Analysis of Smaller Scale Contingencies Using the SABRINA Model

Mr. Danny Sanders

AT&T Government Solutions, Inc.
Arlington, Virginia, U.S.A.
e-mail: danny.sanders@osd.mil

Danny Sanders is a Senior Operations Analyst supporting the Office of the Secretary of Defense Program Analysis and Evaluation Directorate in the analysis of Smaller Scale Contingencies (SSCs). He has worked on the application of Operation Research techniques to SSC analysis since 1999, following his retirement from the U.S. Army. He has been involved in a number of major Department of Defense (DoD) reviews including the 1997 Quadrennial Defense Review (QDR), The Deep Attack Weapons Mix Study, the army's Munitions Requirement Study, and the 1997 Army Advanced Warfighting Experiment (AWE). He has most recently worked on developing and expanding the SABRINA model to address program review issues for DoD. In addition, he serves as a member on the NATO Studies, Analysis, and Simulation (SAS) Panel – 027 (Analysis of Smaller Scale Contingencies). He earned a Bachelor of Science in Mathematics from Florida A & M University in 1973 and a Masters of Science in Operations Research from Florida Institute of Technology in 1979.

ABSTRACT

This paper represents an effort to explore various SABRINA development initiatives based on current and projected global postures of engagement relative to SSCs. During the past decade, DOD and many other international defense agencies have been embroiled in a never-ending series of smaller scale contingencies (SSC). Conventional wisdom has it that these operations have pushed defense planners dangerously close to shortchanging key defense needs in the scramble to meet SSC requirements. SSC analysis presents significant challenges because of problems with methodology, data, and models. The U.S. DoD (OSD/PA&E) in cooperation with the UK (Dstl) have developed numerous enhancements to SABRINA to help better determine if there are problems with recent and anticipated levels of SSC commitment, where those problems are, and what solutions there might be to these problems. This paper will provide the current status and interim results relative to this effort.

OFFICE OF THE SECRETARY OF DEFENSE FOR PROGRAM ANALYSIS & EVALUATION

The Office of the Secretary of Defense (OSD) for Program Analysis & Evaluation (PA&E) provides independent analytic advice to the Secretary of Defense regarding alternative weapon systems and force structures, the development and evaluation of defense program alternatives, and the cost-effectiveness of defense systems. The office also conducts analysis and offers advice in a number of related areas, such as military medical care, school systems for military dependents, information technology, and defense economics. Consistent with its advisory role, the office has no decision authority or line responsibility and has no vested interest in any sector of the defense budget.

The office is also responsible for the management of the programming system, including development of planning and programming guidance (in conjunction with other organizations within the Office of the Secretary of Defense) and direction of the annual program review. The ultimate product of the program review is the Future Years Defense Program – the authoritative statement of what the Department plans, year by year, by way of force structure (how many ships, brigades and divisions, aircraft squadrons and wings, etc., we will operate), procurement (how many ships, tanks, aircraft, missiles, etc., we will buy), manpower (how many people, military and civilian, we plan to employ in each of the services and defense agencies), other supporting programs (such as R&D and military construction), and what it will all cost.

STATUS REPORT

The current OSD (PA&E) Regional Assessments and Modeling Division work on Analysis of Smaller Contingencies began in earnest at Cornwallis IV in March 1999. The initial concept for SSC analysis was presented at the conference. The presentation suggested cooperation in the Context of Long Term Planning for SSC with various nations. The project was intended to develop an understanding of the effects of multiple SSC on Department of Defense (DoD) over time. Additionally, there was quite a bit of interaction with other participants of the conference. The conference provided excellent opportunities to examine problems and possible ways forward. The conference provided the forum which resulted in the highly successful cooperation with UK DERA and acquisition of the UK developed Substitution and Basic Resource Inventory Allocator (SABRINA) model for analysis of multiple SSC over time.

Since Cornwallis IV, there have been a number of notable developments. In cooperation with the four services we have begun to build a joint and agreed upon US DOD historical contingency database. NATO and PfP nations continue to share analytical techniques, models, and data on SSC analysis under Research & Technology Board Studies, Analysis, and Simulation (SAS) panel for SSC Analysis (SAS-027). Continued interactions with the UK on SABRINA and significant investments in both time and money enhancing SABRINA have made it a tool capable of analyzing large force structures over significant periods of time. SABRINA's capabilities were demonstrated during the development of databases and insights as a result of the highly successful Joint Staff led wargame series on SSCs — Dynamic Commitment.

