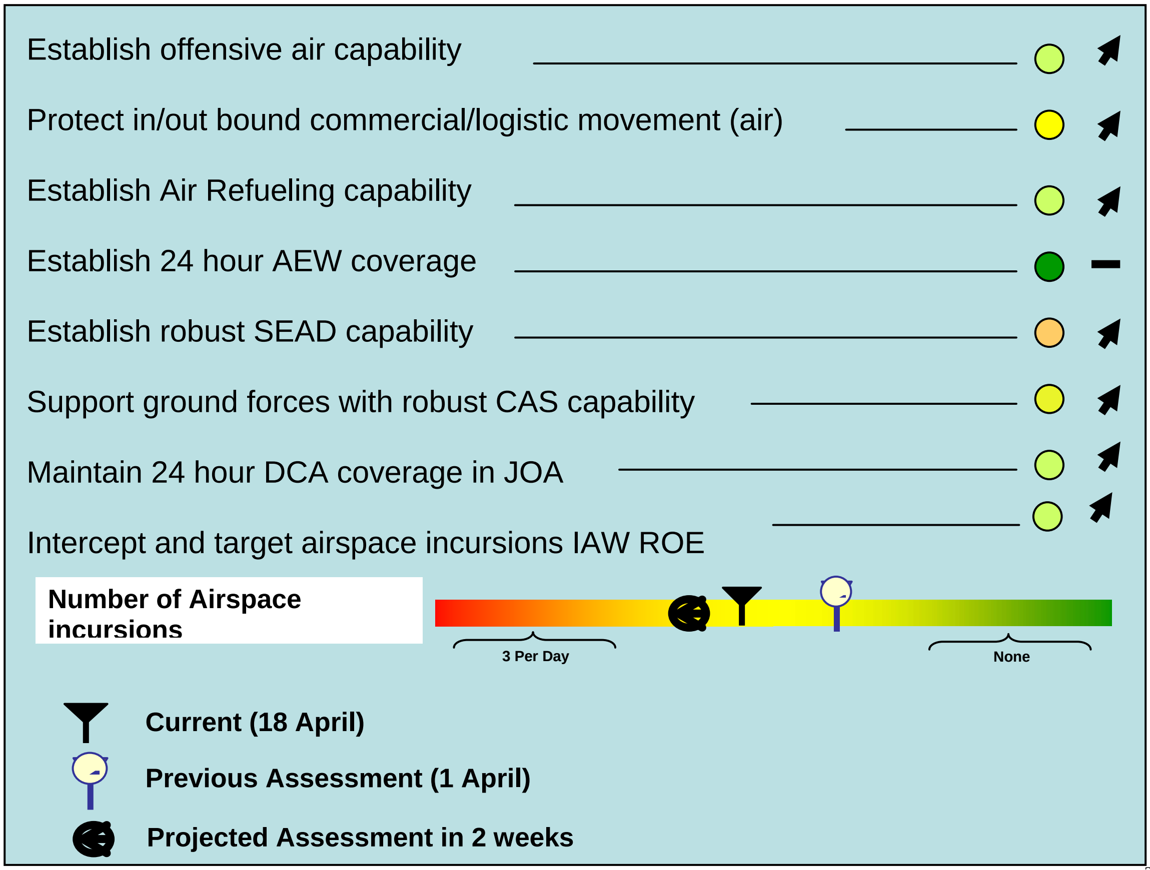


Figure 2. MOPs/MOE for Air Dominance Objective. Note that as the MOPs increase the MOE decreases.[21]

However, by simply distinguishing the difference between a Measure of Performance (MOP) and a Measure of Effectiveness (MOE) without providing a new metric system for either, the EBA fails to substantially transform the process of measuring success. Even worse, figure 2 above depicts an example where an increase in a MOP may cause the appearance of a decrease in the MOE. In this example, the objective is to establish air dominance; the MOE is the number of enemy airspace incursions; and the MOPs comprise the tasks required to establish air dominance. However, the very act of increasing the Airborne Early Warning (AEW) capability also improves the ability to recognize airspace incursions. This results in the perception of a decreasing trend (i.e., an increase in airspace incursions) in the air dominance MOE. While the flaws in this example may seem obvious, Appendix B provides examples of MOEs used in the October 2005 Report to Congress on

Measuring Stability and Security in Iraq that have the potential to inadvertently fall into the same predicament.[22]

Hierarchical Holographic Modeling (HHM)

"The object in war is a better state of peace – even if only from your own point of view."
- Sir Basil Henry Liddell Hart[23]

The Center for Risk Management of Engineering Systems at the University of Virginia developed the technique of Hierarchical Holographic Modeling (HHM) in the early 1980s as a risk analysis tool.[24] Designed to capture the intricate interdependencies of critical infrastructures, HHM was developed to overcome the impracticality of a single model's ability to represent all the important aspects of a complex system.[25] In modeling large-scale, complex systems, many acceptable mathematical and conceptual models emerge, each representing a different, yet accurate point of view.[26] The implementation of HHM allows the development of multiple, valid models that "capture the essence of the many dimensions, visions, and perspectives of infrastructure systems."[27]

Table 3 below provides a concise explanation of the terms that comprise Hierarchical Holographic Modeling. In short, HHM identifies almost every system risk and uncertainty while capturing the complexity of large, heterogeneous systems. HHM accomplishes this by decomposing the system into its individual subsystems and analyzing how each component and process interacts with each other.[28] This decomposition process facilitates the construction and analysis of a complex system by requiring the analyst to view it from multiple perspectives, including "the functions, activities, geo-political boundaries, and structures of the system."[29] In terms of the modeling constructs of HHM, the most important or high-level criteria are labeled as headtopics, and the lower level criteria nested under headtopics are considered subtopics.[30] These subtopics can be further decomposed until an analysis of the interactions among the subtopics provides a quantitative and qualitative risk assessment of the system as a whole.[31] A review of the structure for a typical HHM reveals a construct very similar to that found in the Unified Joint Task List (UJTL) and the S/CRS Essential Task Matrix (ETM) where the headtopics are analogous to the ETM technical sectors. Appendix A provides an example of an application of HHM to Military Operations Other Than War.[32]

Hierarchical refers to the need to understand risks as they appear at different levels in a hierarchy (e.g., risks at the system of systems level, the individual system level, the sub-system level and the component level). **Holographic** refers to the need to access risk from multiple perspectives (e.g., economic, security, geographic, technical, etc). The **modeling** approach is organized to deal with both holographic and hierarchical considerations and uses a formalized approach (Risk Filtering and Ranking Methodology) to prioritize risks.

Table 3. Explanation of the terms Hierarchical, Holographic, and Modeling.[33]

Since its conception and implementation, HHM has been successful in identifying risk scenarios in large-scale, complex and hierarchical systems of systems including studies for government agencies such as the President's Commission on Critical Infrastructure (PCCIP), the FBI, NASA, the Virginia Department of Transportation (VDOT), and the National Ground Intelligence Center.[34] Perhaps the most attractive and powerful attribute of HHM is how easily the model evaluates the risks associated with each subsystem, and then correlates those risks to the risks in the system as a whole.[35] In particular, HHM was specifically developed "to model the intricate relationships among the various subsystems and to account for all relevant and important elements of risk and uncertainty."[36]

Risk as a Measure of Effectiveness

> *"Circumstances vary so enormously in war, and are so indefinable, that a vast array of factors has to be appreciated – mostly in the light of probabilities alone.*
>
> *- Carl von Clausewitz*[37]

Conceptually, the idea of using risk as a measure of effectiveness in large-scale, complex systems is very well established. For example, in the financial industry, a portfolio manager attempts to diversify investments across a broad spectrum of stocks, bonds, real estate, and other instruments in order to minimize the risk, or lessen the volatility to the value of the portfolio. Similarly, the insurance industry applies complex, actuarial models to assess the likelihood of occurrence and the resultant consequences of tragic events. Automobile makers and other manufacturers deliberately engineer their products to safety standards that provide an acceptable level of risk. Likewise, the military applies operational risk management as a method to identify and mitigate risk while conducting intrinsically hazardous operations.

Metaphorically, any parent who has taught a child how to ride a bicycle understands the concept of applying risk as a MOE in SSTR operations. As long as the parent holds on to the back of the bicycle, the child remains secure but stability remains uncertain until the child builds up enough momentum to remain upright without support. If the parent lets go too early, there exists a high probability of the child falling; too late, and the child never learns to ride a bike. Before releasing the back of the bicycle, the wise parent intuitively calculates the risk of the child falling and balances that risk with the need for the child to ride without assistance. In a similar manner, during SSTR operations, the Combatant Commander must assess the level of risk involved in "letting go" and determine if there is enough "momentum" to successfully achieve the desired end state of a self reliant, stable and secure independent State.

In their study on Risk Filtering, Ranking, and Management (RFRM), Haimes et al. identify six basic questions that characterize the process of risk assessment and risk management. Three questions comprise the risk assessment process:

> What can go wrong?
> What is the likelihood of that happening?
> What are the consequences?[38]

Three questions comprise the risk management process:

> What are the available options?
> What are the associated tradeoffs?
> What are the impacts of current decisions on future options?[39]

These same questions should be asked when conducting SSTR operations, yet the complex nature of such operations makes answering those questions a daunting challenge. Fortunately, HHM provides a methodical framework for applying risk assessment and risk management to SSTR operations.

