

# **ARMY SCIENCE BOARD**

## **FY1999 SUMMER STUDY**

### **FINAL REPORT**



DEPARTMENT OF THE ARMY  
ASSISTANT SECRETARY OF THE ARMY  
(ACQUISITION, LOGISTICS AND TECHNOLOGY)  
WASHINGTON, D.C. 20310-0103

## **“ENABLING RAPID AND DECISIVE STRATEGIC MANEUVER FOR THE ARMY BEYOND 2010”**

**August 1999**

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A study focusing on the means to enable rapid power projection incorporating analyses of situations involving enemy anti-access activities. The study panel: (1) identified enablers for early and continuous entry of forces and supplies into and within the theater of operations; (2) Identified enablers to realize the full potential of the Revolution in Military Logistics pertaining to providing the required sustainment to early deploying forces; (3) Addressed the implications of an enemy "anti-access" capability and (4) Assessed current programmed assets in terms of meeting these challenges.  The central recommendations developed include: (1) Establishing the 2nd Armored Cavalry Regiment as lethal early entry force; (2) Establishing a National Guard prepositioned equipment group (Brigade size); (3) Increasing Army participation in DARPA's Advanced Logistics Project; (4) Leveraging commercial operators of air/sealift particularly with respect to the agile port concept and influencing commercial high speed shipping to incorporate national defense features.				
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## **ARMY SCIENCE BOARD STRATEGIC MANEUVER EXECUTIVE SUMMARY**

### **The Task –**

General Reimer initiated our study with a simple question “How can we get Army Forces to the fight faster?” By “faster” he meant ensuring the early arrival of critical maneuver units as part of a joint force to meet the needs of the National Military Strategy. His specific requirement to have a composite mounted brigade deployed in 120 hours by sea lift was expanded to include two Brigades by air in 96 hours (one Strategic Brigade Airdrop, one Strike Force) and a three division corps with sustainment in 30 days. Naturally we formed a study group! The DCSOPS LTG Burnette, DCSLOG LTG Coburn, CG, AMC General Wilson, and Military Deputy to the ASA (ALT), LTG Kern were appointed as our sponsors. General Shinseki, our new Chief of Staff, confirmed the need for this study with his stated vision for strategic responsiveness: adding more punch to the light forces and lightening the heavy force.

We postulated that Army Forces will operate within a joint and combined theater of operations and would be provided in an approach which we termed strategic maneuver. We defined *Strategic Maneuver* as “*The ability to project military power rapidly from all points of the globe to converge simultaneously with overwhelming land, air, space, and maritime forces which paralyze and dominate the enemy. The objective is to wrest the operational initiative, achieve dominance, and prevent or terminate conflict by defeating the enemy or setting the conditions for sustained decisive operations of follow-on campaign forces if they are necessary.*”

This definition required us to assess strategic maneuver holistically, looking at the complete fort-to-fight requirement rather than the more traditional port to port strategic deployability perspective. This caused us to examine all methodologies that enable Army forces to gain strategic maneuver capabilities. We looked at both immediate solutions as well as long-range solutions focused upon the time frame beyond 2010. We were given eight Terms of Reference (TOR) by our sponsors:

- (1) to identify mobility enablers for early and continuous entry of forces and supplies into and within the theater of operations;
- (2) to address the implications of an enemy "anti-access" capability;
- (3) to identify enablers to realize the full potential of the Revolution in Military Logistics (RML) pertaining to providing the required sustainment to employ the early deploying force;
- (4) to review and assess contemplated mobility related experiments, ATDs, and ACTDs;
- (5) to review and assess current and planned mobility related acquisitions;
- (6) to identify opportunities for the Army/DOD to leverage commercial capabilities;
- (7) to assess the current programmed assets to meet identified challenges and shortfalls; and
- (8) to provide actionable recommendations, which have suitable POM and JROC implementation.

### **Our Approach –**

Given these terms of reference and the CSA's guidance to “get our forces to the fight faster,” our approach centered on four main areas: Command and Control, Mobility, Sustainment, and Analysis. Our unifying concept was to determine what needs to be done to make quicker and better decisions, reduce what needs to be moved, reduce transit time, and reduce sustainment requirements. We worked closely with two other study groups. General Abrams' sponsored Army Science Board focused on future force design of combat

systems and LTG Burnette's initiated Strategic Mobility Workshop. We also built upon the Army Science Board Summer Study of 1998, "Concepts and Technologies for the Army beyond 2010," which was led by Dr. Braddock, GEN Gorman (USA, Ret.) and LTG Funk (USA, Ret.). Our work then builds upon these efforts and focuses on those enablers that maximize the projection of Army forces to get to the fight faster. We must change, with clear evidence, the current perception that our Army takes too long to be effectual.

### **Threat/Environment –**

In our analysis, we did not postulate a specific threat scenario. Rather, we used what was made available through the series of studies, to include the most recent Army After Next war games. We benefited from the AAN Force Projection War Game conducted at Ft. Eustis, VA and the Army After Next War Game conducted at Carlisle, PA. General (R) Maddox, our co-chair, was mentor to this year's game and assisted us to think through the effect of a thinking opponent beginning the fight in our homeland. We did not pose a specific threat, but we did consider impacts to strategic mobility in benign, disrupted, and opposed settings.

A thinking opponent must counter our asymmetric deployment requirements and will begin disruption at our CONUS forts and transportation nodes, not to mention affecting support of the general populace. Perhaps most importantly, cyber disruption, the information warfare starting even before the shooting starts, is critically important and study on this issue is required. A thorough assessment of this threat is required. It can be reasonably assumed that the future threat will seek to strike quickly, then assume a general defensive posture that includes an aggressive anti-access strategy. He will attempt to delay, disrupt, and deny our access to the theater through political, informational and physical means. Asymmetric methods to accomplish this are smart mines at maritime choke points, use of cheap missiles and use of WMD at key transport nodes or disrupting our transportation and deployment systems. It may also include terror attacks in both CONUS and Intermediate Staging Base (ISB) locations. For example, a single container "seeded" with explosives, commanded or timed to explode at a critical staging area or transit point, would cause significant delays in deployment time lines and create perceptions of potential havoc. It would certainly imperil the entire connectivity of strategic maneuver.

We also considered the question of who is in charge of security of the deploying force. Simply put there is no one single person in charge of security, although commanders at all levels are responsible. This too needs to be studied intensively as a priority matter.

### **What We Learned about the Force Projection Process --**

Through all of our data gathering and deliberations, some significant considerations emerged:

An overarching conclusion that solutions to reduce deployment time must consider the entire throughput process. Fixing any one problem may not have the desired outcome if not examined from a systems approach.

#### **--Deployment Tools**

- Commanders do not have good automated movement planning tools
- Scheduling, monitoring, and rescheduling tools are not timely

#### **--Perceptions**

- Army currently takes too long to deploy significant lethality

#### **--Deployment Requirements**

- Reducing logistics consumption reduces the deployment requirement
- Split basing can increase combat power availability but may require organizational redesign

#### **--Early Entry Forces**

- Immediate fixes are possible to increase lethality
- Increasing lethality increases the airlift requirement

--Follow On Forces

- Once ships begin arriving, their capacity outpaces air capacity
- Making forces, which now move by sea, air-deployable will increase the requirement for airlift

--Commercial Capabilities

- Commercial lift capacity outpaced military lift capability but economic and technical changes limit its availability
- The Army is not exploiting opportunities to obtain critical features in new commercial craft

**Critical Problems To Solve –**

Through a series of work and research periods we tapped experts from the transportation industry, aircraft and shipbuilding firms, supply chain consultants, other government agencies such as the State Area Readiness Command (STARC), and port authorities. We also tried to take advantage of the most advanced initiatives within DoD to help us get our arms around the totality of this subject. We were able to develop some critical questions as we conducted our research and analysis.

Each of the four panels in this effort completed much more detailed reports which deal with the broad range of these critical problem areas.

“Can we make command and control more timely and accurate?” A CINC does not have the automated tools to assist in deployment planning, determining what forces should travel by which means to what locations. Further, the time required by the Time Phased Force Deployment System does not allow us to meet our deployment objectives. A capability is required which allows the CINC to influence the process before the force deployment list is codified. Presently a CINC is required to state his requirements, these requirements are then matched and flowed. Currently, there is no methodology which allows the supported CINC to inter-act with this process other than acceptance and rejection of proposed deployment flow of units over time. The schedule needs to be developed in hours rather than days and be capable of being changed likewise. Commercial capabilities may assist in this process.

We asked who is in charge of the deployment? One answer is CINCTrans. But essentially he only controls one segment of the process usually termed the strategic deployment. Inherently he receives Army forces through Forces Command through Atlantic Command as the force provider. TRANSCOM then hands the deployment off to the supported CINC. The process is not seamless. This compartmentalization also presents serious security demands in terms of force structure and jurisdiction. We need to look at what must be done to provide real-time information flow to these entities to insure flow management.

None of this activity will take place in an Army-only environment. The joint nature of U.S. military operations must be accepted and facilitated. But to say that the Army merely has to respond to the joint initiatives or requirements is short sighted. **As the principal deploying component of the Armed Forces, the Army must play the key and influential role in the development of joint deployment doctrine, tools, systems and processes, and policy.**

As with the transportation assets of the commercial sector, management and control capabilities have experienced a phenomenal growth in their application and sophistication. Major American and international intermodal companies have made significant investment to ensure that their logistics and transportation functions are a source of ever-increasing productivity. The Army needs to be able to capitalize on this vast resource in as many applications as possible. The DARPA sponsored Advanced Logistics Project (ALP) offers a means to infuse those commercial capabilities into our own planning and management systems and to make our interface with the commercial sector seamless.

“How can we get more capability to the fight earlier?” In order to increase lethality, survivability, and tactical mobility, work on organizational design must look to improve unit effectiveness, readiness to fight immediately upon entry into the theater, and to do so with less personnel and equipment than at present.

This includes a careful look at what functions in our existing structures do not need to be performed in the theater (split base operations), or, in a new method of operating, may not need to be performed at all. With an aggressive set of criteria to examine unit size, functions, capability, and place of operation, we can examine what can be done to bring greater capability earlier in the process.

Equipment design (size, weight, operating characteristics) goes hand in hand with organization design and offers complementary opportunities to build early effectiveness into the theater. Controlled dimensions and weight significantly expand the number of commercial transport assets that can be utilized for deployment. Compatibility with commercial transportation means is key to the use of the very productive and capable global commercial transportation industry.

Reducing the consumption of the deploying force has significant ramifications. The operating characteristics of the equipment such as fuel consumption, probability of kill, and ease of maintenance can make meaningful contributions to deployment enhancement and to follow-on sustainment.

Packaging the unit, whether combat vehicles or supporting equipment and stocks, into modular shipping units further enhances access to the vast assets of the global commercial sector, simplifies the handling at major transfer nodes, and can facilitate the tracking of these units through the entire connectivity of strategic maneuver. Use of such methods and transport assets can also increase discipline and control in the deployment process from its start point.

The producers of transport assets, the aircraft manufacturers and shipbuilders, are developing aircraft with much greater lift capacity and ships capable of higher speeds than are presently possible. The Army has an interest in these developments, particularly as these improvements might contribute to enhanced deployment. We must work to influence the development of transport platforms. The concept of National Defense Features (those militarily useful capabilities built into a transport asset not required for commercial operation, e.g. special ramps, higher deck strength) can play a key role in the development of such projects as the Fast Ship."

"How do we exploit the growth in capacity in the commercial transportation industry?" Just as the entire commercial world has worked hard at "re-inventing" itself, the transportation industry as a sector has had to work doubly hard. It has had to boost productivity for its own corporate health and has had to boost productivity because the shipper industries have focused on transportation and logistics as their source of improved performance.

The trend in the industry is to greater capacity in the air freight sector which today moves 50,000 tons per day, perhaps as much as fourfold, worldwide, in the next 25 years. If the Army cannot take advantage of this great increase in capacity because its equipment is too large to fit through the doors or too heavy for the cargo deck loadings, we will forego a tremendous capability. If we do not influence future design, we will fail to exploit its great capability. We must interface seamlessly at transfer nodes and must take advantage of the commercial capabilities and efficiencies as far forward as possible. We must focus our organic, special assets at the most challenging operational settings.

In the ocean shipping industry, containerization continues to be the major growth sector. That capacity is being concentrated, however, in mega-ships and in a few "load center" deep water super ports outside CONUS where the emphasis is on huge volume, rapid turn-around, and very tight scheduling. The structure of the industry is being further driven by new economic consortia of largely foreign carriers. Only one major U. S. carrier continues to operate in these markets. There is, however, a substantial fleet of smaller (1000 TEU -- Twenty-foot Equivalent Units) ships which could provide access to the world's smaller ports. To stay competitive, ports not destined to become "load centers" are looking at a variety of innovations such as the "Agile Port" and "Rapid Rail" concepts.

American railroads are participating in similar trends. Mergers and acquisitions are producing greater concentration and less system slack. Evolving rail corridors may well leave the Army behind.

In sum, despite massive growth in the industry (now a \$500B/yr sector), there is little room for Army deployment cargo, especially if it is not immediately compatible with the commercial size and weight constraints and able to integrate seamlessly into a system driven by commercial obligations. If the Army is to construct a seamless interface with the commercial transportation industry, we will have to do it by forming strategic, collaborative partnerships, not through the near-confiscatory CRAF and VISA arrangements.

"How can we improve military lift capability?" While we have stressed the development of military capabilities which can mesh seamlessly with the commercial industry, and we have advocated the reliance on commercial assets, methods, and capabilities as much as possible, there remains the requirement to maintain (or in some cases, develop) unique military capabilities or to insist that military equipment have extraordinary operating characteristics.

Because of the problems of access to the theater, we cannot be dependent solely upon highly developed and sophisticated facilities. We need to be able to use a broad range of airfields and seaports where the operating environment may not support the requirements of advanced international commerce. We also need more reliable data on the broad range of facilities. Many airfields have not been certified for certain aircraft operations. By having more extensive knowledge of these facilities, many more options may exist to enhance our access. Austere airfields, even road segments or open fields, may have to be used. Port facilities without significant materials handling gear, or beaches with inland clearance routes may have to be used. And they may have to be put to use quickly, with a minimum of force structure, and then rapidly closed and relocated. Through all of this, we must maintain the situational awareness of our force, where its pieces are, and what sustainment is required for it.

Consequently, aircraft with austere field capability (C-130, C-17) will need to be focused on these challenging parts of the deployment continuum in order to meet operational goals, to take maximum advantage of their unique capabilities, and to keep the rest of the deployment system operating at peak efficiency on the segments for which they are best suited.

"How can we counter threat actions and options?" Because potential areas of operation may have a limited number of air and sea ports, the capacity of which may further limit force arrival, alternative means must be sought. A thinking and capable enemy will also attempt to target the large, capable fixed facilities in order to limit our access as well.

While not a requirement in every case, the Intermediate Staging Base (ISB) can provide a secure, high throughput facility when circumstances call for it. In most scenarios the ISB is likely to be an essential operating facility. The ISB would be established outside the adversary's targeting range or outside his political sphere of influence. It would take advantage of existing, sophisticated capability, serving as an efficient transfer point from high volume commercial carrier to a range of tactical, intratheater transport means which can serve smaller, austere ports. This would then confront the adversary with an uncertain, wide-ranging access capability of the deploying force.

The use of the ISB is not without a price. Because it is a trans-shipment point, it can add to the time flow and it adds "touches" to the process. It will also require infrastructure (personnel and equipment) to operate. But because it is such a likely option to be invoked, examination of the force structure and operating concepts must be explored.

"Where can we accelerate throughput?" At every point across the deployment/employment continuum, there are opportunities to reduce the amount of handling, administrative actions, and time to process. We refer to these as "touches," be they physical or electronic. There are far too many "touches" in the current system, and there are excellent opportunities to reduce them dramatically. Commercially this is a fertile area of endeavor for increased productivity.

At origin (post, camp or station) equipment can be maintained in a ready-to-load or already loaded for movement status. At Indiantown Gap, PA, we visited the controlled humidity preservation (CHP)

warehouses of the Pennsylvania Army National Guard where Abrams tanks and other rolling stock were maintained in mission-ready status. Stored ARNG equipment in CHP warehouses at locations along the littoral make mech force equipment more readily available for loading and will save time.

On the fort-to-port leg improved management and proper integration with the commercial transportation sector are required to ensure that the Army's movement requirements can be accommodated in an increasingly busy and intensively scheduled transport network.

That same requirement carries over to the ports, where the same high productivity pressures have fostered significant investment in sophisticated handling and port management tools. The "Agile Port" and the "Rail Express" project are solid manifestations of this economic necessity.

Speed on the strategic leg en route will also make a great contribution. Development of ocean vessels of significant capacity capable of speeds in excess of 40 knots can make a great contribution to deployment time reductions. Aircraft capable of much larger payloads can do so as well. But if the system is not addressed holistically, we could invest heavily in some aspect of improvement, only to lose that time improvement to poor management or more complicated transfers, thus squandering the value of the investment.

On the ports of debarkation (POD), the same imperatives prevail. We need to reduce the number of "touches," take advantage of technical and management improvements of the commercial transportation industry as far forward as possible, maintain a seamless interface when the hand-off must occur, and adapt this all to a variety of access scenarios from benign to contested.

As the deploying force reaches the "final mile" of this process, as it prepares to conduct its mission, the deployment process and means employed should find that "final mile" to be the logical, seamless, and natural conclusion to the process. Intratheater lift becomes even more critical as we move more and more toward exploiting commercial lift elsewhere.

Because of threat capabilities, political constraints, the physical condition of the infrastructure in the theater, there is a need to cope with multiple and dispersed ports of debarkation, to open and close them quickly and efficiently, and to maintain certain unique capabilities which are not available or required by routine commercial operating practices. Such capabilities as Logistics-over-the-Shore and airfield operating teams are examples.

There are opportunities on every segment of this process, and there are opportunities when the system as a whole is evaluated. It is the optimization of these elements, not just going faster, that will produce the greatest results.

## **Recommendations--**

### **Deployment Command and Control**

- Increase Army participation in Advanced Logistics Project (ALP) development
- Place Army personnel in DARPA program office

- Fund Army programs (e.g., GCSS-A, CSSCS) to integrate ALP architecture

- Encourage ACOM, DISA, and DARPA to include ALP system products into the Joint Theater Logistics ACTD with the objective of demonstrating readiness for early fielding



## Information Technology

Prepare and support a clear vision of an Integrated Information Infrastructure (I.I.I), a military adaptation of the commercial Internet, based upon commercial standards, procedures and practices.

Direct the Army Battle Command Systems (ABCS), or other appropriate GOSC to create an Integrated Product Team (IPT) to:

- Document the Integrated Information Infrastructure vision and develop a road-map for implementation
- Oversee development of an I.I.I. system of systems architecture
- Vector near term acquisitions to consider the future I.I.I. and prepare for a smooth transition
- Promulgate requirements to assure integration of individual programs into the I.I.I. system of systems architecture

Work with ASV C3I and the other services to achieve a DOD-wide III Capability

## Reducing Mechanized Brigade Deployment Time

Have Army staff, with FORSCOM and NGB, develop operational concept for “NG APS” and within 6 months report back with an implementation plan

## Leveraging Commercial Sea Lift

Forward to the Navy revised Army requirements for strategic sea lift to include high speed sea lift

Enter into a partnership with the Navy and DoT to pursue Title XI support for HSS and Support the immediate incorporation of National Defense Features (NDF) to support military cargo and austere port operations

Work with DARPA and the Navy to develop technology alternatives to off-load ships rapidly in austere ports and across the shore

Advocate (Army Executive Agent) DoD-wide packaging standards consistent with best commercial industrial practices and have TRADOC develop and promulgate the associated TTPs to decrease loading time using containers, flat racks and other intermodal devices (equally applicable to air)

## Leveraging Commercial Airlift - Today

MTMC should evaluate commercial airlift compatibility with current early entry equipment

Explore high-payoff, military-specific enhancements to the commercial fleet, e.g., doors, floors

Require that all future early entry equipment be commercial air compatible

Fully use capability of STARC and RC units to expedite deployments from CONUS (equally applicable to sea)

Contract with global service companies for rapid augmentation of cargo transfer resources at airports of debarkation and intermediate staging bases (ISBs)

Solicit DARPA/TRANSCOM to extend their “virtual airline” technology to air, sea and rail freight

Execute several deployment-sustainment exercises using only commercial means to surface problems, explore limitations and train military planners

### Intermediate Staging Bases

Have TRADOC develop a concept for ISB operations and participate in ACOM's "Focused Logistics: Enabling Early Decisive Operations" concept development

Conduct/participate in experiments (possibly Joint Contingency Force AWE) to determine the minimum force required for efficient ISB operations

### Intratheater Military Lift - Today

Establish a specific intratheater lift requirement

Use the C-17 as an intratheater lifter into austere airfields when ISBs are activated; practice/train this procedure

Conduct experiment to determine the minimal efficient force, to include C2, required to open and operate unimproved airfields and austere sea ports and across the shore

Development of means to off-load ships rapidly in austere ports addressed in "Leveraging Commercial Sea Lift"

### Increasing Lethality, Survivability, and Tactical Mobility of Early Entry Forces

Have TRADOC experiment with alternative, available equipment and recommend, within 12 months, needed procurements

Have TRADOC and XVIII Airborne Corps develop split-based support options, to include necessary organizational redesign

Work with TRANSCOM to find deployment configurations (packaging) to reduce time

Develop the justification and approach DoD and Congress for funding in 12 months

Conduct expeditionary experiment within 24 months (possibly Joint Contingency Force AWE) to examine improvements in early entry deployment and capability

### Increasing Lethality, Survivability, and Overall Deployability - Future Forces

Make the commercial lift sector a true strategic partner

Request TRANSCOM develop data essential for exploiting the potential of austere airfields and sea ports

Have DCSOPS and TRADOC establish clear intratheater air requirement and engage CINCs, JCS and Air Force on SSTOL replacement for C-130

Have TRADOC establish the requirement for Joint Transport Rotorcraft to be able to lift 20 tons and TEU (sea level, 95°F). Army is executive agent. AAE should assure successful acquisition.

Have requirements for future vehicles (e.g., Multi-Mission Combat System, Future Combat Vehicle, Future Scout Cavalry System) address transportation requirements compatible with the systems' mission

Have TRADOC examine both traditional platform centric solutions as well as non traditional "ensemble" solutions for future combat systems. Army concept experimentation is needed

Expand lessons learned from 2nd ACR effort and conduct necessary experiments in split basing, modularity, and containerization for the remainder of the Army

**What Can Be Achieved --**

--Timely and accurate planning, scheduling, and execution tools with full collaboration with commercial lift sector

--Increased lethality, survivability, and tactical mobility for rapidly deployable early entry forces-current and future

--Increased ability to leverage commercial air and sea lift capability

--Improved military lift and transfer capability, particularly in the intratheater role

--Use of ISBs and austere ports to counter threat options and actions

--Improved throughput and logistics, not just increased speed



# **Enabling Rapid and Decisive Strategic Maneuver for the Army After 2010**

## **Summary Briefing**



# ***Army Science Board FY1999 Summer Study***

## ***Strategic Maneuver***

### ***Final Report***



# Strategic Maneuver Briefings

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## Strategic Maneuver

Study Leaders: Dr. Michael Krause  
GEN (R) David Maddox  
Dr. Joseph Braddock

### Panel

Command and Control  
and Information Technology

Mobility

Sustainment

Analysis

### Panel Leaders

Mr. John Cittadino

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# Strategic Maneuver

**Strategic Maneuver** is the ability to project military power rapidly from all points of the globe to converge simultaneously with overwhelming land, air, space, and maritime forces that paralyze and dominate the enemy. The objective is to wrest the operational initiative, achieve dominance, and prevent or terminate conflict by defeating the enemy or setting the conditions for sustained decisive operations of follow-on campaign forces if they are necessary.

**Fort to Fight, Ready to Fight!!**



## Our Mission

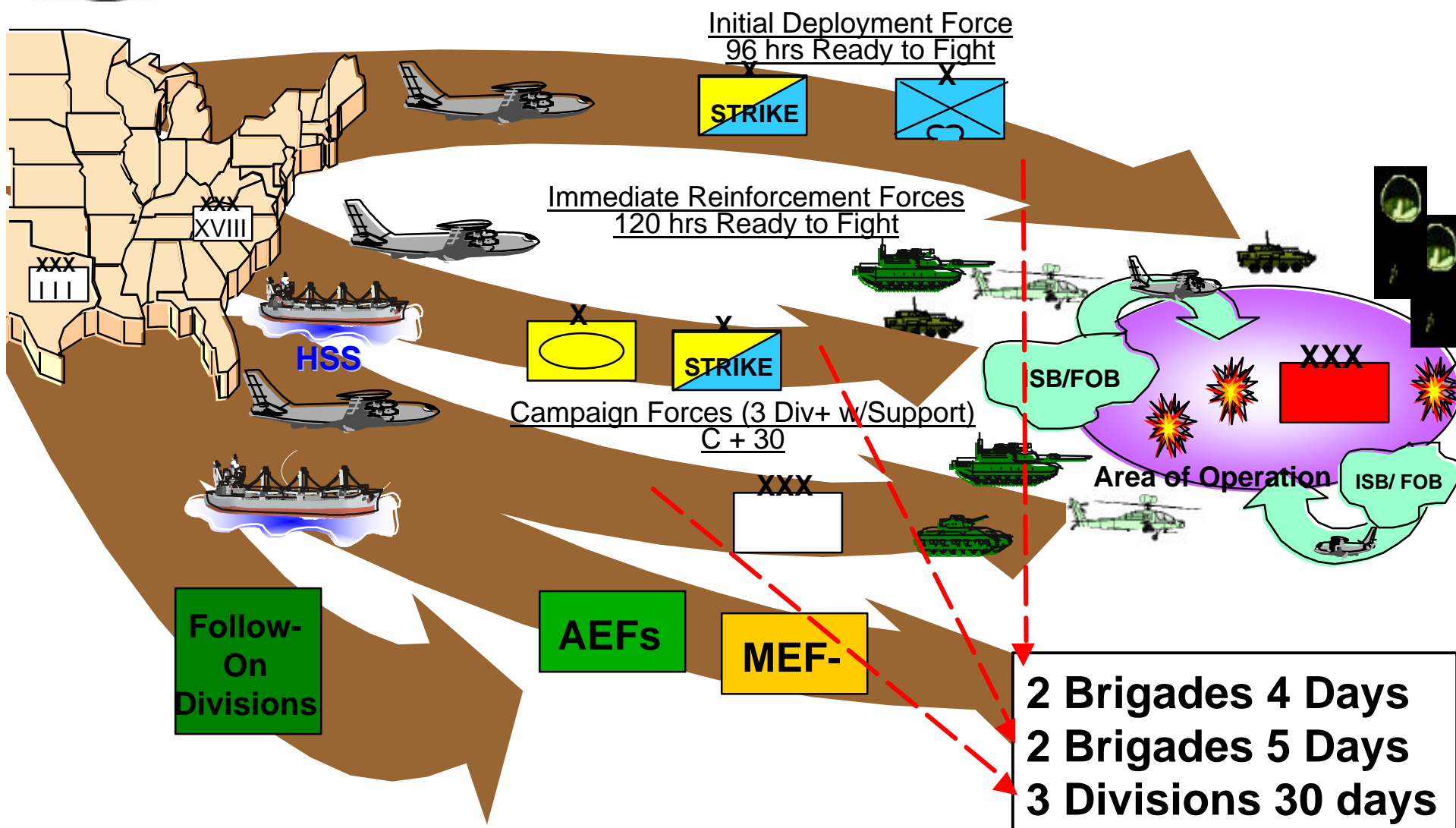
### Terms of Reference - Investigate...

- Identify mobility enablers for early and continuous entry
- Address implications of enemy "anti-access" capability
- Identify enablers to actualize the full potential of the RML
- Review and assess ATDs, and ACTDs
- Review and assess mobility related acquisitions
- Identify opportunities for the Army/DOD to leverage commercial capabilities
- Assess the current programmed assets to meet identified challenges and shortfalls
- Provide actionable recommendations, which have suitable POM and JROC implementation

**Purpose: Get More Combat Power Into the Fight Faster!**



## The Objective - Strategic Maneuver





## What We've Learned Threat

- **A thinking opponent knows that the US asymmetric requirement is strategic force deployment. Precluding or delaying deployment while inflicting significant casualties on deploying forces must be his primary objective.**
  - **Disruption can begin in US homeland**
  - **Precluding overflight and landing rights is a major objective**
  - **Precluding cooperation by host nation workers has great leverage**
  - **Large, fixed commercial air and sea ports are primary targets**
  - **Terrorists, cyber attack, and low cost missiles (including the use of WMD) are weapons of choice**



## What We've Learned Commercial Trends

### **National Land Freight**

Consolidation & economics producing sparse trans continental rail “super highway” with likely result in decreased military rail access

### **Worldwide Air Freight**

Now 50 kt/day throughput, growing to projected 200 kt/day by 2025 (DOD is approx 8 kt/day).