SABRINA ANALYTICAL METHODOLOGY

SABRINA is a resource allocation simulation with the capability to allocate military and non-military units to scenarios in accordance with pre-defined requirements. Substitution of units is allowed and multiple concurrent scenarios can be run over any time period. SABRINA can be easily modified to accommodate multiple alternative futures that may include changes in the force structure and/or scenarios (number, size, location, timing, and frequency). It is also possible to establish multiple orders of battle (ORBATS) for the same set of SSCs in order to determine sensitivities to alternative force structures. The SABRINA modeling process starts out with a resource pool from which it draws assets to fill scenario requirements. If the required unit is available, SABRINA allocates that unit to the scenario and the scenario passes without substitution. If the required unit is unavailable, SABRINA determines if a user defined substitute is available, if so SABRINA allocates the substitute unit and that scenario passes with substitutes. If a substitute unit is unavailable, SABRINA determines if there is a unit available using the minimum (vice normal) recovery period. If the required unit is available using the minimum recovery period, then SABRINA allocates that unit to the scenario and that scenario passes using minimum recovery period, otherwise the scenario fails. Figure 1 illustrates the SABRINA model logic.

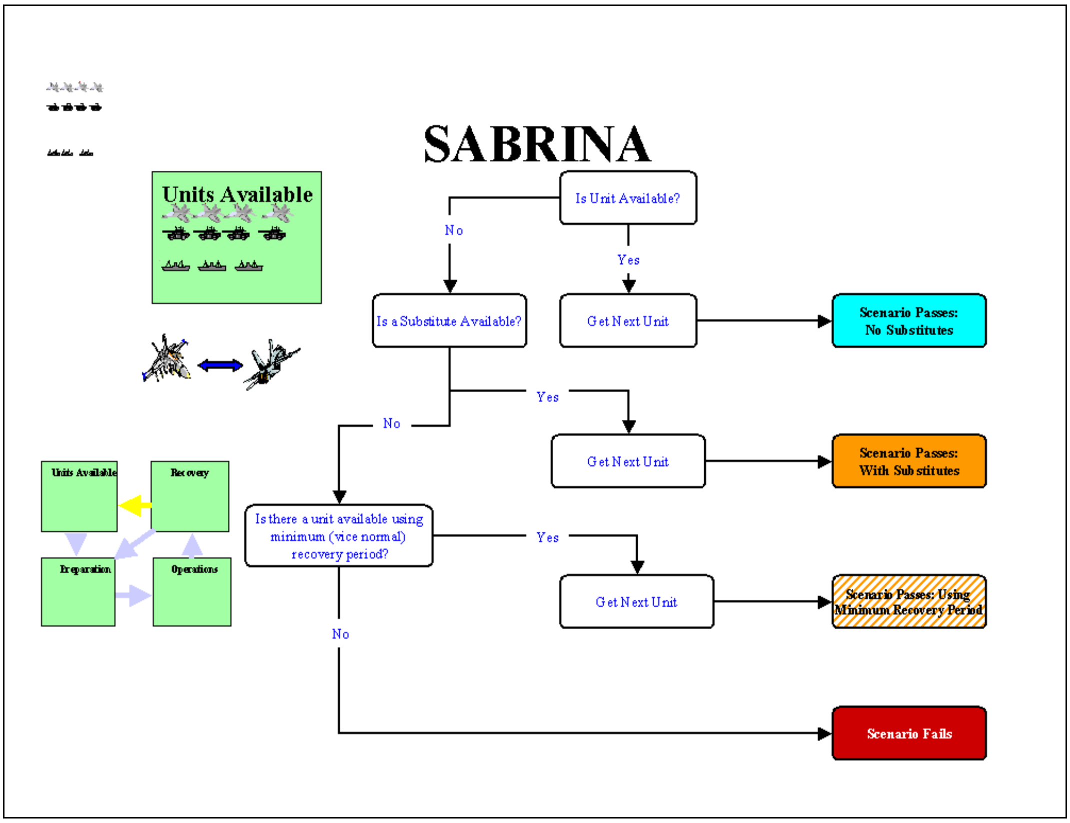

Figure 1: SABRINA Flow Diagram.

SMALLER SCALE CONTINGENCY ANALYSIS

ISSUES TO BE ADDRESSED USING SABRINA

How can concerns about the "over stretch" of U.S. forces be reconciled with the fact that the U.S. has a defense capability of approximately 1.4 million active and 850 thousand reserve military personnel that appears sizable relative to SSC force requirements? How can we analytically determine if there is a problem with the recent and anticipated future levels of commitment. If there is a problem, where the problems are in the U.S. force structure and the solutions for fixing them. If the problem is overstated, how can we demonstrate and document this analytically.

The following issues need to be addressed quantitatively to better understand the scope of the problem at hand. However, the remainder of this paper focusses on the first issue below.