<u>Applying HHM to Develop MOEs for SSTR Operations</u>

Any MOE for SSTR operations must begin with the desired end state in mind. In other words, what conditions must be in place for the SSTR operation to be considered a success. In their work, "Fitting Hierarchical Holographic Modeling into the Theory of Scenario Structuring," Kaplan et al. define these conditions as the success scenario, S_0.[40] With this construct in mind, the HHM diagram presents a graphical representation of the success scenario where the headtopics and subtopics represent essential elements for success. Specifically, each subtopic represents a set of criteria that must be in place for the SSTR operation to be considered a success.[41] For example, considering the Essential Task Matrix (ETM) in table 1 as a rudimentary HHM, if a representative, democratic government is part of the desired end state for SSTR operations, then a self-sustaining, free electoral process must function as described under the “Governance and Participation” headtopic of the ETM. In this example, failure in the “Elections” subtopic or any other subtopic of the ETM represents a deviation from the SSTR success scenario. In terms of HHM, each subtopic represents not only an essential element but also a possible source of deviation from the success scenario, i.e., a source of “What could go wrong?” The combination of all the possible permutations of these deviations makes up the set of risk scenarios, S_i.[42]

Defining the success scenario through a HHM framework, risk can be applied as a MOE in SSTR operations by looking at the problem from an entirely different perspective. Instead of asking the inherently biased question, “Are we doing things right?” the Combatant Commander can apply HHM to answer the critical question, “What could go wrong?” The answer to the latter question is embedded in the set of risk scenarios that comprise the HHM subtopics, any one of which represents a possible failure node in the system. Conceptually, a risked-based approach for determining MOEs for SSTR operations seeks to measure the possible deviation from the success scenario vice the perceived progress towards the desired end state. The ultimate goal of a risk-based MOE is a zero percent chance of failure, i.e., the realization of the success scenario. Unfortunately, such a utopia never exists in reality; however, the probability of failure, P_f, can be objectively determined in some cases and at the very least, subjectively elicited in others.[43]

Figure 3 below, similar to an event tree, graphically depicts the deviation of the risk scenarios, S_i, from the success scenario, S_0. The deviation between S_0 and S_i can be quantified as the probability of the risk scenario occurring, P_f, times the degree of severity of such an occurrence. In a perfect world, each subtopic of the HHM would go “as planned” and the resultant end state would occur across the success scenario path, S_0. In reality, failures do occur, each with a different probability of occurrence and each with a different consequence of occurrence in terms of severity. Qualitatively, the severity of a failure event ranges from the catastrophic, which makes a successful operation impossible, to the negligible, which only presents a minor disruption to the operation. Assessing the individual risks (i.e., the probability and severity of an event occurring) across each subtopic of the HHM produces the complete set of possible risk scenario paths. Through the established mathematics of Bayesian probability theory and expert elicitation of the severity of an event occurrence, the deviation from the success scenario can be quantitatively defined.[44] Finally, the optimal course of action that seeks to minimize the risk in terms of deviation from the success scenario can be derived and success can be objectively measured.

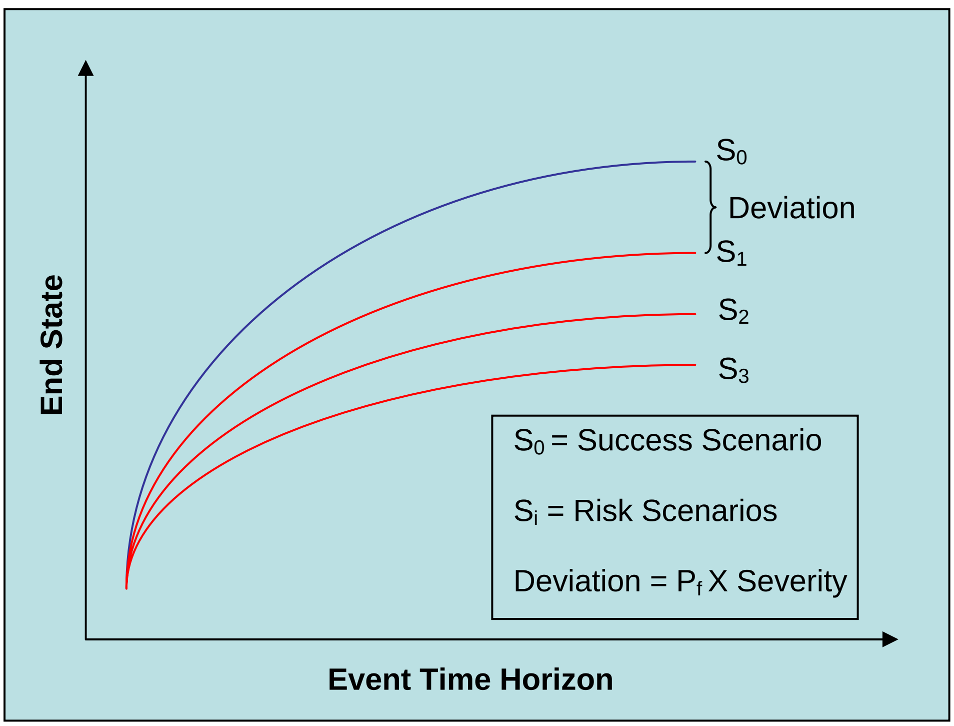


Figure 3. Graph of Success Scenario vs. Risk Scenarios. The deviation of the risk scenarios from the success scenario is quantified in terms of the probability of the risk scenario occurring and the degree of severity of such an occurrence.

As SSTR operations progress, essential tasks are completed; uncertainties and ambiguities are resolved; probabilities of success or failure become more precise; and risk assessments are refined. Ideally, assuming effective SSTR operations, the risk of failure for the individual subtopics and the system as a whole will decrease. Through HHM, the Combatant Commander's staff can decompose the complex system that makes up the SSTR success scenario; identify a large, comprehensive set of risk scenarios; assess the probability of failure and the resultant risk to the entire system and apply that risk as an objective MOE for SSTR operations.[45] Combining this risk assessment with a RFRM technique as described in Haimes et al. allows the Combatant Commander to quantitatively and qualitatively identify the greatest level of risk to the operation.[46]

Applying HHM to SSTR operations provides a two-fold benefit to the Combatant Commander. First, it facilitates the decision of how to optimally allocate limited resources in order to achieve the greatest possibility for success. Second, and for the purposes of this study, the initial risk assessment provides a baseline level from which future reassessments can measure progress towards achieving the desired end state. As SSTR operations progress, uncertainties become clearer, resulting in tighter probability distributions and a greater appreciation for how effective the operations are proceeding. Proper application of HHM can immediately recognize if the risk of failure during SSTR operations is increasing. More importantly, HHM can identify which subtopic contributes the most to the increased risk and thus allows for an immediate and effective response. Therefore, the application of Hierarchical Holographic Modeling as a Measure of Effectiveness can become a powerful tool to the Combatant Commander conducting Stability, Security, Transition, and Reconstruction operations.

Counter Argument

Some argue that the use of a risk-based approach to determining MOEs for SSTR operations takes an inherently pessimistic bias when considering success. They argue that in an attempt to determine "What could go wrong?" the Combatant Commander's staff may fail to recognize "What is going right." Additionally, such an approach may have a tendency to cause planners to be overly risk averse when conducting SSTR operations, and thus forego opportunities that may bring about an improved success scenario. Finally, some say the use of HHM as a method for determining MOEs for SSTR operations merely transposes one form of subjectivity for another. An Effects-Based Approach (EBA) to determining MOEs places subjectivity on the effect an operation has on the Operating Environment (OE). HHM, on the other hand, finds subjectivity in determining the probability or likelihood of a risk event occurring and the resultant consequences thereof.

These arguments are compelling and the use of risk as a measure of effectiveness does require a paradigm shift in the perspective from which decision makers usually view success. Instead of considering success in terms of an aggregate increase in disparate measures (e.g., number of security forces trained, megawatts of electricity generated, growth in gross domestic product) a risk-based measure of effectiveness allows the Combatant Commander to view the system as a whole not just the sum of its parts. Applying the established mathematical methods of Bayesian probability theory in a HHM construct facilitates the objective determination of the likelihood of failure. The complement to such a measure would be the probability of success ($P_s = 1 - P_f$), a more palatable and acceptable measure of effectiveness. Finally, by emphasizing critical subtopics as areas of high risk and vulnerability to the system as a whole, HHM provides the added benefit of determining where the Combatant Commander should focus his resources and efforts in SSTR operations.

Conclusion

Hierarchical Holographic Modeling (HHM) provides a unique perspective for looking at Stability, Security, Transition, and Reconstruction (SSTR) operations. In fact, HHM provides the requisite multi-perspective point of view for accurately determining appropriate Measures of Effectiveness (MOEs) in SSTR operations. Corresponding with the Effects-Based Approach (EBA) to Joint Operations, HHM takes a system of systems approach to providing the Combatant Commander with a holistic view of an intrinsically multifarious, complex problem. However, when determining the appropriate MOEs for SSTR operations, HHM approaches the problem from the objective perspective of "What could go wrong?" rather than asking the inherently biased question, "Are we doing things right?" Applying HHM techniques from the initial planning phase and continuing throughout the completion of SSTR operations provides the Combatant Commander with a consistent, objective assessment of measurable deviation from the success scenario. Using the established mathematical precepts of Bayesian probability theory, this deviation from the success scenario can be quantified in terms of the risk of failure, with the ultimate objective in a SSTR operation of minimizing the risk of not meeting the desired end state.