Substantial conversions creating Army opportunity

Higher throughput airports

### **Worldwide Sea Freight**

Fewer large (6-8,000 Twenty foot Equivalent Unit (TEU)) container ships, small number of very high capacity deep water ports and not many routes

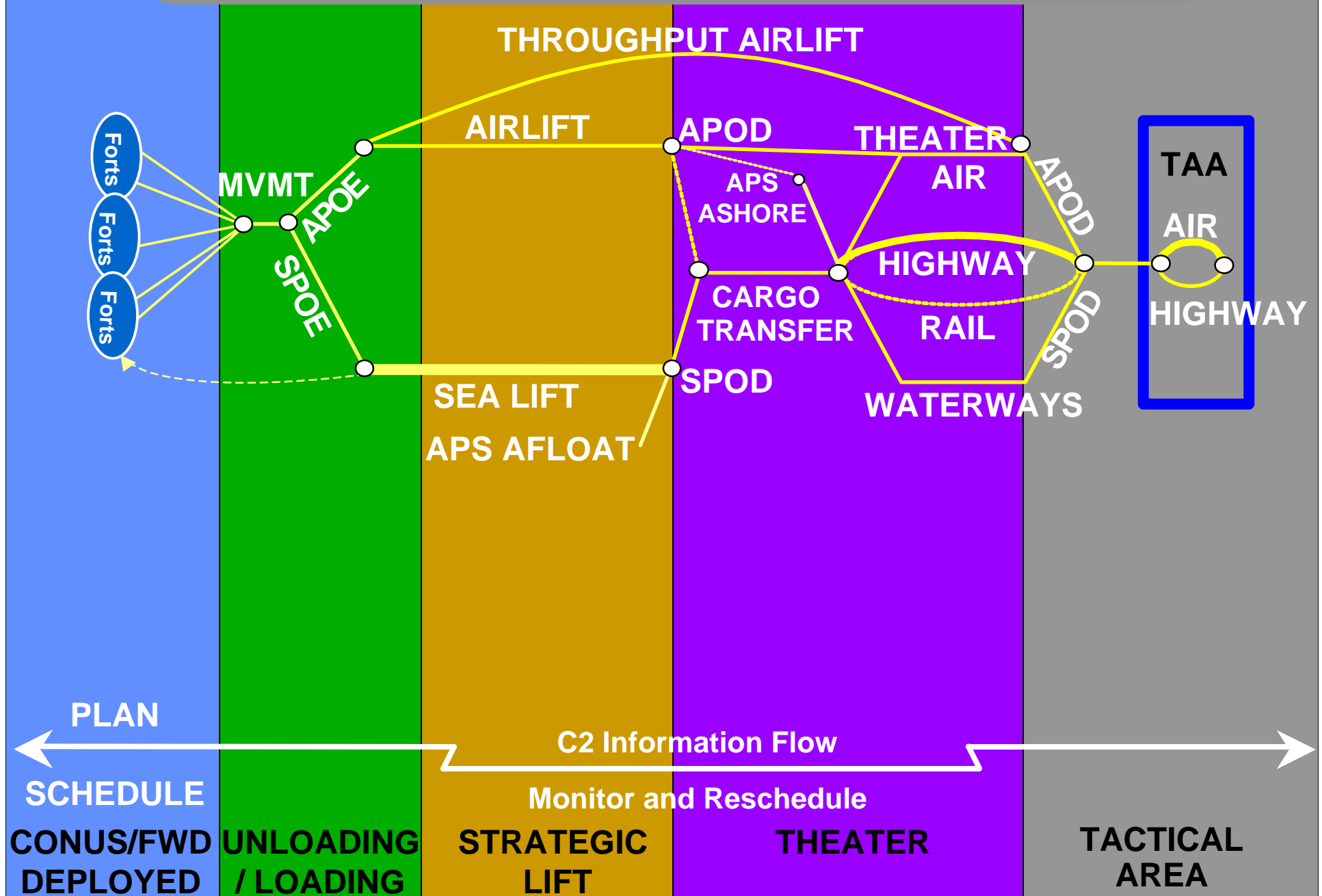
One thousand plus, 1,000 TEU ships (largely foreign flag) available  
Militarily useful commercial RORO fleet (231) and US Military fleet (57) is static at best

Fast load/unload and transit ships offer great advantage to Army

### **Information Technology & Logistics**

Revolutionary changes have already taken place in integrated use of tagging, tracking and optimization of throughput using real time IT systems; IT is totally integrated in the commercial enterprise  
Commercial industry containerizes; the military uses breakbulk

# What We've Learned Force Projection Process





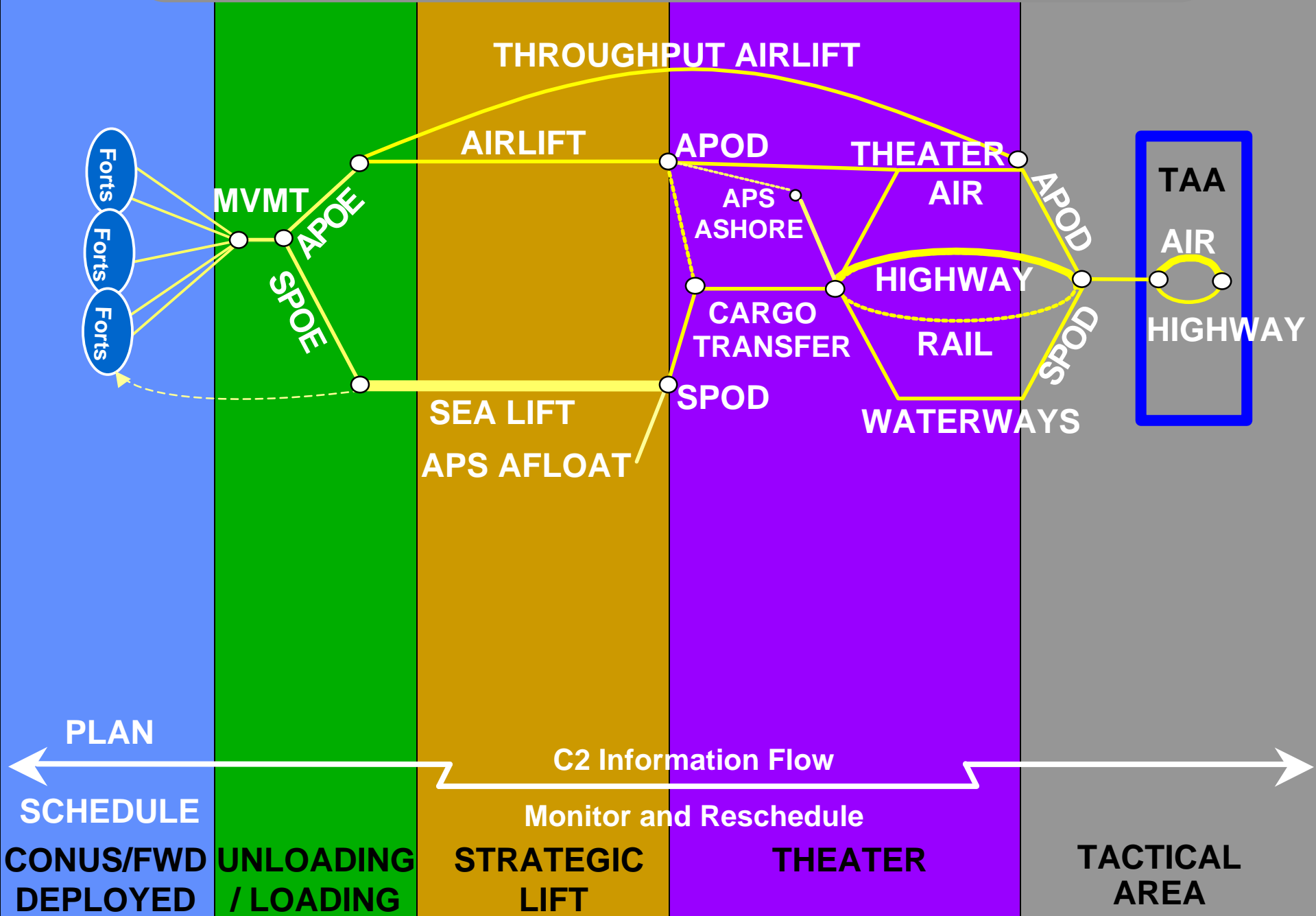
## What We've Learned Force Projection Process

### **Solutions to reduce deployment time must consider entire throughput process**

- Deployment Tools
  - Commanders do not have good automated movement planning tools
  - Scheduling, monitoring, and rescheduling tools are not timely
- Perceptions
  - Army currently takes too long to deploy significant lethality
- Deployment Requirements
  - Reducing logistics consumption reduces deployment requirement
  - Split basing can increase combat power availability ... may require organizational redesign
- Early Entry forces
  - Immediate fixes are possible to increase lethality
  - Increasing lethality increases airlift requirement
- Follow On Forces
  - Once ships begin arriving, their capacity outpaces air capacity
  - Making forces air-deployable increases airlift requirement
- Commercial Capabilities
  - Commercial lift capacity outpaced military lift capability but economic and technical changes are limiting their availability
  - Army not exploiting opportunities to obtain critical features in new commercial craft



## Force Projection Process



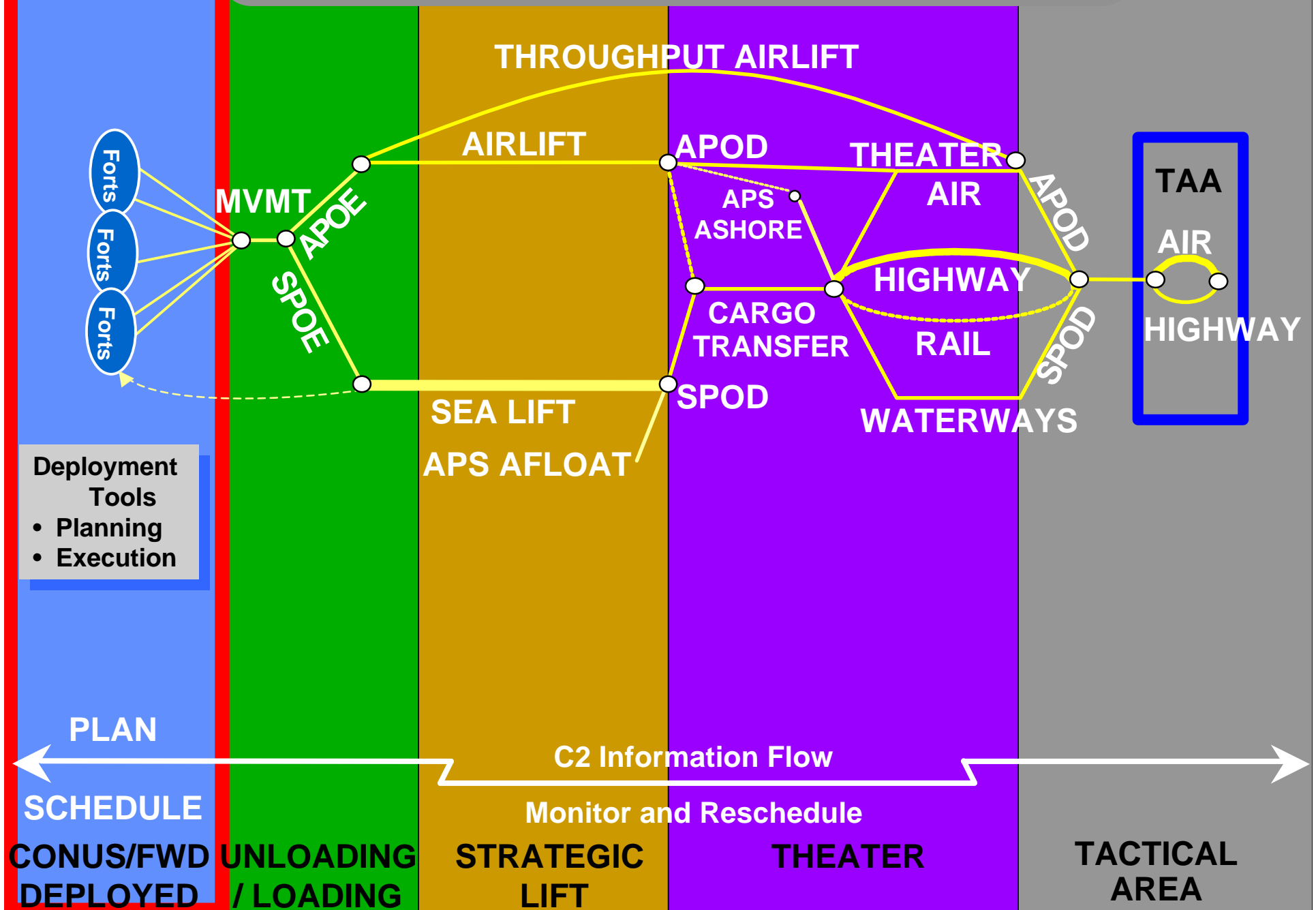


## Strategic Maneuver

### Critical Problems To Solve

- Obtain more timely and accurate planning, scheduling, and execution tools
- Increase lethality, survivability, and tactical mobility of rapidly deployable early entry forces-current and future
- Benefit more from the increase in commercial air and sea lift capability
- Improve military lift and transfer capability, particularly in the Intratheater role
- Counter threat options and actions
- Optimize throughput and logistics, not just transit speed

# Force Projection Process





# Strategic Maneuver Deployment Command and Control

- **Problem**

- There is no effective automated deployment planning tool for crisis management
- Existing scheduling tools do not provide the timeliness required to meet deployment objectives

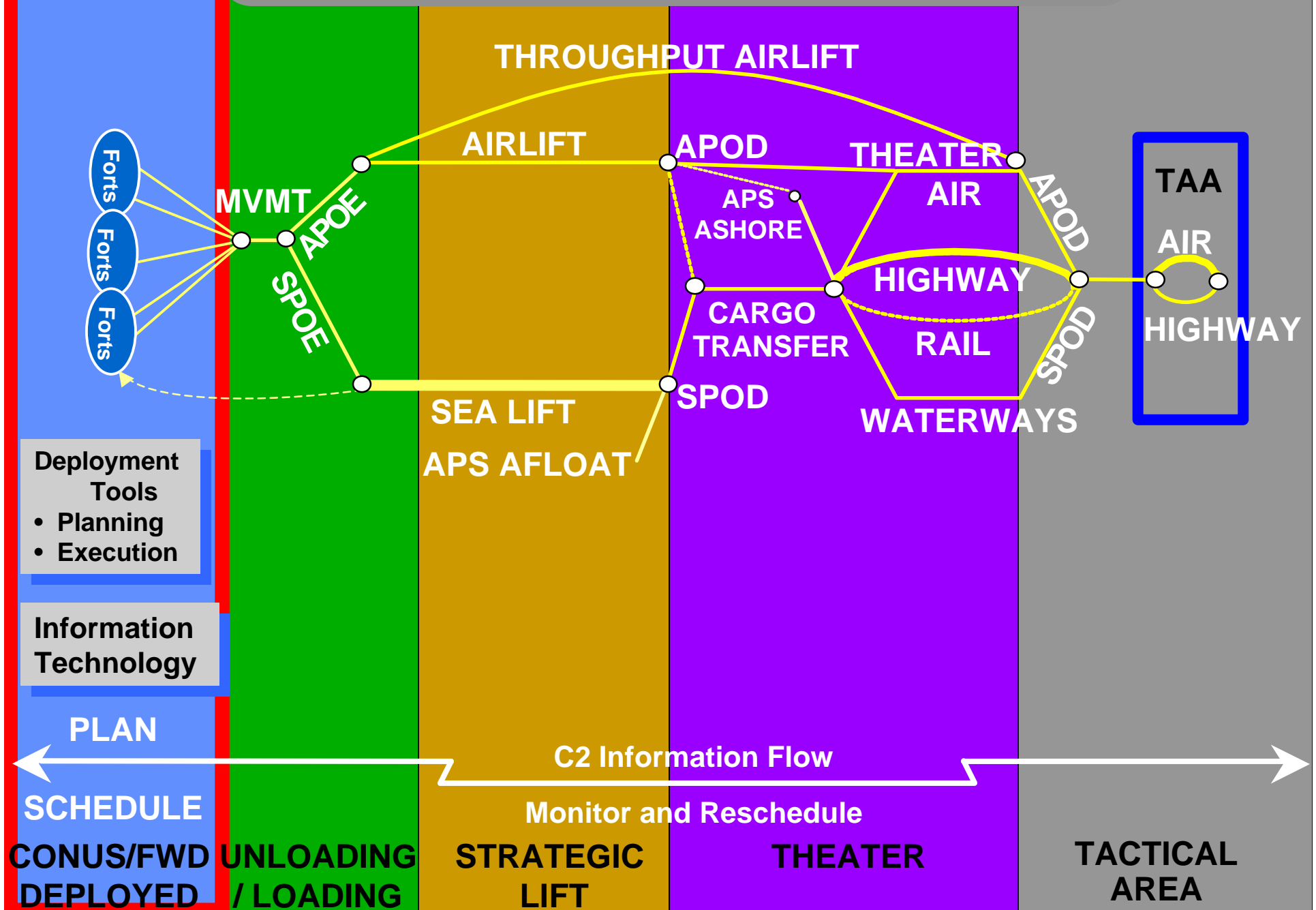
- **Discussion**

- Numerous programs working the problem (GCSS, JOPES, GCSS-A, CSSCS, TCAIMS-II, etc.)
- GCSS-A is under development at the requirements definition phase
- DARPA advanced logistics project (ALP) is a joint, automated technology development project that leverages best commercial practices
- ALP, if successful, would:
  - Produce a complete log plan in 1-4 hours and automatically re-plan/reschedule as required
  - Place the logistician (J-4) and operator (J-3) in a collaborative environment

- **Recommendations**

- Increase Army participation in ALP development
  - Place Army personnel in DARPA program office
- Fund Army programs (e.g., GCSS-A, CSSCS) to integrate ALP architecture
- Encourage ACOM, DISA, and DARPA to include ALP system products in the Joint Theater Logistics ACTD with the objective of demonstrating readiness for early fielding

# Force Projection Process





# Strategic Maneuver Information Technology

- **Problem**

- Army efforts to capitalize on commercial communications and information technology to achieve JV-2010 goals have lagged

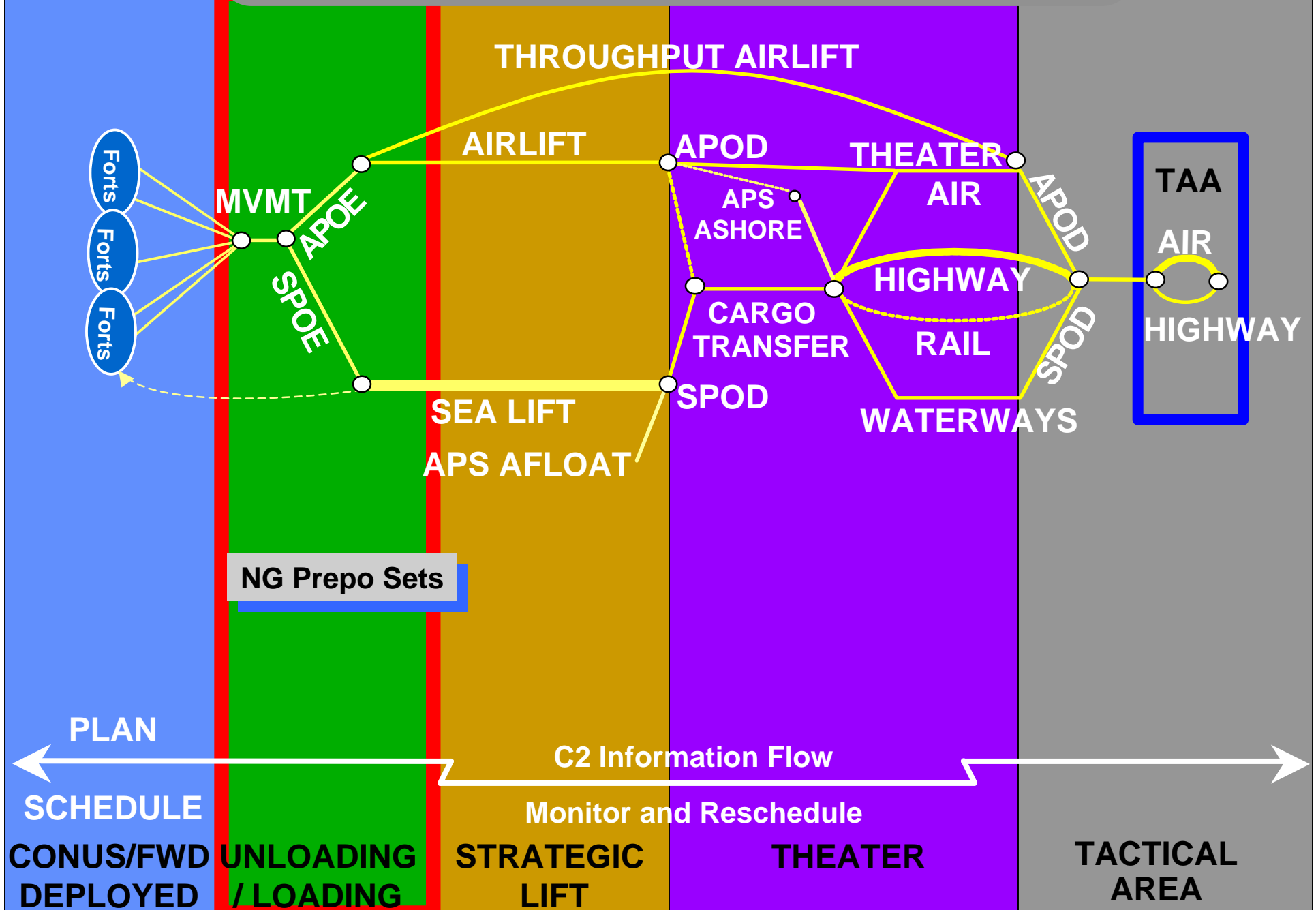
- **Discussion**

- Commercial world is changing rapidly while military acquisition system is slow
- Army does not employ a holistic approach to C4I capability proven so powerful for commercial enterprises
- Army needs an integrated information infrastructure (I.I.I.)
  - To provide seamless, assured exchange of information among users and computers
  - To permit integration and availability of timely information to key systems both logistic (such as GCSS and ALP) and sensor/weapon

- **Recommendations**

- Direct the Army Battle Command Systems (ABCS), or other appropriate, GOSC to create:
  - An Integrated Product Team (IPT) to:
    - Document the Integrated Information Infrastructure vision and develop implementation road-map
    - Oversee development of an I.I.I. system of systems architecture
    - Vector near term acquisitions to consider the future I.I.I. and prepare for a smooth transition
    - Promulgate requirements for integrating individual programs into the I.I.I. system of systems architecture
- Support effort to achieve a commercially-based, DOD-wide I.I.I.

# Force Projection Process





# Strategic Maneuver

## Reducing Mechanized Brigade Deployment Times

- **Problem**

- Most active Army mechanized brigades are too far from ports

- **Discussion**

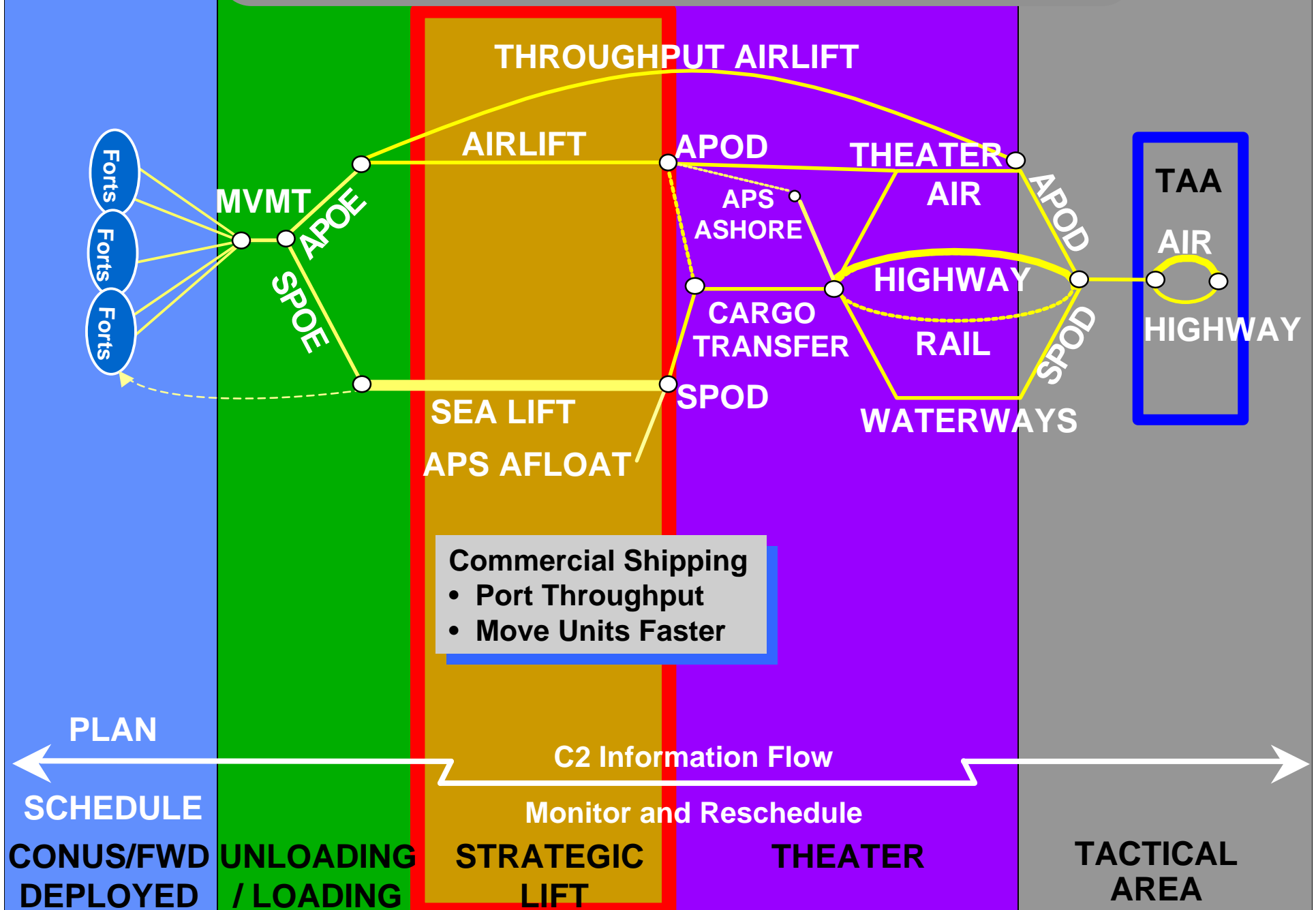
- Many National Guard mechanized brigades are stationed along CONUS coast lines with unit equipment being stored in controlled humidity warehouses
- ARNG equipment could be stored at CONUS ports and could be immediately loaded without requiring surface transportation
- Active unit could deploy by air and reserve units would fall in on the departed active unit's equipment, leveraging the CSA "Division Partnership Program" -- an "Army" solution
- PA ARNG and proposed Philadelphia agile port may be an ideal test case
- Use of ARNG equipment may require a modification in the Army's modernization plan, but would not require the purchase of an additional set of equipment

- **Recommendation**

- Have Army staff, with FORSCOM and NGB, develop operational concept for "NG APS" and within 6 months report back with an implementation plan



# Force Projection Process





# Strategic Maneuver

## Leveraging Commercial Sea Lift

- **Problem**

- DOD shipping is too slow, takes too long to load and off-load, and requires too much water
- Commercial shipping, useful to the Army, is too slow, takes too long to load and off-load, but does have more potential port access.
- Neither DOD nor commercial shipping has fast, austere port off-load capabilities
- Lack of consistent packaging and modularization standards in military is at odds with increased commercial utilization

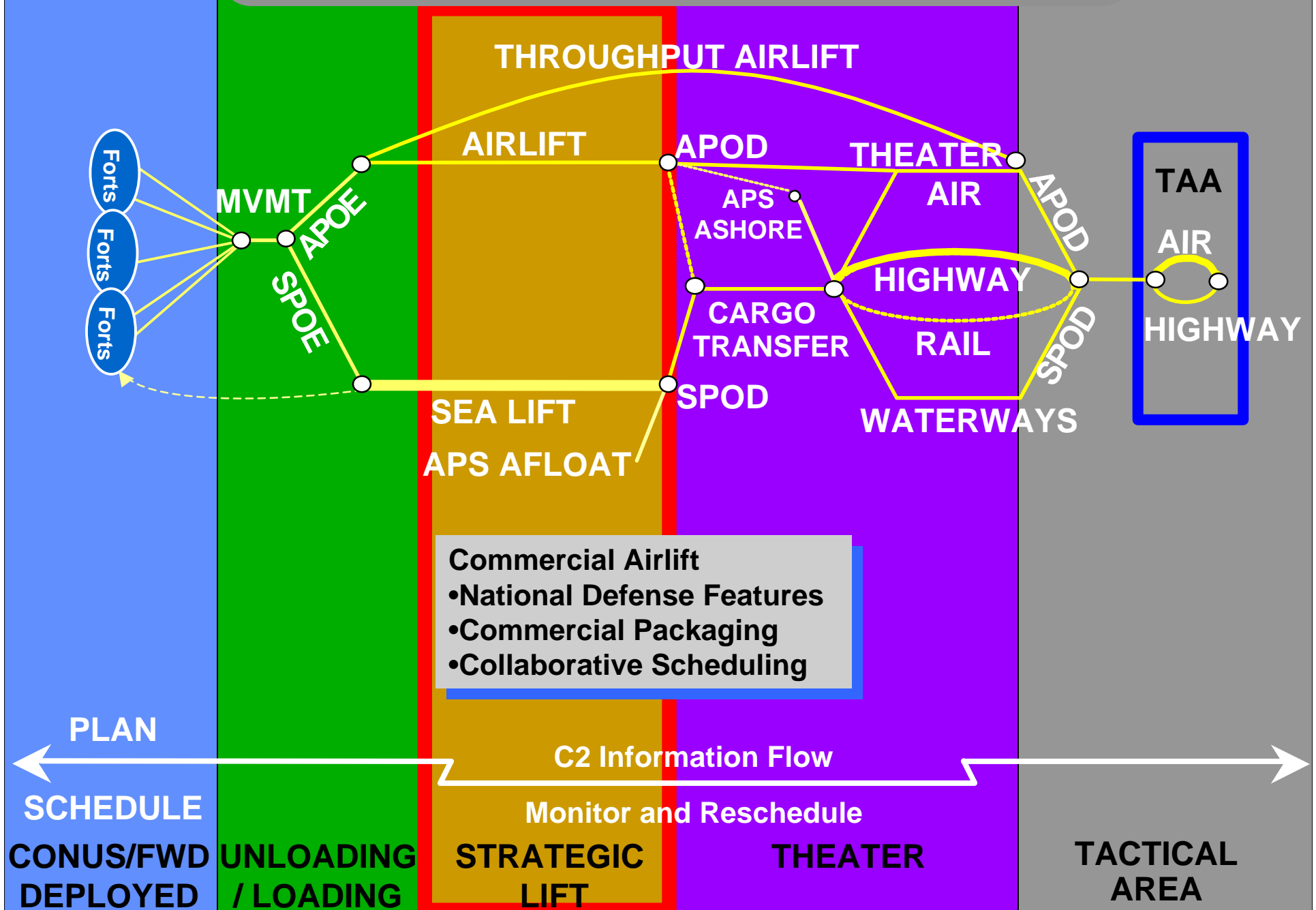
- **Discussion**

- Sea lift has been and will continue to be the primary transportation means for large army forces, equipment, and supplies
- VISA is decreasing in utility due to dwindling US shipping sector
- Army has an opportunity to improve the port to port time by 40% and load/unload time by 75%
- Time window to influence High Speed Ships (HSS) opportunity is short and issues are complex