- What specific units in total DoD inventory are most stressed by SSC operations?
  - Depict degree of stress quantitatively from greatest to least for any given postulated set of multiple concurrent SSCs over multi-year time period.
  - Depict how stress varies with changes in numbers, size, and types of postulated SSCs.
- How many multiple, concurrent SSCs (of a given size and type) can DoD accommodate with modest stress, given:
  - Current DoD force posture projected into future.
  - Alternative postulated force postures.
- For above questions, depict stress effects in following ways:
  - By Unit Type Code, percent of DoD's total inventory required for a given set of postulated SSCs.
  - OPTEMPO for individual Unit Type Code.
- How does postulated DoD involvement in SSCs affect our capabilities required to execute our current or projected military strategy?
- What can be done to reduce OPTEMPO Stress effects caused by SSC operations?
  - Substitution.
    - Within DoD.
    - Within United States Government.
    - Use of commercial capabilities (e.g., Brown and Root).
    - Use of allied military capabilities.
    - Use of International organization and NGO capabilities.
  - Creation of specialized DoD capabilities for SSCs.
  - Creation of more flexible capabilities (a balanced force with equal capabilities in both SSCs and overall defense strategy).

– Review and adjust rotation base factor.

– Redefine strategy by accepting risks in some areas.

APPROACH

U.S. forces are generally categorized by types of units (e.g., Army Infantry Battalions, Attack Submarines, and F-15E squadrons) which are referred to as a Unit Type Code (UTC). UTC usage rates can be determined based on a set of SSC scenarios over time. Using SABRINA, the model developed in the United Kingdom, UTC usage rates can be determined across a multiple year time period. Where there are either shortages or very close to shortages, an in depth review using SABRINA at a given time step will reveal the degree of stress on specific assets and permit further analysis of other factors. SABRINA displays the UTC utilization rate for every asset played in the scenarios over time. By reviewing the vignettes, key components of unit stress can be identified and it is easy to determine why the particular UTC was demanded at such a high rate relative to the inventory level of the asset. Figure 2 shows a possible set of vignettes that make up the postulated future.

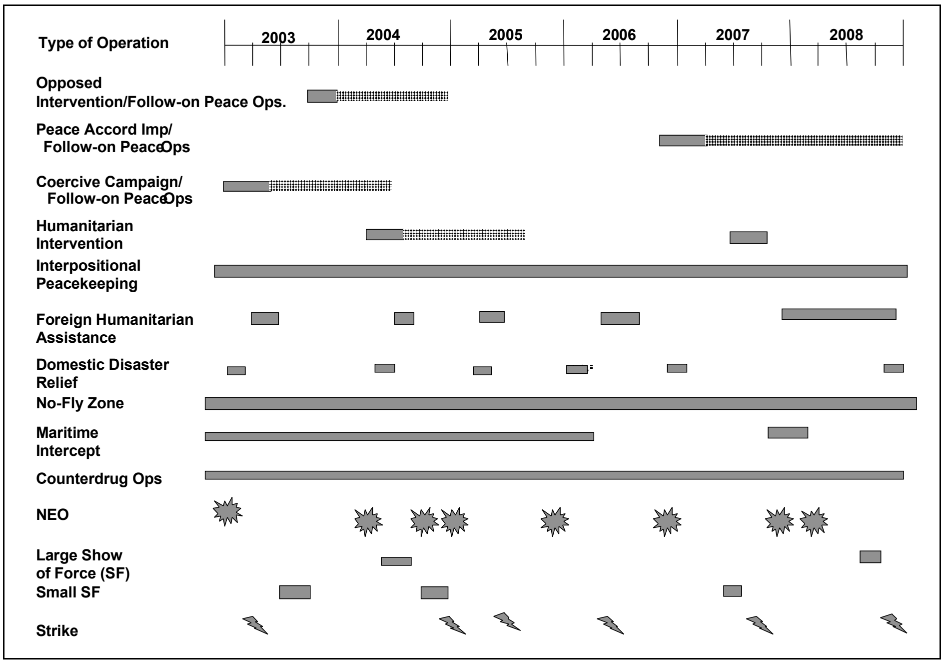

Figure 2: Possible Future.

Based on evaluating the usage rate of all the UTCs required for the set of vignettes, SABRINA produces a rank ordered by average utilization rate with the peak usage rate highlighted. Figure 3 provides an illustrative example for a given set of vignettes over a multiple year time period. The vignette laydown as shown in Figure 2 can be reshuffled. These new futures are then checked to make sure they fit within the concurrency and frequency rules as established based on the historical data. These new laydowns are then rerun in SABRINA and compared to previous laydowns to see what changes and why. Figure 4 shows a typical UTC utilization over time.