Recommendations

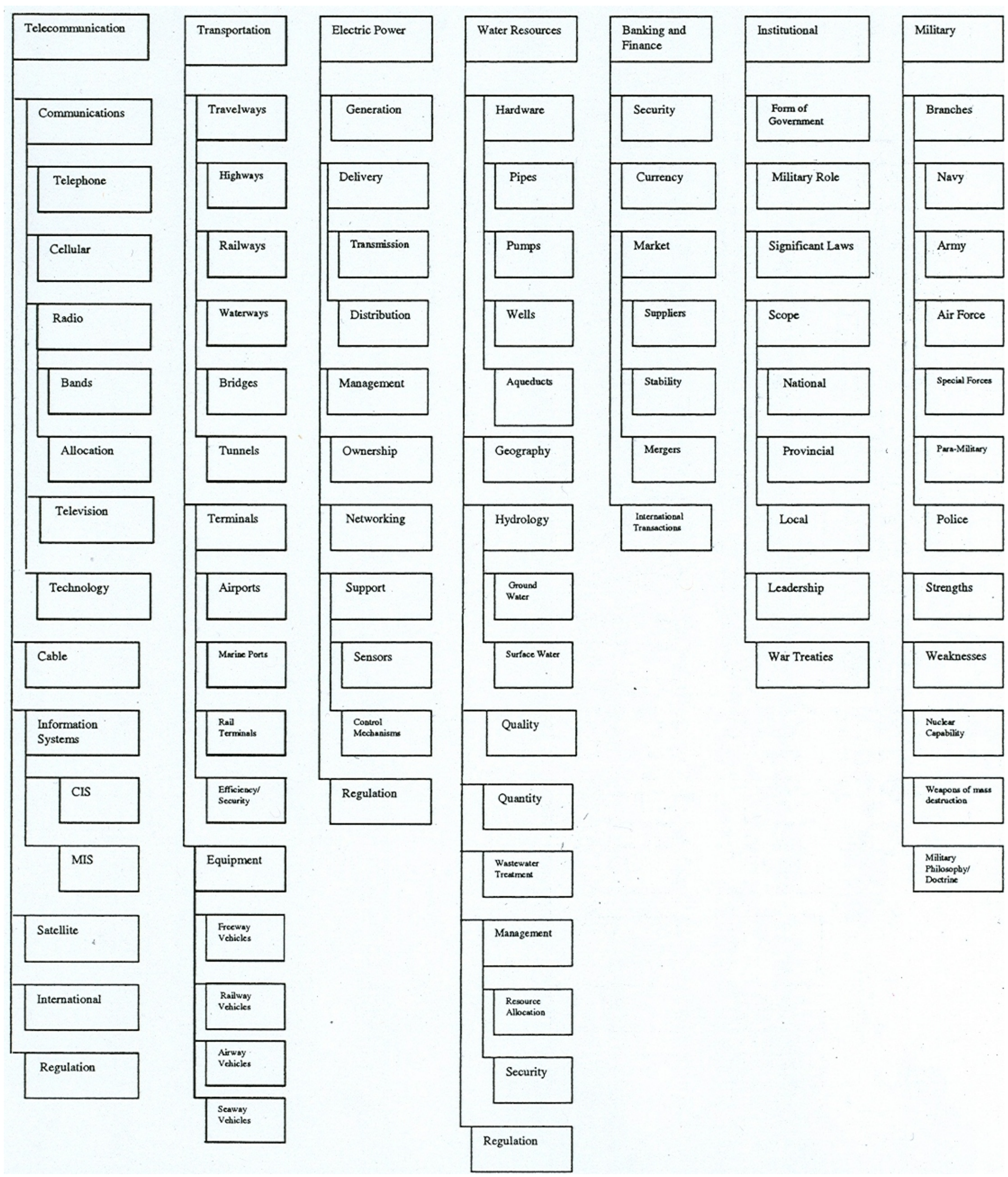
Although this paper made reference to the Effects-Based Approach (EBA) to Joint Operations when describing the paradigm shift currently taking place in planning, conducting and measuring effectiveness of an operation, the study intentionally avoided focusing on the Political, Military, Economic, Social, Information, and Infrastructure (PMESII) and

Operational Net Assessment (ONA) constructs of the EBA system of systems concept. The intent of this paper is to demonstrate the utility of applying a technique from an academic discipline outside of the Joint Doctrine and to describe how a risked-based methodology can facilitate the objective determination of MOEs for SSTR operations. The application of HHM to developing MOEs for SSTR operations requires additional research, particularly in the fields of subjective probability elicitation and Risk Filtering, Ranking, and Management (RFRM). However, the concept of applying risk as a MOE is well established and applying Hierarchical Holographic Modeling to developing Measures of Effectiveness for Stability, Security, Transition, and Reconstruction operations should be integrated into the Doctrine for Joint Operations.

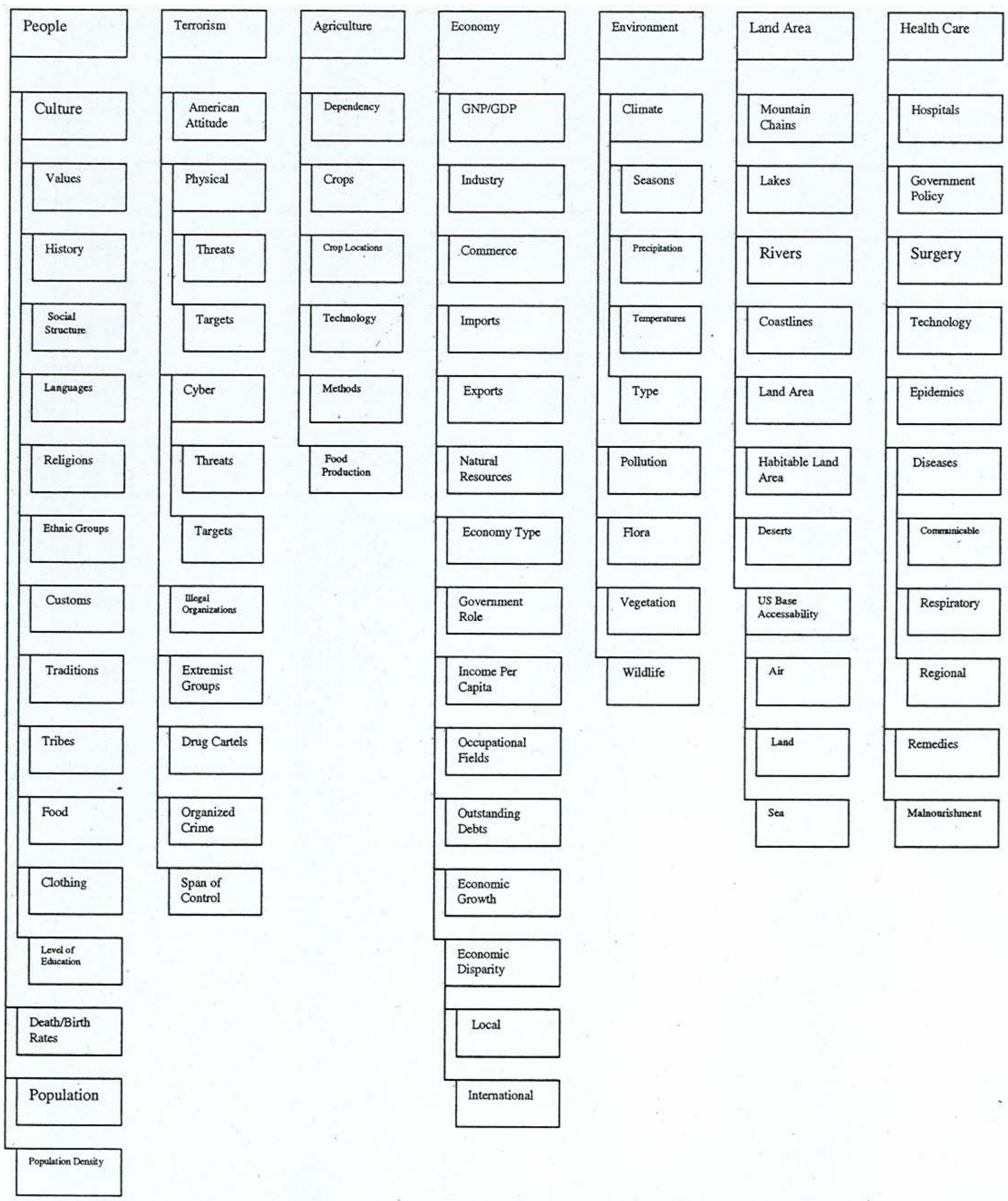
APPENDIX A

Hierarchical Holographic Model for Military Operations Other Than War[47]

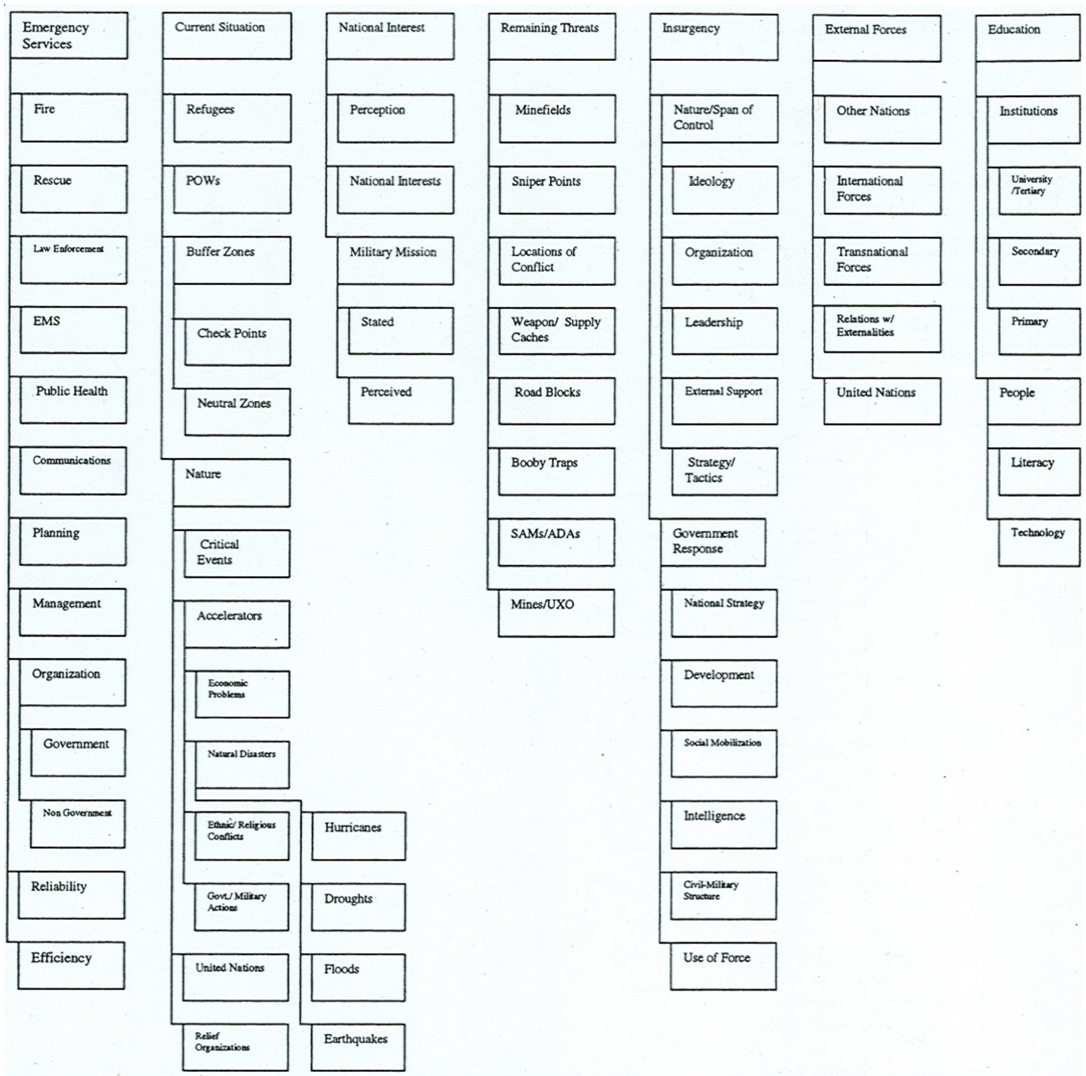
The *Country HHM* as developed by Dombroski et al. in "Risk-Based Methodology for Support of Operations Other Than War." The HHM depicts important risks to consider about the host nation from societal, technical, political, and environmental perspectives.[48]



