A FRAMEWORK FOR EVOLVING AGILE COMBAT SUPPORT CONCEPTS TO MEET NATO REACTION AIR FORCE OPERATIONAL REQUIREMENTS

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1. INTRODUCTION

This paper presents a framework that could be used in evolving the Agile Combat Support (ACS) and mobility systems of participating partners to meet the operational needs of the NATO Reaction Air Force (RAF). Based on our experience in evaluating ACS/mobility options to meet the United States Air Force Expeditionary Aerospace Force (EAF) operational goals, we suggest that the NATO RAF concept may require a rethinking of the entire combat support system, as was the case for the USAF EAF, and that subsequently the strategic *planning* framework for combat support should also be re-examined and enhanced. To a large degree future force projection and resultant combat capability will be dependent upon strategic choices concerning combat support system design that will be made in the near future. This paper explores a planning framework that is based on an integrated set of models and a process for making such strategic decisions. Some USAF EAF results of analyses based on using this framework are presented as they may be relevant for the NATO RAF. The paper also discusses some impediments in using this framework and evolving an effective coalition ACS system.

2. THE NATO REACTION AIR FORCE CONCEPT AND COMBAT SUPPORT SYSTEM PLANNING

Under the NATO Reaction Air Force concept, participating countries would develop air force packages that could be melded together at time of execution to achieve certain operational effects based on the specific scenario. Under this concept, these national force packages would be required to be able to project highly capable and tailored force packages from their individual countries on short notice, presumably within the NATO region, or elsewhere where NATO interests are involved, in response to a wide range of possible operations. This concept requires the ability to deploy and employ quickly around the world, adapt rapidly to changes in the scenario, and sustain lethal combat operations indefinitely. This concept is very similar to the EAF concept being developed by the USAF.[1] RAND has been involved in evaluating alternative USAF EAF ACS/mobility concepts, and this paper offers some results of that work to the extent that it may be of interest to the planners for the NATO RAF ACS/mobility system of the future.

To meet the demanding NATO RAF timelines, units must be able to deploy and set up logistics production processes quickly. Deploying units will therefore have to minimize the amount of support they deploy which in turn demands that the support system be able to ensure sufficient resources are delivered when needed to sustain combat operations.

To meet what may be demanding operational requirements, the future combat support system should be designed to maintain readiness levels to support immediate deployments, provide responsive support to deal with unanticipated events, provide support for units if the spectrum of operations enlarges, and be efficient and affordable. These challenges differ considerably from those posed by Cold War employment concepts and require a complete reexamination of the combat support system to

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[1] The EAF is based on the Air Force Vision to organize, train, equip, and sustain itself to provide rapidly responsive, tailored aerospace force for 21st Century military operations. Its purpose is to improve response speed and flexibility while decreasing deployment strain for a CONUS-based Air Force. The EAF will organize the Air Force into 10 virtual Aerospace Expeditionary Forces comprising combat, mobility, and support resources that Joint Force Commanders can tailor to specific missions. AEFs will operate on a "on-call" window for a specific time and the "on-call" period will be rotated among units on a known scheduled basis.

determine how they can best be met. Strategic Agile Combat Support (ACS) design tradeoff and investment decisions need to be made in the near term to create the ACS capabilities necessary to achieve the operational capabilities required in the future.

Focus on Strategic Planning

The time horizon over which planning is done determines a number of key characteristics of the planning process including: the response time required to construct a plan, the level of detail of inputs, and the flexibility of the available resources. Planning for the ACS system could operate on three different time horizons:

- At the level of *execution* (days to weeks) the ACS system should support ongoing operations.
- At the mid-term or *strategic* level[2] (months to years) the system should acquire or construct resources to support the current force structure across the full spectrum of operations and in any location critical to NATO interests, subject to peacetime cost constraints.
- At the *long-term* level (decades) the ACS/mobility system and its strategic infrastructure should be modified to support new force structures as they come on line and to utilize new technologies.

We concentrate on an integrated planning framework that addresses strategic decisions. These planning decisions on ACS system design and policy issues, made in peacetime, affect the logistics footprint, closure time, peacetime costs, and other important metrics for evaluating support of expeditionary operations. The goal of our research is to formulate a strategic planning process that addresses how to make decisions about infrastructure development, resource positioning at forward or rear locations, and other policies and practices affecting logistics support.

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[2] We use the term strategic because these decisions are affected not only by time horizon, but also by the geopolitical strategic situation, by technology, and by fiscal constraints. As we will argue, these decisions have to be made by complex tradeoffs of risks and benefits using criteria that are strategic in the broadest sense.

3. A STRATEGIC ACS PLANNING FRAMEWORK FOR NATO RAF

We suggest that a detailed, continuous, careful end-to-end planning process focusing on strategic time horizons can be used to develop the infrastructure necessary to transition to the NATO RAF and USAFE EAF concept effectively and efficiently. We note that much, if not most, support effectiveness comes from planning and decisions made for these longer time horizons, where options include redesigning support equipment, developing support processes and infrastructure, setting up prepositioned resources, and negotiating base access and relationships with coalition partners.