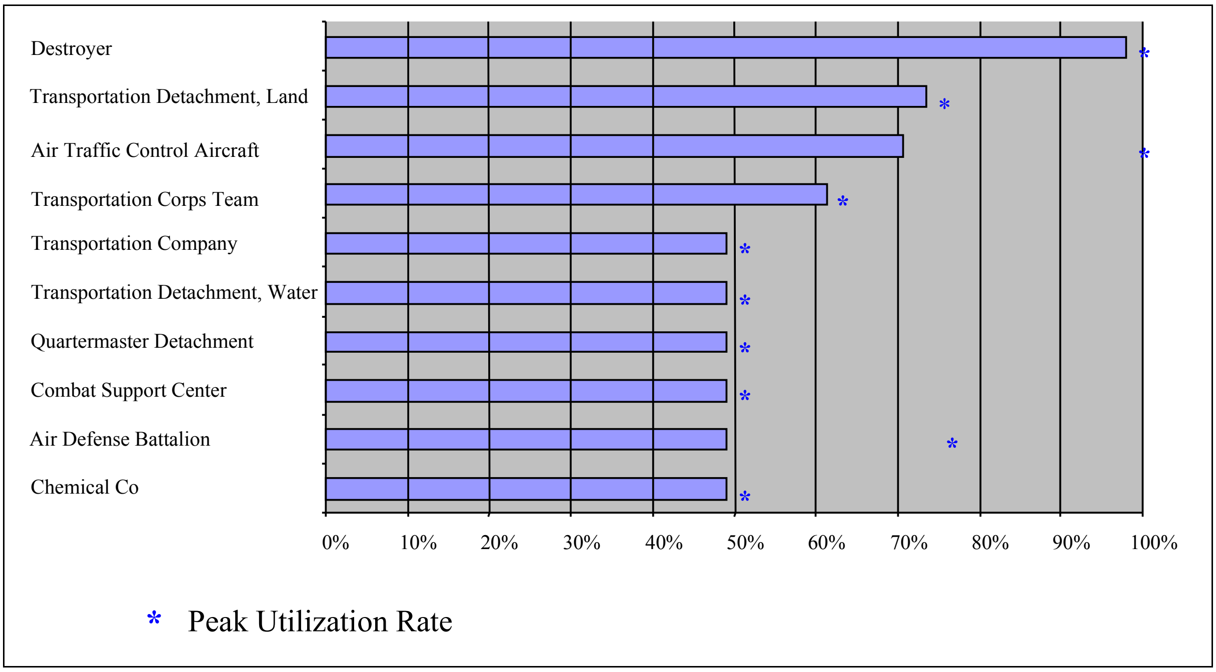

Figure 3: Average utilization rate over time.

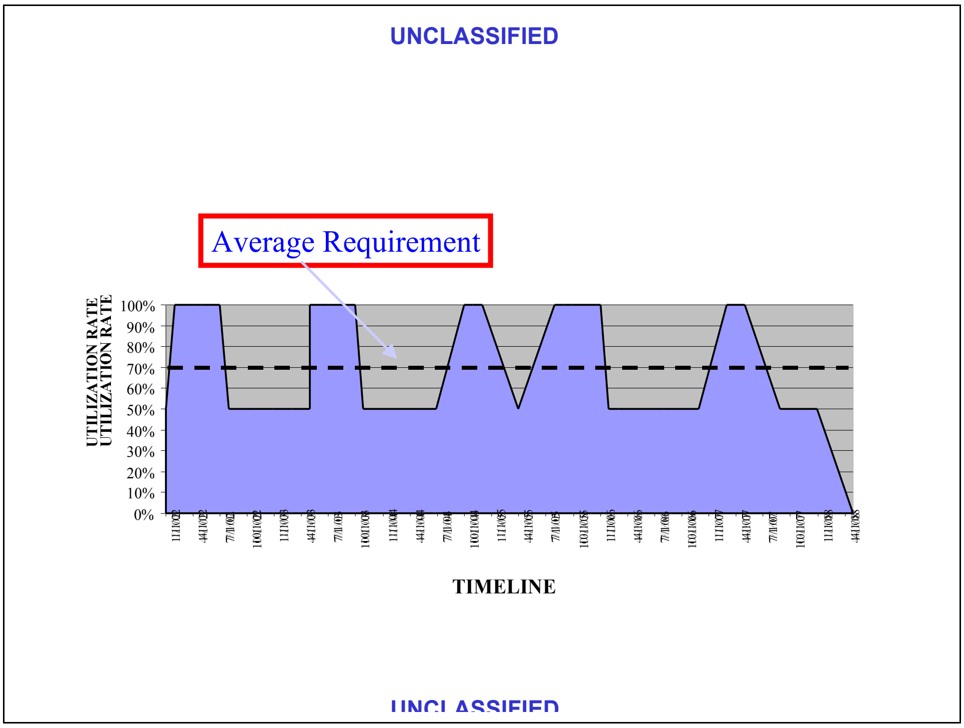

Figure 4: UTC utilization over time with average utilization plotted.

ALTERNATIVE FORCE STRUCTURE IMPACTS

Additionally, for a given set of futures, the U.S. force structure can be altered to measure the impact of a set of vignettes. Figure 5 provides an illustrative example of possible outcomes.