- **Recommendations**

- Forward to the Navy revised Army requirements for strategic sea lift to include HSS
- Enter into partnership with the Navy and DOT to pursue Title XI support for HSS and support the immediate incorporation of National Defense Features (NDF) to support military cargo and austere port operations
- Work with DARPA and Navy to develop technology alternatives to off-load ships rapidly in austere ports and across the shore
- Advocate (Army Executive Agent) DoD-wide packaging standards consistent with best commercial industrial practices and have TRADOC develop and promulgate the associated TTPs to decrease loading time using containers, flat racks and other intermodal devices (Equally applicable to air)

# Force Projection Process





# Strategic Maneuver

## Leveraging Commercial Airlift - Today

- **Problem**

- Military strategic airlift capacity inadequate to support desired early entry timelines
- Military equipment designed and packaged without regard to commercial airlift technical limitations
- Throughput limited, at least initially, by military cargo transfer resources
- Current process does not facilitate collaboration with commercial carriers

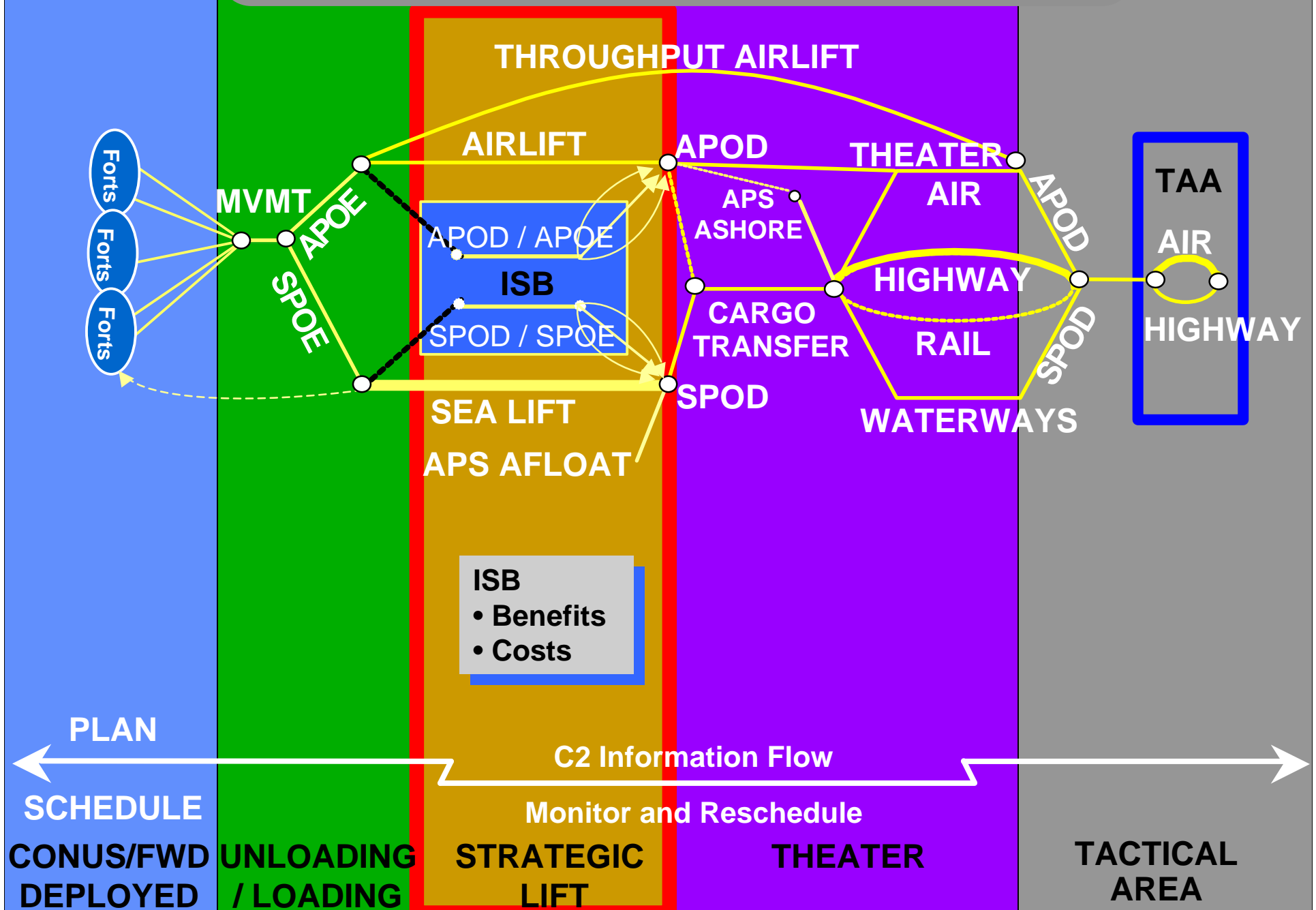
- **Discussion**

- US air freight throughput capacity twice military air lift capacity today and 6 times by 2025
- Commercial airlift load constraints: 20 tons, 8 ft x 8 ft x 20 ft for most of fleet
- CRAF support is dwindling because its demands are in direct conflict with inter-airline competition
- State Area Readiness Commands and RC units have mission/capability to enhance deployment
- DARPA and TRANSCOM have a “virtual airline” program to identify and use hidden passenger airlift capacity

- **Recommendations**

- MTMC evaluate commercial airlift compatibility with current early entry equipment
- Explore high-payoff, military-specific enhancements to the commercial fleet, e.g., doors, floors, etc.
- Require all future early entry equipment be commercial air compatible
- Fully use capability of STARC and RC units to expedite deployments from CONUS (Equally applicable to sea)
- Contract with global service companies for rapid augmentation of cargo transfer resources at airports of debarkation and intermediate staging bases (ISBs)
- Solicit DARPA/TRANSCOM to extend their “virtual airline” technology to air, sea and rail freight
- Execute several deployment-sustainment exercises using only commercial means to surface problems, explore limitations, and train military planners

# Force Projection Process





# Strategic Maneuver Intermediate Staging Bases

- **Problems**

- Potential areas of operation may have limited air and sea ports
- Air and sea port capacity may unacceptably limit force arrival
- Threat will attempt to target commercial air and sea ports to limit force arrival

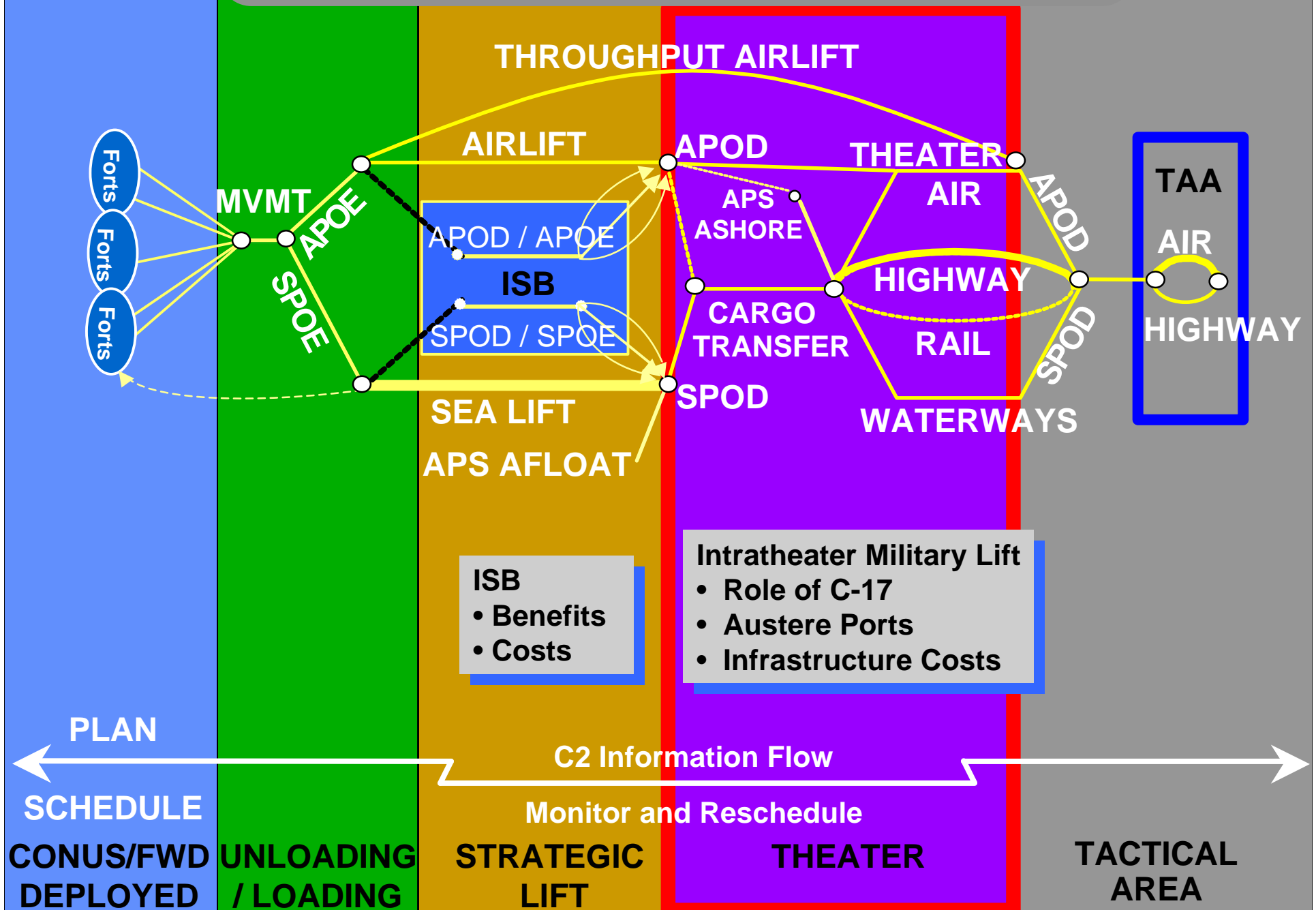
- **Discussion**

- Intermediate staging bases (ISB) will become essential in some future operations
- ISB can provide secure, high throughput facility
- Desired characteristics
  - ISB outside the adversary's targeting arc
  - Container capable with extensive Material Handling Capabilities
  - Hub-like operations with fuel service, maintenance and transfer crew accommodations
  - Modern traffic management and information support
- Costs
  - ISB, as a trans shipment point, can add time to the flow
  - ISB will require infrastructure to operate

- **Recommendations**

- Have TRADOC develop a concept for ISB operations and participate in ACOM's "Focused Logistics: Enabling Early Decisive Operations" concept development
- Conduct/participate in experiments (possibly Joint Contingency Force AWE) to determine the minimum force required for efficient ISB operations

# Force Projection Process





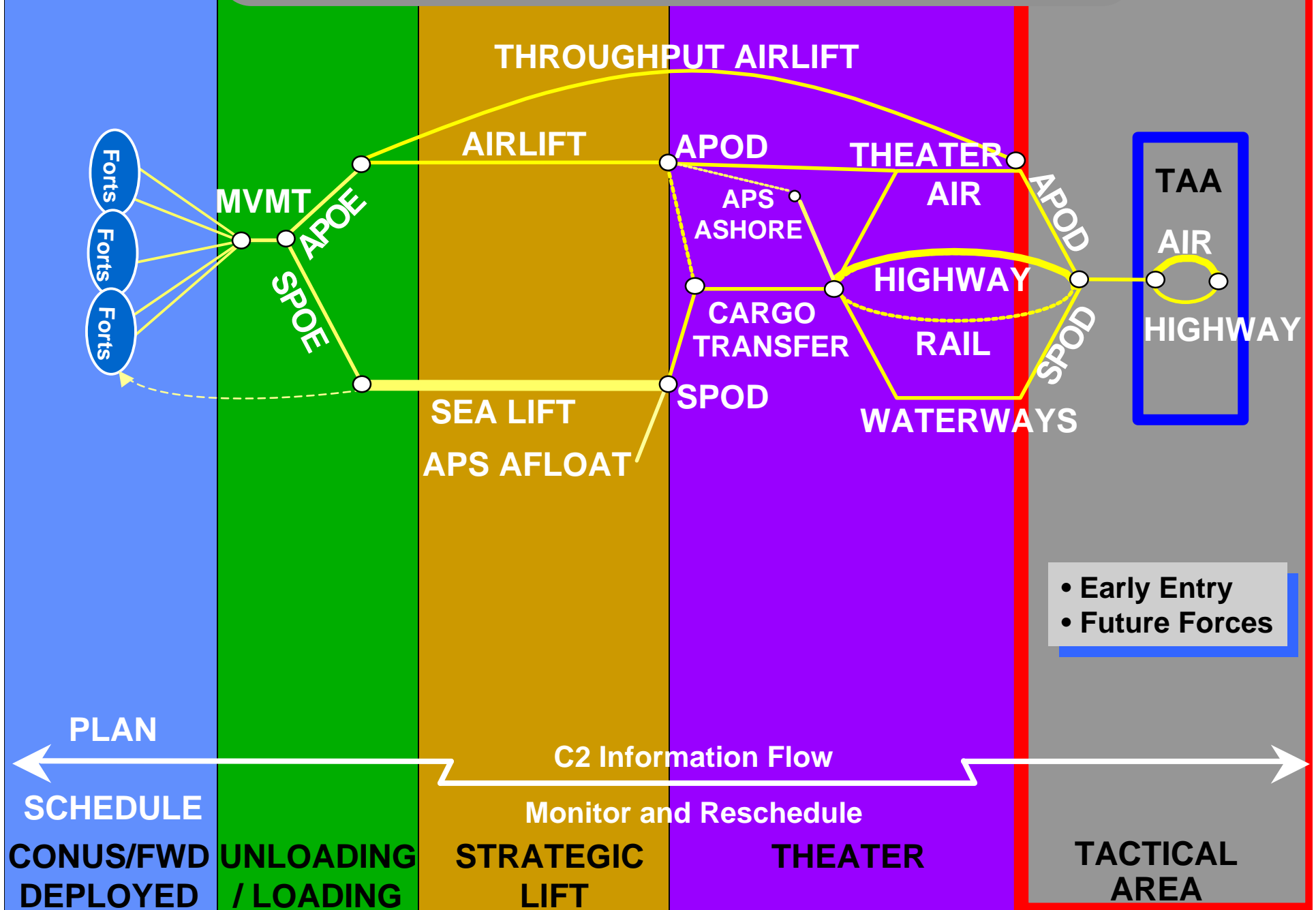
# Strategic Maneuver

## Intratheater Military Lift - Today

- **Problem**
  - Gaining adequate throughput with assured access in the theater
- **Discussion**
  - Must have adequate capacity from ISB to in-country ports (# aircraft and ships)
  - Must be able to use unpredictable access points for air and sea
  - Intratheater air lift is inadequate if C-17 not used as intratheater lifter
  - Water craft are limited in availability and capability to move to austere, dispersed ports
- **Recommendations**
  - Establish a specific intratheater lift requirement
  - Use the C-17 as an intratheater lifter into austere airfields when ISBs are activated; practice/train this procedure
  - Conduct experiment to determine the minimal efficient force, to include C<sup>2</sup>, required to open and operate unimproved airfields and austere seaports and across the shore
  - Development of means to off-load ships rapidly in austere ports addressed in “Leveraging Commercial Sea Lift”



# Force Projection Process





# Strategic Maneuver

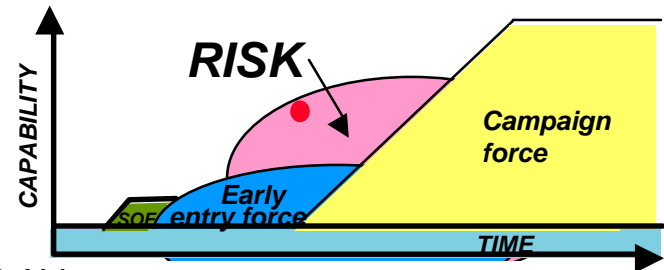
## Increasing Lethality, Survivability, and Tactical Mobility of Early Entry Forces

- **Problem**

- Significant deficiency exists in providing adequate lethality in early entry force to preclude enemy from achieving initial objectives

- **Discussion**

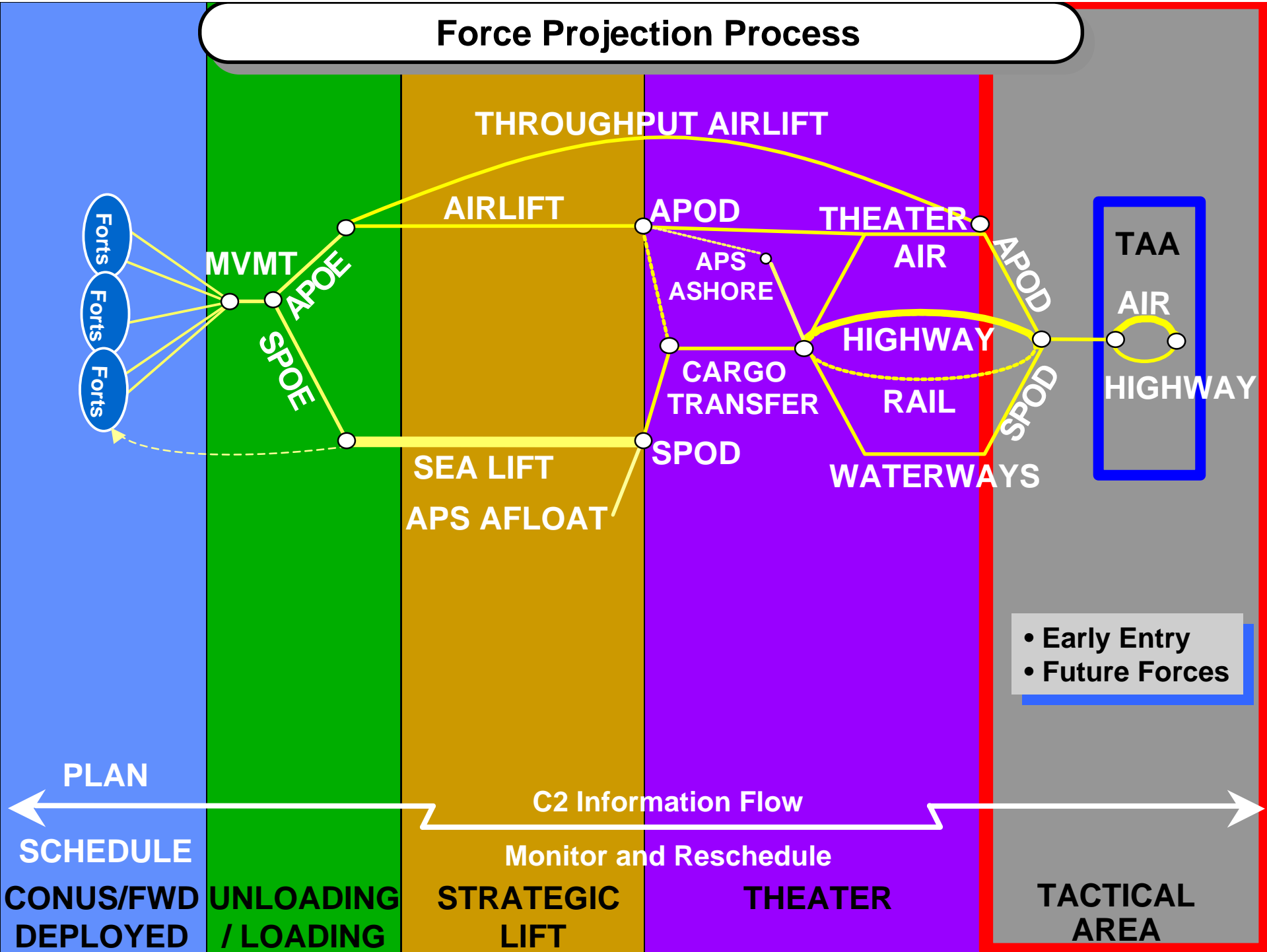
- 2nd ACR assigned to XVIII ABN Corps
- Variety of existing systems can provide enhanced lethality, and are C-130 transportable, e.g.,
  - Armored Gun System
  - Light Weight HIMARS
  - LAV
- Deployment time of 2nd ACR could be decreased by having selected subordinate units organized to conduct split base operations
- Commercial packing (racks, containers, etc.) has potential to decrease loading time



- **Recommendations**

- Have TRADOC experiment with alternative, available equipment and recommend, within 12 months, needed procurements
- Have TRADOC and XVIII Airborne Corps develop split-based support options, to include necessary organizational redesign
- Work with TRANSCOM to find deployment configurations (packaging) that reduce time
- Develop the justification and approach DOD and Congress for funding in 12 months
- Conduct expeditionary experiment within 24 months (possibly Joint Contingency Force AWE) to examine improvements in early entry deployment and capability.

## Force Projection Process





## Strategic Maneuver

### Increasing Lethality, Survivability and Overall Deployability - Future Forces

- **Problem**

- Maximizing deployment and sustainment throughput for the Army
- Maximizing sea and air access

- **Discussion**

- Leveraging all possible commercial lift capability will require (a) strategic partnering and (b) addressing technical constraints for aircraft (weight and cube) and the inherent MHE (Materiel Handling Equipment)
- Having timely, reliable information on potential airfields and sea ports
- Improving VTOL capability to 20 tons (95°F, sea level) for the tactical movement of forces and for unloading ships and clearing air and sea ports
- Improving rapid unloading at austere seaport (treated previously)
- Establishing transportability requirements (weight and cube) compatible with those of lethality, survivability & endurance



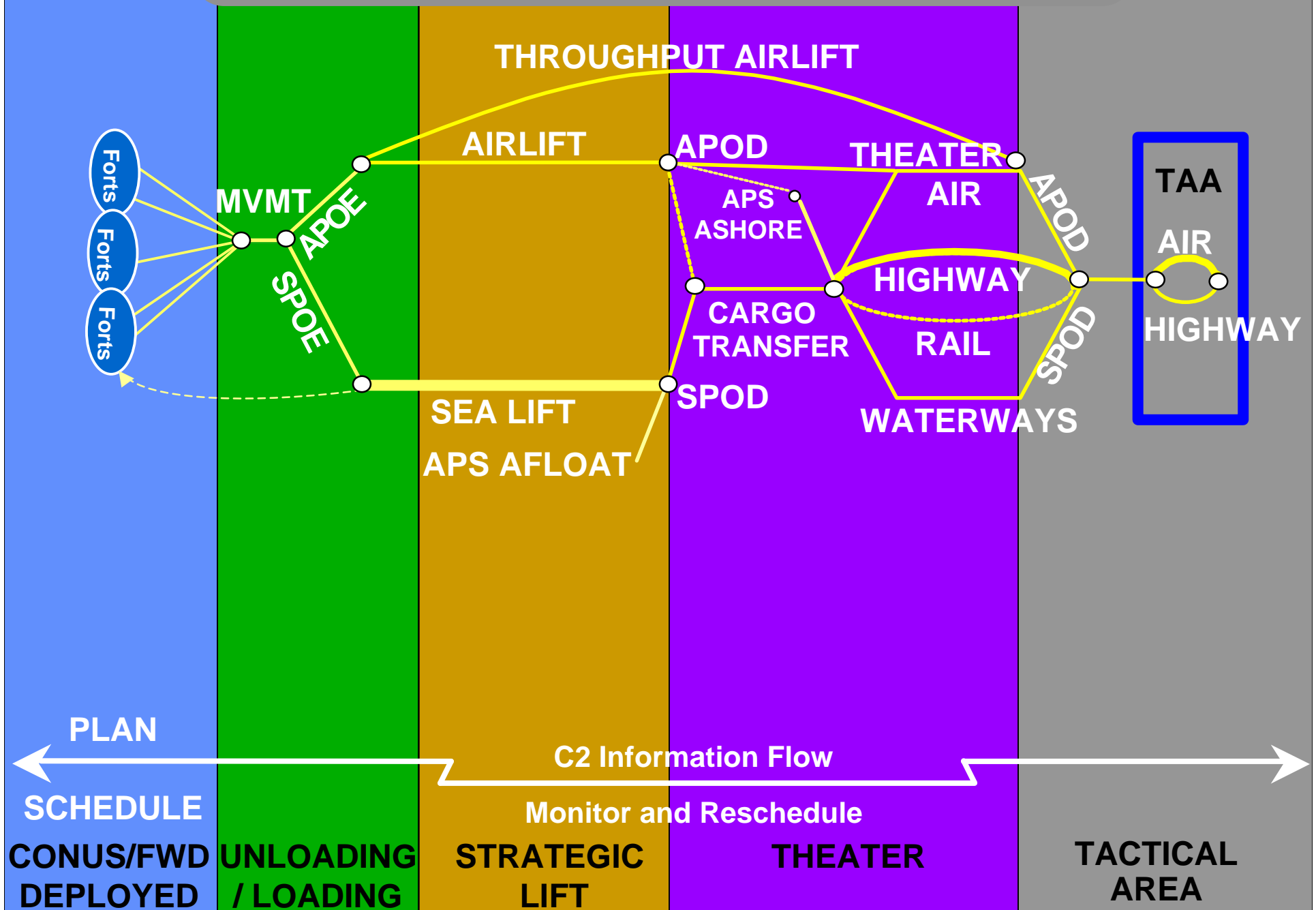
## Strategic Maneuver

### Increasing Lethality, Survivability and Overall Deployability - Future Forces (continued)

- **Recommendations**

- Make commercial lift sector a true strategic partner
- Request TRANSCOM develop data essential to exploiting the potential of austere airfields and sea ports
- Have DCSOPS and TRADOC establish clear intratheater air requirement and engage CINCs, JCS and Air Force on SSTOL replacement for C-130
- Have TRADOC establish the requirement for Joint Transport Rotorcraft to be able to lift 20 tons and TEU (sea level, 95°F). Army is executive agent. AAE should assure successful acquisition.
- Have requirements for future vehicles (e.g., Multi-Mission Combat System, Future Combat Vehicle, Future Scout Cavalry System) address transportation requirements compatible with the systems' mission
- Have TRADOC examine both traditional platform centric solutions as well as non traditional “ensemble” solutions for future combat systems. Army concept experimentation is needed
- Expand lessons learned from 2nd ACR effort and conduct necessary experiments in split basing, modularity, and containerization for the remainder of Army

# Force Projection Process





## Strategic Maneuver

### What Can Be Achieved

- Timely and accurate planning, scheduling, and execution tools with full collaboration with commercial lift sector
- Increased lethality, survivability, and tactical mobility for rapidly deployable early entry forces-current and future
- Increased ability to leverage commercial air and sea lift capability
- Use of ISBs and austere ports to counter threat options and actions
- Improved military lift and transfer capability, particularly in the intratheater role
- Improved throughput and logistics, not just transit speed



## Central Recommendations

- Constitute 2nd Armored Cavalry Regiment as lethal early entry force
- Constitute National Guard prepositioned equipment group (Brigade size)
- Increase Army Participation in DARPA's advanced logistics project
- Leverage commercial operators of air/sealift particularly the agile port concept and commercial high speed ship with national defense features



# **Enabling Rapid and Decisive Strategic Maneuver for the Army After 2010**

## **Mobility Panel Report**





## 1999 Army Science Board Study

*Enabling Rapid and Decisive Strategic Maneuver  
for the Army After 2010*

# MOBILITY PANEL REPORT

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**MOBILITY PANEL REPORT**  
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## INTRODUCTION

The Mobility Panel of the Army Science Board Strategic Maneuver Study of 1999 consisted of members drawn from the Army Science Board as well as experts from the Army and industry.

The panel addressed the issues that relate to and integrate with mobility in the course of its deliberations, focusing on Strategic Maneuver. Strategic Maneuver is the ability to rapidly project military power from all points of the globe to converge simultaneously with overwhelming land, air, space, and maritime forces that paralyze and dominate the enemy. The objective is to wrest the operational initiative, achieve dominance, prevent or terminate conflict by defeating the enemy, or setting conditions for sustained decisive operations of follow-on campaign forces if they are necessary. Strategic Maneuver underwrites a rapidly mounting and seamless military dominance. It is extremely different from the typical phased campaign of halt, buildup and counter offensive.

In the study terms of reference, enablers were sought in the following domains:

- mobility, integrated processes, means and technologies
- concepts and capabilities needed to offset enemy anti-access strategies
- processes, means and technologies which could underwrite improvements to actualize a favorable revolution in military sustainment.

Desired outputs included:

- defining opportunities to leverage, adapt to and/or stimulate useful commercial capabilities
- suggesting experiments, advanced technology demonstrations and advanced concepts technology demonstrations
- reviewing and addressing planned improvements
- providing actionable Joint and Army recommendations encompassing the above.

A preceding study done by the Army Science Board during 1998 addressed concepts and technologies for the Army After 2010. It recognized that the Army is in steady

transition. The objective posited in that study was that the Army After 2010 (AA 2010) would be three times more mobile, three times more effective and require only 1/3 of today's support. It would include a combination of Army XXI (so called legacy forces) along with what were called Strike Forces, which had an air-mobile and mechanized character.

While current service legacy forces are heavy and bulky, important reductions are underway at this time. The Army XXI Division has been reduced from that of a few years earlier by as much as 15% in personnel and 20% in weight. The Strike Force of the future is expected to be much lighter with fewer personnel.

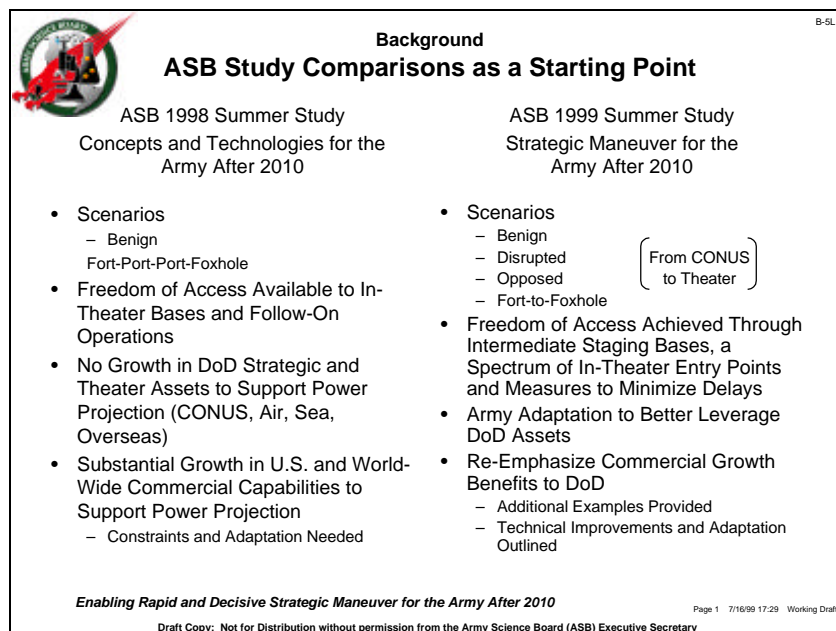
Similar changes are occurring in the Air Force as well. For comparison, today's Wing has a manning of between five and seven thousand people and weighs, with all its equipment (exclusive of its 72 fighters), about 7000 tons. The Aerospace Expeditionary Task Force of 15 to 20 years hence is expected to deploy only 2500 people and have its functions carried out with roughly 4000 tons of equipment exclusive of its aircraft.