Characteristics of Strategic ACS Planning in the NATO RAF Environment

Generally, a strategic ACS planning system for the new environment should assess how alternative logistics designs affect a number of important metrics including: timelines to achieve the desired operational capabilities; peacetime costs; risks; flexibility: and provide feedback as to how well the existing ACS system is meeting the spectrum of operational requirements. In comparing the current planning system with the ACS planning requirements of the EAF and NATO RAF concept, we have recommended enhancements in the following areas:

- **Supporting the entire spectrum of operations.** The future planning system must be capable of estimating resource requirements for a number of likely scenarios from a "significant contingency" to current "boiling peacetime operations."
- **Dealing with uncertainty.** NATO "out-of-area" and USAF EAF operations are fraught with uncertainty. There is great uncertainty surrounding the operational scenario, which will greatly affect support resource requirements. For instance, low optempos may require far less resources to be deployed, or potentially prepositioned at selected Operating Locations (OLs), to meet rapid employment timelines, whereas, high optempos may create a need for much more resource deployment or prepositioning. The NATO RAF planning system will need to address these uncertainties as well.
- **Evaluating alternative designs for deployment/employment timelines and associated costs.** The NATO RAF and EAF concepts emphasizes rapid deployment timelines, which should be accounted for in future ACS system design. Alternatives to achieve fast deployment (e.g., prepositioning

equipment, developing OLs with adequate facilities and resources to support rapid deployments and immediate employment, developing host nation support agreements) have significant peacetime costs. On the other hand, the timelines might be slightly longer if materials were provided from National Support Locations (NSLs) or potentially multinational Shared Support Locations (SSLs), with significantly lower costs. Assessing such tradeoffs between timeline, cost, and risk is integral to future strategic NATO RAF ACS system planning, and offers many challenges, such as sharing data on weapon system reliability or consumption data.

- **Integrating ACS planning between support functions, between nations, and with operations.** Current combat support planning systems are stove-piped in several ways. Each commodity and its support processes are viewed largely independently to determine resource requirements. In this fragmented process, opportunities to develop consolidated support operations or other policies that may support more than one theater or area may be missed. Moreover, feedback needs to be provided among commodity managers (e.g., engines, fire control systems, or munitions) such that they may determine how the best support option for one commodity (e.g., consolidated intermediate maintenance) may affect the "best" ACS design for the other. Additionally, feedback on support options and costs need to be provided to operations planners to inform trade-off decisions (e.g., 48 hours versus 96 for dramatic savings of resources). Some of this data may not be currently shared by each nation. If combined combat support options are to be pursued, sharing data and developing a common ACS options analysis framework will be needed, as well as an organization that could conduct options assessments and have nations decide on the most cost-effective solutions.
- **Integrating the assessment and development process for technology and policy**. In the areas of technology and policy, many different actors are pursuing initiatives that are part of the overall ACS system but may not formally be coordinated outside national decisionmakers. There has been little attention given to developing a capability that can evaluate options among those sets of competing policies and technologies which may be developed both to produce the most cost-effective regional ACS capability and which may serve multiple areas of interest and operational scenarios.

- **Controlling variability and improving performance.** Insuring that a redesigned support process is working and identifying areas for improvement will require attention to monitoring the support system as it evolves, yet feedback for system design improvements may not be routinely captured. A few critical parameters drive wartime and peacetime requirements for resources. While some of these parameters are measured, much improvement can be made in controlling their variability. Further improvement may be made by developing a measurement system that can indicate when corrective action is needed or when the system may need redesigning.[3]

A Framework for Strategic ACS Planning: Employment-driven ACS Requirements Determination

We call our approach to requirements generation "employment-driven" because it starts with operational analysis: the forces, weapons, optempo, and required timelines. These key parameters drive most of the support requirements. This planning process has three steps. The first step is shown in the leftmost panel of Figure 1, which depicts our overall approach to analyzing support requirements, begins with determining the operational requirements.

The middle panel represents the resource requirements determination model, which generates time-phased combat support requirements for each support resource as a function of the operational requirements and alternative logistics policies, practices, and technologies. ACS planning is beset by uncertainties and options. Therefore, we have constructed some simple aggregated spreadsheet models to compute requirements for fuel, munitions, vehicles, support equipment, and shelters. As these models are easier to specify and run than the usual highly detailed models, they may be used to quickly screen several scenarios permitting a more thorough analysis of uncertainty. Yet, these relatively simple models provide enough detail to estimate the personnel, equipment, and commodity requirements to support alternative operational requirements, and the time frames required to assemble the production function for those commodities and operate them to sustain operations for the operational scenario provided.

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[3] For further details, see Tripp and Pyles, 1982.