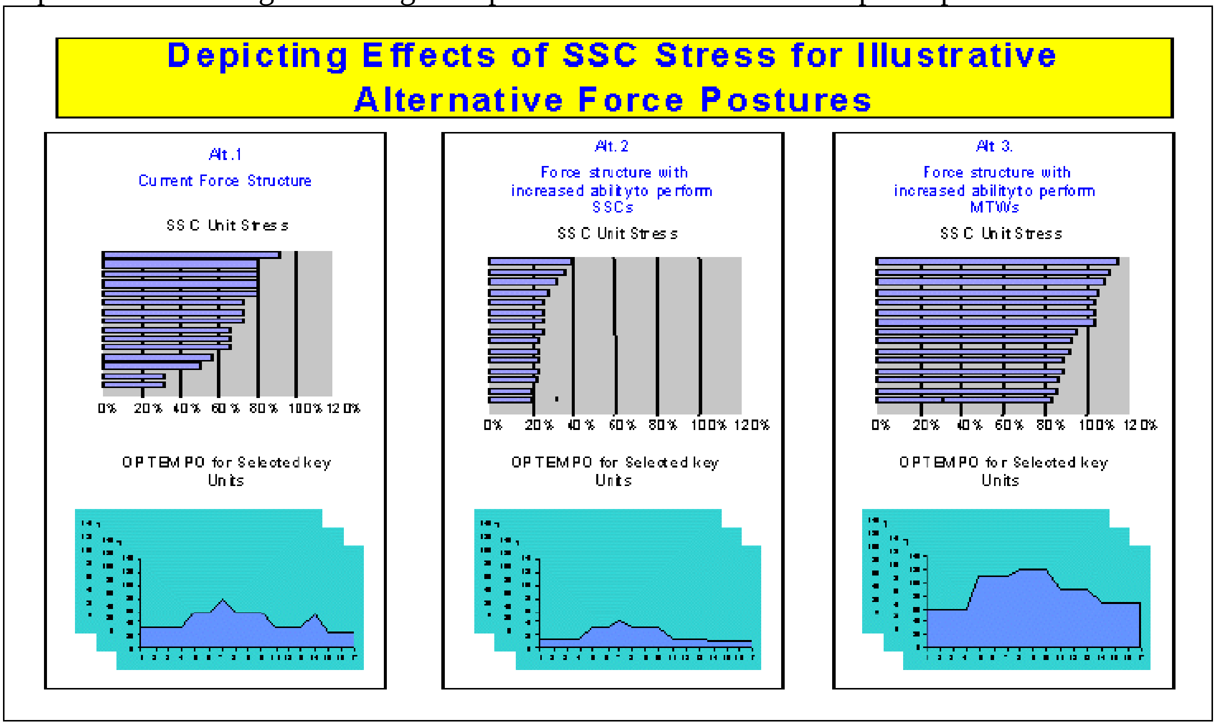

Figure 5: Depicting Effects of SSC Stress for Illustrative Alternative Force Structures.

FACTORS INFLUENCING SSC STRESS

Substitution as defined in the context of SSC operations is the use of one or more units to satisfy a requirement for a unit that is currently unavailable (a shortage of assets in the DOD force structure, not operationally ready due to personnel or equipment shortages, etc). Earlier in the paper it was mentioned that substitutions might be a way to help alleviate stress on certain US forces. If there is a requirement for an Infantry Battalion that is either unavailable or in short supply, it may be possible to use another type of battalion to fulfill the SSC requirement based on the type of SSC and other factors such as Mission, Enemy, if there is one, Time, Terrain, and numerous other factors all influencing the feasibility of using a particular substitute.

The substitution criterion is a key factor in determining the level of stress and whether the SSC operation can be carried out. If the substitution criteria is flexible (e.g. there are numerous unit types capable of fulfilling the SSC requirement), then stress can most likely be reduced. However, if there is a stringent criteria (e.g.trying to find a reasonable substitute for JSTARS or AWACS), it will most likely be increased. It is important to understand for a given type of operation, which kinds of substitutions are reasonable and which is not. It would be very helpful if reasonable sets of simple substitution rules by SSC type can be established for SSC modeling assessments.

Other factors that affect the stress on units include the rotation base of the forces involved. As a general rule, SSCs of short duration will produce only modest stress, but long duration SSCs (typically those beyond 6 months) may require a rotation base, which can substantially increase stress (because of the units standing by to deploy). In addition to the SSC operations, units that participate in the deployment of units to the SSC still have to maintain training and readiness requirements and will normally lose filler personnel to the deploying units to get it to it's required strength. Therefore, both the deployed unit and the unit supporting the deployment are faced with numerous readiness issues.

ALLEVIATING UNIT OVER USAGE

There are some things that can be done to help alleviate the stress on certain units.

1. First, add more of the affected units to the resource pool. Review both number of required units and the rotation factor for those units. Alternatively you can reduce the rotation factor, usually by decreasing readiness levels of a unit (e.g., reduced training and engagement requirements). An increase in the number of a specific unit type must be measured against the potential cost of a unit.

2. Second, expand substitution opportunities by forming more flexible units within DoD. For example, train infantry units in Military Police duties if the requirements of the SSC permit. There will need to be an assessment done of the associated costs and readiness impact and on the ability to conduct major theater war (the current primary mission of U.S. forces). Also examine the participation of allies, NGOs, contract personnel, IOs, PVOs, etc. in a higher proportion for certain operations and how they could be encouraged to participate with more personnel.