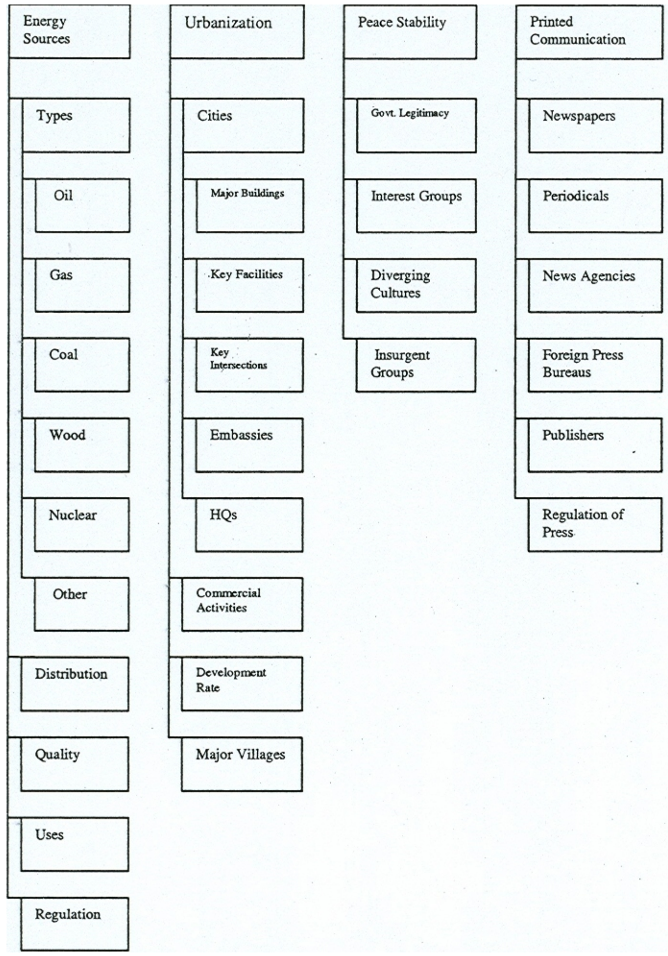
Hierarchical Holographic Model for Military Operations Other Than War (Cont)[49]



Hierarchical Holographic Model for Military Operations Other Than War (Cont)[50]



Hierarchical Holographic Model for Military Operations Other Than War (Cont)[51]



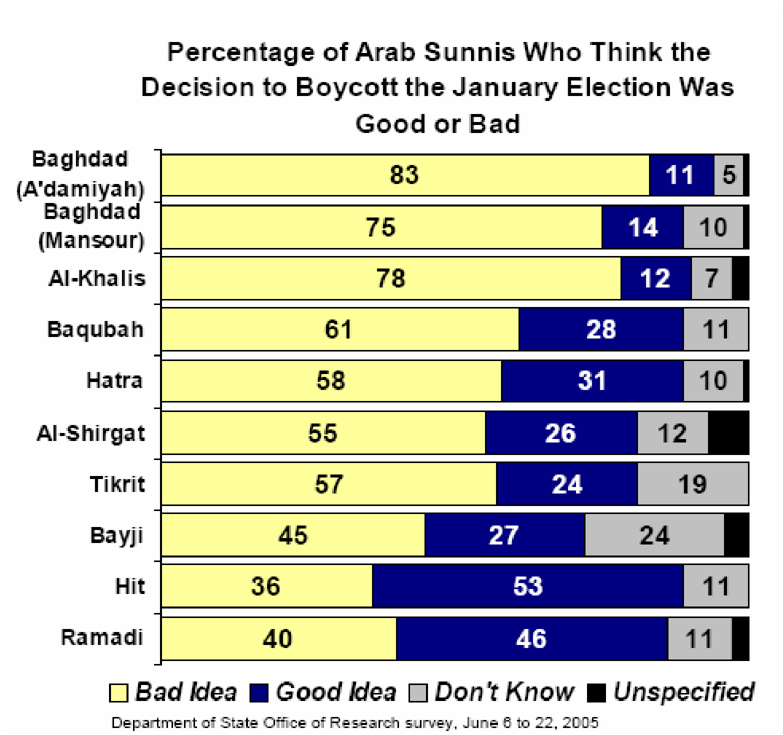
APPENDIX B

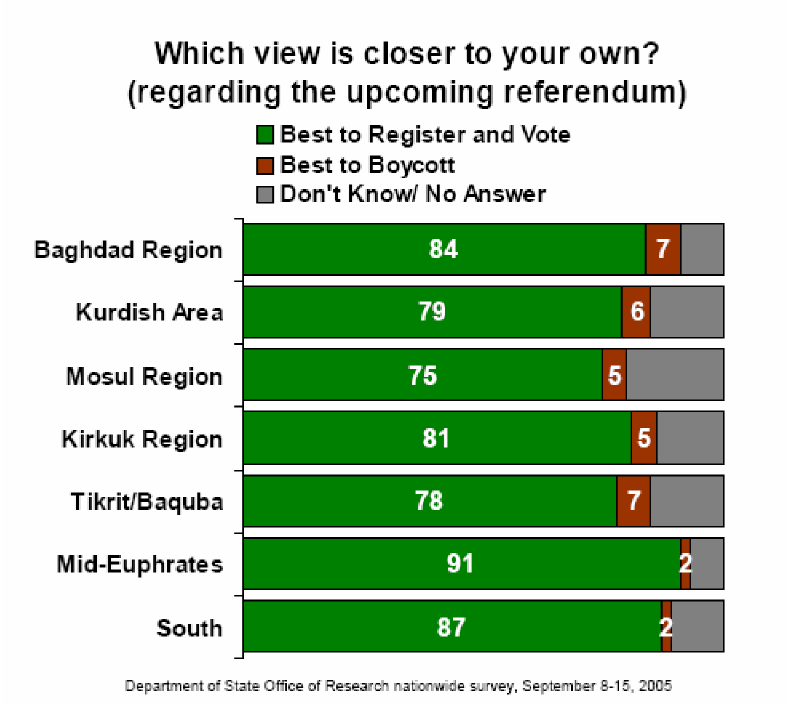
Measures for Stability and Security in Iraq[52]

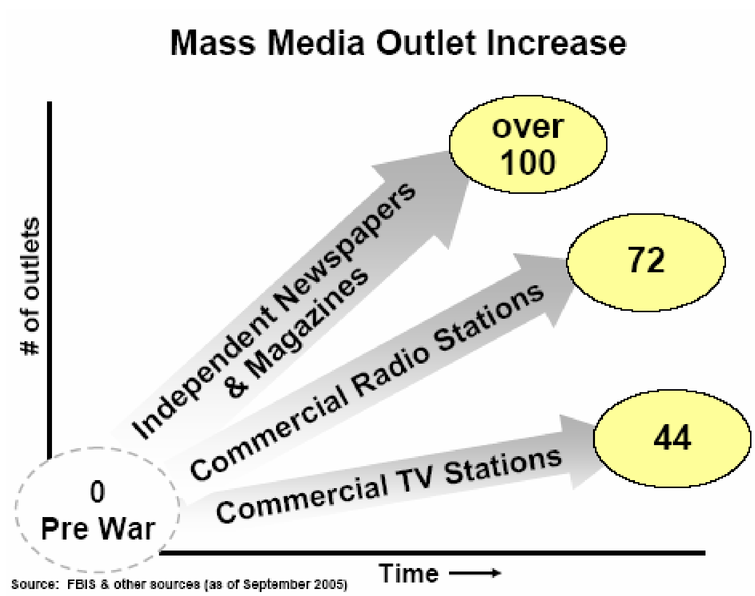
Disparate MOEs for measuring stability and security in Iraq as presented in the October 2005 Report to Congress. Note that while the following MOEs attempt to measure a broad range of subtopics for stability and security in Iraq, no measure exists to account for the interdependence among the subtopics or to measure the overall success of the efforts in Iraq as a whole.

Political Stability

Participation in the Political Process




Which view is closer to your own?
(regarding the upcoming referendum)
Best to Register and Vote
Best to Boycott
Don't Know/ No Answer
Baghdad Region
84
7
Kurdish Area
79
6
Mosul Region
75
5
Kirkuk Region
81
5
Tikrit/Baquba
78
7
Mid-Euphrates
91
2
South
87
2
Department of State Office of Research nationwide survey, September 8-15, 2005

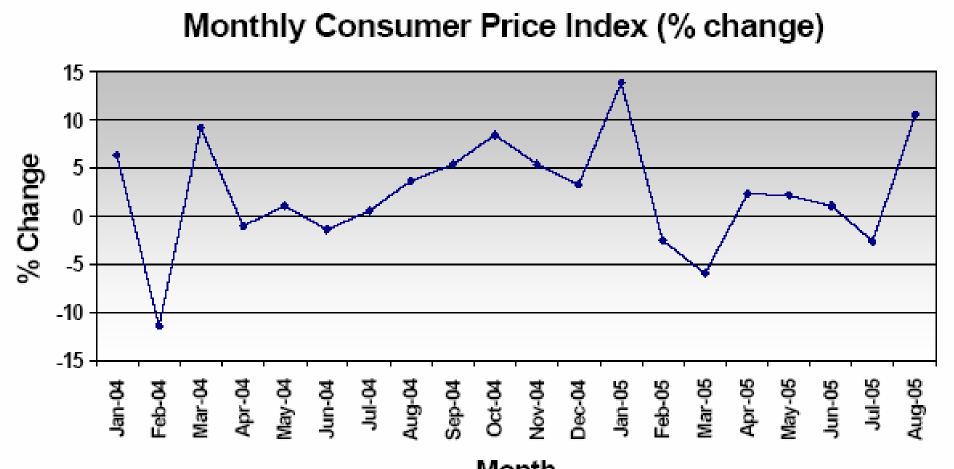

Mass Media Outlet Increase
# of outlets
over 100
72
44
Independent Newspapers & Magazines
Commercial Radio Stations
Commercial TV Stations
0 Pre War
Time
Source: FBIS & other sources (as of September 2005)