This Strategic Maneuver study and its Mobility Panel's report draw from the 1998 Army Science Board study dealing with Concepts and Technologies for the Army after 2010, as well as an Army staff study by the Office of the Deputy Chief of Staff for Operations dealing with strategic mobility. They also draw on the Army After Next TRADOC studies that culminated in the Force Projection War Game and the Spring War Game. These activities provided insights and information into this Study and a companion study dealing with the survivability and lethality of future combat systems.

The current Study builds on and expands the major thrust of the 1998 Army Science Board Study, which had as its central theme "employing the capability resident in the combination of DoD civilian-like assets and DoD active and reserve forces combined with similar, but not identical, capabilities of related commercial sector processes and means." It employs scenario details and sensitivity analyses drawn from both the studies by the Deputy Chief of Staff for Operations and TRADOC's Army After Next wargames. It also employs technical and analytic information from the ongoing Army Science Board 1999 study on Combat Systems Survivability and Lethality. Subsequent sections of this Mobility Panel report will touch on the following:

- scenarios and their ramifications including operational concepts, basing, rapid transfer and coping with anti-access strategies
- freedom of access from fort to foxhole by means of air mobility, sea mobility, and operational and tactical mobility
- integrating across all domains required to assure the ability to successfully strategically maneuver which would include timely access, requisite endurance and assured control capabilities
- Providing related recommendations.

As a point of departure, it is useful to compare what will be done to build on the 1998 study previously mentioned. Figure 1 summarizes the base case for the 1998 study. It describes what will be examined in addition to the issues addressed in the prior study and which of those will be part of the Mobility Panel Report.

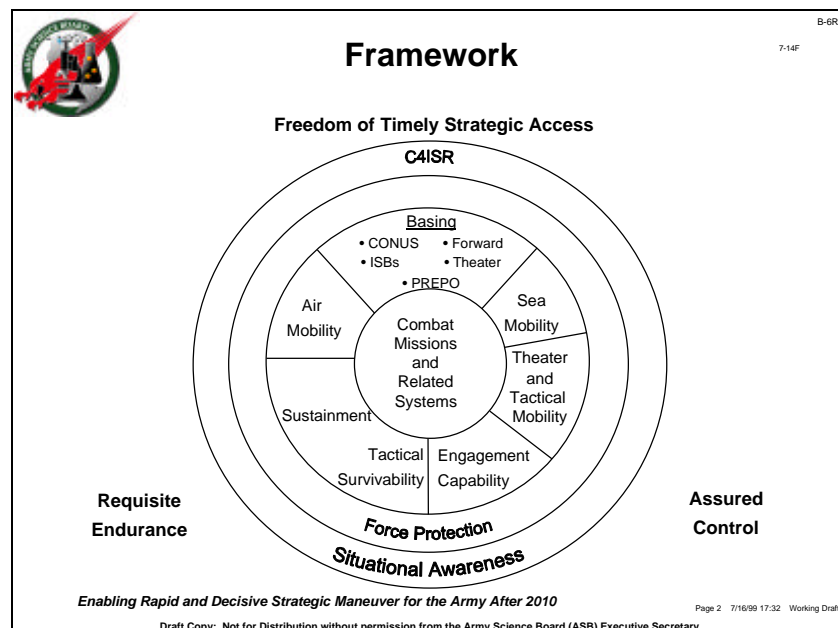


**Figure 1**

In simple fashion the 1998 study addressed benign scenarios; the 1999 Study addresses benign, disrupted, and opposed scenarios. The former examined only situations where there was freedom of access into theater bases and for follow-on operations. The current study addresses freedom of access achieved through a variety of means including intermediate staging bases, a spectrum of in-theater entry points, and measures to minimize delays and maximize survivability.

The earlier study noted no growth in DoD strategic and theater assets to support force projection. The current study addresses issues to further adapt and leverage DoD as well as commercial assets. The 1998 study pointed to the substantial growth in U.S., Allied and worldwide commercial capabilities to support power projection although there were constraints and adaptation needed. This study and the Mobility Panel Report in particular reemphasize the benefits of commercial assets and address beneficial adaptation and technical improvements.

A final piece of background information is contained in Figure 2. It attempts to relate in diagrammatic fashion the top level properties of the force: freedom of timely strategic access, assured control in tactical and operational settings, and requisite endurance for any and all circumstances. Subordinate to these are Mobility Panel issues such as basing, air and sea mobility, theater and tactical mobility, sustainment, and measures that contribute to force protection and survivability. The companion study (1999 ASB Combat Systems Survivability and Lethality) addresses in detail tactical survivability and engagement capability.



**Figure 2**



## SCENARIOS

The DCSOPS study posited a set of operational concepts shown in Figure 3. A variety of Joint Force elements including Army strike forces, Army legacy (Army XXI) forces, Aerospace Expeditionary Task Forces, and Marine Expeditionary Forces are involved in a major seamless buildup in a notional theater. Prepositioned equipment afloat is employed, and a variety of Intermediate Staging Bases (ISBs) are used. In the study, which is still in progress, assets available or presumed to be available are used to address the timeliness of the movement and the access to be gained. These assets provide the means to achieve the three-fold improvement previously discussed in power projection, control, and reductions in sustainment.

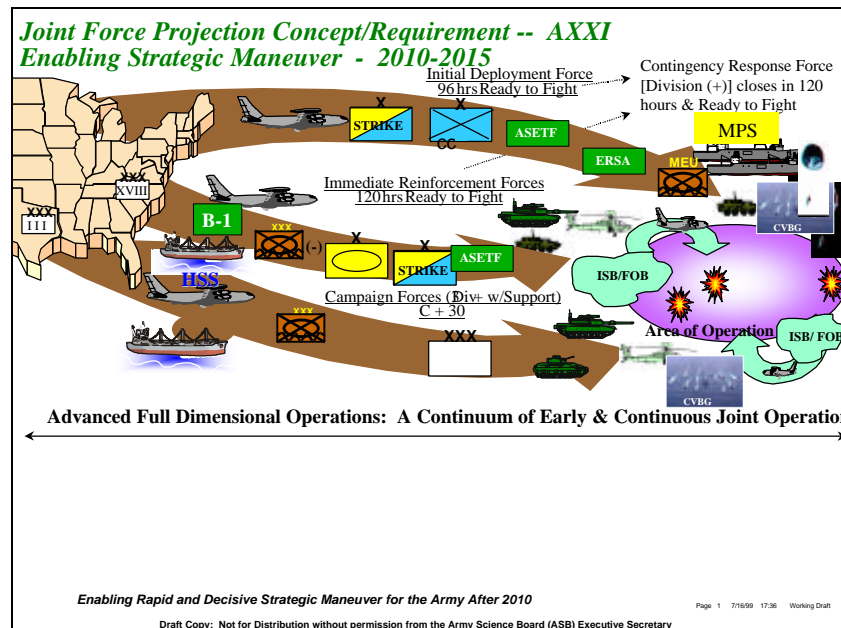


Figure 3

Figure 4 characterizes the scenarios that are being considered: benign, disrupted, and opposed. In the benign case, the force deployment time is minimized and the slowdown is zero for any sustainment. In disrupted case, it is assumed that sabotage and the actions of para-military forces affect the stages of movement from fort to ports through insertion into the theater and in subsequent theater movement. In the opposed case, it is a combination of the forces in the disrupted case and the opposition of formal military forces in and near the theater of operations that affect the deployment.

S-1R

Scenarios Generalized Movement Cases			
Movement Type	Condition: Benign	Disrupted	Opposed
Subsequent Theater Movement			
Staging and Integration With Unit			Opposed With Military Land
Unload At Port			Sea And/or Air Forces Including WMD
Move by Air, Sea or Land	As Needed	Disrupted Through Sabotage And Actions of Paramilitary Forces	Disruption Through Sabotage and Paramilitary Forces
Transfer At ISB			
Move by Air or Sea			
Load At Port			
Move To Port			
Organize Unit for Move			
Time:	Minimum	Lengthened	Longest

*Enabling Rapid and Decisive Strategic Maneuver for the Army After 2010*

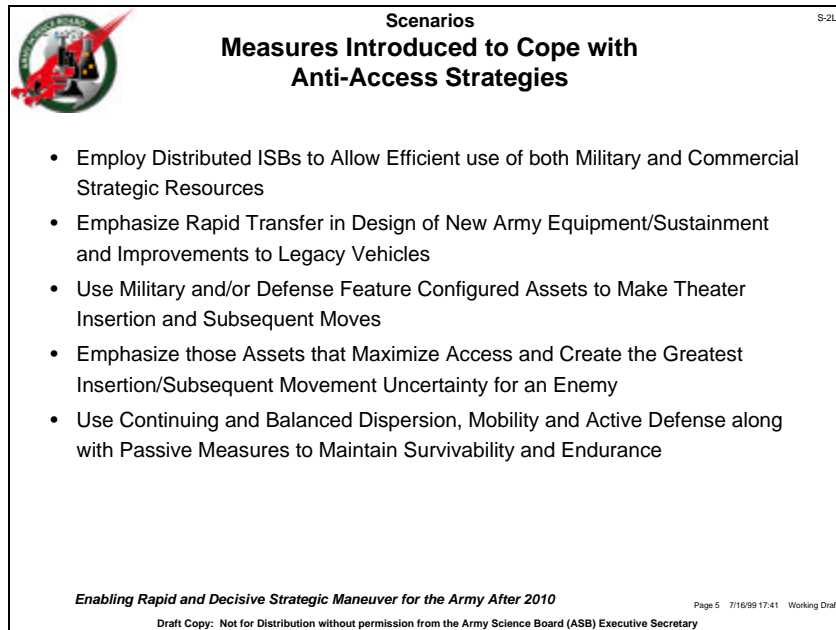
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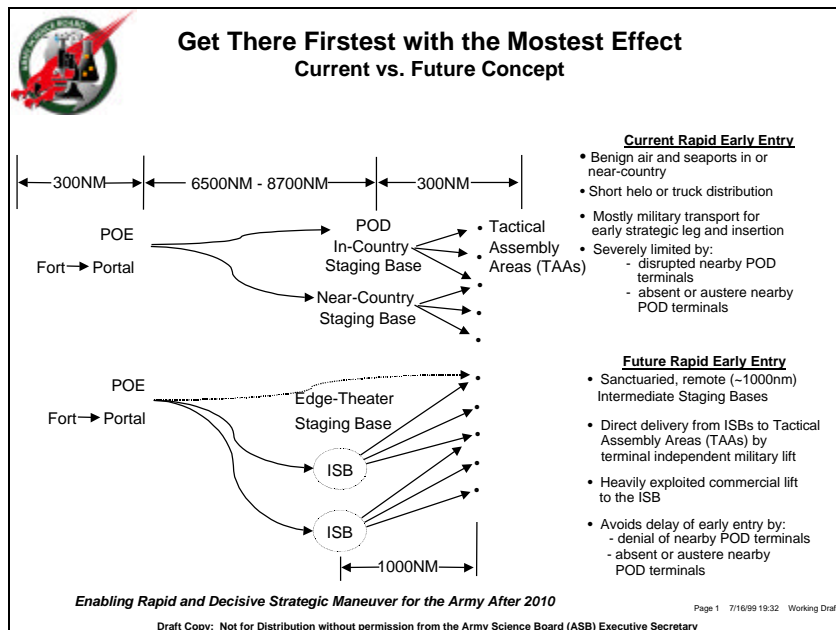
**Figure 4**

Threat studies carried out over the past decade or so are inconclusive relative to the emergence of a peer, although possibilities exist for either China or Russia to emerge as one. We anticipate that threats might have a more regional character and that thinking opponents would create asymmetric threats, including disruption in the US, which would keep the United States out of the theater. These might include sabotage and para-military forces that could disrupt entry processes at well defined airports and ports. They could also include chemical or biological use, or possibly even nuclear weapons, to disrupt entry activities as well as hinder operations—it could also impact activities outside the immediate theater and threaten bases and Allies.

Figure 5 enumerates those measures that have been introduced to cope with this “anti-access strategy.” Emphasis is placed on concepts and means that maximize access and create the greatest insertion and subsequent movement uncertainty for an enemy. In addition, the use of continued and balanced dispersion, mobility, and active and passive defense measures are employed to maintain survivability and endurance. Figure 6 is a generic portrayal of some of these aspects. The distances represented are not specifically derived from a scenario.



**Figure 5**



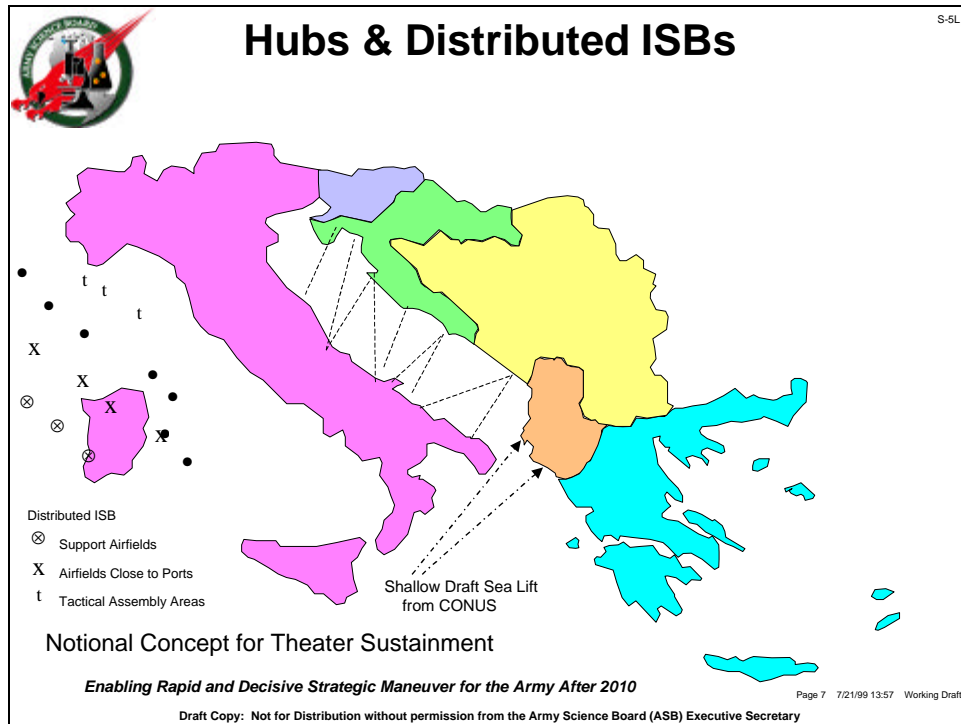
**Figure 6**

Circumstances suggest that there will be cases where edge of theater basing might be possible. There will also be situations where intermediate staging bases well outside the theater might be needed. Analysis of these suggest that the greatest distances of displacement might be as much as 3000 nautical miles. On the average, one should expect these to be hundreds of miles for two important reasons.

First, tactical aviation will desirably be based within 300-500 nautical miles of the theater to have a steady presence. Events in the Balkans have shown this need. Second, sustainment operations needed to make air bases and land forces viable demand roughly the same geometry. Having said this, it may still be necessary to conduct some operations at a great distance. Therefore, in looking to the future, mobility assets might be needed with substantially greater operating radii and capabilities. For example, adding technological improvements and high speed capability to Army watercraft will provide an ability to deliver combat power rapidly to austere ports or searches.

Intermediate staging bases should be operated as hubs and should be distributed for air and sea mobility. The use of existing air facilities and seaports could be leveraged. An example shown in Figure 7 displays this in a possible concept for the Balkans. Seaports and airports in Italy as intermediate staging bases are depicted. For air mobility, there is substantial commercial access to a number of cities on the eastern side of the Italian peninsula. These are not, however, major airports with elaborate fuel, maintenance, and support capabilities. Airports with those capabilities are located on the western side of the peninsula. However, the distances are short enough that commercial assets can fly into the first set of somewhat austere airfields, then jump back to the better supported western side airfields for refueling prior to return. Shuttling equipment into the Balkan Tactical Assembly Areas by air, ferry, or Army watercraft across the Adriatic would create rapid turnaround operations.

The VCSA should task TRADOC to develop a concept and a Mission Essential Needs Statement for ISB establishment and operations. TRADOC, in conjunction with TRANSCOM, should conduct experiments to determine the minimum ISB overhead (forces, command and control, equipment—both military and commercial assets) required for efficient ISB operations. In the same vein, TRADOC and TRANSCOM should conduct similar experiments to determine the minimal overhead (again, both commercial and military assets) required to open and operate unimproved air and seaports. Finally, TRADOC should participate in the ACOM “FLEEDO” concept development and the likely ACTDs.



**Figure 7**

Making intermediate staging bases operationally useful and improving their survivability means adopting some of the things that are today's commercial practices. Airports and seaports are increasingly being considered as hubs. Residence times at hubs are short; residence times at terminals are traditionally long. Air mobility is ahead of the sea sector in that regard, although agile seaports are now coming into existence.

Load and unload times are growing shorter for both air passengers and air freight. The same is true for seaports. Where once the time to load a ship might have been as much as 5 or 6 days; today we achieve 2-3 days. Future loading improvements strive for 12 to 24 hours by application of technology and new processes.

Central to all of this is uniformity in packaging and handling, the employment of information for tracking, command and control for correction of unforeseen circumstances, and work force training to achieve desired performance. While the Army has fine examples of such packaging as an enabler, this practice has not been uniform. In fact, it has been far from uniform. Containerization initiatives undertaken following the Gulf War cut down the transit time for ammunition supply by more than a factor of

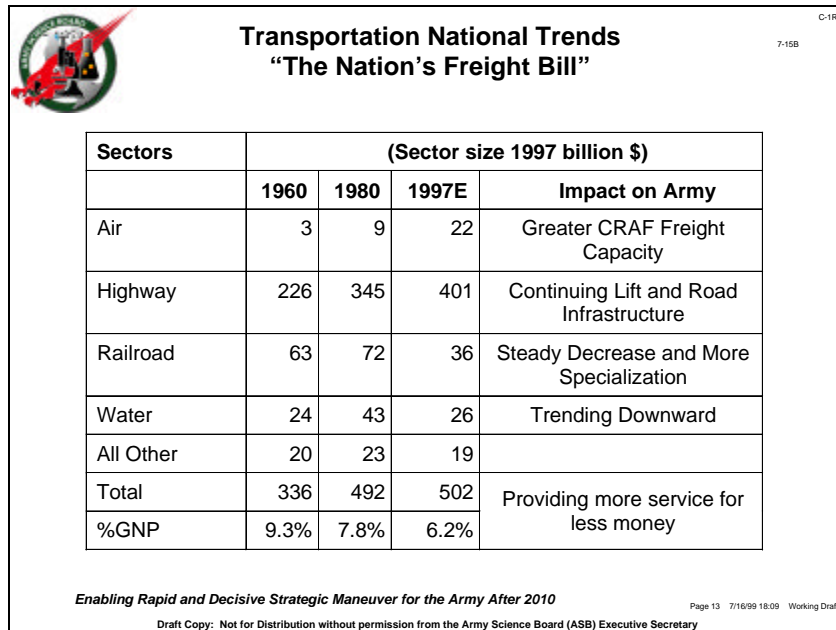
two—to 34 days, which represents about twice the sea transit time. There is an equal time spent in loading and unloading and transit to ports.

In a similar matter, one might look at a high overhead portion of the Army's support base. In the medical field, for example, a hospital and surgical equivalent are provided with trailers and tents. Containerization and modularity could reduce three vehicles required to one and could reduce support crews from six or seven immediate people to two. If one were to look at the overhead behind these, they would be even more substantial. Consequently, TRADOC should develop and promulgate TTPs for improving packaging and outload using containers, flat racks and other intermodal devices.

There are implications for the design of the strike force. The ability to move the strike force is as important as its combat capabilities. Therefore, primacy and attention must be given to its packaging, its basing, and its deployability. While these will be discussed later, it is important to note at this time that these details cannot be subordinated to design features that are solely focused on combat capabilities.

## **COMMERCIAL TRENDS**

Trends in the commercial sector can be clearly discerned from Figure 8. This is an excerpt from a recent Goldman-Sachs financial report that shows “the Nation's freight bill.” It is clear that there are two sectors growing at a substantial rate, air and trucking. When one considers the rates of inflation over the past 40 years (for which the information is displayed), it is evident that the railroads have declined substantially in importance as have other sectors that might affect the Army. What this means is that there are few resources available for modernization in these shrinking sectors.



**Figure 8**

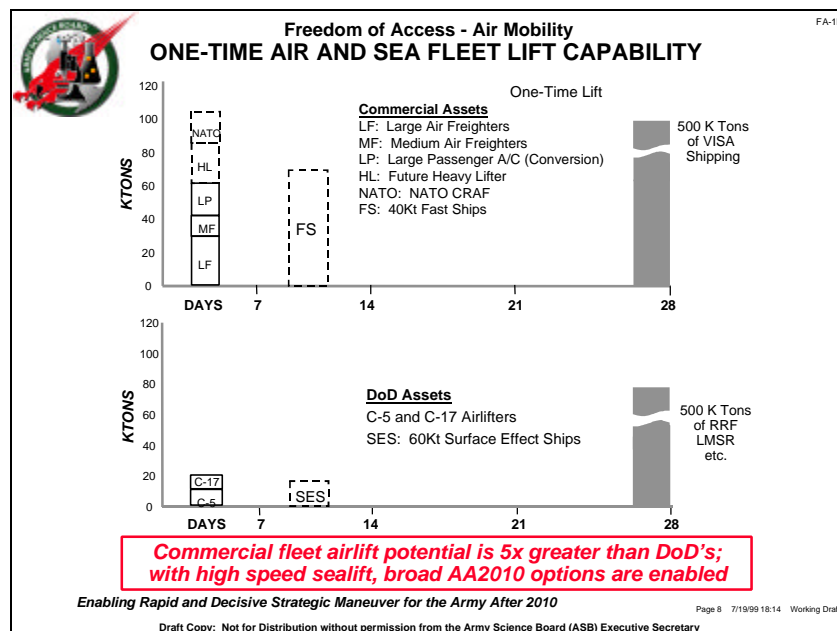
Sea transport has been declining in U.S. ownership but growing on a worldwide basis. However, the growth is skewed toward two types of vessels; the first is bulk carriers such as tankers, and the second is large container ships. The Army of the future has to be designed with these facts in mind. If it were smaller and lighter, the Army of the future could be moved rapidly by specialty carriers. These shippers have small fleets with small vessels and can typically operate in ports at which larger ships cannot berth. Increasingly, Army heavy equipment is dependent on a segment (the specialty carriers). The Army must pay particular attention to the commercial trend away from smaller, militarily useful vessels that can berth at shallow water ports.

In sum, the Army has to consider the nature of the commercial market that impacts on its mobility, specifically on its ability to do Strategic Maneuver.

## **FREEDOM OF ACCESS-AIR MOBILITY**

The 1998 ASB Study used the construct of fleet lift comparisons to show that commercial lift capacity dramatically exceeds military air lift and sea lift capacity. The important conclusion taken from this fact is that military equipment should be designed or modified so that both means might be employed for strategic mobility. Figure 9 is

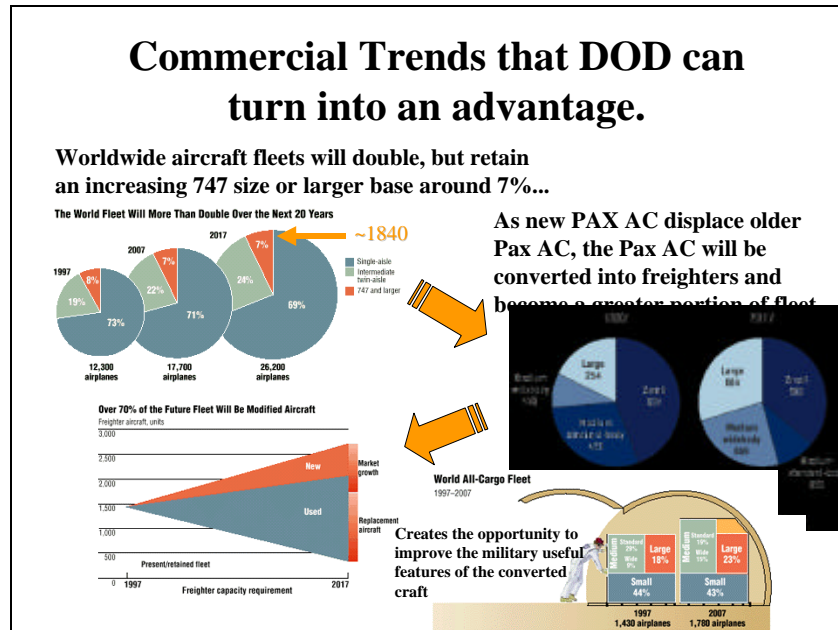
carried over from the earlier study and also includes the possible contribution of tactical operational lift from either the C-17 or the C-130, or a follow-on to the C-130.



**Figure 9**

In the same vein, Figure 10 describes the growth expected in the air freight fleets over the next 20 years and innovations that might come along to provide additional air freight lift. These would include the larger 747 freighters, blended wing body, and the aero lifter. The 1998 study recommended aggressively interacting with the manufacturers to stimulate and adapt to these possibilities.





**Figure 10**

## TECHNICAL CHALLENGES

In the employment of commercial assets for air lift, there are technical challenges. These include the limitations on door sizes, floor strengths, rapid loading and unloading, and handling equipment for that set of tasks. In addition, the current Civilian Reserve Air Fleet (CRAF) policy and implementation would have to be improved. (See Annex B). Innovations such as the virtual airlines program at DARPA should be exploited and expanded to extend from the passenger domain to the freight domain. There is real promise in the virtual airline. Figure 11 shows some of the technical constraints. Figure 12 shows wide body commercial aircraft capacity available that the Army could leverage.

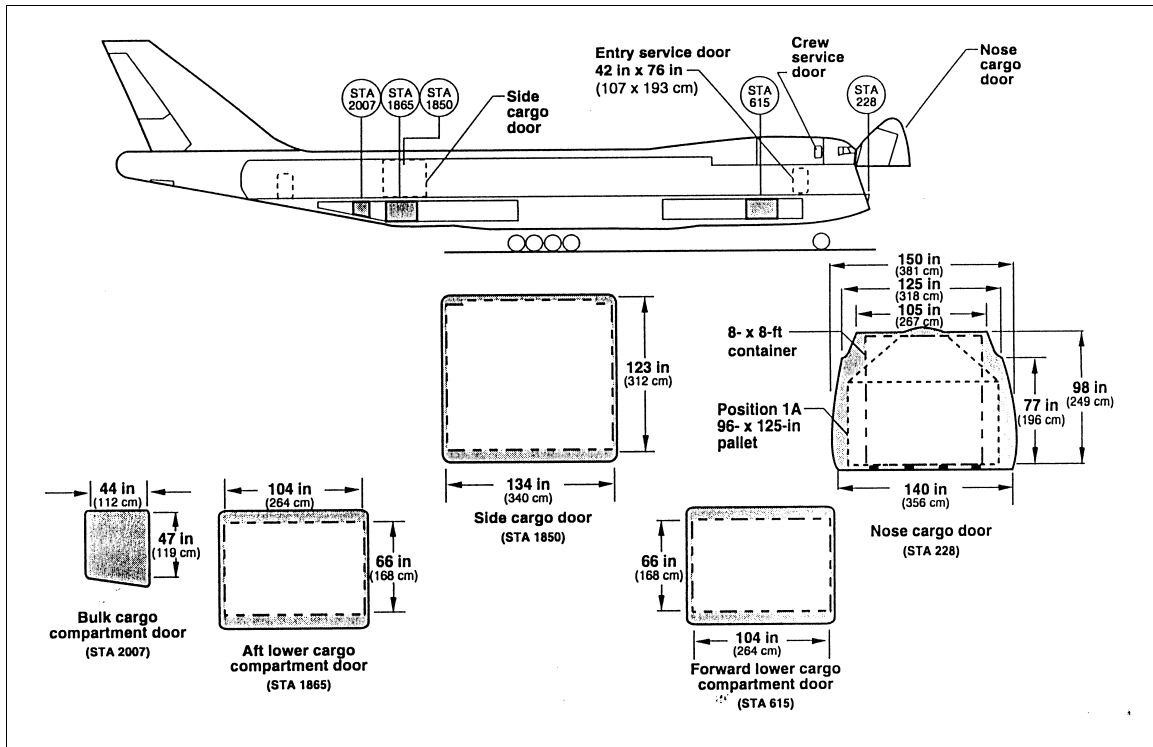


Figure 11



Figure 12

MTMC-TEA should evaluate commercial airlift compatibility with current early entry equipment and explore high-payoff, military-specific enhancements to the commercial fleet, e.g., doors, floors, etc. In addition, TRANSCOM and the Army should jointly sponsor expansion of the “Virtual Airline” work done by DARPA for both passenger and freight operations. DCSOPS should take the responsibility to employ these capabilities in its planning activities, both war and exercise.

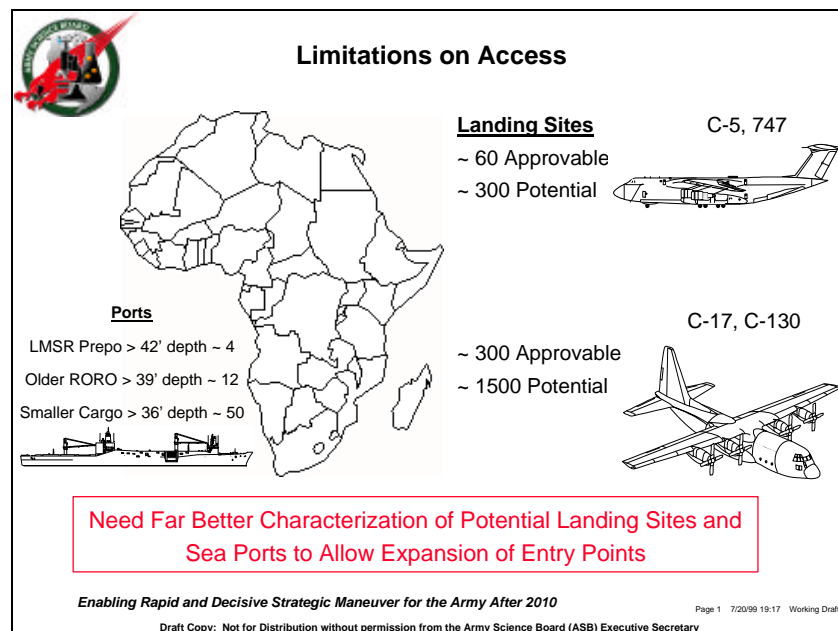
A nine ton vehicle is significant for the near term (Circa 2005). The entire air lift fleet (commercial and military fixed wing, and military rotary wing) can be employed for both rapid strategic and operational/tactical movement for vehicle weights of nine tons or less (with volumes less than 20’x8’x8’). Greater than nine tons, the CH-47 fleet is not usable and at 14 tons the CH-53 is not usable. Beyond 20 tons, the C-130 is not usable. Commercial air freight requires no special support at 9 tons. Commercial air very likely requires cribbing (and the corresponding increased loading/unloading times) for vehicle weights of 20 tons. Beyond 20 tons, the C-5 and C-17 fleet must provide all the lift. Losing the VTOL capability reduces access by an order of magnitude. Losing the C-130 and commercial fleets reduces fleet left by at least 80,000 tons leaving only 15,000 tons of military lift to do the entire task to move a joint force of in excess of 100,000 tons to 200,000 tons.