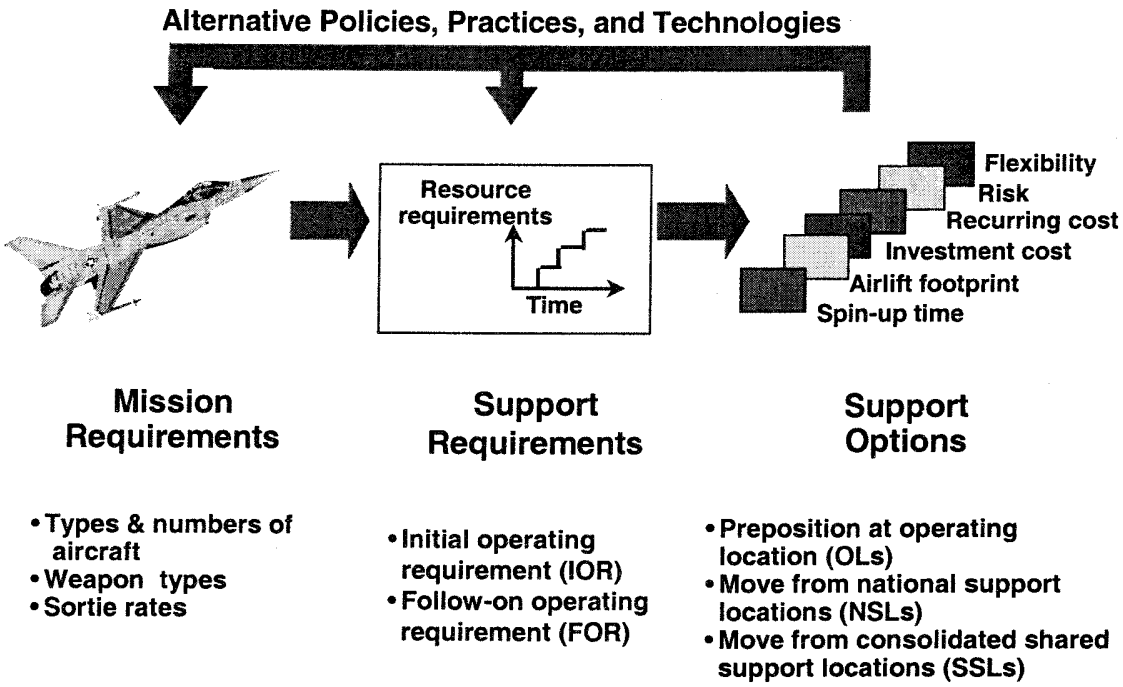

Figure 1—Employment-Driven Combat Support Requirements Generation

For example, in the fuel model, the refueling system requirements (e.g., number of R-9 refuelers) are determined by the aircraft go sequence, aircraft fuel acceptance rates and capacities, and refueling system flow rates. For refueling by truck, the system flow rate would be determined by the truck acceptance rate, the distribution system pumping rate (e.g., fill stand), and the driving time to and from the fill stands. While not a detailed simulation of the fuels support operation, the model can be used to compute requirements for a number of fuel reception, storage, and distribution methods.[4]

As noted in the middle panel of Figure 1, two of the key outputs from the requirements determination models are the Initial Operating Requirement (IOR) and follow-on Operating Requirement (FOR) for each resource (if applicable). The IOR is the amount of resource that is necessary to initiate and sustain operations while resupply pipelines are initiated for that resource. In the case of munitions it may be that three days

[4] To determine munitions support and avionics repair requirements and associated personnel and equipment workload, we had to develop new algorithms and modeling technology. In other cases, suitable models exist or can be modified to generate requirements for resources. Such is the case for spare parts. In this case, the Aircraft Sustainment Model provides requirements for spares as a function of optempo, force module size, maintenance concept, resupply times, and so forth.

are required to reestablish resupply of munitions. Thus, three days of munitions would be the IOR. The FOR is the projected amount of the resource that is required during the remainder of the planned operation. The FOR can be delivered periodically to keep the flow of resources into the FOL easy to handle by a relatively lean forward support force. These parameters are the key to determining deployment resources and timelines, and sizing the resupply capability, respectively.

As depicted in the rightmost panel of Figure 1, the support options for various commodities need to be evaluated across the different phases of operation. As with operational analysis, the aim is to identify support options that provide good performance (in terms of the set of metrics) across all phases of operation and across a range of potential scenarios (the number and range depending on the time horizon under consideration). Again, tradeoffs may have to be made across the scenarios and the metrics (e.g., a low-cost option may have a large risk). Additionally, support options may be evaluated for different mixes and home-based national, coalition-shared, and out-of-area-based logistics. This approach allows these tradeoffs to be made with a clear picture of the effects across different options and scenarios.

Specific key variables affecting ACS system design include:

- Options for force composition, employment timeline, and optempo
- OL capabilities, including infrastructure and resources as well as the political and military risks associated with prepositioning resources at specific locations
- Technology options affecting performance, weight, and size of test equipment, munitions, support equipment, and other support
- Resupply time, particularly as it affects initial operating requirements (IOR) and follow-on operating requirements (FOR)
- Alternative support policies, such as conducting repair operations at deployed or consolidated support locations
- Strategic and tactical airlift capacity.

These and other variables form a rich array of possible decisions from which Air Force leaders will choose in designing the future ACS system. Generally, there are no right or wrong answers. System trade-offs will be required.

ACS design decisions will depend on how NATO leaders value different criteria. Some system needs, such as rapid employment timelines, high operating tempos, and airlift constraints, favor forward positioning of resources. Others, such as the cost and

risk of positioning resources at OLs, favor positioning of resources at potentially shared consolidated support locations.

Figure 2 depicts the general tradeoffs. Investment costs, as shown in blue, are higher for an extensive support structure positioned at numerous forward locations. They decline as the number of support locations declines. Employment time, as shown in yellow, is lower for an extensive support structure with numerous forward locations. It increases as the number of support locations increases.