Economic Activity

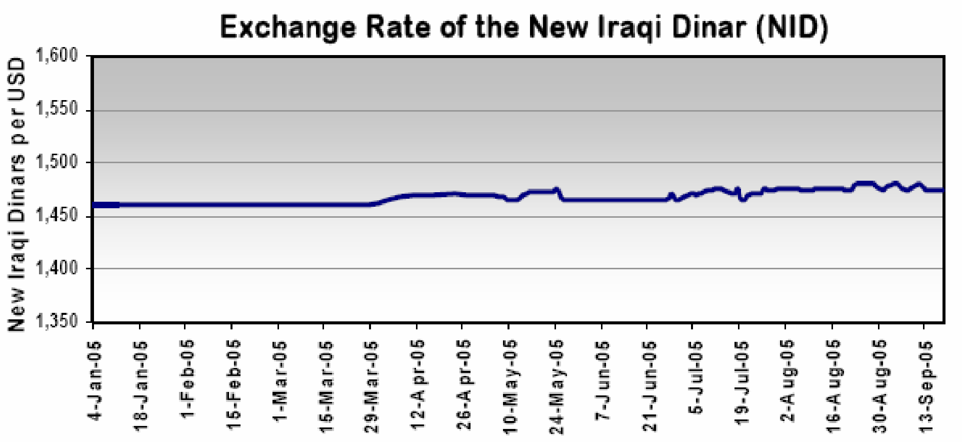
Macroeconomic Indicators

GDP Estimates and Projections, 2002-2005				
	2002	2003	2004	2005p
Population	25.5	26.3	27.1	27.9
Nominal GDP (in USD billion)	20.5	13.6	25.5	29.3
Of which non-oil GDP (%)	32	32	33	37
Real GDP Growth Rate (%)	-7.8	-41.4	46.5	3.7
Per Capita GDP (USD)	802	518	942	1,051
Consumer Price Inflation (annual average)	19	34	32	20

Source: World Bank and IMF estimates and projections (p).

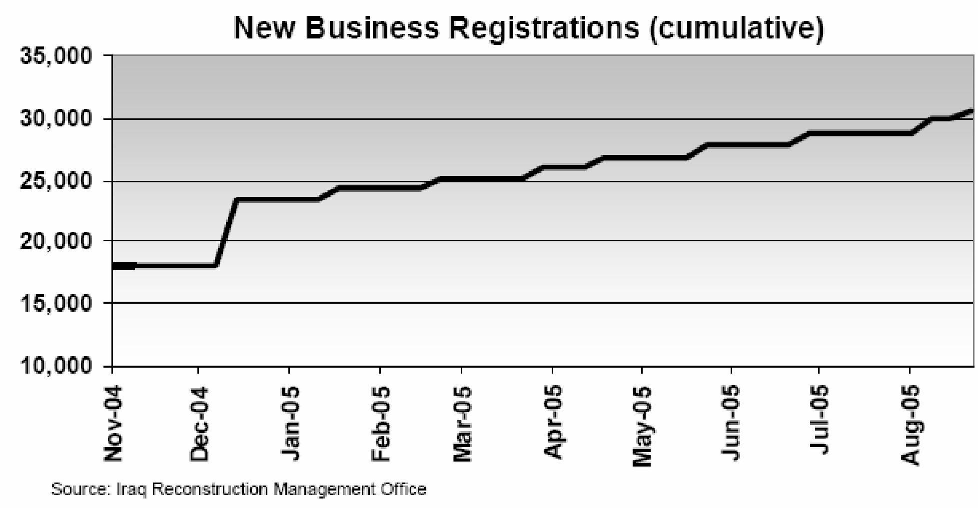


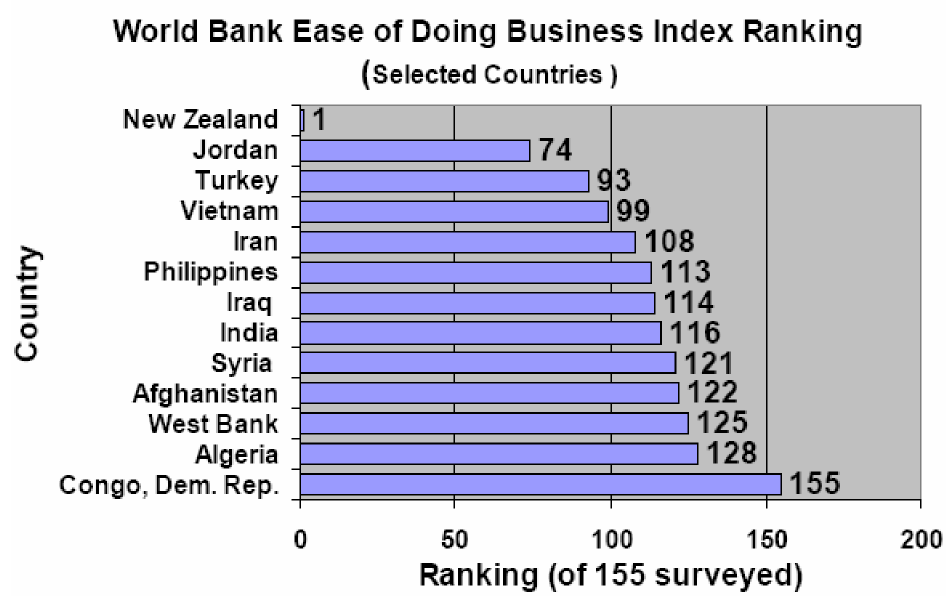
Source: Central Bank of Iraq



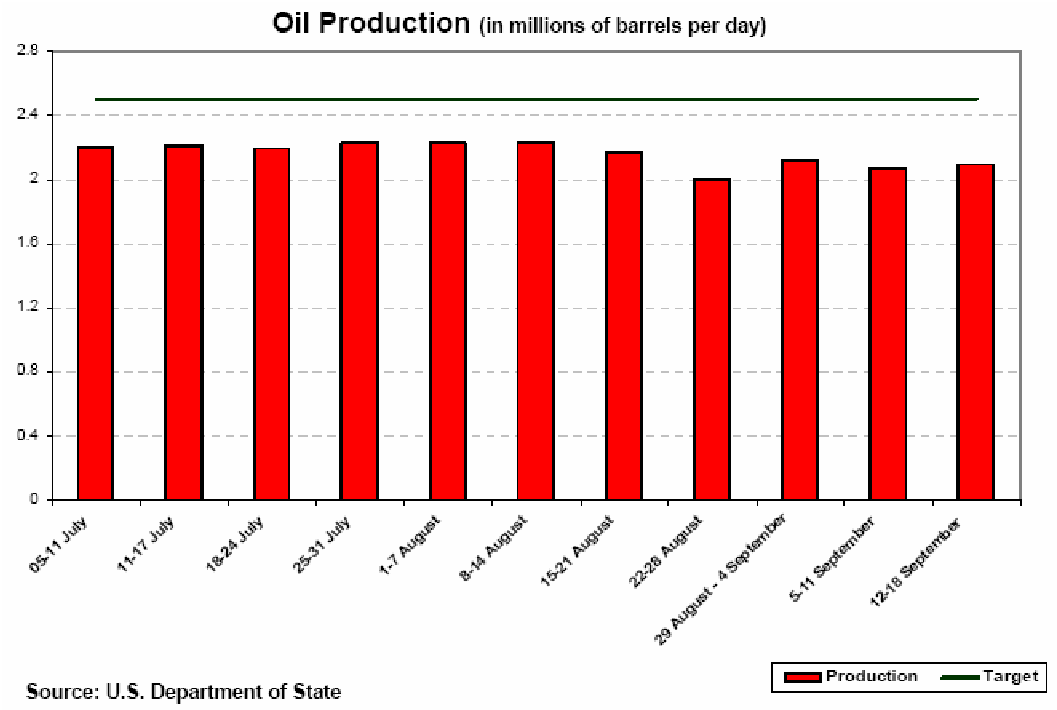
Variation in prices represents less than 2% of total value of the dinar.