In the mid to far term (2015-2025), DoD might acquire an SSTOL for operational lift (replace the C-130) and improved VTOL JTR capability to replace the CH-47 and CH-53. In this case, the 9 ton break point shifts to 12 tons. The C-130 break point could move up to 30 tons but the impact on commercial lift is the same in terms of vehicle tonnage but the lift fleet potential is estimated at 200,000 tons. That is a large “give up.”

The Army should undertake an initiative with its MTMC-TEA to find the limits of techniques to accommodate future and selected current vehicles at the least time penalty. This agency, which is an engineering activity, should determine how heavier vehicles might be accommodated possibly up to 15 or even 20 tons and how the loading of these might be rapid and efficient.

## **FREEDOM OF ACCESS-OPERATIONAL AND TACTICAL AIR MOBILITY**

Strike Forces must be deployed rapidly enough to prevent the enemy from setting or, more ideally, from even escalating to a significant level of belligerency. To accomplish this, necessary lift, timely generation of forces, and access are required. Figure 13 shows airfields large enough (though not necessarily strong enough) for particular aircraft in Africa, as well as seaports. The C-5 and 747 can access approximately the same number of potential airfield sites, with the 747 accessing slightly more (based on runway dimensions). The C-17 and C-130, with shorter runway needs, have potential access to many more airfields. For seaports, only a few ports are LMSR capable.



**Figure 13**

Unfortunately, only 1/5 of the large airfields (>6,000 feet long, paved runways) are reliably known to possess adequate bearing strength for the large aircraft. And fewer than 1/10 of the smaller airfields (>3,000 feet long both paved and unpaved) are approvable for landing (even though the C-17 and C-130 possess soft field landing gear) because of poor data on field surface bearing strength. So without better airfield characterization, heavy cargo aircraft are likely precluded from supporting early entry through closely proximate in-theater staging bases. And intra-theater aircraft will likely be limited to a few proximate fields which are easily targetable by a rationale enemy even though that enemy may have few resources for airfield disruption.

Consequently, the concept to underwrite strategic maneuver involves in its more extreme cases the need to bring equipment and men by commercial and military air and sea into sanctuaried intermediate staging bases (ISBs) somewhat remote from the Tactical Assembly Areas and insert them from the ISBs into the militarily active areas of theater by means such as C-17s and C-130s. There is great benefit to doing this, particularly if airfield surveys validate landing at a higher percentage of the known 3,000 foot strips. There is potentially somewhere between  $\frac{1}{2}$  and 1 order of magnitude improvement in the number of insertion places available to these short field aircraft. This denies the thinking enemy foreknowledge of insertion points. On the other hand, delivery into a limited set of known locations provides the enemy with an opportunity to interdict these known insertion points by disruption or direct attack.

In addition to increased access to surveyed airfields, the C-17 and the C-130 could use road segments and appropriate open fields were these adequately surveyed and assured ahead of time. Concepts such as the Super Short Takeoff and Landing (SSTOL) make this even more viable. Further, advanced rotorcraft concepts for heavier loads and much longer ranges might allow truly flexible force insertion.

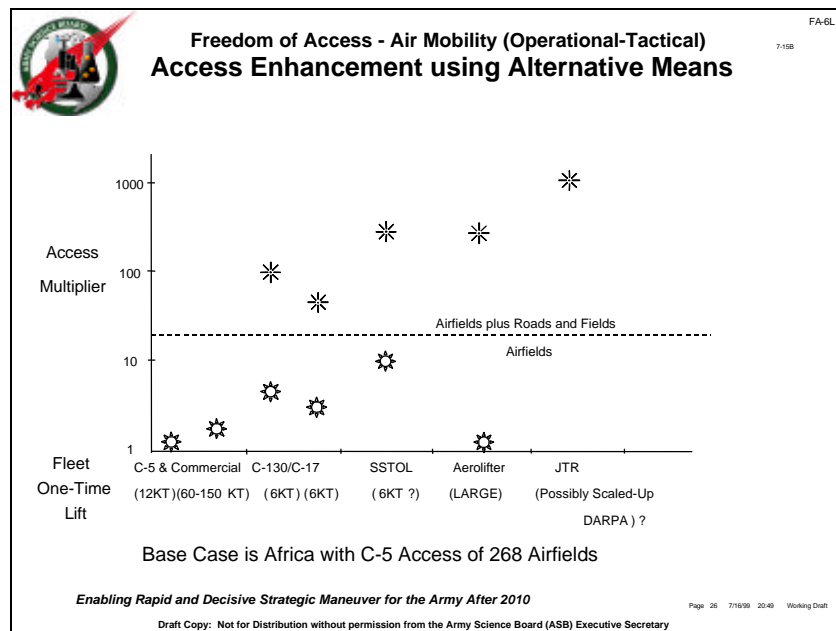
Along these same lines, joint tilt rotors, non-traditional rotary wing, and Vertical Take Off and Landing (VTOL) might be developed and acquired to perform this mission, provided they become affordable and sufficiently efficient. DARPA has a non-traditional rotary wing aircraft project underway. A hybrid airship might be employed in a vertical takeoff and landing mode under conditions in which its fuel load is appropriate.

One of the complexities associated with the choice is the fact that current military fixed wing aircraft are four times more efficient than current helicopters in terms of fuel usage, and their ranges are ten times greater. Further, their cost per pound of empty weight is around \$600 / lb. vs. \$800 / lb. for current helicopters.

Since insertion in the theater should be done under conditions where the aircraft do not have to be refueled or maintained at the insertion point, for all the obvious reasons, fixed wing aircraft have an advantage in this regard because of their overall flight efficiencies and long operating radii.

Figure 14 portrays access for the variety of aircraft that are being considered. The chart shows the access point multiplier available for various lift means. When the

required runway bearing strength and apron area are available, the C-130 and C-17 enjoy at least a half in the order of magnitude advantage in the three continent example shown in Annex D, and the SSTOL enjoys a potential advantage beyond that.

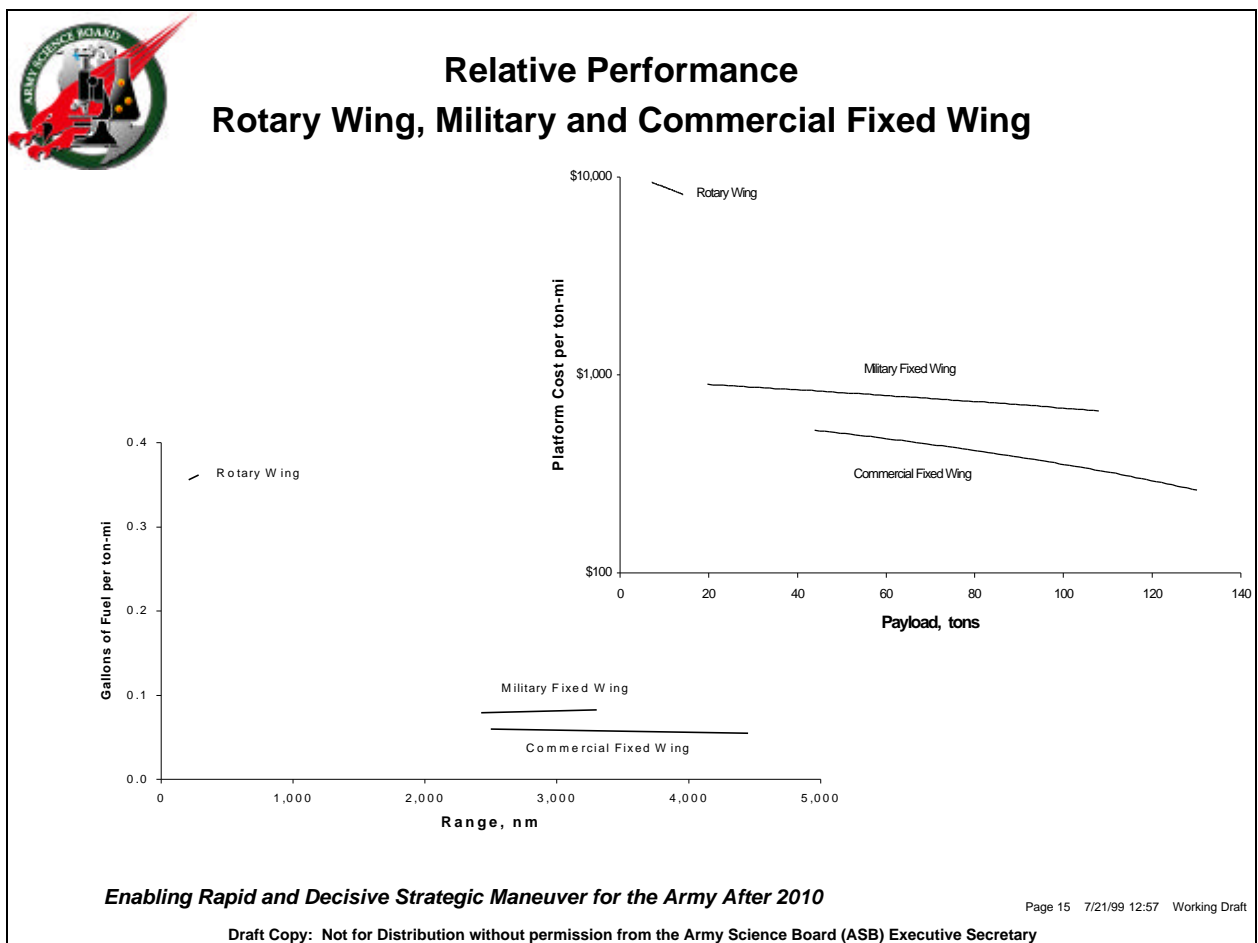


**Figure 14**

A major change occurs when roads and open fields are added to the possible inventory of landing sites. C-130 and C-17 enjoy an order of magnitude improvement. The SSTOL adds an order of magnitude beyond its already existing advantage. Vertical takeoff and landing (VTOL) capabilities expand potential landing sites further (they also require much simpler site surveys). Additional airfield survey and road/field use provide access improvements by 2-1/2 to 3 orders of magnitude beyond that available with the C-5 alone.

In viewing the trends, it is clear that the first big access improvement occurs when using C-130 and C-17 austere landing capabilities that exist today. As technology opens the possibility for SSTOL, it clearly becomes an advantageous choice, with an accessibility factor of three or more than the C-17 and the C-130. The Army should work closely with the development activities for the SSTOL. Similarly, a joint tilt rotor or a scaled up version of the current DARPA program might provide a VTOL solution, although substantial technology advances are required to improve range, fuel efficiency, and cost.

Some of these challenges are more explicitly seen in Figure 15, which uses tons of payload multiplied by range as a measure of productivity. Cost is portrayed as acquisition cost per ton mile versus payload. Efficiency is characterized by fuel burned per ton mile versus range. The conclusions that one might draw are rather obvious. Military fixed wing aircraft are more expensive to purchase per ton mile than commercial aircraft by about 60% and more fuel consuming per ton mile by about 60%. Current rotary wing aircraft, compared to fixed wing aircraft simply do not have much range and payload. Choices for the future, if they are to favor rotary wing, will require substantial improvements in performance and efficiency.



**Figure 15**

	757-200F	767-300F	747-400F	C-130J	C-17	C-5B	CH-47D	CH-53E	CH-47F	CH-53E
<b>Weight (lb)</b>										
Mission Gross Weight	255,000	412,000	875,000	155,000	549,000	769,000	44,000	72,694	48,277	72,694
Operating Empty Weight	112,400	181,900	349,600	80,620	277,000	374,000	24,377	35,329	27,111	35,329
<b>Mission Performance</b>										
Payload, lb	87,700	127,100	260,400	39,310	122,200	216,000	14,356	32,305	14,265	28,365
Payload, ton	43.9	63.6	130.2	19.7	61.1	108.0	7.2	16.2	7.1	14.2
Fuel, lb	54,900	103,000	265,000	35,070	149,800	179,000	5,267	5,060	6,901	9,000
Fuel Burned, lb	49,909	93,636	240,909	31,487	136,182	162,727	4,048	3,889	5,682	8,182
Fuel Reserve, lb	4,991	9,364	24,091	3,583	13,618	16,273	1,219	1,171	1,219	1,171
Mission Range, nm	2,500	3,270	4,450	2,423	3,300	2,820	200	100	286	210
<b>Fuel Consumption</b>										
Fuel Burned, gallons (JP-8)	7,449	13,976	35,957	4,700	20,326	24,288	604	580	848	1,221
gallons/ton-mi	0.059	0.058	0.054	0.086	0.088	0.069	0.366	0.312	0.361	0.356
<b>Cost (1994 \$)</b>										
Unit Flyaway, \$k	\$67,000	\$110,000	\$175,000	\$50,000	\$175,000	\$236,000	\$20,000	\$28,000	\$22,000	\$28,000
\$/lb OWE	\$596	\$605	\$501	\$620	\$632	\$631	\$820	\$793	\$811	\$793
\$/k/ton-mi	\$531	\$460	\$262	\$912	\$754	\$775	\$12,106	\$15,064	\$9,372	\$8,154

**Table 1**

The DCSOPS study will address the cost aspects of mixes of aircraft that might perform the missions discussed here. The concept is to use commercial as well as strategic military aircraft for movement to intermediate staging bases, and then employ tactical operational aircraft to insert forces and move them around the theater. The results of the analyses, as far as cost is concerned, will show the expected results for approximately the same delivery times. The base case (commercial assets, C-5, C-17, and C-130) will provide the base case cost. Other cases will include:

- commercial assets, C-5, C-17, and SSTOL,
- commercial assets, C-5, C-17, and Joint Tilt Rotor, and
- all military solution.

## **FINDINGS AND FORMATIVE RECOMMENDATIONS**

The material reviewed so far suggest the following:

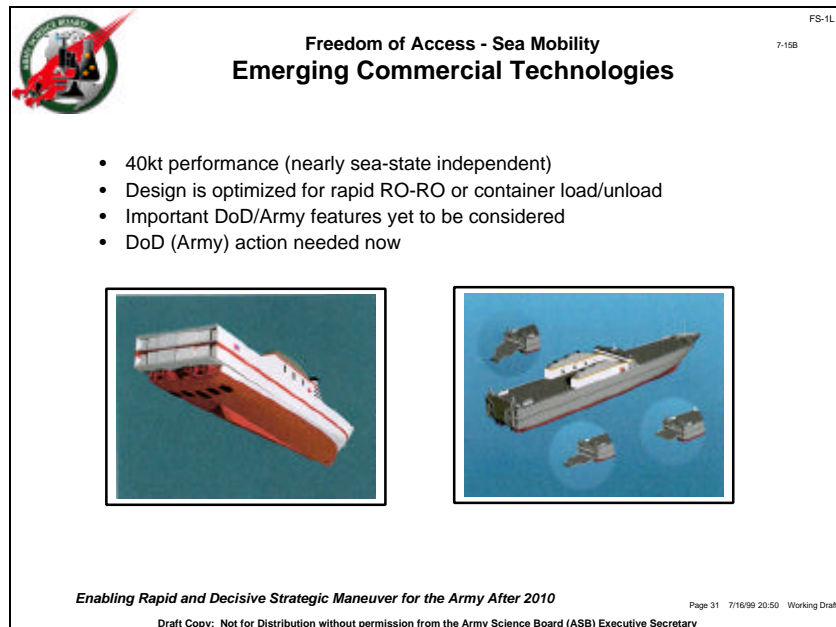
- The Army should make commercial adaptation and stimulation a first line activity because of the benefits that it would create for strategic maneuver.
- Potentially, the most cost effective support is derived from adapting and stimulating commercial air lift, both traditional and non-traditional.
- C-17 and C-130 capabilities should be exploited for the Strike Force as an initial effort, with a follow-on focus on greater airfield independent SSTOL or VTOL.
- Implications for the Strike Force: limit weight and cube of vehicles to the limits imposed by commercial assets (9 tons in less than 8 x 8 x 20 Feet} or develop floor appliques to allow for 18 to 20 tons in the same volume.



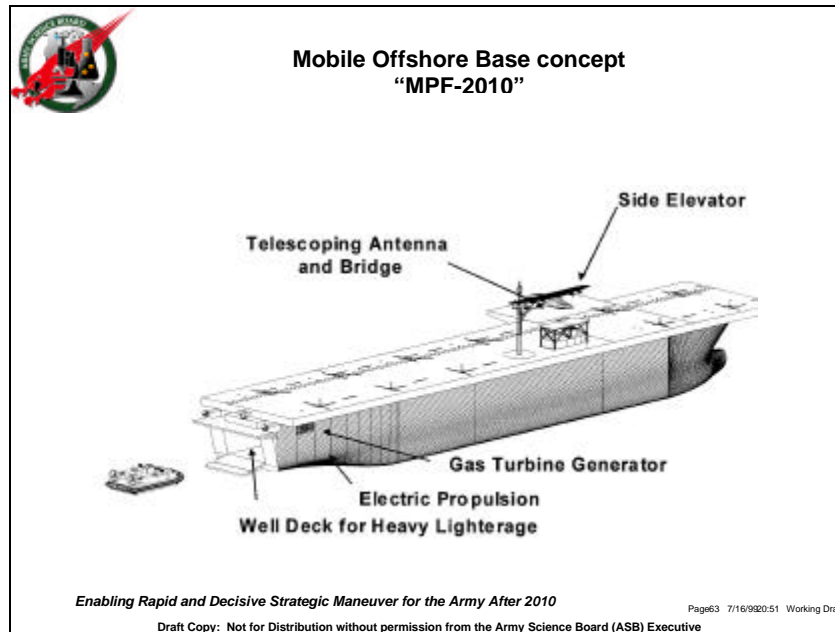
- Develop data bases and intellectual infrastructure to optimize the selection and use of distributed intermediate staging bases and theater access points and leverage U.S., but non-DoD, investments such as those from the World Bank and the International Monetary Fund.
- Make intermodal swiftness a top line vehicle design parameter.

## FREEDOM OF ACCESS-SEA MOBILITY

This section of the report deals with recommendations made in the 1998 Army Science Board study. In that study, the Army was encouraged to stimulate and adapt to the fast ship and ferry-like programs and examine surface effect ships and the possibilities resident in mobile offshore bases (MOBs). Figures 16 and 17 show in diagrammatic form these possibilities.



**Figure 16**



**Figure 17**

The current strategic maneuver study reinforces and emphasizes the conclusions and recommendations of the prior study. Great benefit would apply to the Army if such programs emerged commercially as far as fast ships and ferries are concerned.

Surface effect ships and MOBs are another matter because these would require Defense expenditures. We believe that the Army should fully exploit, adapt, and stimulate the first two initiatives (high speed ships and ferry-like ships) and extract all the benefit in them before considering funding that might apply to surface effect ships or MOBs. While the MOB may offer some advantages, it requires substantial time for positioning. Studies do not support that the MOB is any more advantageous than PREPO ashore or PREPO afloat.

Analyses, conducted by several organizations in this set of studies, show clearly that transit time strategically is half or less than the total time for total deployment. For legacy forces, which are based in the central portions of the United States, a substantial amount of time is spent in generating, moving, and loading the force at ports. In the analyses performed to date, along with actual experience from the Gulf War and other deployments, it might take as much as 4 to 6 days, plus preparation time, to move units from Ft. Hood to Gulf ports and load them. Railroads would be the primary means of moving heavy tracked vehicles from interior posts.

An additional analysis was made of the time to move a heavy brigade (M1/Bradley) from Fort Indiantown Gap, Pennsylvania - a littoral post - to the Port of Philadelphia, a road distance of 105 miles. Assuming 100% efficiency of deployment operations (equipment availability, personnel availability, etc.) and an absence of natural or man-made disruption, the required time to move the brigade force was determined to be ten days, using a mix of commercial and military over-the-road transportation.

An earlier portion of this report cited the character and growth in the U.S. freight and transportation marketplace. In that marketplace the railroads have been in a state of steady decline for the last 40 years. The interstate highway system has spurred growth in the trucking sector, and airfreight is a steadily growing component. The Army has an opportunity to make a substantial change in deployment time through what might be called a combined Active – Reserved initiative, one that leverages the historic ability of the states to contribute to the marshalling of national military power. This initiative is discussed in greater detail in Annex A.

Recent technological advances in the operational storage of Army equipment also present a significant opportunity for improvement in the timely projection of heavy forces. The National Guard is making extensive use of Controlled Humidity Preservation (CHP), a storage method that stores equipment in fully mission capable status - ready for immediate deployment – over an extended period of time. The cost of a CHP facility large enough to house the tracked vehicles of a heavy brigade task force is of the order of 3 to 4 million dollars (\$24.00 per square foot). In time, the cost of the CHP facility would be recovered by the savings on scheduled and unscheduled maintenance of the housed equipment.

CHP provides an excellent means whereby a portion of the on-hand equipment of our heavy divisions could be stored in an immediately deployable condition. In geographic situations such as that enjoyed by the 3d Infantry Division, the CHP facility could be located at or within tracked driving distance of the ship loading point. Not only would the close proximity to the port enhance speed of loading (estimated task force loading less than 48 hours), it would also greatly reduce the potential for hostile disruption and make a visual and physical statement to the American people that the Army is ready to move. In the case of the 3d Division, the 48<sup>th</sup> Brigade (if available),

Georgia National Guard and other reserve forces in the area, could assist with equipment preparation and ship loading, thereby releasing 3d Division soldiers for other pre-deployment activities.

To exploit the possibilities resident in delivery to austere ports, National Defense Feature funding for ships and ferries should be directed toward improving rapid loading and unloading and austere capabilities for commercial ships, particularly high speed sealift.

Findings and formative recommendations are analogous to those for air:

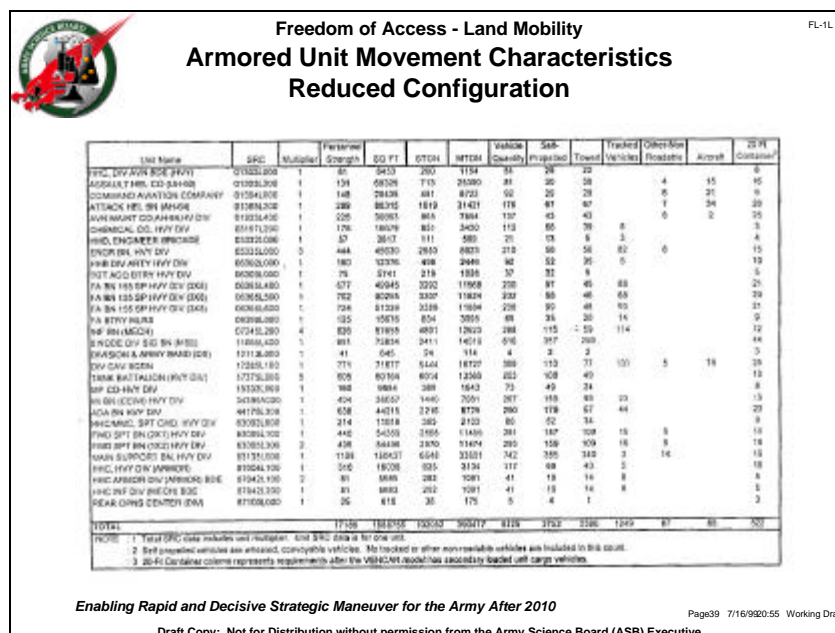
- Emphasize the exploitation, stimulation and adaptation to commercial initiatives, which have high payoff for the Army such as high speed sealift. The DCSOPS should forward to the Navy revised Army requirements for Strategic Sealift, to include High Speed Sealift (HSS). The VCSA should enter into partnership with the Navy and DOT to pursue actively Title XI support for HSS and the incorporation of National Defense Features (NDF) to support military cargo and austere port operations.
- A combined Active and Reserve component initiative should be undertaken to save substantial deployment time for Army XXI units in the very near future—concepts to be tested as part of periodic strategic responsiveness exercise. The VCSA, together with FORSCOM and NGB, should develop an operational concept and report back to the CSA within six months with a formulated plan.
- National defense funding should be focused on rapid loading and unloading, and austere capabilities for commercial shipping that would be leveraged by the Army.
- 

## **FREEDOM OF ACCESS-LAND MOBILITY**

Both the Strike Forces and Army XXI Forces will undertake substantial movement on land. There is no great change that could be made in the Army XXI forces except in reducing numbers to reduce foot print and weight for shipping and fuel

consumption in theater. The Army already has underway a set of initiatives to reduce the size of the armored and mechanized divisions. Beyond that, what improvements might be made?

Figure 18 is a display of a data base from MTMCTEA Reference 97-700-5 (*Deployment Planning Guide*) that characterizes the older armored division. It is a notional armored division having 17,000 men, weighing 100,000 tons, having 8,000 vehicles and 522 containers. When loaded on ships (or aircraft when possible) it occupies a million and a half square feet. Division equipment includes almost 2,000 tracked vehicles, approximately 4,000 wheeled vehicles, and about 2500 towed vehicles, as well as nearly 100 aircraft. When one examines the weight of the combat platforms relative to that of the entire division, the operating ratio is about 42%. For personnel, the ratio is about 24%. For deploying larger Corps units, the ratio is approximately 15%. Virtually all of the overhead employs trucks. Improving trucks and their performance should be a major initiative for the legacy Army, that is Army XXI, and the Strike forces of the future.



**Figure 18**

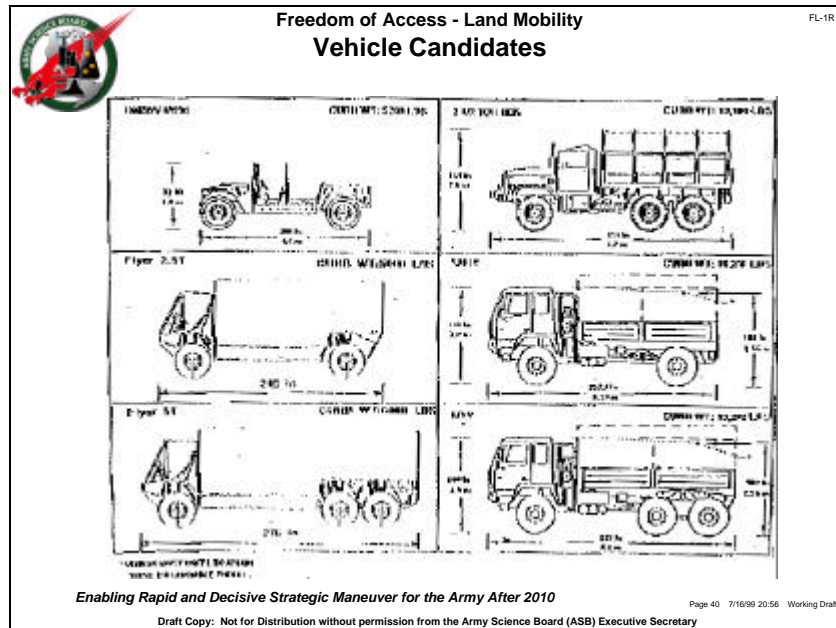
The 1998 study emphasized trends in the commercial sector towards hybrid electric drive and ultimately toward fuel cell employment for generating electricity for propulsion. The Army should track these programs carefully. The informal estimate

made in the 1998 study was that the Department of Defense was spending possibly \$100 million dollars a year in research and propulsion for advanced vehicles. An informal estimate made by DARPA was that ten major automobile manufacturers were investing something between 2 billion and 6 billion dollars a year.

For example, Toyota has recently fielded its first hybrid electric vehicle for evaluation. It will be first to market. These propulsion innovations could make a substantial change in today's performance and would dramatically affect the Strike Forces.

Another commercial innovation, which could be regarded as a non-developmental item, is called the FLYER. The FLYER is currently being developed along the lines of a truck built structurally like an airplane. It has a very lightweight chassis which is strong and adequate but avoids the weight excesses that exist in today's designs.

Performance can best be characterized by saying that the trucks employed in the Army today carry about half their empty weight. FLYER vehicles carry loads equal to or slightly greater than their empty weight. Shown in Figure 19 are three different current Army vehicles (the HMMWV and two trucks) along with three possible FLYER configurations. The first and lightest of the FLYER vehicles is one which is currently being sold to nations such as Singapore--and the Marine Corps. The Marines are currently buying about 60 of these for evaluation. The heavier versions of the FLYER are engineering estimates—they have not yet been built.



**Figure 19**

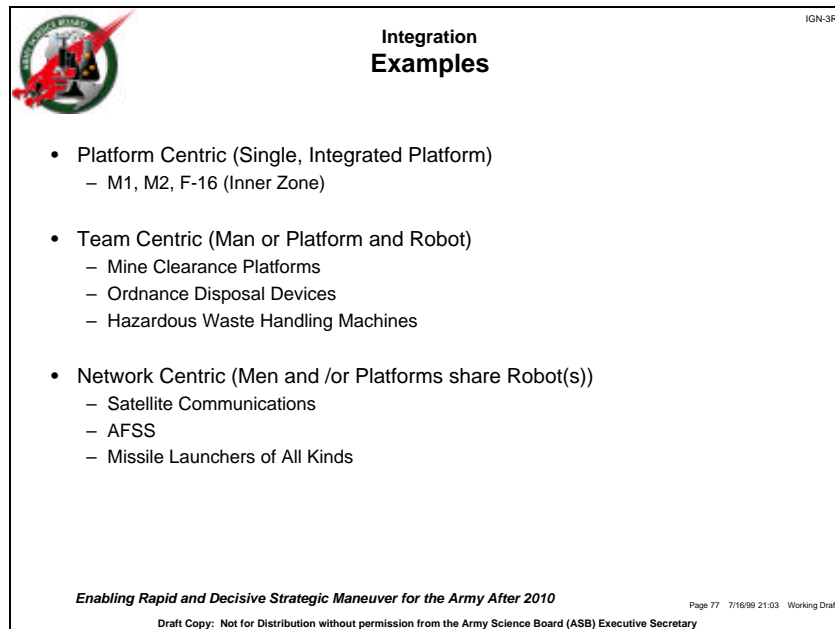
The findings and formative recommendations relative to land mobility are that there are substantial opportunities to improve efficiency. These would apply to the legacy forces and to the Strike Forces as well. The roughly 3,000 or more trucks in the notional Army XXI division could be replaced by approximately 1500 trucks for roughly the same savings in fuel consumption. Additional savings would be in crews, in parts and maintenance.