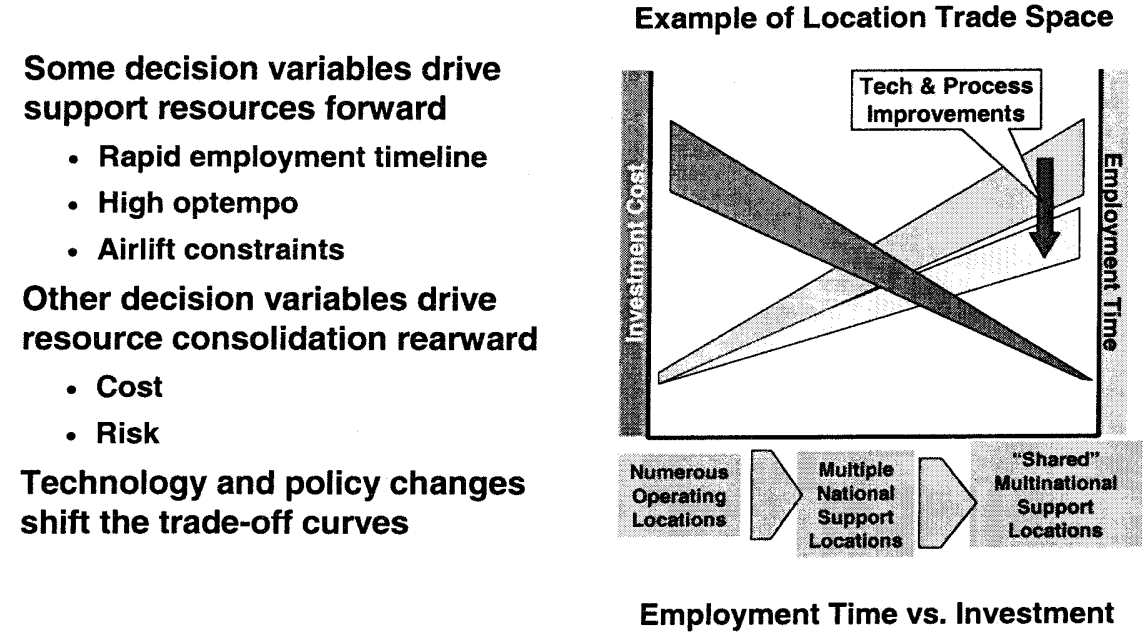

Figure 2—General Decision Trade Space by Location

While the general direction of these relationships is fixed, the specific details are not. The arrow on the graph indicates the effect of reengineering processes or implementing new technologies, such as developing lightweight munitions or support equipment. New technologies or processes can shift the timeline curve downward. This allows more rearward positioning of resources than would otherwise be possible.[5]

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[5] We again direct the reader's attention to Peltz et al., "Evaluation of F-15 Avionics Intermediate Maintenance Concepts for Meeting Expeditionary Aerospace Force Packages," for a more specific discussion of tradeoffs regarding one part of the support process.

Integration of Individual Commodities Options into an ACS System

The next step is to select among these options in each of the commodity areas to create candidate NATO RAF and/or EAF support concepts. As shown in Figure 3, we have done preliminary work on an "integrating framework" to choose among the EAF options we analyzed. This framework helps select combinations of the options that meet the objective function subject to several constraints and thereby quickly identifies feasible support concepts. Taken together, these options represent a possible support concept for NATO RAF that could then be looked at more closely to consider additional issues such as the flexibility of the concept and its transportation feasibility.

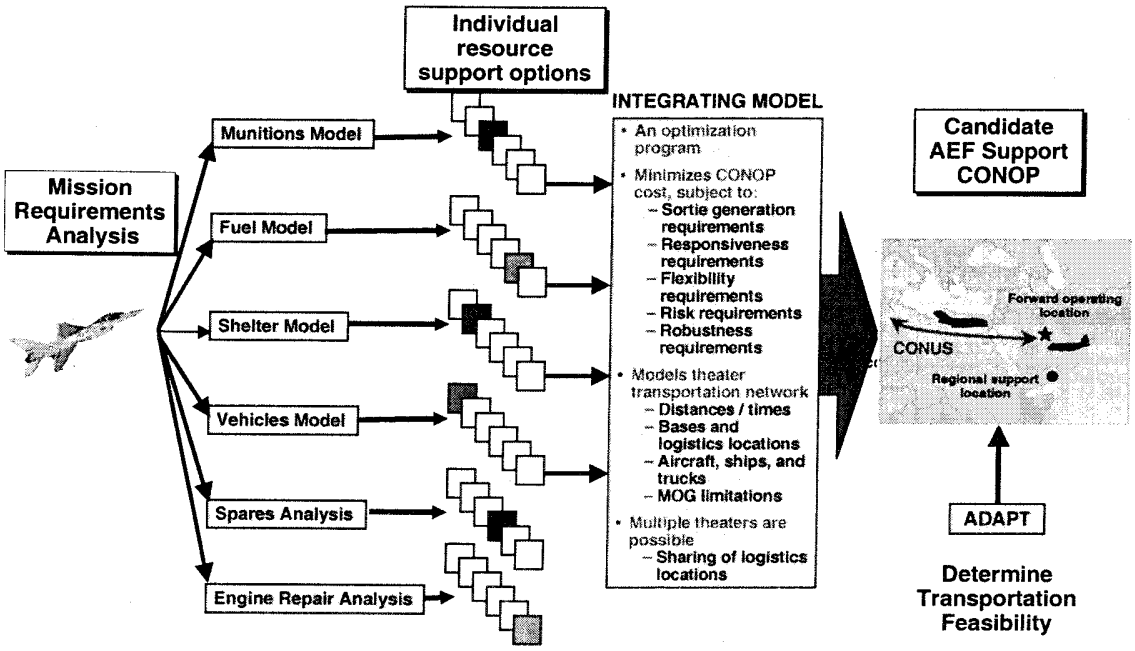

Figure 3—An Integration Framework Assists in Choosing Among Support Options

For each commodity considered, the framework (a mixed integer math programming model) can select among alternative ways to provide the resources needed to support operations. Each option has different fixed (investment) and variable (recurring) costs and varies according to their robustness and suitability for long-term

use.[6] The model accounts for such issues by allowing each option to be given a subjective rating with respect to its robustness. It then requires options with low robustness (but high initial deployability) to be replaced by more robust options within a specified period of time.

While the model allows the identification of interesting EAF support concepts, it is also useful in answering a range of questions that give insight into the robustness of the concepts. For example, by varying the costs of certain aspects of a CONOP, the "breakpoints" could be identified that would motivate a switch to another CONOP. This allows a number of important questions to be explored, such as the maximum desirable cost associated with the opening of a new NSL or SSL, or how sensitive a CONOP might be to annual transportation costs. Another important issue that can be analyzed by the model is the effect of various levels of airlift availability, which is a key make-or-break assumption associated with each EAF or NATO RAF support CONOP. Finally, the payoff of improved technology to lower the deployment footprint of a resource option could be explored. In this way, the effect of an improvement in the deployability of a particular resource on the overall NATO RAF deployment could be gauged.