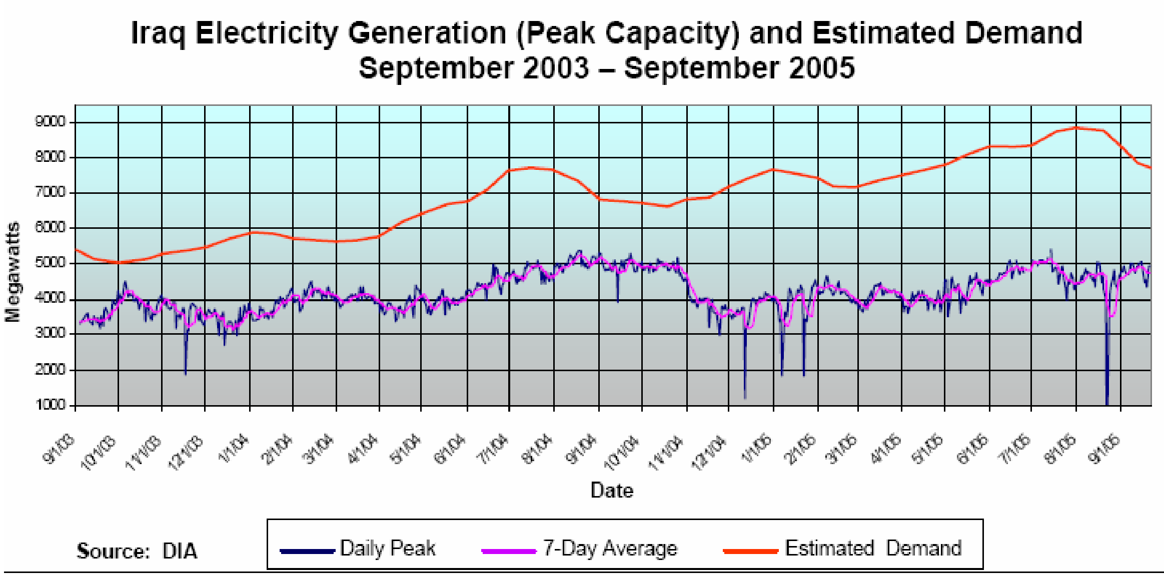
Source: Central Bank of Iraq

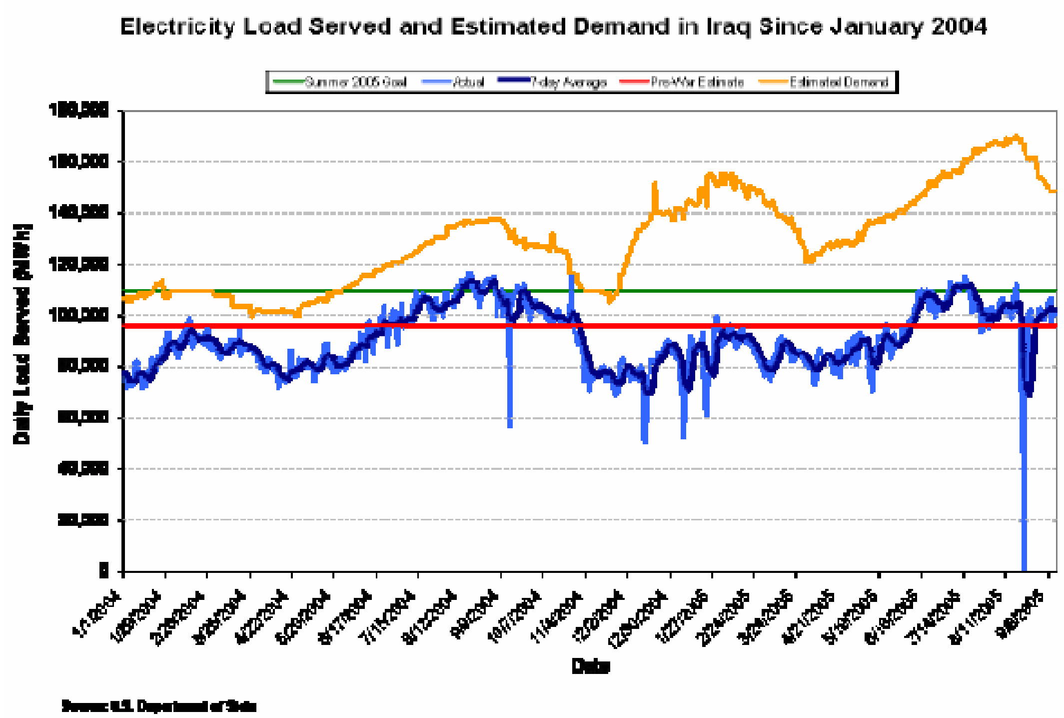

New Business Registrations (cumulative)
35,000
30,000
25,000
20,000
15,000
10,000
Nov-04
Dec-04
Jan-05
Feb-05
Mar-05
Apr-05
May-05
Jun-05
Jul-05
Aug-05
Source: Iraq Reconstruction Management Office

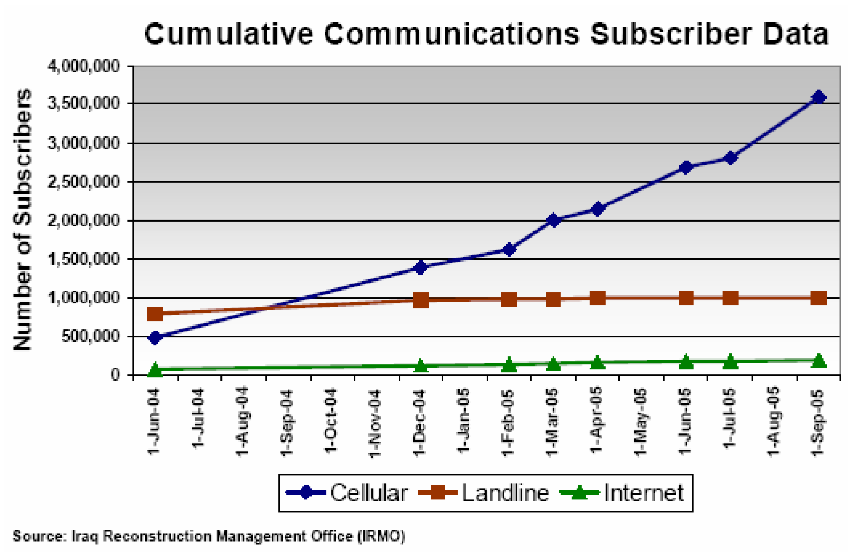

World Bank Ease of Doing Business Index Ranking
(Selected Countries)
Country
New Zealand 1
Jordan 74
Turkey 93
Vietnam 99
Iran 108
Philippines 113
Iraq 114
India 116
Syria 121
Afghanistan 122
West Bank 125
Algeria 128
Congo, Dem. Rep. 155
0
50
100
150
200
Ranking (of 155 surveyed)

Sector Indicators



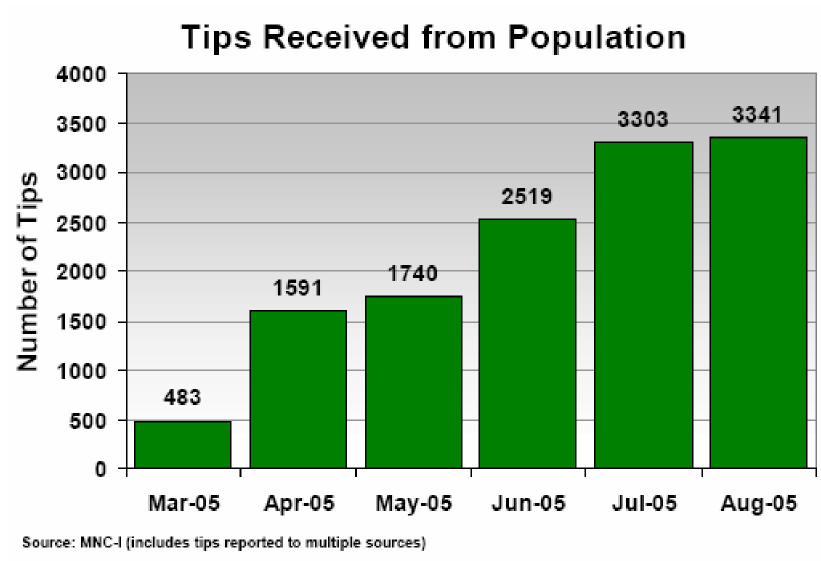



Electricity Load Served and Estimated Demand in Iraq Since January 2004
Summer 2005 Goal
Actual
7-day Average
Pre-War Estimate
Estimated Demand
Daily Load Served (MWh)
Date

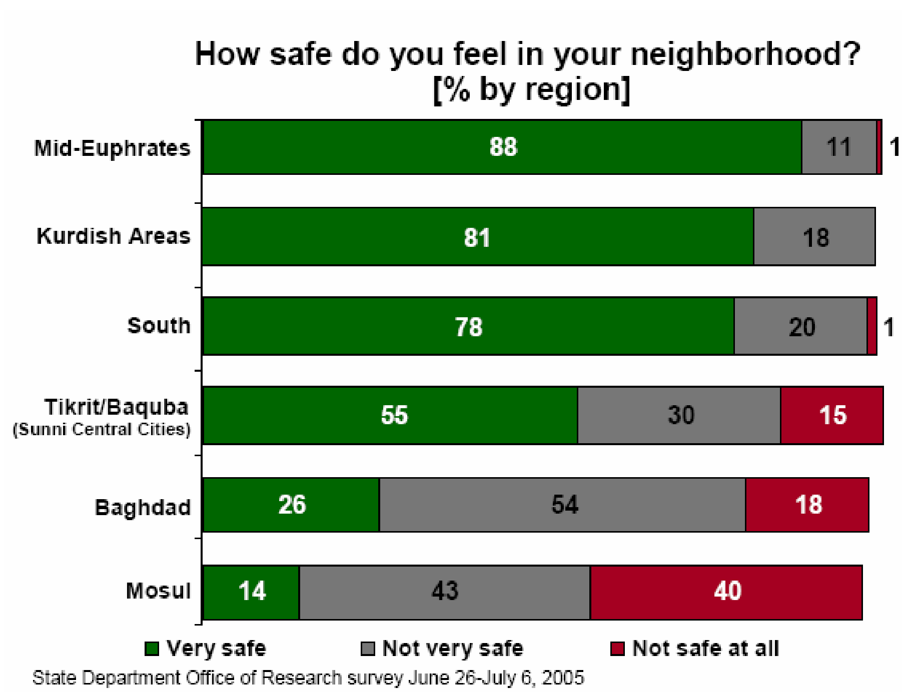

Cumulative Communications Subscriber Data
Number of Subscribers
4,000,000
3,500,000
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
0
1-Jun-04
1-Jul-04
1-Aug-04
1-Sep-04
1-Oct-04
1-Nov-04
1-Dec-04
1-Jan-05
1-Feb-05
1-Mar-05
1-Apr-05
1-May-05
1-Jun-05
1-Jul-05
1-Aug-05
1-Sep-05
Cellular
Landline
Internet
Source: Iraq Reconstruction Management Office (IRMO)