Relative to these insights, it is recommended that the Army, like the Marine Corps, experiment with such designs in the course of structuring its Strike Forces and making its legacy forces more fuel efficient. In addition, it should undertake an aggressive program of adaptation and stimulation to seize the advantages present in the commercial market with hybrid electric and fuel cell drives.

An interesting observation worth noting is that the Army spends, on average, \$8-20 per pound for equipment. Initiatives that are undertaken to lighten the vehicles through efficiency measures and architecture changes would have enormous financial benefits connected with them just on the basis of these metrics alone, let alone the cascading effect of savings relative to fuel burning and lowered maintenance costs associated with improved vehicles.

## INTEGRATION

In this section of the Mobility Panel Report, we address the issue of integration across all of the areas that must be considered in designing platforms and small units. Figure 20 is an attempt to try to show these.



**Figure 20**

The intention is to try to design combat systems that will fulfill combat missions as shown at the center of the nested circles. The design must take into account that, at the overall joint force level, the capabilities being sought are freedom of both timely and successful strategic access, assured control when access has been gained, and requisite endurance to carry out the campaign. What lies in between the outer sections of the diagram and the most central portion are those things that must be considered to achieve a balanced and successful integration.

For the Strike Forces, these matters include air mobility, initial basing (either CONUS or forward based), the use of intermediate staging bases, and access to the theater. In each of these cases, transfer is a critical factor--just as it is with sustainment. The time it takes to transfer force components from one transport asset to another, or from one location to another, is critical and should be a top line design item.



Access and its overlap with assured control is the area where theater and tactical mobility come into play. Control, though, derives from the ability to maneuver and engage and the ability to survive engagements.

### **ALTERNATIVE APPROACHES TO ACHIEVE BALANCED AND OPTIMIZED STRIKE FORCES**

To achieve strategic maneuver in a balanced manner and resultantly achieve desired access, it will be necessary to combine the efforts of both military and commercial strategic lift to provide entry to the theater. Thus, whatever is designed in the way of platforms and team (from which units are built) must consider the use of commercial assets, must treat intermodal transfer time and complexity, and must address the issue of theater entry using existing assets (C-130s and C-17s) or future assets (such as SSTOLs or VTOLs).

The basis for designing multi-mission combat systems is much broader than that currently being considered. There are three possibilities. One might be called platform centric as shown in Figure 21. This could be a single 20-25 ton vehicle that might, at the 18 ton limit, allow the use of the C-130. An alternative approach would be team centric. A team centric approach would involve putting people in a very survivable platform and mounting the major armament on a separate robotic platform. The two would be employed in a synergistic fashion. We believe that the weight of the total should be 18 tons or less.

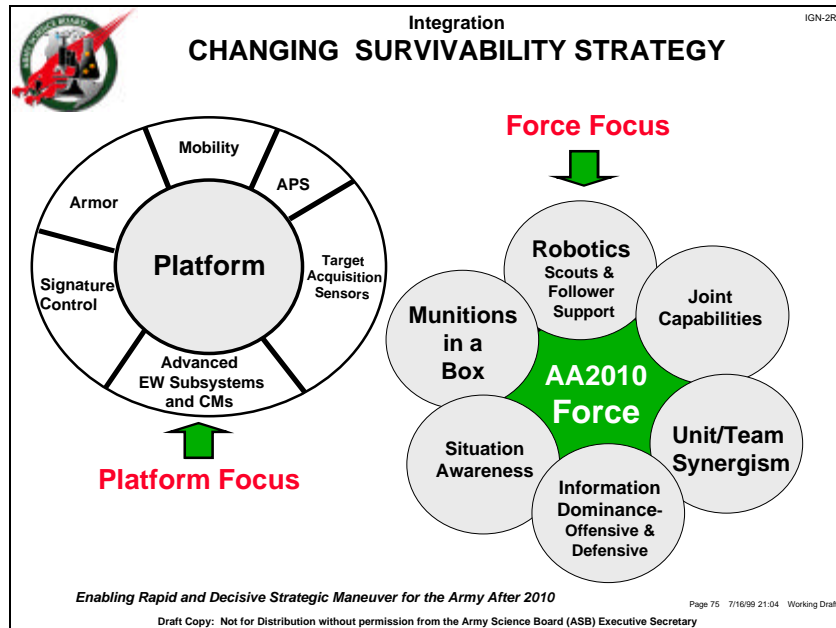


Figure 21

A third approach expands the team centric scheme and might be called an ensemble scheme—more than two vehicles, but the entire ensemble weighs less than 18 tons. Estimates made in the 1998 study based upon the design of strike forces suggest that these are technically feasible. The companion Army Science Board study is addressing survivability matters related to such designs.

The ensemble approach might involve a sheltered vehicle and two smaller vehicles that would provide indirect fire means and direct fire means. The combination could involve something like the unarmored version of the Armored Gun System and a small Advanced Fire Support System (AFSS). In the long run, it might be better to have several vehicles share an AFSS. These are tradeoffs that could evolve in an experimental setting.

It is this Panel's estimate that a manned ten-ton vehicle with about 100 cubic feet of sheltered volume with active protection could provide adequate first hit survival for a crew of two. [This is based upon sizing relationships that were developed for the prior study by the Army Research Laboratory (ARL).] The companion vehicle of nine tons could mount a gun and a deep magazine. Protection would be provided against a modest range of lethality means. Again, this appears to be feasible based upon the ARL work.

Ensemble architectures that are team or network centric, if successfully implemented, might accommodate the constraints that allow for the greater lift fleet to be realized. To that end, a series of vehicle design studies were requested of the Army Research Laboratory and TARDEC. Dr. Larry Johnson and Mr. Roger Halle conducted these using scaling tools development by the Army. The following platforms were thus “sized:”

- A manned platform with 16 protection missiles and modest (12.5 mm, 14.5 mm and fragment) protection.
- The same manned platform protected to the level of the current M1A2.
- A companion vehicle that was robotic and mounted a gun with a sizable magazine or missiles in substantial numbers.

In addition, other possible manned or robotic vehicles were assessed by the ASB:

- Armored Gun System
- M113 APC
- Commercialized version of the A2C2 battalion CP (C2OTM)
- FLYER vehicle with 5 ton payload of AFSS
- FLYER vehicle with a 5 ton payload of fuel and supplies
- Robotic rotary wing aircraft that could support a variety of functions—RST, medical, communications relay, resupply, etc.

Up to this point in the discussion most attention has been paid to decreasing the weight of the early entry forces. But increasing “punch per lb. forward” can also benefit from increased lethality of separate and combined elements of the force. A neglected example of this would be increasing early entry force lethality with robotic, VTOL sensor and weapon carrying aircraft. This study assumes that the RAH-66 Comanche will continue to be modernized with emerging sensory weapons and survivability technologies. However, the greatest advances in effectiveness will be achieved by an ensemble approach that employs robotic aircraft operating in the highest threat areas. These vehicles would be equipped with an array of counter CC&D (Concealment, Camouflage, and Deception) all-weather sensors that will effectively deny an opponent’s capability to avoid detection. New sensor examples currently being developed by

DARPA and other agencies include: foliage penetration SAR and MTI radar, harmonic radars for locating metal-metal junctions, ultra-sensitive detectors for unintentionally radiated emissions and stimulated emissions of mounted and dismounted troops, advanced hyperspectral–imaging sensors and other devices intended to detect targets across the entire electromagnetic and acoustic spectrum. Certain of those advanced target signatures are only detectable at very short ranges (1-5Km) either due to weak signals, foliage and terrain obscuration, buried targets, or targets within building. The only means to detect and target is by flying in relatively close proximity (low altitude and slow) wherein the sensor platform is at risk to MANPADS and other close-in weapons. This situation mandates a robotic vehicle. On the other hand, the enemy, by countering the sensor aircraft, places himself at risk to attack by the Commanche and other weapon systems. Ultimately self-carriage of precision weapons by the robotic aircraft may be needed for fastest response.

From an early entry and logistic support standpoint the greatest value for the robotic sensor aircraft would be a self-deployment capability with ‘hand-off’ to the strike force. Extended endurance--enduring presence in the target area—is an equally important capability that reduces the number of vehicles required to provide continuous forward support.

Another important capability is extremely low speed in order to allow ultra low Doppler velocity detection of dismounted troops. An ability to land and takeoff vertically would allow deployment of sophisticated ground and ground mobile sensors in forward and perimeter areas, including BC detection.

These varied requirements mandate long endurance, vertical takeoff and landing robotic vehicles able to self-ferry to and into theater and to operate under the local control of the early entry forces.

Conservative weights for the vehicles follow:s

<u><b>Vehicle</b></u>	<u><b>Weight</b></u>
Manned/necessary protection	9 tons
Manned/medium protection	12 tons

<b><u>Vehicle</u></b>	<b><u>Weight</u></b>
Manned/M1 level protected	20 tons
Unmanned/weapon platform	11 tons
Armored Gun System	18 tons
M-113 APC	9 tons
C <sup>2</sup> OTM	4 tons
Flyer w/5 ton AFSS	10 tons
Flyer, 5 ton resupply	10 tons
Robotic rotorcraft	Self ferry

All systems were fully fueled and armed. Manned system had substantial provisioning for crews in terms of food, water and other necessities.

Previous estimates made for the Strike and Battle Force initiative and the Future Scout and Cavalry System suggested platform centric solutions with substantial weight be accomplished by about 20 tons with substantial development investment owing to needed risk reduction or a low-medium risk design in the 30 ton to 40 ton range.

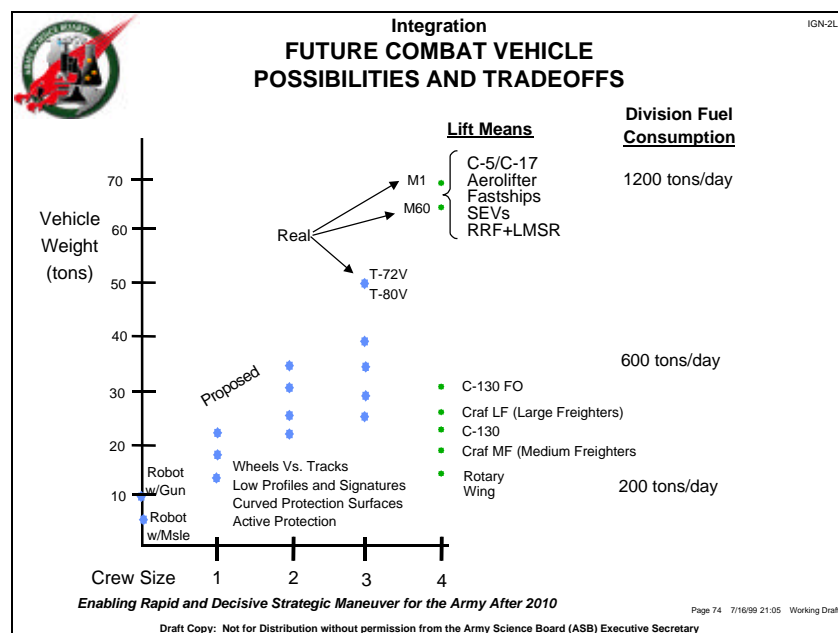
The Panel's conclusion is that the Army should pursue the ensemble-alternative architecture path because it is more likely to produce 9 to 12 ton vehicle pairs or ensembles of such systems. The Multi-mission Combat System program with DARPA should reach for these capabilities to benefit the early entry forces by leveraging the total airlift fleet. At the same time, a successful MMCS program will lighten the follow-on force by mixing manned and robotic platforms thus reducing the total weight and fuel consumption of the "heavy" force.

There is an additional set of benefits. Such lower manning alternatives provide the opportunity to man platforms with multiple crews and create continuing circumstances to maintain both the initiative and high op tempo. Annex C shows the ARL-TARDEC data.

Achieving endurance could come from a variety of approaches. One might be the traditional approach of having an overhead organization provide sustainment, as in Army XXI. An extreme alternative would be to create a self-sustained unit. For example, a unit might be equipped and loaded such that it would not require replenishment for a week. Recognizing the inherent design challenges, this alternative would change the

organization radically and reduce the in-theater foot print. Other alternatives might employ a combination of these two.

Figure 22, derived from the 1998 Army Science Board study, addresses a platform centric set of parametrics. Regardless of whether the team or ensemble approach is taken, this display still applies. If all the airlift (both fixed and rotary wing) that could be employed without floor appliqué is to be adapted or exploited, it will be necessary to employ a family of platforms, manned and unmanned, which have weights less than ten tons. This is a worthwhile area to pursue--it will provide the Army a maximum of mobility and strategic maneuver.



**Figure 22**

Before leaving this section, two statements made earlier should be repeated. First, the air-mech concepts for strike forces will require more airlift--not less. Some could be commercial—some will have to be military. Measures such as taking full advantage of C-17 capabilities, expanding C-130 use, and modernizing the C-130 must be addressed by the Army and Air Force. Second, a thinking enemy will exploit a variety of symmetric and asymmetric measures to deal with any attempt by the United States to exercise its influence in a region of importance. Access is critical. Optimizing, platforms, organizations and sustainment means to achieve access contributes to primary properties of the joint force.

## SUMMARY

### GET THERE FIRSTEST WITH THE MOSTEST EFFECT

These four objectives, approaches, and initiatives synthesize the report.

OBJECTIVE	APPROACH	INITIATIVES
<b>Increased Punch per Pound Forward</b>	<ul style="list-style-type: none"> <li>• Lighten Early Entry Force Manning and Equipment</li> <li>• Reduce Sustainment Consumption Rates</li> <li>• Increase Lethality               <ul style="list-style-type: none"> <li>• ground vehicles:                   <ul style="list-style-type: none"> <li>down-man</li> <li>down-size</li> <li>down-weight</li> <li>up fuel efficiency</li> <li>up lethality</li> </ul> </li> <li>• air vehicles:                   <ul style="list-style-type: none"> <li>augment RAH-66 with long endurance lethal/ISR VTOL UAVs</li> </ul> </li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• require new ground vehicles to have loaded GVW &lt;10 tons and dimensions that fit within an 8'x8'x20' container</li> <li>• initiate aggressive air-transportable combat ground vehicle development program (hybrid-electric, manned/ robotic ensemble)</li> <li>• adopt newly emerging high payload to GVW support vehicle options</li> <li>• initiate an Army long endurance VTOL UAV exploratory development program</li> <li>• equip 2 ACR with available combat systems and technologies to be rapidly air insertable and sustainable using <u>all</u> of the following               <ul style="list-style-type: none"> <li>• strategic: 747,767, DC-10, MD-11 and C-5</li> <li>• operational: C-17, C-130</li> <li>• tactical: CH-47, Ch-53</li> </ul> </li> </ul>
<b>More "Fast" Lift to Theater</b>	<b>Exploit Commercial Lift</b> <ul style="list-style-type: none"> <li>• leverage civil air freighter fleet</li> <li>• participate in outsized airlifter and rapid sealift venture formulation process</li> </ul>	<ul style="list-style-type: none"> <li>• require all future early entry equipment be designed for commercial air compatibility (9 tons desired, 20 tons max, 8'x8'x20', standard commercial MHE interface)</li> <li>• require new Army aircraft be globally self-deployable</li> <li>• partner with commercial activities to achieve Army strategic lift capabilities               <ul style="list-style-type: none"> <li>• contact and exploration (e.g., future air freighters)</li> <li>• national defense features (e.g., aerolifter)</li> <li>• - Army influence (fast ship)</li> </ul> </li> </ul>
<b>Faster Nodal Transfer (at both both ends)</b>	<b>Tailor MHE &amp; Standardize Packaging</b> <ul style="list-style-type: none"> <li>• plan for distributed ISBs and Tactical Entry Points and means to load, transfer and unload those sites without indigenous support</li> <li>• exploit Reserves and Guard to accelerate CONUS-end load-up</li> <li>• test loadability of all equipment onto commercial carriers and adopt commercial packaging standards where possible</li> </ul>	<ul style="list-style-type: none"> <li>• establish MTMC linked movement facilitation teams within State Area Readiness Commands</li> <li>• position brigade equipment sets at sites that eliminate or minimize the fort to port challenge (24 hr outload)</li> <li>• structure and execute several deployment-sustainment exercises (CPXs, FTXs) using only commercial means, processes, modularity, containerization, manning, tracking, command and control (could be a joint ACTD)</li> </ul>

OBJECTIVE	APPROACH	INITIATIVES
<b>Assured Access within Theater for:</b> <ul style="list-style-type: none"> <li>• <b>Entry</b></li> <li>• <b>Follow-on, and</b></li> <li>• <b>Sustainment</b></li> </ul>	<b>Reduce Dependence on Large Airfields and Ports</b> <ul style="list-style-type: none"> <li>• recognize growing need for airfield and port-independent entry due to increasing threats to known "improved" entry sites</li> <li>• pre-identify and characterize usable short fields, road segments and beach sites worldwide</li> <li>• re-emphasize use of C-130 and C-17 for 2,000-3,000 ft soft field runways for contested or austere entry conditions</li> </ul>	<ul style="list-style-type: none"> <li>• initiate aggressive technology program (DARPA/ATD) to narrow the flyaway cost per ton-mile gap between SSTOL/VTOL and military fixed wing from 10 times to 2 or 3 times and to increase operating radius to ~1000 nm</li> <li>• search for and examine non-traditional concepts and technologies to provide rapid unloading and port clearing at austere ports and beaches</li> <li>• initiate and regularly update Army sponsored CINC surveys of airfields, ports and austere surrogates</li> <li>• use C-17 in intratheater role when ISBs are activated</li> </ul>

## RECOMMENDATIONS

### Counter Enemy Options and Actions

**What:** Prepare and regularly update a multi-theater survey and characterization of ISB, airfields, ports, austere surrogates for both and commercial services available. Employ to optimize survivable deployment and sustainment and provide data bases and tools for executors

**Why:** Needed for rapid deployment of current army and design of future army (new and legacy) and to vector and leverage expenditures for SSTOL, aerolifter, surface effect ships, etc.

**Who:** DCSOPS tasks Army War College to form "regional desks" with appropriate support from relevant TRADOC schools. Organization becomes counterpart of and analog to Air Force "checkmate;" ties are established with TRANSCOM.

**When:** Prepare two scenarios per regional CINC by end of CY 99. Formulate schedule to do remainder with CINCs on a continuing basis. Fold results into next spring war game (Spring 2000).

### Counter Enemy Options and Actions

**What:** Search for and examine non-traditional concepts and technologies to provide rapid unloading at austere and non-ports. Engage DARPA as a partner in this endeavor because it should address both non-traditional and high risk possibilities.

**Who:** SAALT with support from Army and TRANSCOM specialists. DARPA would provide industry (possibly globalized) outreach.



**When:** Establish program so that it can start early in FY 00. Review at six month intervals to achieve closure in possibilities within a year. R&D to follow depends upon outcome.

#### **Leverage Commercial Capabilities**

**What:** Improve Army and DoD ability to leverage commercial land, air and sea capabilities through a collaborative experimentation program whose finding would lead to improved policy and performance on behalf of DoD by this large and growingly efficient sector of our economy. Structure and execute several deployment-sustainment exercises (CPXs and FTXs) using only commercial basing means, processes, modularity, containerization, manning, tracking and command control (could be a joint ACTD) It would extend virtual airline to land, sea and intermodal aspects.

**Who:** A joint Army-TRANSCOM-DARPA regional desk team led by a three or four star General officer.

**When:** For team before end of FY 99: organize, plan, staff and prepare for first experiment starting in FY 01, continue program for 3 years, undertake CRAF, VISA, etc. improvement along the way.

#### **Leverage Commercial Capabilities**

**What:** Promulgate policy that the Army:

- Will assure its ability to employ both commercial, traditional and innovative transport and its related modularity and containerization along with DoD transport means through as appropriate adaptation, stimulation integrations as contrasted with only exploitation.
- Partner in various ways with commercial activities to achieve these objectives through adaptation stimulation and using Army influence.

Near action required relative to:

- Contact and exploration (e.g., future air freighters)
- National defense features (e.g., aerolifter)
- Army influence (fast ship)

**Who:** Army Acquisition Executive

**When:** Now

#### **Leverage/Improve Military Capabilities (Near Term Rapid Deployment Initiative)**

**What:** Use CONUS Port and Near Port prepositioned Brigade to deploy within a day and marry with active unit troopers airlifted to theater. NG Troopers fall in with active unit equipment.

**Who:** VCSA task CG FORSCOM, CNGB, and CG AMC to form action group to use PA NG and Port of Philadelphia to develop initiative by experimentation and plan its extension.

**When:** Form group and initial plan by 30 September 1999. Undertake experimentation and complete by Spring 2001. Have plan for extension available for upcoming Fiscal Year.

**Payoff:** Save days to a week in deployment time. Reduce dependence on rapid reaction rail assets. Reduce political dependence and time for OCONUS prepo deployment.

#### **Leverage/Improve Military Capabilities**

**Who:** DCSOPS, along with ACOM, should sponsor a JWCA to address underwriting strategic maneuver for 2007, 2012 and 2020 employing advanced capabilities along with traditional military and commercial airlift, addressing air and sea access to include distributed ISB AUBA as well as austere insertion locales and including interagency participants with influence in OCONUS ports and infrastructure funding and construction. It should include RD&A expenditures which could influence capabilities in those time frames.

Military Rotor Craft, SSTOL, Surface Effect Ships and commercial capabilities should be considered. The executing team should have permanent members drawn for defense and commercial industry as well as the normal cast of participants. Army and ACOM might take DAMO-SS works as a starting point.

**When:** Assessment by end of CY 99, formulate, complete JWCA by end of CY 2000.

#### **Leverage/Improve Military Capabilities**

**What:** Re-establish role of C-17 as intratheater airlifter. Make C-17 and C-130 available for experimentation with 2ACR and for contingencies which may occur.

**Who:** DCSOPS as OPSDEP

**When:** As soon as 2ACR experimentation is approved and scheduled

#### **Improve Force Deployability Along with Lethality, Survivability and Tactical Air Mobility**

**What:** Capitalize on XVIII Airborne Corps addition of 2ACR. Explore/procure currently available vehicles that are C-130 and commercially deployable. Examples: Armored Gun System, Flyer Trucks, M-113, Light Weight HIMARS, C2 On the Move (A2C2 for Secret Service). Select, Redesign and Test units for: Unit Deployment Integrity, Split Basing, Packaging, Modularity, and Containerization. TRADOC should support this activity with experimentation of alternative available equipment.

**Who:** Commander XVIII Airborne Corps, supported by AAE, SARDA, and TRADOC

**When:** within 12 months.

**Leverage/Improve Military Capabilities**

**What:** Expand 2ACR “lessons learned” (from above recommendation) and conduct necessary experiments in split basing, modularity, and containerization for the remainder of the Army.

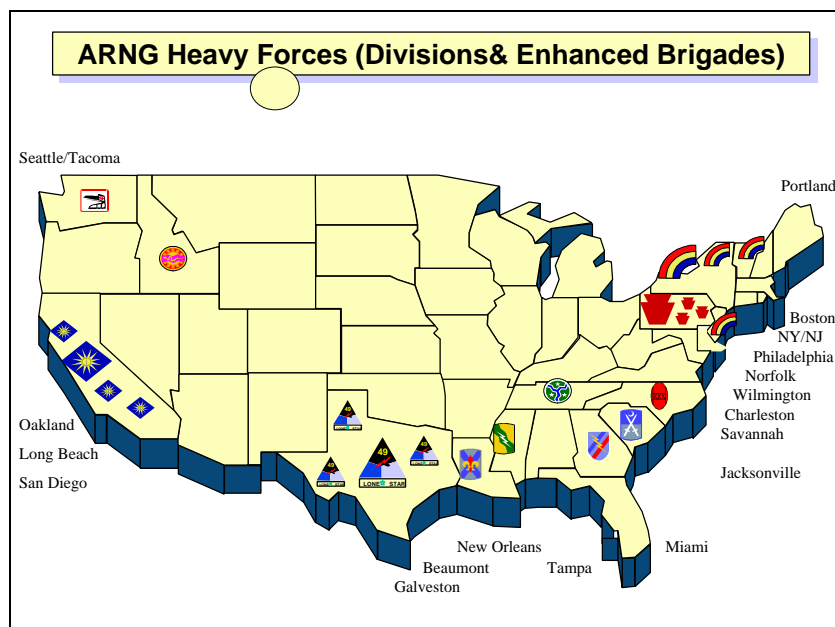
**Who:** DCSOPS, TRADOC, and AMC.

**When:** As soon as results are available from 2ACR experimentation.

## **Annex A: National Guard Support to Army Strategic Deployment.**

As previously observed, for legacy forces which are based in the central portions of the United States, a substantial amount of time is spent in generating, moving and loading the force at ports. Dependence on rail transportation (a dependence that increases as distance increases) is viewed as a significant physical security challenge in the deployment chain. In a disrupted or opposed deployment, hundreds of miles of roadbed, rail crossings and bridges present a multitude of opportunities for disruption and a very difficult challenge for security forces.

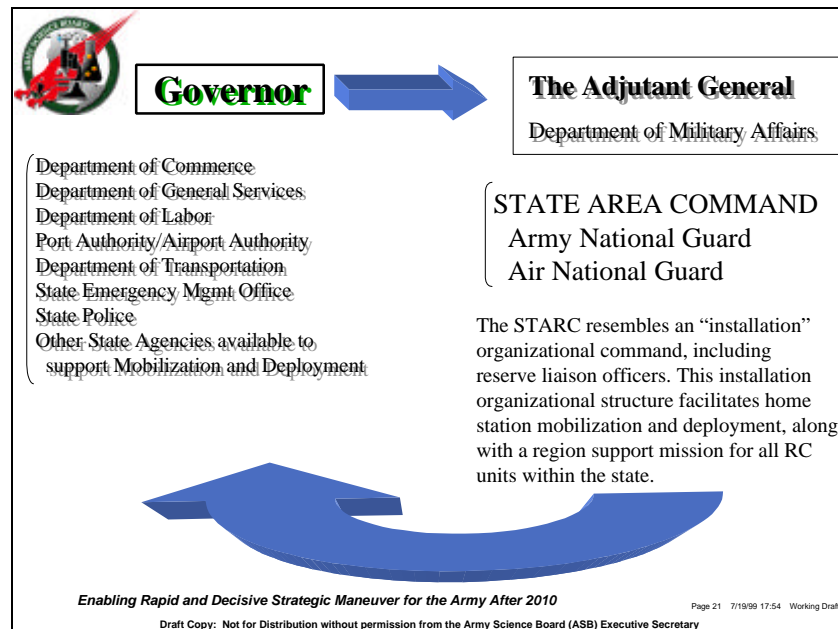
The majority of the Army heavy forces that are located in the littoral areas of the United States are found in the combat forces of the Army National Guard. The 42<sup>d</sup> Infantry Division and the 28<sup>th</sup> Infantry Division in the northeast, the 49<sup>th</sup> Armored Division on the Gulf and the 40<sup>th</sup> Infantry on the Pacific represent a large pool of trained manpower available to assist with the deployment of early entry Army forces in times of national emergency. Figure A-1 indicates the littoral nature of heavy National Guard forces.



**Figure A-1**

The innovative concept of Controlled Humidity Preservation (CHP) storage facilities, coupled with the historic role of the states in the marshalling of federal military

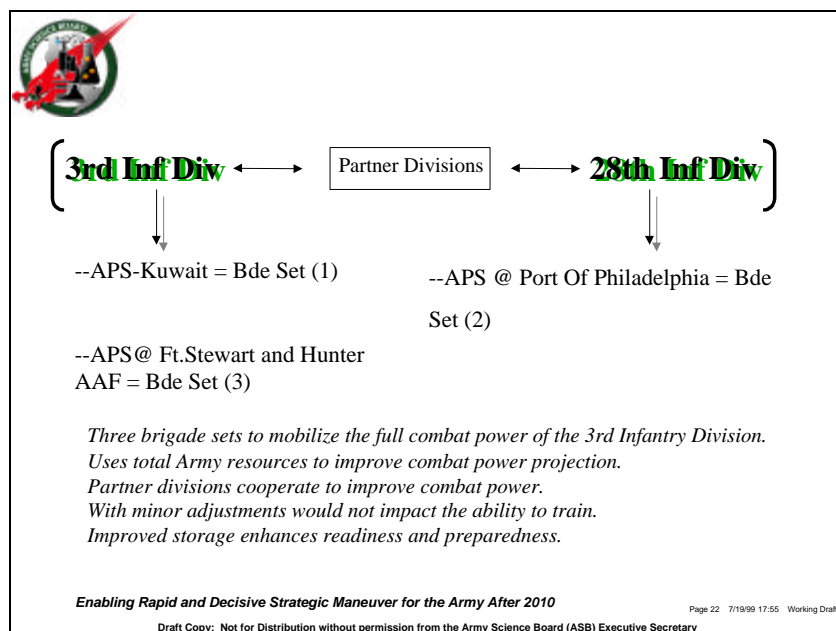
power, lend great weight to the ability of the Army to project forces and to manage and support the long term missions of the Army. State support to federal military requirements is accessed through the office of the Adjutant General, a state cabinet officer appointed (in most cases) by the Governor. The linkage of the office of Adjutant General and the State Area Readiness Command (STARC) to the governor and other state agencies is showed in Figure A-2 and discussed in greater detail later in this annex.



**Figure A-2**

Pennsylvania is used as an example for a description of this initiative. The tracked and heavy equipment, which would be difficult to move over the road, would be stored in the port in controlled humidity environments. These CHP facilities have been shown to be very effective by the Pennsylvania Army National Guard. When a call up occurs, the equipment could be driven for loading on ships as soon as ships became available. The wheeled equipment would be brought in from equipment parks in the port region. The package would be structured in advance with active and reserve component units participating as necessary. Estimates which have been made by the National Guard suggest that the loading of heavy equipment could start within about 4 hours and the entire loading of a brigade task force will take less than 48 hours, assuming that ships are available. The legacy equipment would be on its way in a short period of time, saving anywhere from three to five or more days in deployment time.