As the Air Force extends its analysis of support structures beyond single theaters of operation, the complexity of issues involved will make the application of automated techniques such as the integrating model essential. The complex interactions between the region-specific security challenges, mutually-supporting theaters, geography, and required levels of responsiveness will create an almost overwhelming number of possible support structures. Automated models such as the integrating model are needed to manage this complexity in order to identify low-cost global or regional support structures for the EAF and NATO RAF.

Integration of ACS and Mobility System

Executing NATO RAF or EAF deployments requires that a multitude of mobility-related actions be set in motion. These include forward positioning of tankers, deploying aerial port personnel, placing mobility crews in crew rest, etc.

Mobility processes comprise a substantial portion of the overall deployment timeline. As interweaving mobility processes with logistics support processes is a key

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[6] For example, an austere shelter option may be permissible during the first few days of a deployment, but may be replaced by a more robust option as time goes on and the airlift capacity is available.

aspect of future NATO RAF agile combat support structures, there should be a way to test the mobility/logistics interfaces for any candidate NATO RAF or EAF support structures we might devise. Toward this end, we developed a high-level simulation model of the air mobility system, called the AEF Deployment and Planning Tool, or ADAPT.[7] This model provides insight into the chain of mobility-related events that makes deployments possible, and can test the transportation feasibility of possible support structures.

Feedback Loops for Control

The final element of the proposed planning framework is feedback, which provides indications that there are discrepancies between plans and reality. Information on deviations from plans can be used to initiate correctional actions to solve the problems. We envision two primary feedback loops in the planning framework.

The first feedback loop is between logistics planning and operations planning as shown at the top of Figure 1. Operational analysis can provide alternative force packages that can accomplish "equivalent" goals. This is important to consider because the alternative force packages can have very different support requirements.[8]

In some circumstances logistics constraints may not be removable because some logistics resources may be strongly tied to expensive and relatively fixed infrastructure, which has limited flexibility. For example, fuel resources available within a given country and distribution capabilities to forward operating bases may not be available to support sustained high NATO RAF optempo. Operational plans may have to be modified to deal with this constraint. This requires close interaction between logistics and operations in designing the ACS system of the future. With these strategic time horizons the interaction needs to be continuous, but not real-time. Time is available to plan and acquire logistics infrastructure that can support more ambitious operational plans if the costs and risks are judged to be acceptable.

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[7] The model is programmed using *ithink Analyst* software. See *ithink Analyst Technical Documentation,* High Performance Systems, Inc., Hanover NH, 1997.

[8] For instance, an AEF operational analysis might indicate that, under some scenario variations, an AEF composed of 12 F-15Es, 12 F-16Cs, and six F-16CJs could produce the same results as an AEF composed of 18 B-1 bombers and six F-16CJs. The support requirements and corresponding support alternatives are very different for these force packages. They may also have different deterrent implications. The fighter package may involve bedding down the force closer to the adversary. Using the reception sites of a neighbor may have a greater deterrent impact than indicating to an adversary that we may inflict punitive strikes from bomber bases located further away. These alternatives also have different costs and risks.

The second feedback loop is between logistics planning and the control of the logistics infrastructure. First, there is a diagnostic loop in which logistics constraints identify areas of the ACS system where enhancement is needed. The diagnostic results are used to focus modifications to the logistics infrastructure to enhance its capabilities at the points where such improvement is needed to support operational plans.

A tracking and control feedback loop is needed to monitor the performance of logistics processes that are not (currently) constraints, and to insure that their performance remains adequate.

These feedback loops and control system insure that the logistics system evolves as needed to support current and future operational plans and that the system achieves and maintains required support capability.[9] The result is a continuous cycle of planning, diagnostics, improvement and replanning.

[9] For a more detailed description, see Pyles and Tripp, 1982.

4. KEY FINDINGS FROM EAF ACS MODELING RESEARCH

Our use of this analytic framework and prototype models for some specific commodities has made clear the broad characteristics of the ACS system needed to support future expeditionary operations. Table 1 shows the results we generated from using the integrating model to minimize support costs and to meet employment timeline goals while satisfying resource requirements for an employment scenario of surge levels for seven days. These results were obtained by using inputs from our commodity models for munitions, fuel, vehicles, shelter, F-15 avionics components, and LANTIRN needs for a 36-ship AEF force, composed of 12 F-15Es, 12 F-15Cs, and 12 F-16CJs.

Table 1—Cost/Timeline Resource Allocation Tradeoffs

	Operating location	Regional (national) support locations	CONUS (Shared) support locations
48 hours	Bombs (IOR) Fuel FMSE Shelter Vehicles	Missiles (IOR&FOR) Bombs (FOR) Repair: avionics and engines	Unit equipment
96 hours	Bombs (IOR) Fuel Shelter Vehicles	Bombs (FOR), FMSE Repair: avionics and engines	Unit equipment Missiles (IOR&FOR)
144 hours	Fuel	Bombs (IOR&FOR) Repair: avionics and engines Shelter Vehicles	Unit equipment Missiles (IOR&FOR) FMSE

Deployment times and distances are based on Southwest Asia

FOLs assumed to have adequate runway length, LCN, MOG of 2

Source: New ACS Postures for Supporting the EAF, MR-1075-AF, 2000

This illustration shows that a 48-hour timeline requires substantial material to be prepositioned at the OL. A bare base can be used only if the deployment timeline is extended to 144 hours and substantial materiel is prepositioned at a regional support location, or RSL, and if intra- and inter-theater transportation is available to move resources to the OL.