Security Environment

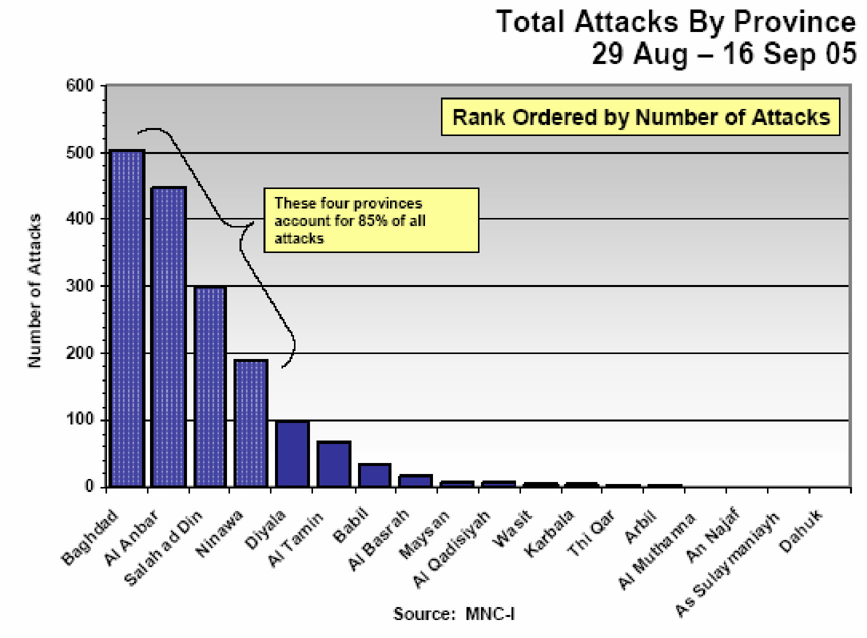
The Insurgency

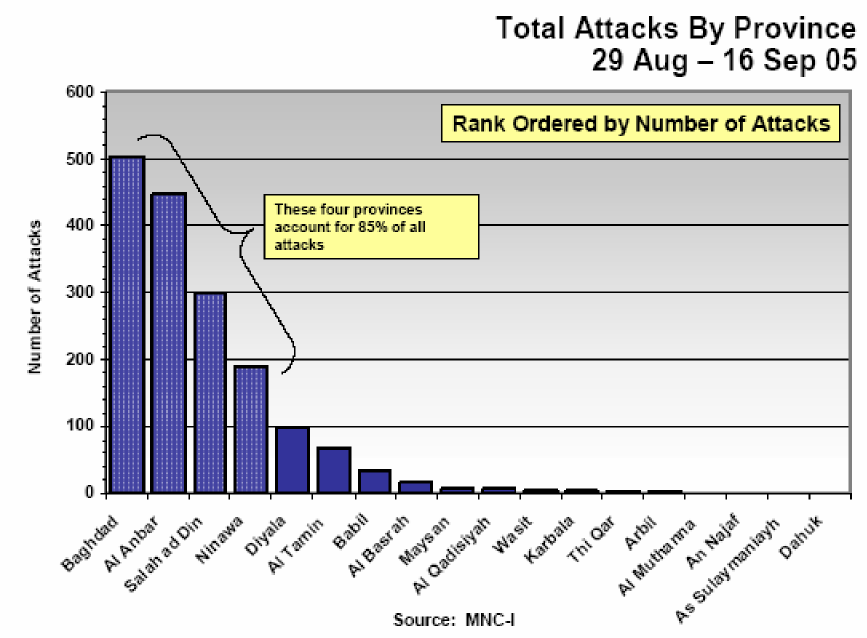


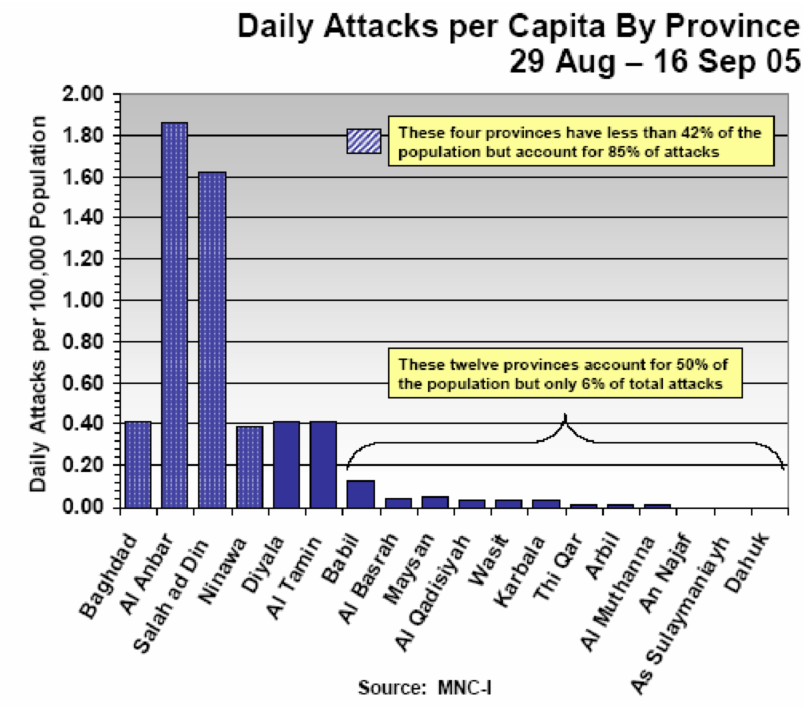
Iraqi Perception of Security

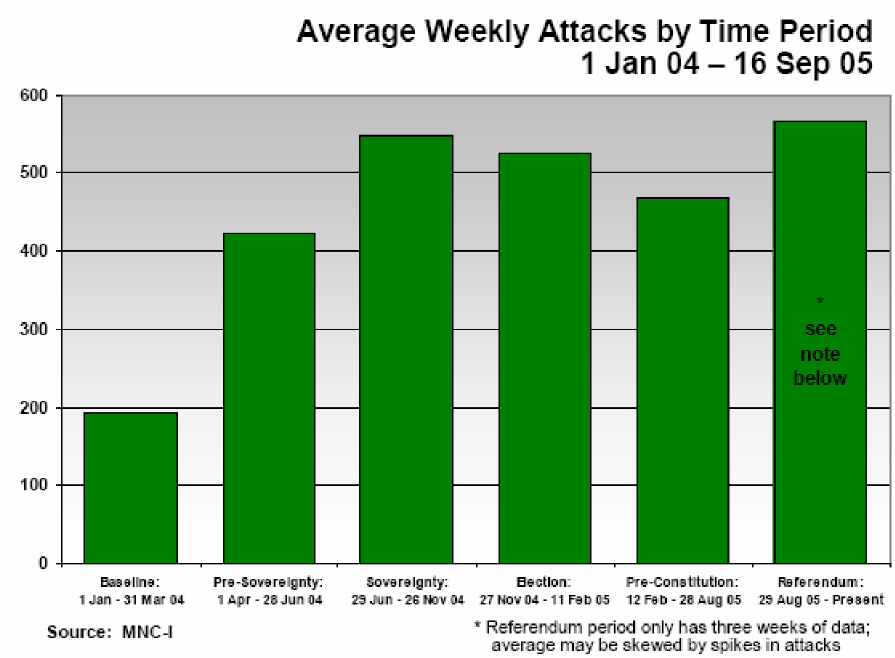


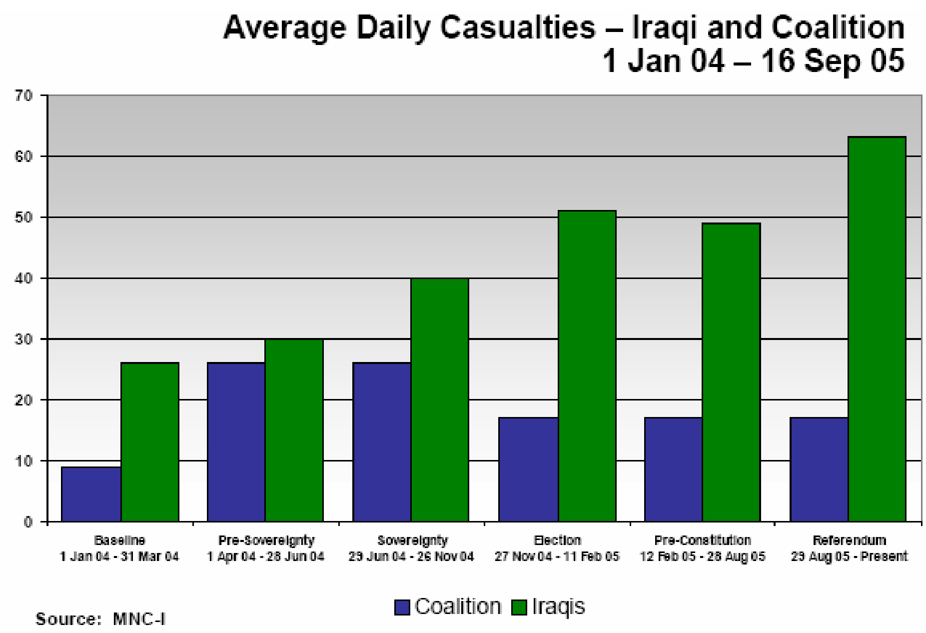
Attack Trends



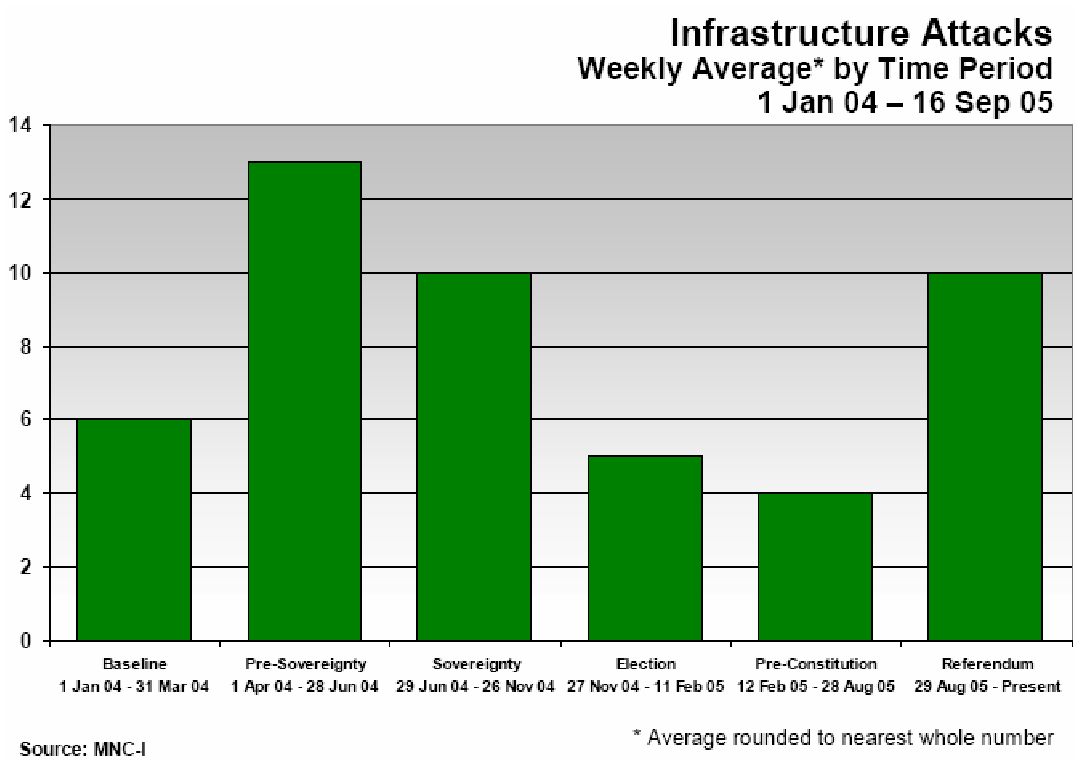

Total Attacks By Province
29 Aug – 16 Sep 05
Rank Ordered by Number of Attacks
These four provinces account for 85% of all attacks
Number of Attacks
600
500
400
300
200
100
0
Baghdad
Al Anbar
Salah ad Din
Ninawa
Diyala
Al Tamin
Babil
Al Basrah
Maysan
Al Qadisiyah
Wasit
Karbala
Thi Qar
Arbil
Al Muthanna
An Najaf
As Sulaymaniayh
Dahuk
Source: MNC-I


Daily Attacks per Capita By Province
29 Aug – 16 Sep 05
Daily Attacks per 100,000 Population
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
These four provinces have less than 42% of the population but account for 85% of attacks
These twelve provinces account for 50% of the population but only 6% of total attacks
Baghdad
Al Anbar
Salah ad Din
Ninawa
Diyala
Al Tamin
Babil
Al Basrah
Maysan
Al Qadisiyah
Wasit
Karbala
Thi Qar
Arbil
Al Muthanna
An Najaf
As Sulaymaniayh
Dahuk
Source: MNC-I


Average Weekly Attacks by Time Period
1 Jan 04 – 16 Sep 05
600
500
400
300
200
100
0
* see note below
Baseline: 1 Jan - 31 Mar 04
Pre-Sovereignty: 1 Apr - 28 Jun 04
Sovereignty: 29 Jun - 26 Nov 04
Election: 27 Nov 04 - 11 Feb 05
Pre-Constitution: 12 Feb - 28 Aug 05
Referendum: 29 Aug 05 - Present
Source: MNC-I
* Referendum period only has three weeks of data; average may be skewed by spikes in attacks



Infrastructure Attacks



Security Forces Training and Performance

Current Status

Current Status of Trained and Equipped Iraqi Security Forces

Ministry of Defense Forces*

COMPONENT	OPERATIONAL
ARMY	~86,900
AIR FORCE	~200
NAVY	~700
TOTAL	~87,800

Ministry of Interior Forces**

COMPONENT	TRAINED & EQUIPPED
POLICE	~68,800
HIGHWAY PATROL	
OTHER MOI FORCES	~35,500
TOTAL	~104,300

Total Trained & Equipped ISF:

~192,100

Data as of 19 Sep 05

Note: Numbers in this report are estimates derived from reports provided by Iraqi Security Forces.

***Ministry of Defense Forces:** Absent Without Leave (AWOL) personnel are not included in these numbers. Unauthorized absences are no longer impacting operations. The Army component includes the operational totals of the combat battalions, special operations forces, combat support/combat service support/training units, and the Strategic Infrastructure Battalions.

****Ministry of Interior Forces:** Exact Absent Without Leave (AWOL) personnel numbers are unknown. However, embedded Special Police Transition Teams (SPTTs) and the Police Partnership Program (P3s) are gaining better fidelity on MOI present for duty status. As a result, all known police AWOL and causalities have been dropped from the rolls and are not included in these numbers.

Readiness of Iraqi Security Forces

Estimated MOD Forces Capabilities

COMPONENT	IRAQI UNITS ACTIVELY CONDUCTING COUNTER INSURGENCY OPERATIONS	
	Battalions Fighting Side by Side with Coalition Forces	Battalions in the Lead with Coalition Support or Fully Independent
Iraqi Army and Special Operation Combat Forces	52	36
	IRAQI UNITS ACTIVELY SUPPORTING COUNTER INSURGENCY OPERATIONS	