3. Third, decrease the demand for certain assets by not participating in SSC operations that use up those forces. Perhaps the most cost-effective in the short term, but must be balanced against strategic risk for the long term.

SABRINA APPLICATION TO GLOBAL MILITARY FORCE POLICY (GMFP)

In 1996, SECDEF approved implementation of a GLOBAL MILITARY FORCE POLICY (GMFP). The intent of this program has been to assist senior-level decision-makers in allocation, deployment, and employment decisions involving uniquely capable and scarce assets. In GFMP, Service Chiefs and The Combatant Commander for the Special Operations Command designate certain assets as “low density, high demand” (LDHD) and then develop metrics to determine their availability under routine (steady state) and contingency (surge) conditions. GFMP concepts have matured during the policy's existence. Past annual reviews, however, have been confined to LDHD asset list changes and incremental OPTEMPO metrics adjustments.

The concept of "acceptable substitutes" may now have less utility for some assets, for example, since many such substitutes (e.g., EF-111 for EA-6B) are no longer in the force structure. Some "in place" operational commitments may degrade readiness over time even though no physical deployment is involved. In addition, the role of reserve component forces has not thus far been specified within GMFP. Finally, greater clarity in tracking and reporting of LDHD assets is required to ensure visibility and sound decision making. In summary, experience with the policy and the nature of ongoing contingencies are now better understood, making evident the need for policy adjustments to reflect force structure changes, revalidate mission priorities, and to formalize combatant command and joint staff coordination of assets and metrics. Figure 6 illustrates the problem that GMFP is intended to address.

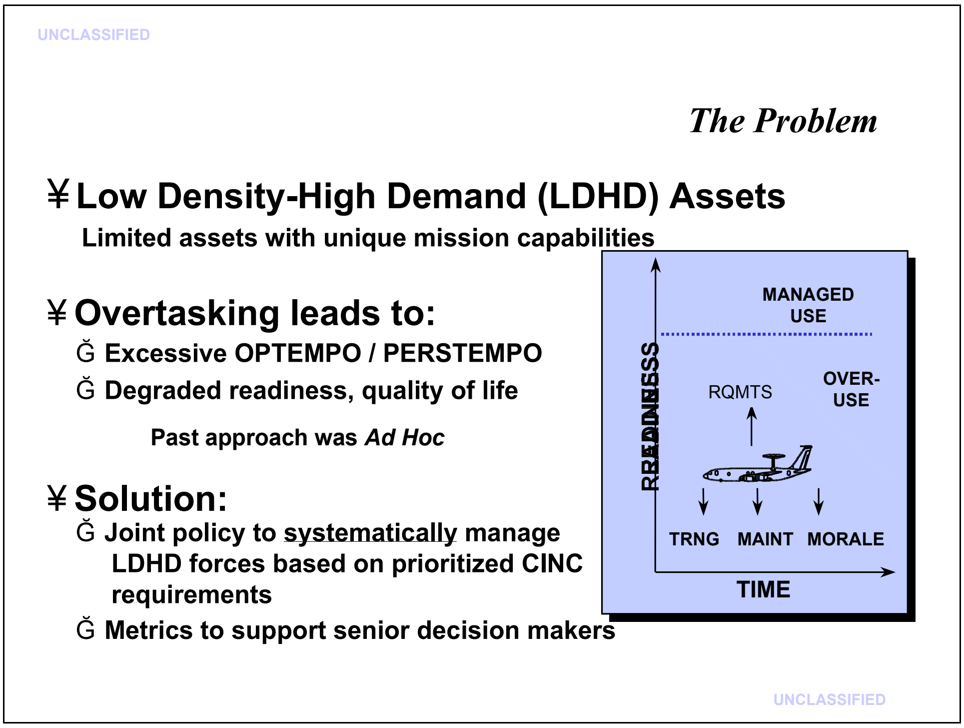

Figure 6: The low density, high demand (LDHD) problem.

POLICY GOAL

The primary goal of GMFP is to preserve near- to mid-term readiness and crisis response capacity of low density, high demand (LDHD) assets while providing Combatant Commanders with sufficient warfighting capabilities to ensure mission success. Senior decision makers must remain aware of the potential readiness impact of high levels of operational demand (lost training, less exercise support, deferred maintenance, and lower retention) and of the thresholds at which readiness degrades.

Allocation decisions must meet worldwide national security objectives and balance Combatant Commanders' competing requirements against the need to preserve longer-term crisis response capability. This policy establishes criteria to assist senior leaders in developing employment options for LDHD assets, based on mission priority guidelines and quantifiable data. This policy is mainly focused on LDHD asset visibility and near-term allocation decisions for emergent joint contingencies, but may influence longer-term scheduling processes.