The reason for this conclusion is simple. Current support resources and processes are "heavy." They are not designed for quick deployments to OLs having limited space for unloading strategic airlift. Significant numbers of vehicles and material handling equipment such as forklifts and trailers, for example, are required to meet EAF operational requirements. The airlift required to move this material, not including munitions, is enormous, and it may not always be available.

Shelter needs present another constraint on options for quick deployment. The current Harvest Falcon shelter package for bare bases requires approximately 100 C-141 loads to move and almost four days to erect with a 150-man crew. The construction time for the Harvest Falcon shelter package alone means shelter must be prepositioned to meet a 48-hour timeline, or even a 96-hour timeline.

These results do not mean expeditionary operations are infeasible. Technology and process changes may reduce the need to deploy heavy maintenance equipment. For now, however, these results do mean that setting up a strategic infrastructure to perform expeditionary operations involves a series of complicated tradeoffs.

Expensive 48-hour bases may best be reserved for areas such as Europe or Southwest Asia (SWA) that are critical to U.S. interests or under serious threat. In other areas a 144-hour response may be adequate. In still other areas, such as Central America, most operations may be humanitarian relief missions that could be deployed to a bare base within 48 hours since combat equipment would be unnecessary. For all these cases, the models and analytic framework that we are developing can help in negotiating the complex webs of decisions.

One key parameter that affects ACS design is resupply time. If resupply time is cut, the initial operating requirements (IOR) and initial deployment can also be cut. In addition to IOR, resupply time affects repair locations. If resupply time is long, more maintenance equipment and personnel must be deployed to keep units operating, and greater quantities of supplies will be needed to fill longer pipelines.

Short resupply times can help in dealing with uncertainties caused by inability to predict requirements or by changes in requirements resulting from enemy actions. A short resupply time provides the ability to react quickly to inevitable surprises, mitigating their impact.

The future ACS system needs to be designed around expected wartime resupply times, not peacetime resupply possibilities. To examine its constraints, we analyze resupply time as it varies by delivery process and assumptions. Parts of these data were gathered from actual delivery times. Others were generated with models, using optimistic

assumptions, which help show differences between possible and actual system performance.

The left most curve in Figure 4 (AMX-C) shows the distribution of best expected resupply times for small items (less than 150 pounds) that could be shipped via express carriers to SWA from CONUS. This distribution includes the entire resupply time, from requisition to receipt, and has a mean of about four days, including weekends, holidays, and pickup days. This distribution was generated from a simulation model using very optimistic times for each part of the resupply process. It assumes the processes are perfectly coordinated with no delays due to weather, mechanical problems, or enemy actions. This curve represents a "current process optimum" to SWA.

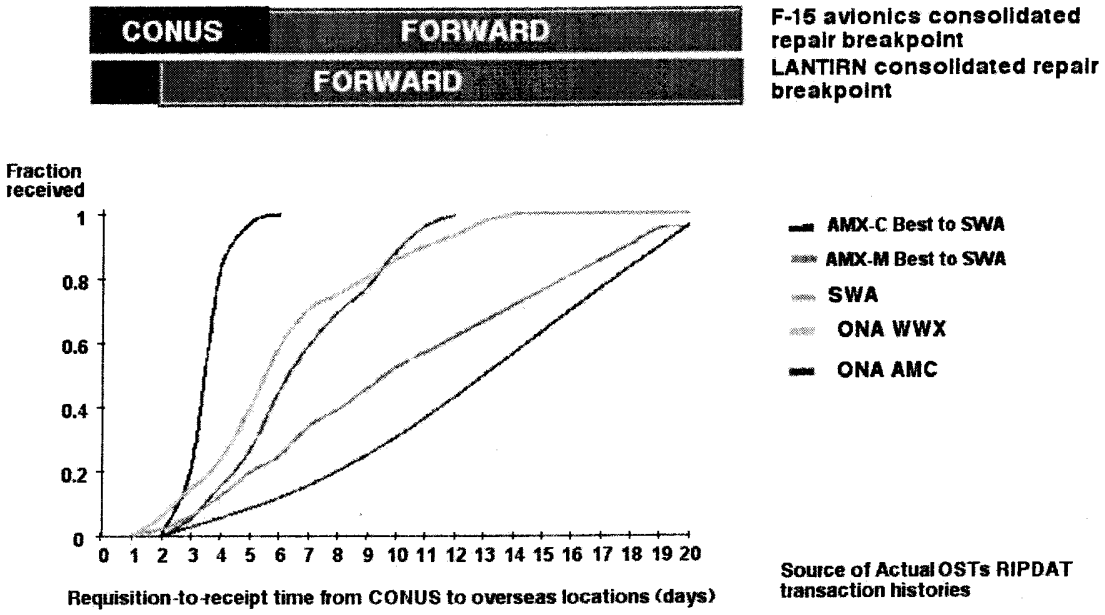

Figure 4—CONUS to SWA Resupply Times and Support Breakpoint Solutions

The third curve (AMX-M) shows the expected distribution of best resupply times to SWA for AMX-M, the system used for large cargo in wartime, under optimistic assumptions. Median resupply time for this system is about seven days. The fourth curve (SWA) shows the current actual delivery times for high-priority cargo to SWA units. This data includes delivery times for both small and large cargo. Note that half these requisitions took more than nine days to deliver.

ONA provided extensive evidence of this challenge. The second left most curve (ONA WWX) shows the distribution of WWX deliveries during ONA. WWX is a Department of Defense (DoD) contract with commercial carriers to move small items within CONUS and from CONUS to the rest of the world. The contract specifies "in-transit" delivery times for shipments between specific locations. Most in-transit times to overseas theaters are about three days, but this excludes the day of pickup and weekends.