Combat Support, Combat Service Support and Training Units	2	3
Air Force	0	3
Navy	0	2

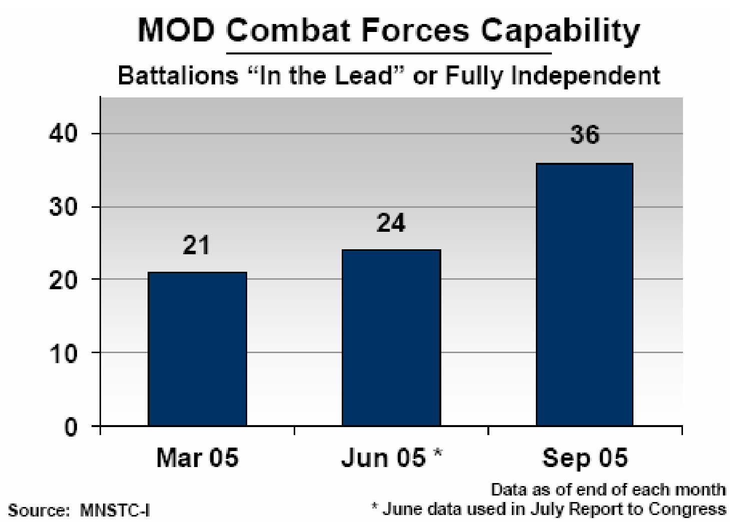
Data as of: 19 September 05

Estimated MOI Special Police Forces Capabilities

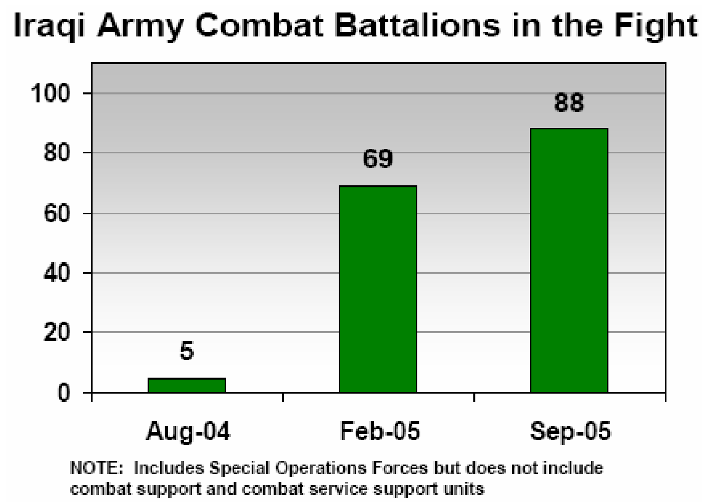
COMPONENT	IRAQI UNITS ACTIVELY CONDUCTING COUNTER INSURGENCY OPERATIONS	
	Battalions Fighting Side by Side with Coalition Forces	Battalions in the Lead with Coalition Support or Fully Independent
Public Order Battalions	12	0
Mechanized Battalions	2	1
Special Police Commando Battalions	12	0
Emergency Response Unit	0	1

For conventional police forces, transition readiness has not yet been assessed.
Data as of: 19 September 05

Progress of Iraqi Security Forces



Iraqi Ministry of Defense Forces



NOTES

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[5] Ancient Chinese Proverb.

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[14] George Oliver, "JMO III-06 NGO-IOs," Seminar Presentation, U.S. Naval War College, Newport, RI: 1 May 2006, 4.

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[20] Ibid., GL-6.

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[24] Yacov Y. Haimes, "Hierarchical Holographic Modeling," IEEE Transaction on Systems, Man, and Cybernetics, 11(9) (1981): 606-617.

[25] Yacov Y. Haimes, Stan Kaplan, and James H. Lambert, "Risk Filtering, Ranking, and Management Framework Using Hierarchical Holographic Modeling," Risk Analysis, 22(2) (2002): 385.

[26] Ibid.

[27] Ibid.

[28] Dombroski, 20.

[29] Keith R. Hayes, "Final Report: Inductive Hazard Analysis for GMOs," Australian Government Department of the Environment and Heritage Publications, (23 June 2005): 1. <http://www.deh.gov.au/settlements/publications/biotechnology/hazard/hierarchical.html> [3 May 2006].

[30] Dombroski, 20.

[31] Hayes, 1.

[32] Dombroski, 22-25.

[33] Steven C. Davis, and Barry M. Horowitz, "Intelligence Tracking and Relationship Analysis for Counter Terrorism (ITRACT)," Intelligence Analysis Methodology and Process Description (Charlottesville, VA: 18 July 2003), 8. <http://web-services.gov/ITRACT_XMLWorkinggroup(7-18-03).ppt> [3 May 2006].

[34] Haimes et al., 385.

[35] Ibid.

[36] Ibid.

[37] Clausewitz, 112.

[38] Ibid., 386.

[39] Ibid., 388.

[40] Stan Kaplan, Yacov Y. Haimes, and B. John Garrick, "Fitting Hierarchical Holographic Modeling into the Theory of Scenario Structuring and a Resulting Refinement to the Quantitative Definition of Risk," Risk Analysis, 21(5) (2001): 809.

[41] Haimes et al., 386.

[42] Kaplan, 810.

[43] For an illustrative example of determining the quantitative probability of a risk scenario occurrence, see Haimes et al., 394-396. The example provides an analysis of the risk scenarios/subtopics nested under the Telecommunication headtopic for a Military Operation Other Than War.

[44] For a thorough explanation of the application of Bayesian Theory in a HHM framework, see Florentine et al., "A Risked-Based Methodology for Combating Terrorism," Proceedings of the 2003 Systems and Information Engineering Design Symposium, (2003): 157-166.

[45] Ibid.

[46] Haimes et al., 384.

[47] Dombroski, 22.

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[50] Ibid., 24.

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