DEFINITIONS

For GMFP purposes, the following definitions apply:

A. READINESS. Preserving near- to mid-term readiness is one of the primary goals of GMFP. Operational Readiness is the capability of a unit/formation, ship, weapon system, or equipment to perform the missions or functions for which it is organized or designed. Typical components of readiness include, but are not limited to training and exercises, maintenance, manning, and quality of life. Normally, GMFP addresses readiness of LDHD assets assigned to combatant commands at the overall inventory level. For example, AWACS aircraft and crews are considered as an aggregated fleet, rather than as separate force or individual unit. When the asset is uniquely configured or the crews have unique skills that are not readily transferable across Combatant Command AORs or geographic areas (e.g., intelligence crews/linguists), these factors may impact metric determinations.

B. LOW-DENSITY, HIGH-DEMAND (LDHD) ASSETS. Force elements consisting of major platforms, weapons systems, units, or personnel possessing specialized attributes or capabilities, which have historically been called upon by Combatant Commanders to execute worldwide joint operations at a rate that degrades their near- to mid-term readiness. There is no universal formula to determine which assets should be designated LDHD. It is important to note, however, that the primary differentiating characteristics of these assets are their unique joint mission capabilities and an unusually high demand by Combatant Commanders (relative to availability in the force).

C. LDHD TEMPO (FORMERLY "OPTEMPO"). An LDHD asset's overall instantaneous level of commitment to operational demands. Service chiefs and the Combatant Commander Special Operations Command (SOC) track all operational demands in determining their assets' LDHD tempo. To establish a common reference for decision makers, this policy defines three metrics to quantify levels of LDHD tempo:

   1. STEADY-STATE: This level of commitment can reasonably be sustained indefinitely (i.e., with no adverse effect on normal training, exercise support, scheduled maintenance cycles and/or retention) and does not violate service- or U.S. Special Operations Command (USSOCOM)-specific perstempo goals. Steady-state is normally bounded by a maximum steady-state threshold metric.

   2. SURGE: An additional level of commitment during crisis or contingency response that can be sustained for up to 60 days (nominal) with some decline in readiness and possibly exceeding service perstempo goals. This commitment level may adversely impact training, exercise/experiment support, maintenance, and/or manning.

A follow-on recovery period (nominally 90 days) at steady-state LDHD tempo can be expected. In certain cases, a service chief or USSOCOM may elect to establish different surge and recovery conditions appropriate to a specific asset. Surge conditions are bounded by a maximum surge threshold.

3. ABOVE MAXIMUM SURGE: Conditions in excess of the maximum surge metric and/or the nominal 60-day surge period will be considered above maximum surge. Commitment levels above maximum surge can be expected to result in a significant and immediate impact on training, exercise support, maintenance, manning, and/or retention during (and subsequent to) the time this level of commitment is sustained. This level of commitment is bounded by a total capability metric, which corresponds to the total number of deployable assets (normally active duty assets) assigned to combatant commands and available to meet operational demands.

Figure 7 illustrates the concept of GMFP Steady State metric for a given asset.

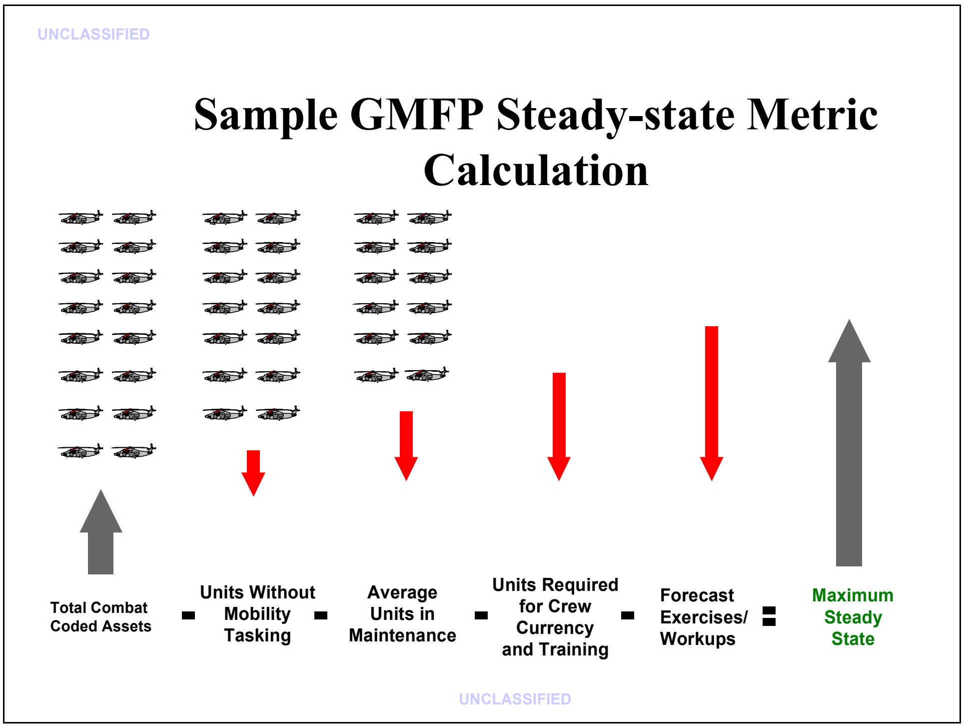

Figure 7: GMFP Steady-State example.