During ONA, the resupply times using WWX to Europe averaged about five days, while more than ten percent of deliveries took more than ten days. As shown in Figure 4, the large items that were moved by military flights averaged more than fifteen days to deliver.[10] Even in a highly developed theater for a benign conflict environment, resupply times are lengthy and far from offering the benefits of small response times.

As mentioned above, resupply time affects repair location decisions. We are completing separate studies on maintenance support for key equipment in an expeditionary environment. For two cases in which the analysis is complete, F-15 avionics[11] and LANTIRN (Low Altitude Navigation and Targeting Infrared for Night) pod repairs,[12] we show at the top of Figure 4 the breakpoints for locating repair facilities in CONUS or regional support locations located in or near the area of operations.

For F-15 avionics, consolidating repairs at regional or CONUS facilities sharply reduces personnel needs, as well as the need for some upgrades currently being considered for repair equipment. Resupply time for any consolidated repair facility, however, must be less than six days or the longer pipeline will require substantial investments in new spare parts. Figure 4 shows that achieving such delivery times from CONUS may be difficult, although data from theater support of MICAP requisitions show that transportation times from regional support locations located near the area of operation can meet the six-day breakpoint.[13]

For LANTIRN targeting pods, for which no new acquisitions are planned, the breakpoint timeline is even shorter due to the lack of spares. Maintaining the availability

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[10] AFMC/LSO briefing dated 6 July 1999, Wright-Patterson AFB, Ohio 45433.

[11] Eric Peltz et al., 1999, *Supporting Expeditionary Aerospace Forces: An Analysis of F-15 Avionics Options*, RAND AB271-1-AF, Santa Monica, California.

[12] Amatzia Feinberg et al., 1999, *Supporting Expeditionary Aerospace Forces: A Preliminary Analysis of LANTIRN Options*, RAND AB-293-A, Santa Monica, California.

[13] Data collected from 4th AEW deployment to Doha, Qatar from May 1997 to August 1997. MICAP requisitions that were processed at Prince Sultan AB in Saudi Arabia averaged less than five days. At that time, Prince Sultan AB and Doha were connected by scheduled military resupply flights.

of working pods in a MTW requires transportation times of less than two days from a consolidated repair facility. Figure 4 shows this is out of reach from CONUS and that it might even be difficult to achieve within theater. At the same time, however, deployment of LANTIRN repair to OLs is not an attractive option. The test equipment is old, very heavy, and increasingly unreliable, so repair consolidation reducing the need for test equipment deployment may be required.

Models of individual support processes yield important insights on supporting processes for expeditionary operations. To plan an ACS system, we need to integrate the outputs of models for different processes and consider mixes of options. This may include a mix of prepositioning some materiel, deploying other materiel from FSLs, and deploying still other materiel from CONUS or Shared Support Locations. Our research on this topic explores the use of optimization techniques to integrate options for several support processes.

From these analyses, we conclude that performing expeditionary operations for the current force with current support processes and technologies requires judicious prepositioning of equipment and supplies at selected OLs. This must be backed by a system of regional support locations (RSLs) providing equipment and maintenance services. Such a system would require a transportation system linking OLs and RSLs.

The U.S. Air Force already makes some use of FSLs, particularly for munitions and WRM storage. Consolidated regional repair centers have also been established to support recent conflicts. During Desert Storm, C-130 engine maintenance was consolidated at Rhein Main AB. During ONA, intermediate F-15 avionics repair capabilities were established at Lakenheath AB.

Overview of a Global ACS System

Based on our preliminary results, we can begin to envision an evolving ACS system to support USAF expeditionary operations and one that may be applicable for the NATO RAF. The system would be global and have several elements based outside CONUS. Figure 5 gives a notional picture.

The system has five components:

1. OLs. Some bases in critical areas under high threat should have substantial equipment prepositioned for rapid deployments of heavy combat forces. Other more austere OLs with longer spin-up times might augment these bases. Where conflict is not likely or humanitarian missions will be the norm, the OLs might all be of this second, more austere form.