With similar equipment, troopers from an active unit could marry up with the Army XXI legacy equipment when it arrived in the theater. Troopers from the National Guard brigade would be sent to the base from which the active troopers were deployed and fall in on the active units' equipment. From then on they could train up and be part of the next deployment of forces. A visual representation of how this initiative could work to deploy an entire active division (example using the partnered 3d and 28<sup>th</sup> Infantry Divisions) is shown in Figure A-3. Short of an actual deployment, the periodic requirement to rotate equipment through the CHP would prove an excellent opportunity to conduct deployment training exercises.



**Figure A-3**

Even greater efficiency in port and airport operations (and one that would open a greater range of facilities available for military deployment) could be obtained by establishing a MTMC linked deployment facilitation cell within the TDA of the State Area Readiness Command of the state where the port or airport is located.

This cell would be tasked with linking the resources of state and regional resources and agencies to the Army deployment and sustainment process.

## **Annex B: Civil Reserve Airfleet Considerations**

National Airlift Policy recognizes the importance of civil airlift resources to meet defense mobilization and deployment requirements and “requires DOD and DOT to jointly develop policies and programs to increase participation in CRAF and promote the incorporation of national defense features in commercial aircraft...policies should also support research programs which promote the development of technologically advanced transport aircraft and related equipment.” With this in mind, DOD should look to both policy (how CRAF is used) and technical solutions (make the aircraft more accommodating to military equipment) to more enhance strategic maneuver. Before beginning any talk of CRAF modifications, DOD must recognize that any actions it recommends must provide cost-benefits to industry. DOD must make it financially “worthwhile” for commercial air carriers to participate in CRAF in the manner DOD desires.

Consider the technical solutions. First, DOD should ensure that military planners/program managers work with industry as it develops future aircraft design parameters. A small up front manpower cost-knowledgeable planners with the authority to talk to industry about vehicle parameters (both new and planned)-could prove very beneficial to DOD. Through a proactive interface, DOD may be able to influence industry in the design stages to make floors strong enough, and doors large enough, to accommodate military equipment. Second, DOD should work with both aircraft manufacturers and airlines to ensure that like aircraft of different airlines are able to accommodate like military equipment. A council of airlines, manufacturers, and DOD could potentially avoid the difficulties in CRAF planning which exist today. Today’s CRAF load plans, for example, call for a 96.5 ton maximum on an Evergreen-operated 747-100F, but a 87.5 ton maximum on a UPS-operated 747-100F-a difference of nine tons. Standardization would aid the military deployment.

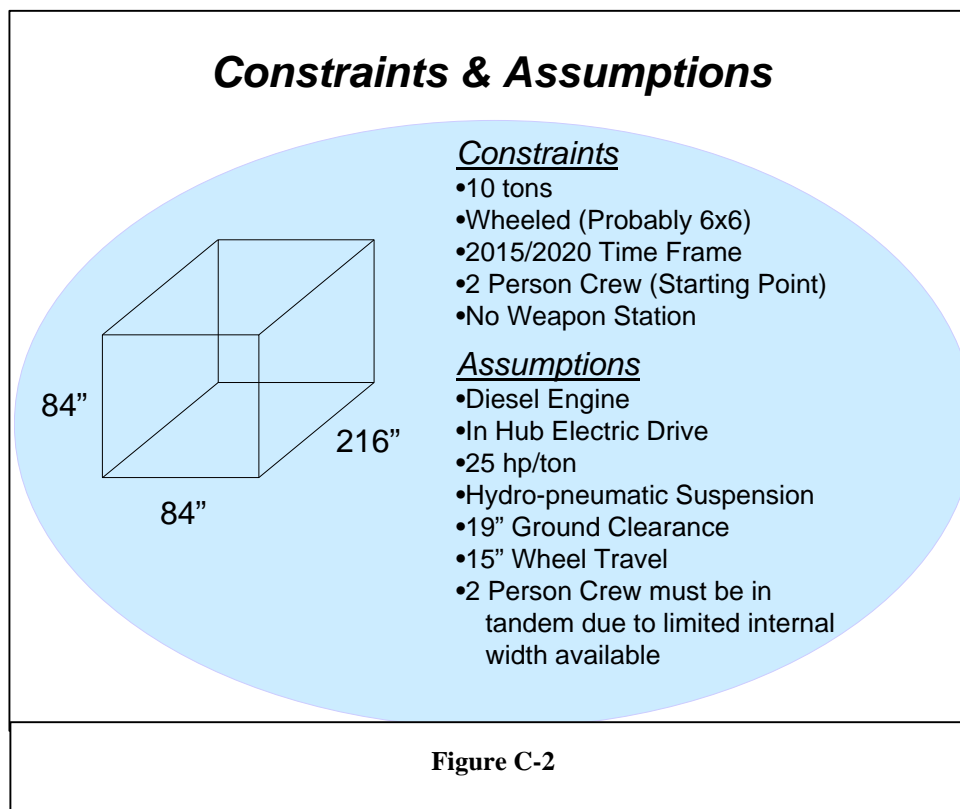
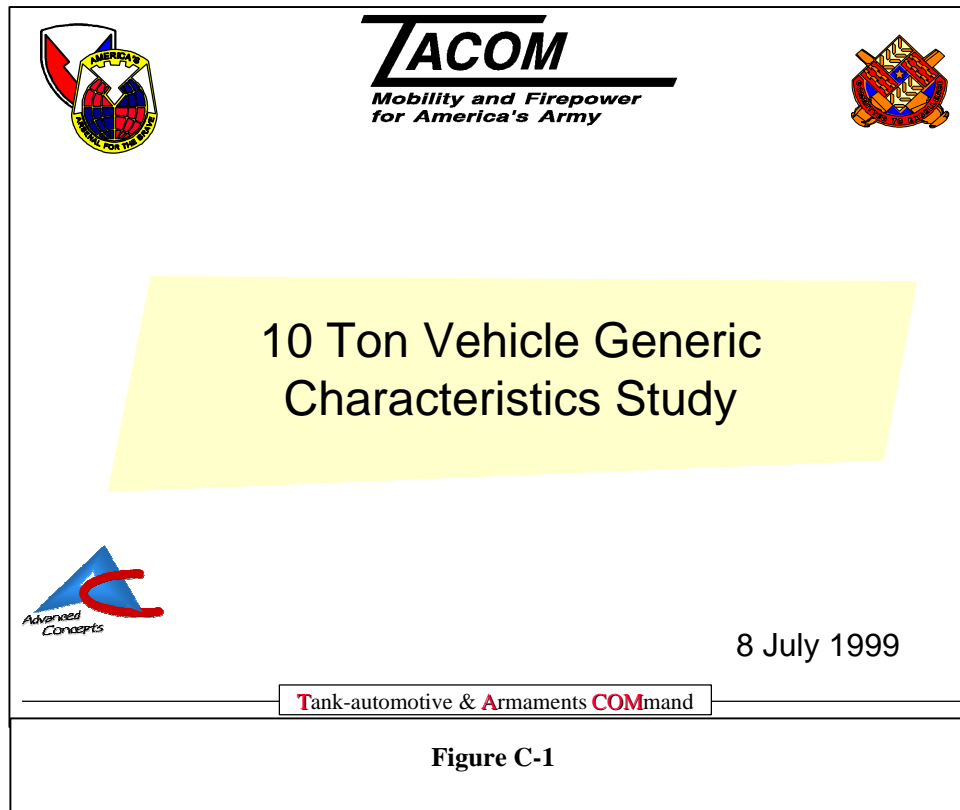
Next, several policies could be examined that might provide more flexibility to both military operations and those airlines with CRAF commitments.

- **Inter-fly Agreements.** By agreeing to let crews fly other than their own airline’s aircraft, the airline industry might be able to pool crews for CRAF

and provide themselves added flexibility. That is, if one United aircraft were committed to CRAF, rather than have four United crews committed, the airlines might share crew assets. This would enable the airlines to maintain some additional control over their crews.

- **CRAF Foreign Partners.** An agreement similar to the VISA's Vessel Sharing Agreement (VSA) would allow added flexibility to CRAF participants. Contingent upon several requirements being met, e.g., safety inspections, governmental controls, CRAF participants might use non-participant or foreign-owned and operated aircraft capacity as a substitute for their CRAF commitments. That is, Delta airlines, for example, might be able to provide a Swiss Air aircraft to meet its CRAF obligations, thereby providing added flexibility to CRAF participants. [This option would require modification of the Fly America Act.]
- **MHE Agreements.** Currently, a long-range international CRAF commitment calls for one aircraft and four air crews. AMC personnel trans-load the civilian airframes using military MHE. In certain circumstances, it might be beneficial to take advantage of civilian MHE and MHE crews to expedite trans-loading. Particularly, in situations in which B-747 cargo is trans loaded to C-17s, the capability to have civilian crews working the civilian plane, while military crews work the military planes might substantially increase throughput capacity. [We recognize that the benefits are scenario dependent.]
- **More Rapid On-Off Loading Times.** Current AMC planning factors for a B-747 Cargo plane calls for five hours on-load/off-load times, vice 2 ¼ hours for a C-5. The inability to meet more rapid trans-load times somewhat negates the greater cargo capacity of the larger CRAF resources. With the appropriate infrastructure, FEDEX can off-load a B-747 in 29 minutes. DOD should look to develop faster trans-load times with industry through both increased infrastructure and concurrent ground operations (simultaneous refueling and loading/off loading).





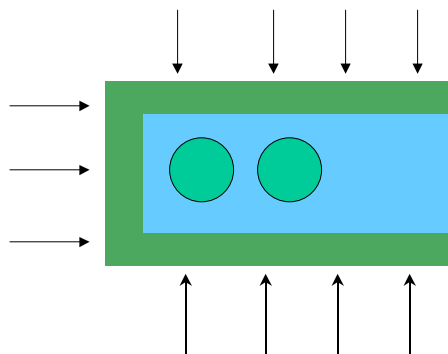
## **Weight Breakdown**

**(2 Person Crew, 5/16" Steel Structure)**

<u>Automotive</u>	<u>lbs.</u>
Suspension	2500
Electric Dr	1400
Aux. Automotive	500
<u>Power Mgmt</u>	
Prime Power	2100
Batteries	550
Misc.	200
Fuel	880
<u>Survivability</u>	
Detection Avoidance	850
NBC	300
Fire Extinguishing Sys	100
<u>Crew</u>	
Crew Station	620
Crew	380
OVE	1240
Misc	300
<u>Structure (5/16" steel)</u>	<u>5580</u>
TOTAL	17500

**Figure C-3**

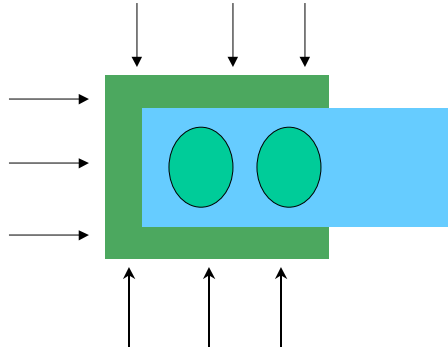
## **Weight Change with Add On Protection Over 180 Degrees of Vehicle**



<u>Protection Level</u>	<u>Structure Wt. (lbs)</u>	<u>Vehicle Wt. (lbs)</u>
5/16" Steel	5580	17500 (8.75t)
14.5mm CAV @ Range	9480	21400 (10.7t)
@ 0 deg	12760	24680 (12.34t)

**Figure C-4**

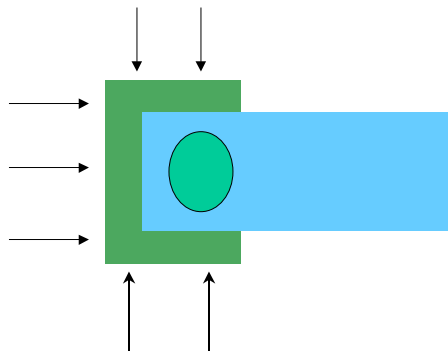
### ***Weight Change with Add On Protection Over 180 Degrees of Crew Area***



<u>Protection Level</u>	<u>Structure Wt. (lbs)</u>	<u>Vehicle Wt. (lbs)</u>
5/16" Steel	5580	17500 (8.75t)
14.5mm CAV @ Range	6770	18690 (9.3t)
@ 0 deg	8270	20190 (10.1t)

**Figure C-5**

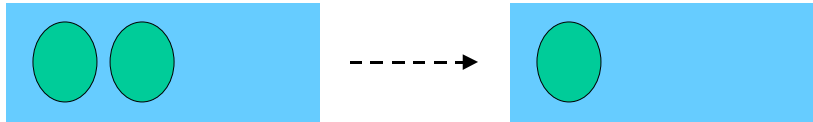
### ***Weight Change with Add On Protection Over 180 Degrees for 1 Person Crew***



<u>Protection Level</u>	<u>Structure Wt. (lbs)</u>	<u>Vehicle Wt. (lbs)</u>
5/16" Steel	5580	17500 (8.75t)
14.5mm CAV @ Range	6470	17760 (8.9t)
@ 0 deg	7530	18810 (9.4t)

**Figure C-6**

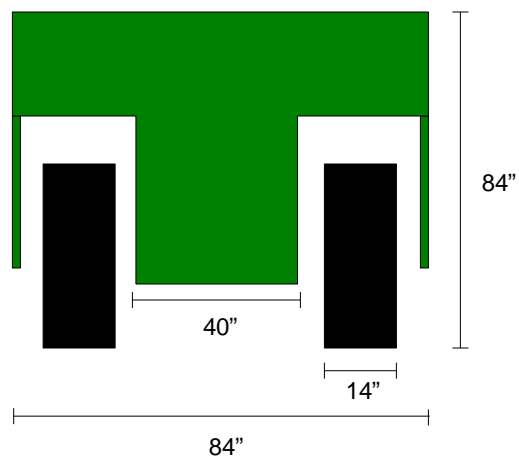
## ***Weight & Volume Changes With 2 to 1 Person Crew***



Crew Size	2	1
Volume of Crew Stations (cu ft)	92.4	46.2
Weight of Crew Stations (lbs)	1280	640

**Figure C-7**

## ***Vehicle Measurements***



**Figure C-8**

## ***Weight Swap Crew for Missiles***

<b><i>Available wt for missile system</i></b>		<u>lbs</u>
Crew Station (2)		620
Crew (2)		360
Personal Gear (2)		300
NBC		200
5/16" protection wt. savings to bring up to 20t		<u>2500</u>
Total		3980

<b><i>Missile system wt</i></b>		
Smart Boy Missiles (29)		1914
Fire control		1110
Autoloader/Structure		<u>900</u>
Total		3924

**Figure C-9**

## ***Weight of Weapon Station***

•35mm gun	480
•Weapon station/structure	4580
•Autoloader	150
•35mm rds (192)	662
•Fire Control	<u>1110</u>
Total	6982

**Figure C-10**

## Annex D Airfield Accessibility

Increasingly, a handful of determined belligerents can disrupt or deny the use of easily identifiable sizable airports near (within 300-500 nm) the area of operations through the use of shoulder-launched SAM geo-precision strike missiles, and biochemical agents. Even without the threats, the availability of logistically suitable large airports for close-on theater staging areas is limited in many of the less developed parts of the world.

To get some feel for the magnitude of the problem, Boeing extracted and composed Figures D-1, D-2, and D-3 from the Automated Aerospace Flight Information File (AAFIF) which illustrate the area density of both large paved (>6,000 foot length) airfields possibly suitable for theater staging bases and smaller (>3,000 foot) austere runways possibly suitable for tactical staging areas. The larger fields could handle 747s and C-5s if runway bearing strength and apron space are adequate. The smaller could handle C-17s and C-130s again if runway bearing strength is adequate.

One can easily be misled by these figures because only a small percentage of their airfields are currently sufficiently well characterized to permit authorized use by the strategic and tactical airlift. In fact, only 9% of worldwide airfields of >3,000 foot length (excluding U.S. and former block countries) have adequate characterization as shown in Figure 4. Of the larger fields (>6,000 foot) approximately 20% are adequately classified in Figures D-1, D-2 and D-3.

A careful systematic effort is needed to adequately characterize a much larger fraction of the airfields in these data bases before a well considered decision can be made about our ability to gain rapid, survivable access to these parts of the world, with our current intra-theater airlifters. Further, road segments may offer a further means to expand the entry point uncertainty; so these should be explored as an added option.

## Annex E Port Accessibility

Emphasis in World-Wide commercial port useage is trending towards serving 12 mega ports, each with deep channels of > 50 feet. These heavily facilitized ports serve approximately 20 major routes. At the same time, Prepo is up-sizing its ships (LMSR) to 38 ft. draft (42 ft. channels) from earlier, widespread, 34 ft. draft ships.

Figure E-1 from Sealift Ship Port Accessibility Study, Military Sealift Command, 1991, examines 580 worldwide significant seaports and provides a breakout of the percentage of ports in each specified region of the world which can serve various channel geometrics and berthing requirements.

The picture is disturbing from a military access point of view. For instance of the 50 significant seaports in Africa, only four can support the newer LMSR prepo ships, and only 12 support the older prepo RORO ship. Even 36 ft. channel depths (nominally 32 ft. draft ships) are available in only 17 ports. Such scarcity almost assures that few or none will offer convenient proximity to areas of hostility without becoming a focal point for denial or disruption actions by the intelligent adversary.



# Worldwide Regional Port Accessibility

Region	36' Channel Analysis Option 1		39' Channel Analysis Option 2		42' Channel Analysis Option 3	
	700'	950'	700'	950'	700'	950'
Continental U.S. – North East Coast	57 %	57 %	52 %	52 %	33 %	33 %
Continental U.S. – South East Coast	75 %	75 %	33 %	33 %	17 %	17 %
Continental U.S. – Gulf Coast	37 %	32 %	32 %	26 %	11 %	5 %
Continental U.S. – West Coast	43 %	43 %	43 %	43 %	22 %	22 %
U.S. – Outside CONUS	40 %	30 %	30 %	30 %	20 %	20 %
Southwest Asia	63 %	63 %	60 %	60 %	20 %	20 %
North Atlantic Treaty Organization (NATO)	56 %	52 %	48 %	45 %	26 %	26 %
Europe	53 %	41 %	34 %	29 %	20 %	19 %
Indian Ocean	44 %	44 %	31 %	31 %	19 %	19 %
Northeast Asia/Western Pacific	49 %	49 %	37 %	37 %	26 %	26 %
Australia/New Zealand	61 %	52 %	39 %	21 %	9 %	9 %
Africa – East Coast	59 %	8 %	35 %	6 %	18 %	3 %
Africa – West Coast	30 %	9 %	18 %	6 %	6 %	1 %
South America – East Coast	50 %	45 %	40 %	40 %	30 %	30 %
South America – West Coast	29 %	29 %	14 %	14 %	7 %	7 %
Caribbean	25 %	25 %	10 %	10 %	5 %	5 %
Central America – East Coast	20 %	20 %	20 %	20 %	20 %	20 %
Central America – West Coast	50 %	40 %	30 %	30 %	20 %	20 %
Mediterranean	53 %	53 %	35 %	35 %	19 %	19 %
Canada – East Coast and Iceland	33 %	33 %	33 %	33 %	17 %	17 %
Canada – West Coast and Alaska	62 %	54 %	54 %	54 %	46 %	46 %

17 ports }  
33 ports } 50 ports

Source: "Sealift Ship Port Accessibility Study", Military Sealift Command, 1991

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Figure E-1

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# *Annex F*

## *Mobility Panel Briefing Slides*

Dr. Joe Braddock  
Panel Chair  
Study Co-Chair

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## Background

# Terms of Reference (TOR) - 1

- Strategic Maneuver is
  - The Capability to Rapidly Project and Sustain Early Entry Joint Forces with Continuing Operations to Dominate Contingency Circumstances subject to NCA Guidance
- The Capability is intended to be Multipurpose such that it could accomplish any or all of the following:
  - Deter Conflict
  - Lessen or Eliminate Intimidation
  - Defeat Enemy Aggression
  - Set conditions for Successfully Sustained and Decisive Operations by Follow-on Campaign Forces if they are needed

In Execution it Provides a Rapidly Mounting and Seamless Dominance (not a phased capability \_\_\_\_)



## Background Terms of Reference (TOR) - 2

### **ENABLERS SOUGHT**

- Mobility Processes, Means and Technologies
- Concepts and Capabilities Needed to Offset Enemy Anti-Access Strategies
- Processes, Means and Technologies which could Underwrite Improvements to Actualize a Favorable Revolution in Military Sustainment

### **OUTPUTS DESIRED**

- Define Opportunities to Leverage, Adapt to and/or Stimulate Useful Commercial Capabilities
- Suggest Experiments, ATDA and ACTDA
- Review and Assess Planned Improvements
- Provide Actionable Joint and Army Recommendations Encompassing the Above



## Background

# Ingredients Incorporated in the Strategic Maneuver Study

- Built on and Expanded the Major Thrust of ASB 1998 Study
  - Employ Capability Resident in Combination of DoD Active and Reserve Forces and Commercial Means and Processes
- Used Scenario Details and Sensitivity Analyses of DAMO-SS and Power Projection Wargames
- Employed Technical and Analytic Information from ASB 1999 Combat System Survivability and Lethality and DAMO-SS Study Groups to Provide an Integrated and Balances Study



## Background

# ASB Study Comparisons as a Starting Point

ASB 1998 Summer Study  
Concepts and Technologies for the  
Army After 2010

ASB 1999 Summer Study  
Strategic Maneuver for the  
Army After 2010

- Scenarios
  - Benign  
Fort-Port-Port-Foxhole
- Freedom of Access Available to In-Theater Bases and Follow-On Operations
- No Growth in DoD Strategic and Theater Assets to Support Power Projection (CONUS, Air, Sea, Overseas)
- Substantial Growth in U.S. and World-Wide Commercial Capabilities to Support Power Projection
  - Constraints and Adaptation Needed
- Scenarios
  - Benign
  - Disrupted
  - Opposed
  - Fort-to-Foxhole

From CONUS  
to Theater
- Freedom of Access Achieved Through Intermediate Staging Bases, a Spectrum of In-Theater Entry Points and Measures to Minimize Delays
- Army Adaptation to Better Leverage DoD Assets
- Re-Emphasize Commercial Growth Benefits to DoD
  - Additional Examples Provided
  - Technical Improvements and Adaptation Outlined

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## Background

B-2L

# An Army in Continuing Transition

2020  
(AA2010)

AA2010 vs AOE	{ 3x MORE MOBILE 3x MORE EFFECTIVE 1/3 OF TODAY'S SUPPORT
---------------------	--

ARMY XXI  
+ COMBINED ARMS  
AIR-MECH  
STRIKE FORCES

2010  
ARMY XXI

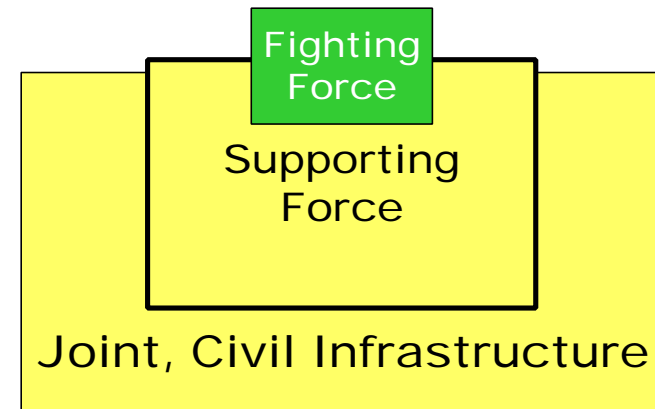
ARMY XXI  
+ CRUSADER  
COMANCHE WITH  
DEVELOPMENTAL  
STRIKE FORCES

2001

AOE AND  
ARMY XXI  
WITH  
EXPERIMENTAL  
STRIKE FORCES

1998

ARMY OF  
EXCELLENCE  
(AOE)

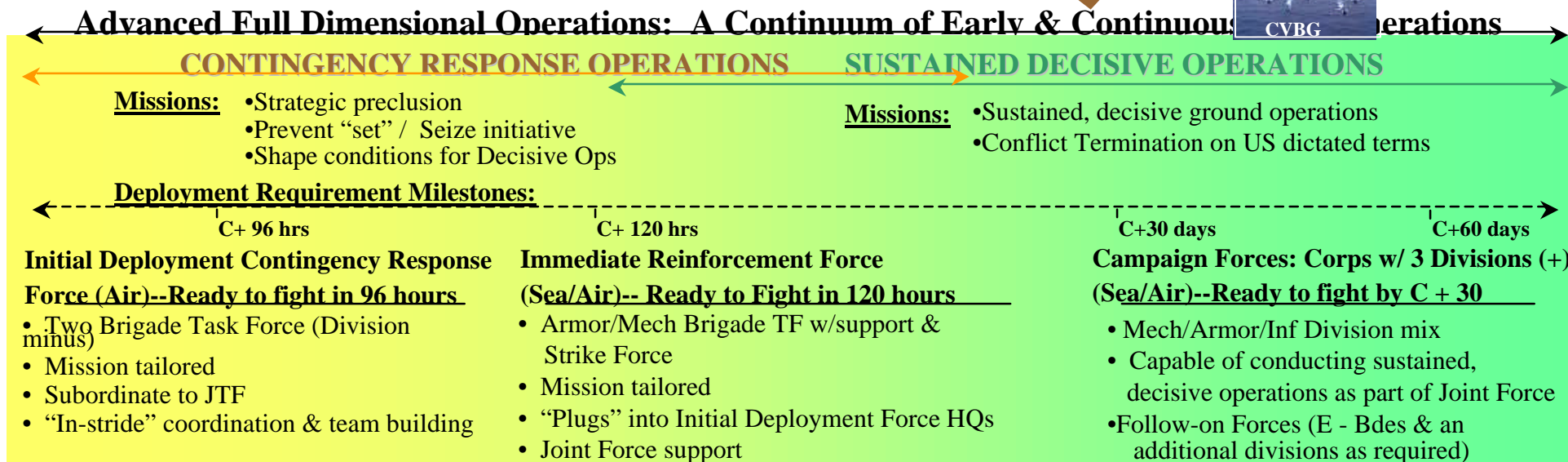
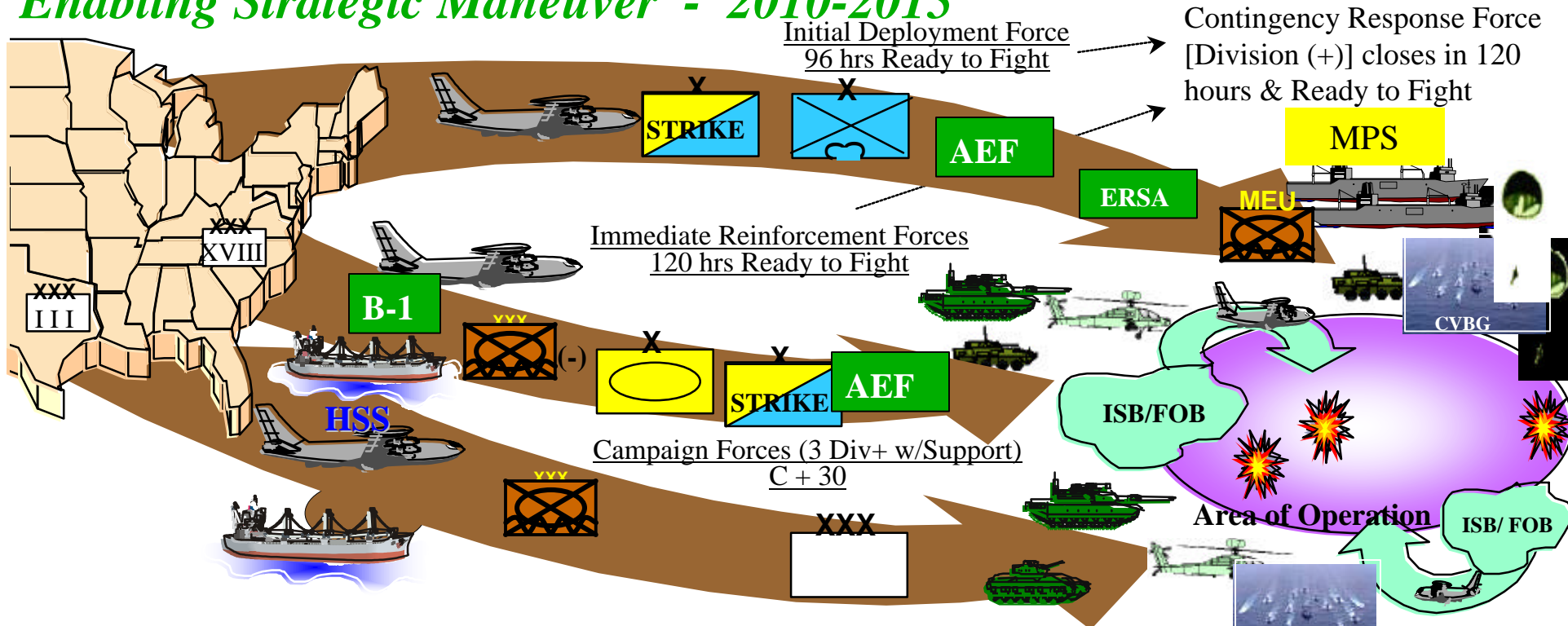


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Ref 7 & 8

# Joint Force Projection Concept/Requirement -- AXXI

## Enabling Strategic Maneuver - 2010-2015





## Background

B-2R

# While Joint Force Elements are Heavy and Bulky...

**...Important Reductions are Underway and Planned Future Force Elements are Lighter and Smaller**

Unit	Manning	Total Weight	Primary Platforms	Daily Fuel Sustainment
1997 Army Division	17,000	100,000	1,000	1,200
1999 Army Division	15,000	80,000	800	1,000
2015 Strike Force	6,000	20,000	1,400	200
1997 Air Wing	7,000	7,000	72	1,000
2015 Air Expeditionary Force	2,500	4,000	72	1,000