As previously mentioned, part of the normal output from the SABRINA post-processor is a UTC utilization chart for every unit type played in the scenarios over the theoretical run time. Since a U.S. force structure can contain thousands of unit types, SABRINA now contains a filter that is used to track only those units of interest from either an analyst or decision maker perspective. If one is interested in LDHD assets only, then the SABRINA resource pool will contain only those assets, or those assets will be flagged as a subset of a larger resource pool. By quickly scanning all assets in the resource pool after a run, it is easy to assess what units are most stressed for a particular posture of engagement. In the overall scheme of things, this macro view provides an initial look at the types and numbers of certain units that may need to be included in a force structure. SABRINA is exactly the kind of tool to engage current and projected future issues associated with the management of LDHD assets. Figure 8 shows a SABRINA illustrative UTC utilization chart with an illustrative set of metrics applied. Assuming that we have translated the UTC utilization rate into actual numbers of units, a visual scan of the chart yields some rather interesting facts.

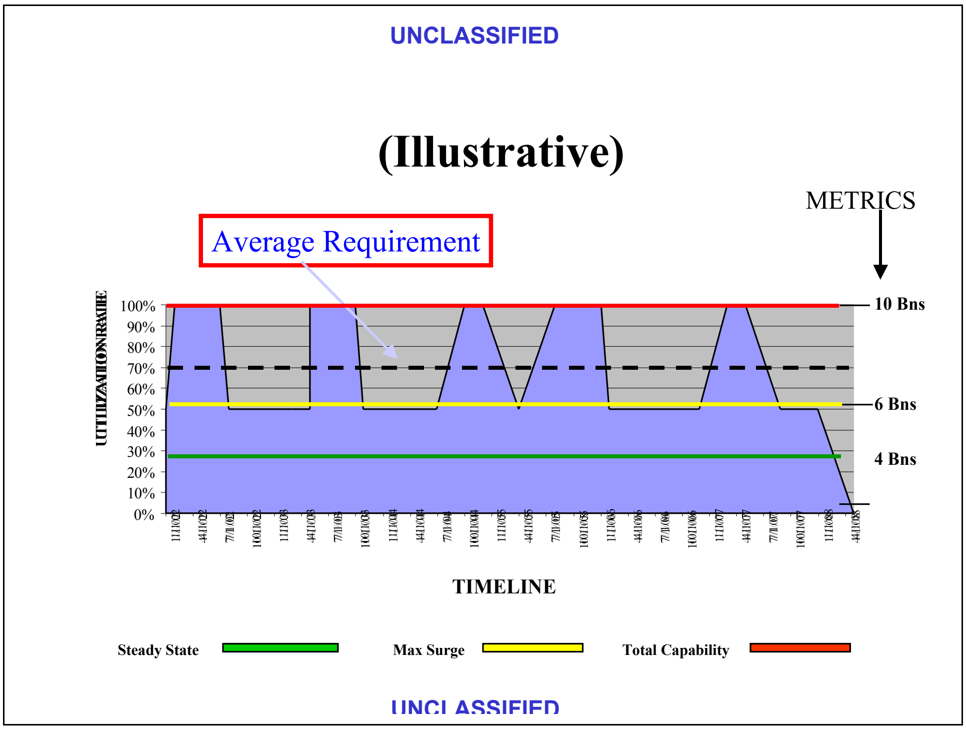

Figure 8: UTC utilization chart with illustrative LDHD metric.

Notice that this particular unit type is consistently above steady-state (green line), which implies that the current level of commitment could impact readiness, training, exercise support, etc. In fact, this unit is committed at the max surge rate as indicated by the yellow line and commitment levels above this rate can be expected to result in a significant and immediate impact on training, exercise support, maintenance, manning, and/or retention during (and subsequent to) the time this level of commitment is sustained. Notice that on at least five (5) occasions, this unit is 100% committed. So the question now becomes what is driving this level of commitment and what can be done to alleviate the stress associated with this unit type. We have discussed several options, but it is easily seen how a simple chart of this nature provides the kinds if insights that might began to answer questions regarding the current level of commitment regarding U.S. involvement in SSCs.

CONCLUSION

Based on the work to date and the databases that have been developed, we are ready to conduct analysis on the effects of multiple SSC on the current or alternate DOD force structures. With some additional cooperation from our allies and other organizations, it could also include coalition as well as non-defense organization participation. As analysis is completed, assessments of capabilities involved in peace operations can be incorporated into future SSC analytical efforts.