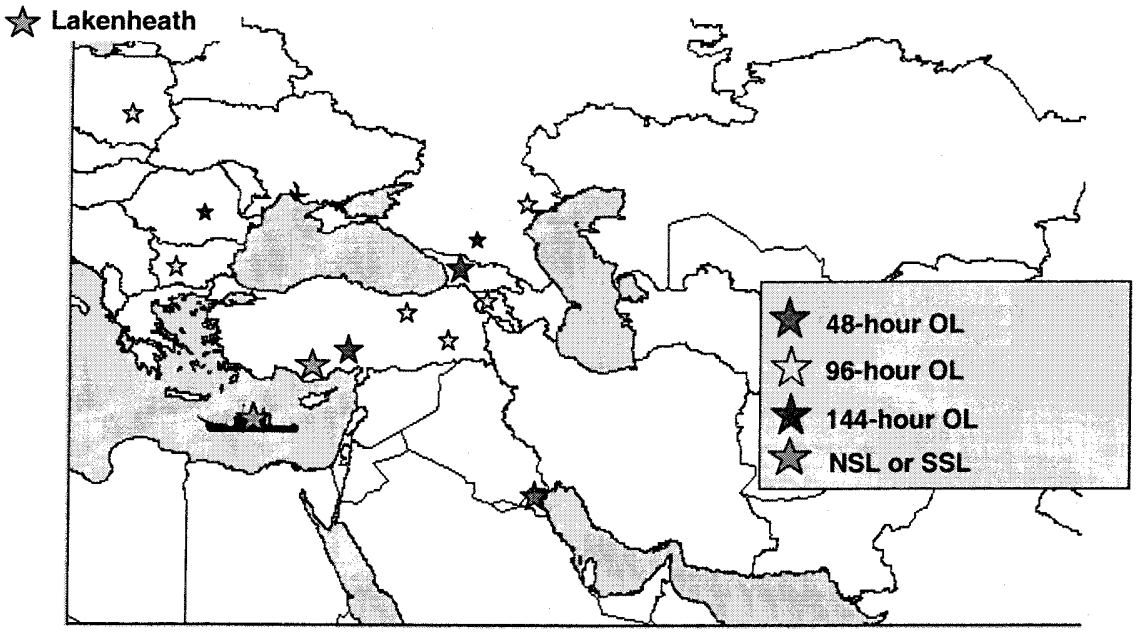

Figure 5—Potential Regional ACS Network

2. RSLs. The configurations and functions of these would depend on geographic locations, presence of threats, and the costs and benefits of using current facilities. Western and Central Europe are presently stable and secure; it may be possible from European FSLs to support operations in areas such as SWA or the Balkans. Note for the NATO RAF RSLs could be national support locations or shared support locations.
3. CONUS Support Locations (CSLs). CONUS depots are one type of CSL, as are contractor facilities. Other types of CSLs may be analogous to FSLs. Such support structures are needed to support CONUS forces, since some repair capability and other activities may be removed from units. These activities may be set up at major Air Force bases, convenient civilian transportation hubs, or Air Force or other defense repair depots.
4. A transportation network connecting the OLs and RSLs with each other and with CONUS, including en route tanker support. This is essential; RSLs need assured transportation links to support expeditionary forces. RSLs themselves could be transportation hubs.
5. A logistics command-and-control (C2) system to organize transport and support activities and for swift reaction to changing circumstances.

The actual configuration of these components depends on several elements. These include local infrastructure and force protection, political aspects (e.g., access to bases and resources), and how site locations may affect alliances. The analytical framework introduced here needs to be expanded and linked with methods for planning ACS systems with our allies, such as in planning for the NATO RAF.

We emphasize that this potential structure and our key findings depend on the current force and support processes. As new policies are developed and implemented, as the Air Force gains experience with expeditionary operations, and as new technologies for ground support, munitions, shelter, and other resources become available, the system will need adjustment to reflect new capabilities. Improvements in transport times, weight, and equipment reliability may favor greater CONUS support and shrinking the network of RSLs.

An advantage of our analytic framework is that it helps focus research and attention on areas where footprint reductions could have big payoffs. Munitions is a key area where reductions in weight and assembly times could pay big dividends in deployment speed. For operations at bare bases, where shelter must be established, the development and deployment of more lightweight shelters (e.g., ASC/WM small shelters program, AEF Hotels) can also pay dividends in deployment speed and footprint. Changes in these areas will not be made immediately, however, and the structure outlined above will enable expeditionary operations in the near term.

Peacetime cost is important for our analysis. The new support concept may help contain costs by consolidating assets, reducing deployments for technical personnel, using host-nation facilities, and, possibly, sharing costs with allies. Considerable infrastructure, including buildings and large stockpiles of war reserve materiel, may already be available in Europe.

Limited testing of our envisioned ACS occurred during ONA. Before the war, USAFE/LG consolidated WRM storage at Sanem Luxembourg. During ONA, USAFE/LG established consolidated repair facilities at Lakenheath and Spangdahlem. An intra-theater distribution system was created to provide service between RSLs and OLs. Munitions ships designated for use in another AOR were moved to support ONA munitions resupply. This transfer of assets between theaters raised several issues about how non-unit resources should be stored for use in multiple AOR.

ONA raises several general issues for those designing the future ACS system. Support design for ONA took time that may not always be available in war. Heroic efforts were required to overcome system, training, and concept of operation shortfalls. This

raises questions on what new efforts should be institutionalized in an ACS system. Some resources needed for ONA were tied to other AOR. This leads to questions on how logistics support can become more of a strategic rather than a tactical asset. The proposed support planning system likely requires integration across U.S. Air Force organizations and across commodities with one agency endowed with responsibility and authority to integrate and rationalize this global strategic planning from a U.S. Air Force perspective.

5. CONCLUDING REMARKS: SPECIFIC ELEMENTS OF AN ACS PLANNING FRAMEWORK FOR THE NATO RAF

Based on the foregoing, we believe that an integrated ACS planning framework could enhance NATO RAF ACS decisions. The following elements are integral components of an enhanced ACS planning framework:

- A closed loop strategic ACS planning process to develop alternative strategic ACS designs for the NATO RAF concepts of the future.
- Use of employment driven end-to-end requirements generation models to specify requirements as a function of operational requirements and logistics policies, practices, and technologies for important logistics commodities and processes.
- Use of support options assessment models to compute metrics to compare alternative approaches for satisfying the requirements for individual commodities and processes across the phases of operations, e.g., peacetime operations and readiness preparation, deployment, employment/sustainment, redeployment, and reconstitution.
- Use of an integration model to evaluate integrated commodity ACS structures and processes.
- Use of measurements and assessments of actual process performances and resource levels with those that were planned.
- Designation of ACS planning and assessment responsibilities to direct and advocate the strategic system design and evolution.

The NATO RAF concept is a radical departure from past NATO employment concepts, and it holds promise for enhancing NATO's ability to deal with a new and uncertain international environment. We believe that an integrated, continuous strategic ACS planning process will enable the realization of the full potential of NATO RAF capabilities. Many challenges exist in implementing such a capability including sharing of information, entrusting planning organizations to develop options, and accepting reliance on shared assets.

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