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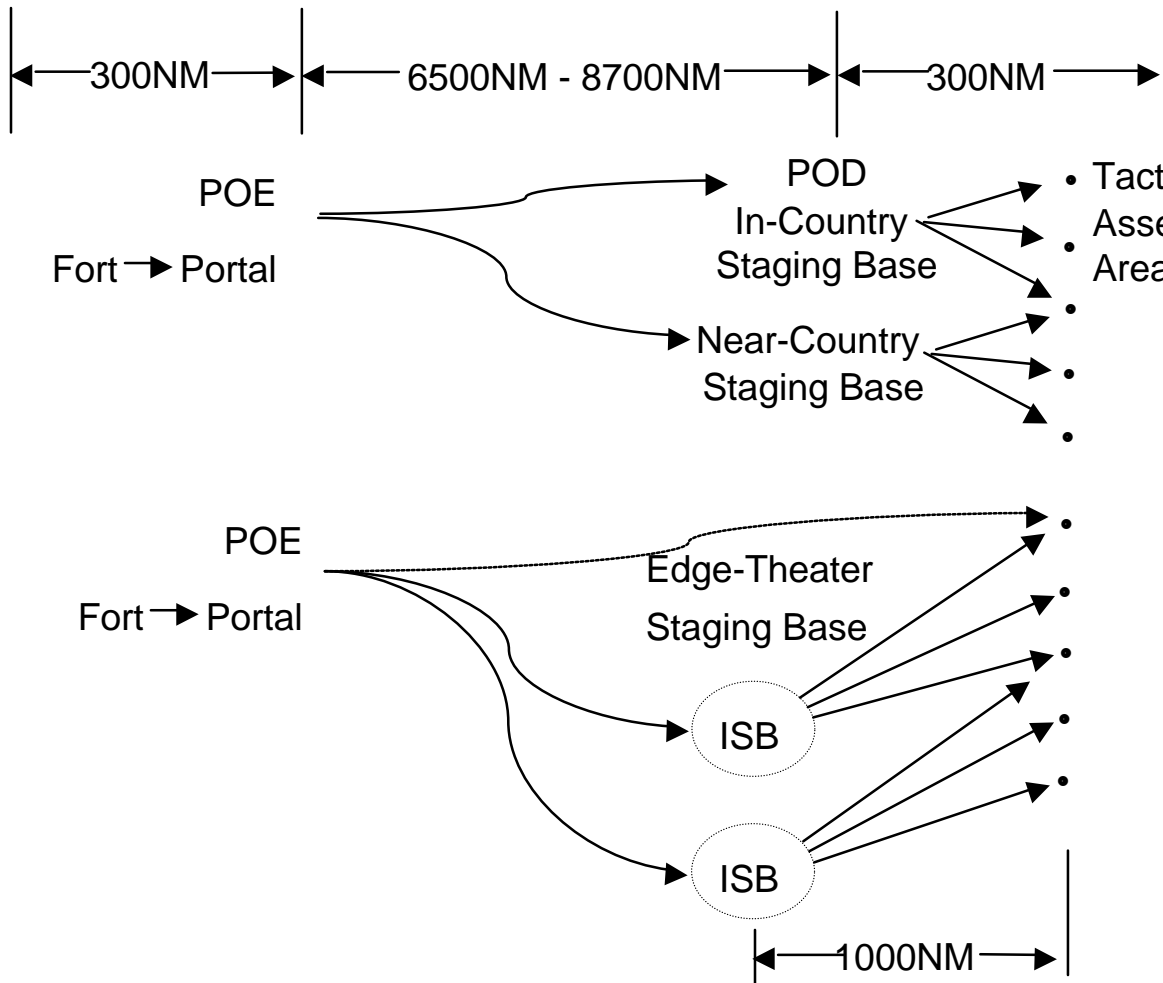
## Background Agenda

- Introduction
- Background
- Scenarios
  - Operational Concept
  - Measures to Offset Enemy Anti-Access Strategies
- Commercial Trends
- Freedom of Timely Access
  - Air Mobility
  - Sea Mobility
  - Land Mobility
- Endurance
- Integration
- Findings and Recommendations
  - – Central
  - Contributing



# Get There Firstest with the Mostest Effect

## Current vs. Future Concept



### Current Rapid Early Entry

- Benign air and seaports in or near-country
- Short helo or truck distribution
- Mostly military transport for early strategic leg and insertion
- Severely limited by:
  - disrupted nearby POD terminals
  - absent or austere nearby POD terminals

### Future Rapid Early Entry

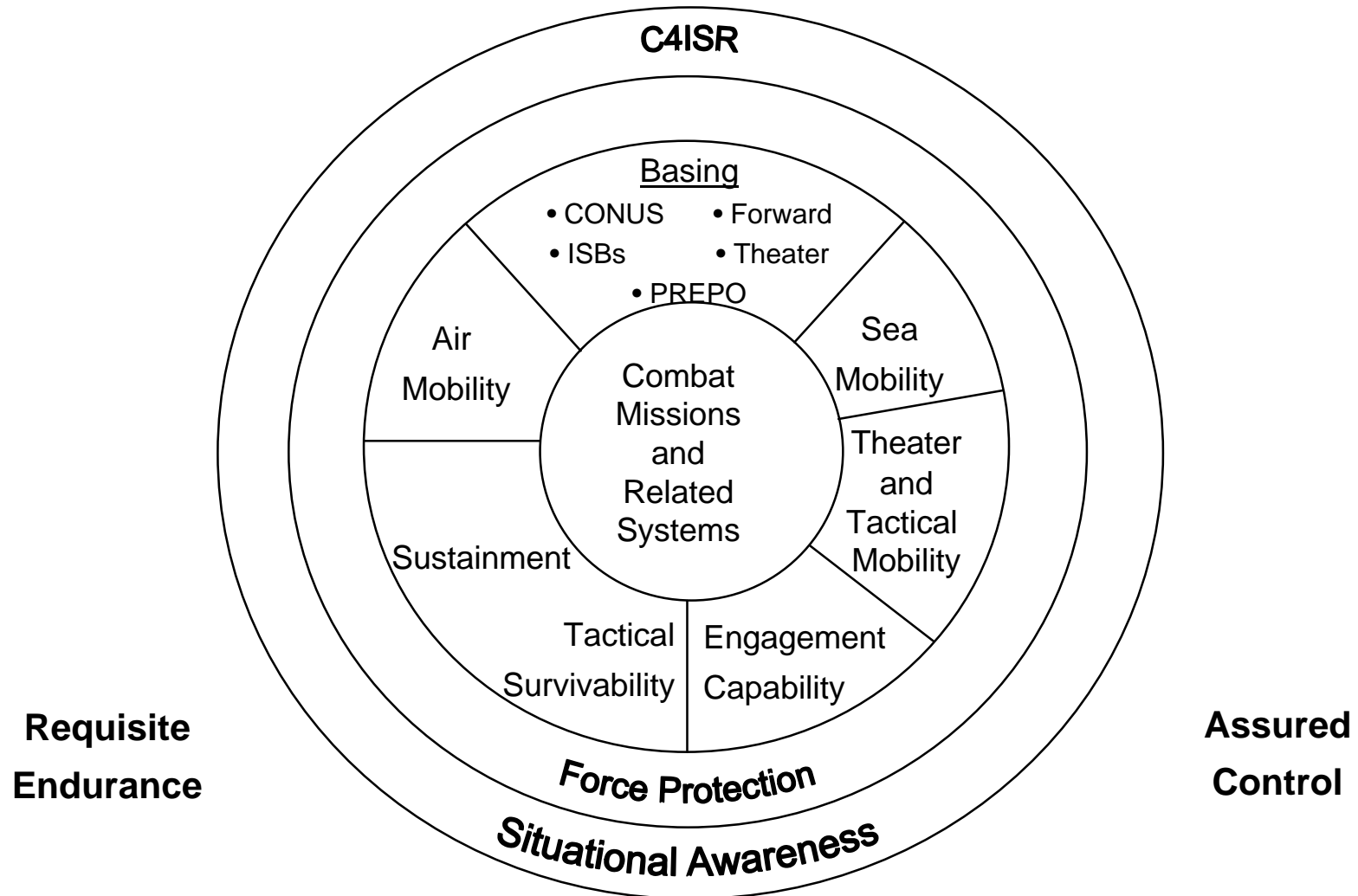
- Sanctuaried, remote (~1000nm) Intermediate Staging Bases
- Direct delivery from ISBs to Tactical Assembly Areas (TAAs) by terminal independent military lift
- Heavily exploited commercial lift to the ISB
- Avoids delay of early entry by:
  - denial of nearby POD terminals
  - absent or austere nearby POD terminals

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# Framework

## Freedom of Timely Strategic Access



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## Scenarios

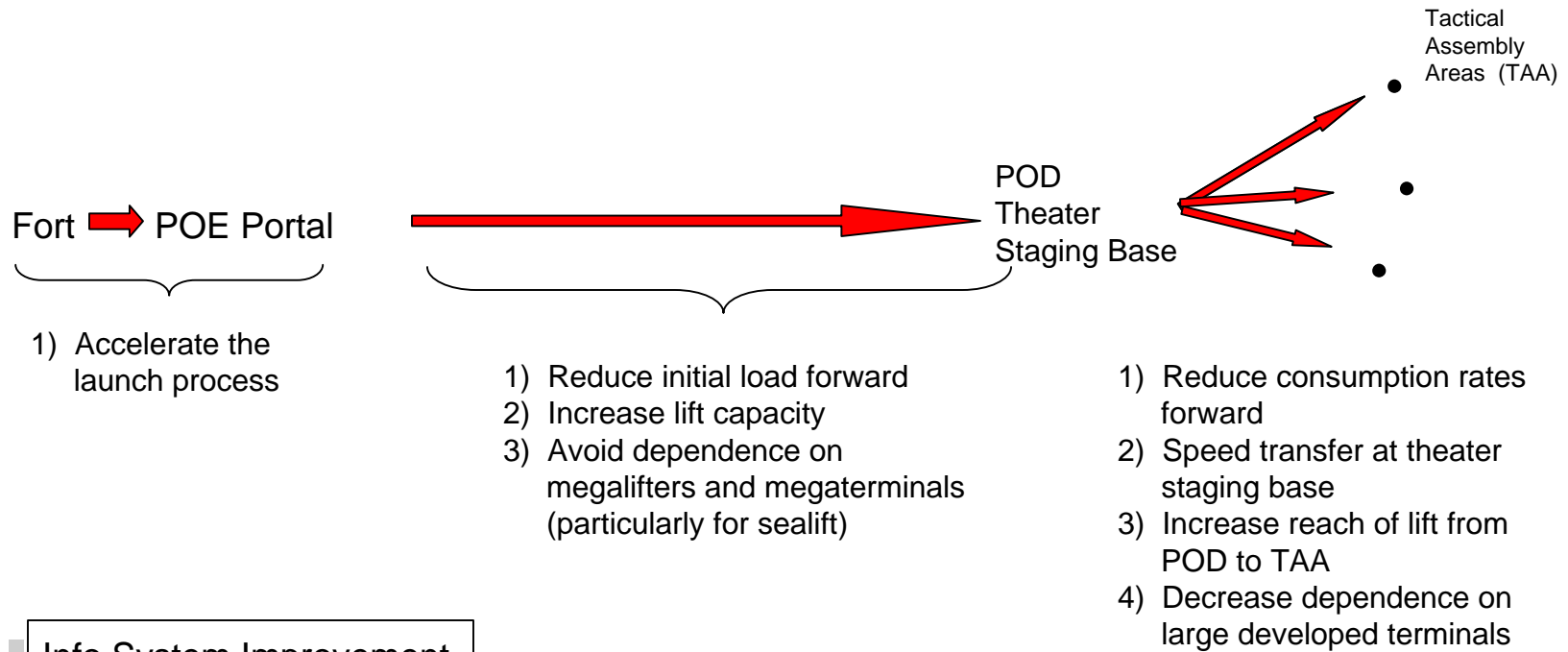
### Generalized Movement Cases

Movement Type	Condition: Benign	Disrupted	Opposed
Subsequent Theater Movement			
Staging and Integration With Unit			Opposed With Military Land
Unload At Port			Sea And/or Air Forces Including WMD
Move by Air, Sea or Land	} As Needed	} Disrupted Through Sabotage And Actions of Paramilitary Forces	} Disruption Through Sabotage and Paramilitary Forces
Transfer At ISB			
Move by Air or Sea			
Load At Port			
Move To Port			
Organize Unit for Move			
Time:	Minimum	Lengthened	Longest

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## Get There Firstest with the Mostest Effect The Themes



### Info System Improvement

- 1) Rapidly learn in detail what force components are needed forward
- 2) Know in detail where all supplies and transport resources are in real time

### Closure Time

Desert Storm: C + 210 Days - For 5 1/3 Divisions  
 ASMP: C + 30 Days - For 3 1/3 Divisions  
 Goal: C + 5 Days - For 4 Brigades

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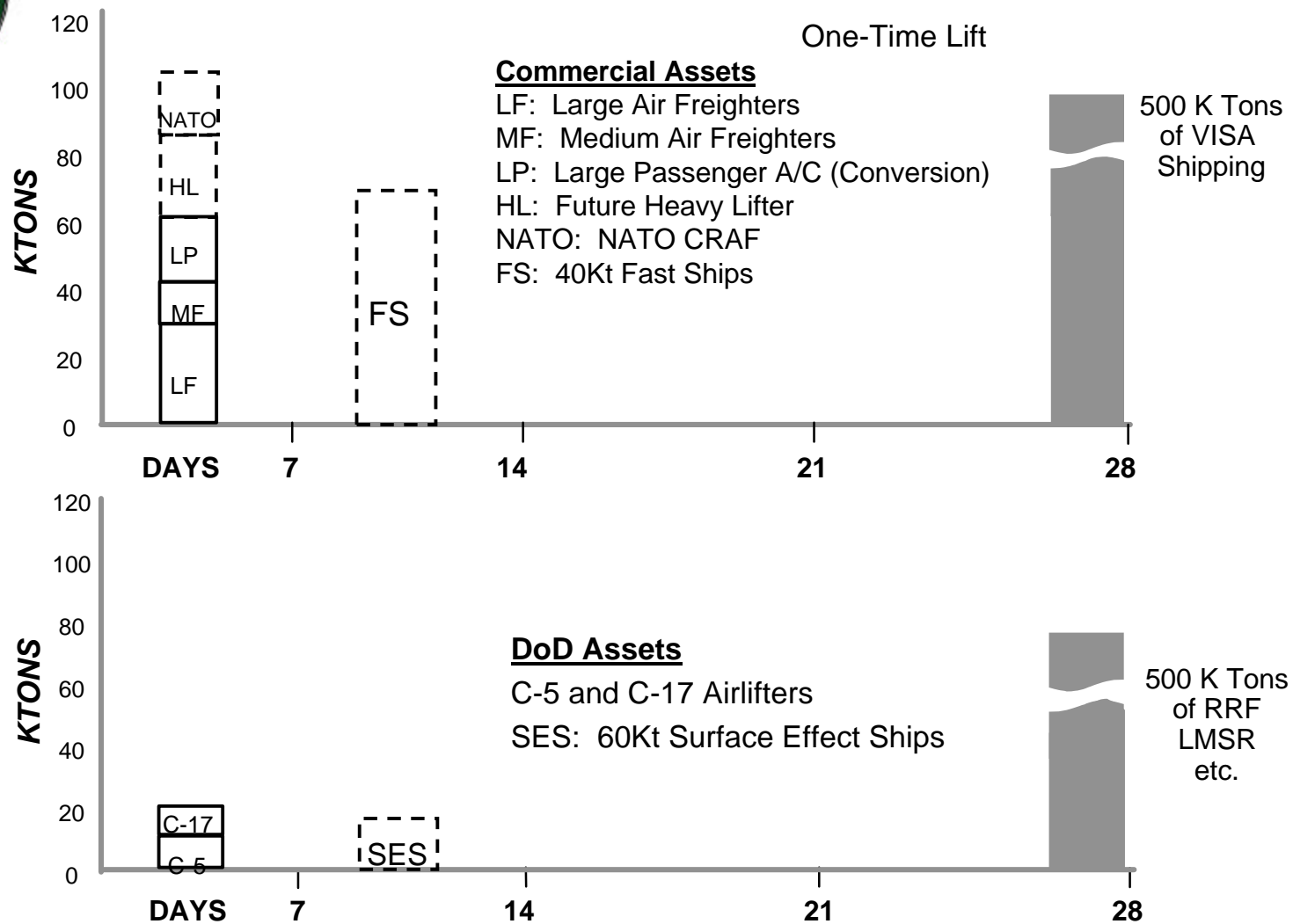
## Transportation National Trends “The Nation’s Freight Bill”

Sectors	(Sector size 1997 billion \$)			
	1960	1980	1997E	Impact on Army
Air	3	9	22	Greater CRAF Freight Capacity
Highway	226	345	401	Continuing Lift and Road Infrastructure
Railroad	63	72	36	Steady Decrease and More Specialization
Water	24	43	26	Trending Downward
All Other	20	23	19	
Total	336	492	502	Providing more service for less money
%GNP	9.3%	7.8%	6.2%	



## Freedom of Access - Air Mobility

# ONE-TIME AIR AND SEA FLEET LIFT CAPABILITY



**Commercial fleet airlift potential is 5x greater than DoD's; with high speed sealift, broad AA2010 options are enabled**

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## Scenarios

# Measures Introduced to Cope with Anti-Access Strategies

- Employ Distributed ISBs to Allow Efficient use of both Military and Commercial Strategic Resources
- Emphasize Rapid Transfer in Design of New Army Equipment/Sustainment and Improvements to Legacy Vehicles
- Use Military and/or Defense Feature Configured Assets to Make Theater Insertion and Subsequent Moves
- Emphasize those Assets that Maximize Access and Create the Greatest Insertion/Subsequent Movement Uncertainty for an Enemy
- Use Continuing and Balanced Dispersion, Mobility and Active Defense along with Passive Measures to Maintain Survivability and Endurance



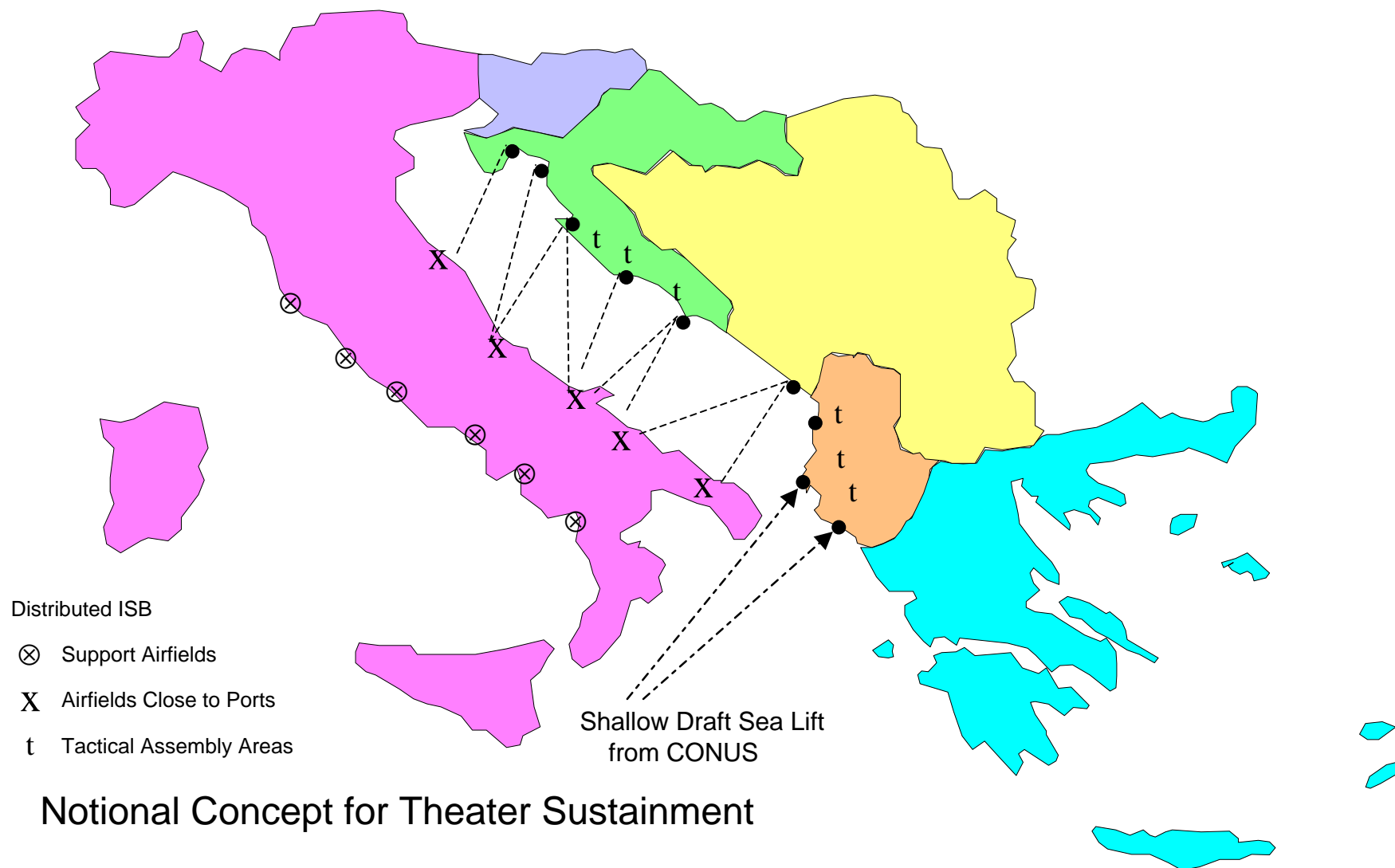


## Scenarios Major Findings

- The creations of Strike Forces or Battle Forces increases the requirement for air lift.
  - The creation of more capable light forces (AAN or Strike Forces) adds weight to current light forces and thus increases their lift requirement.
  - The creation of air deployable “mech” forces creates a force not currently air transportable and thus establishes a new requirement for air lift, even if these forces are considerably lighter and smaller.



# Hubs & Distributed ISBs

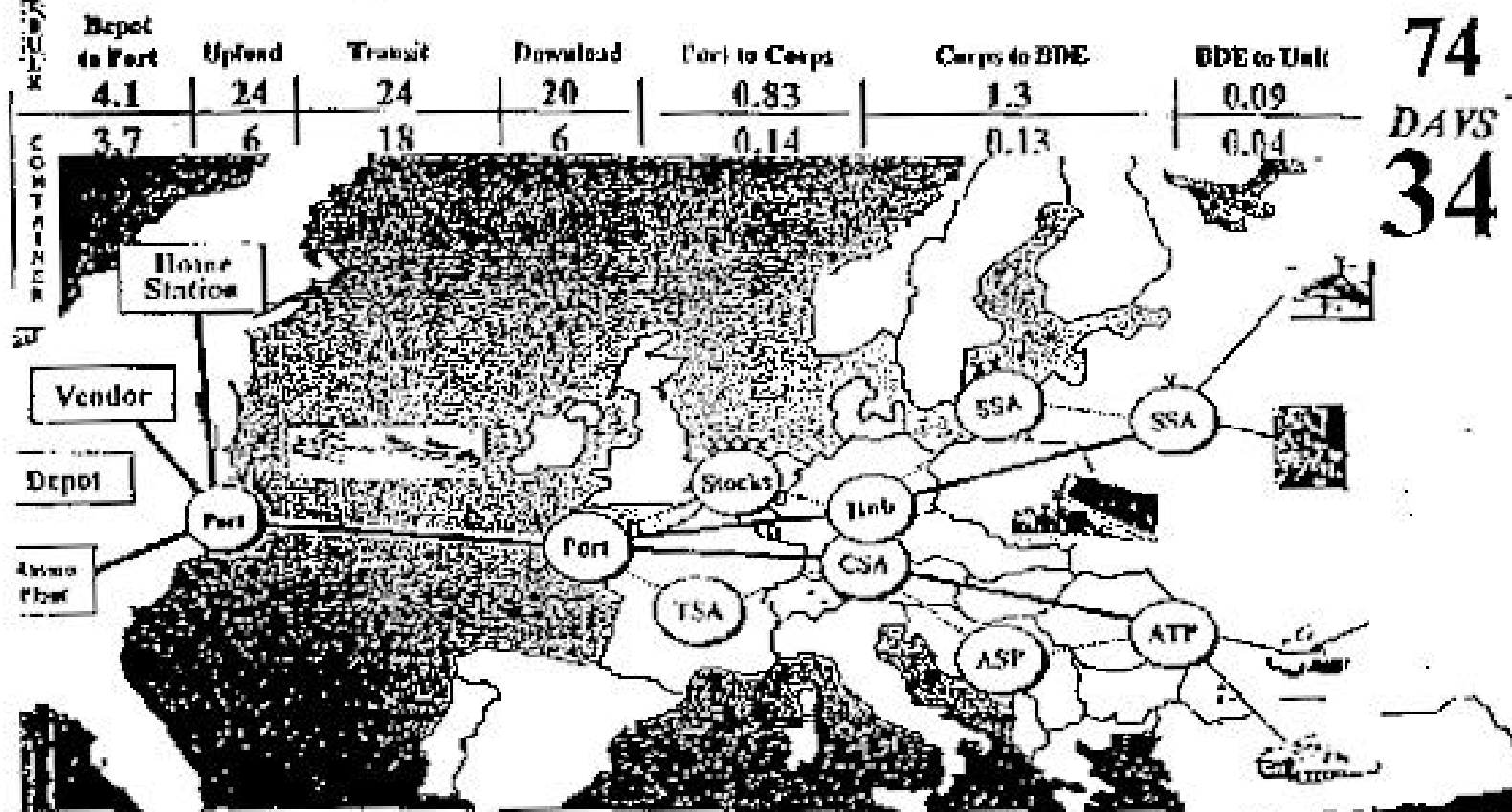


## Notional Concept for Theater Sustainment

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## Scenarios Distribution Based Logistics



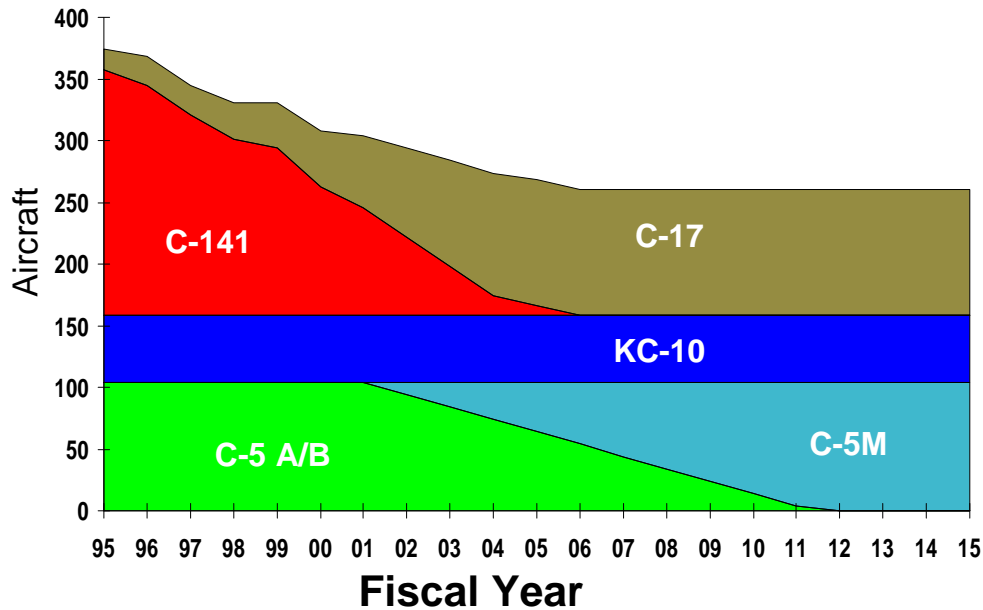
*“The Distribution Pipeline is the  
Army XXI Warehouse”*

S-6L

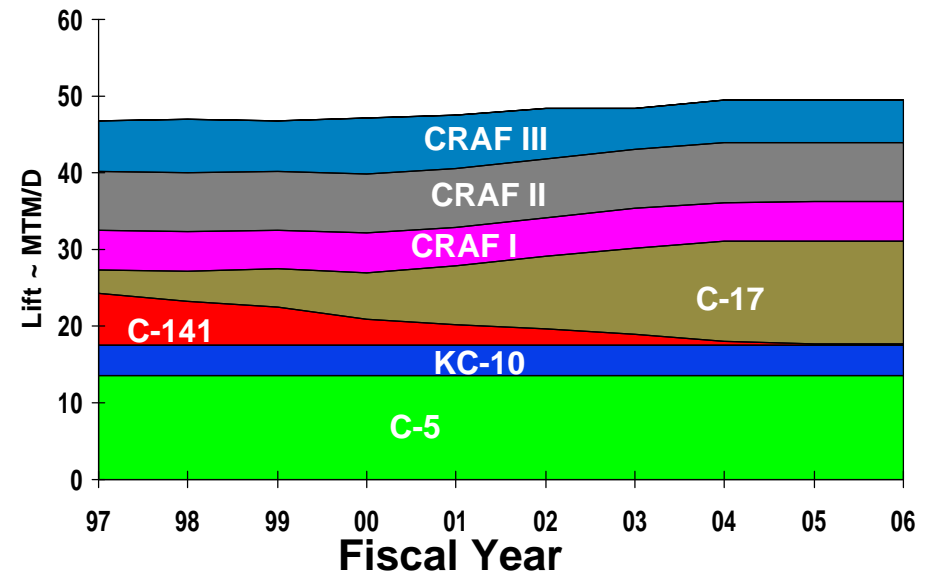


## Mobility and Sustainment **AIR MOBILITY MASTER PLAN**

**Future Military Strategic Airlift Force Structure**



**Strategic Airlift Throughput**



- TRANSCOM long term planning calls for no new strategic or tactical cargo aircraft
- Use of Civil Reserve Air Fleet (CRAF) is **mandated** in current deployment planning

Air Mobility Master Plan shows that CRAF is a critical strategic lift component

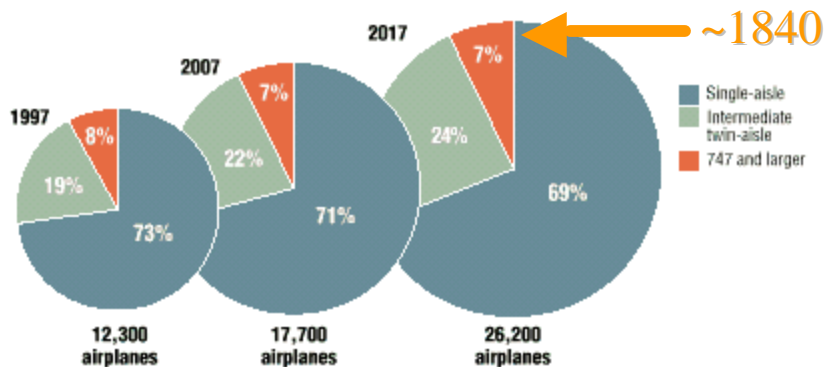
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# Commercial Trends that DOD can turn into an advantage.

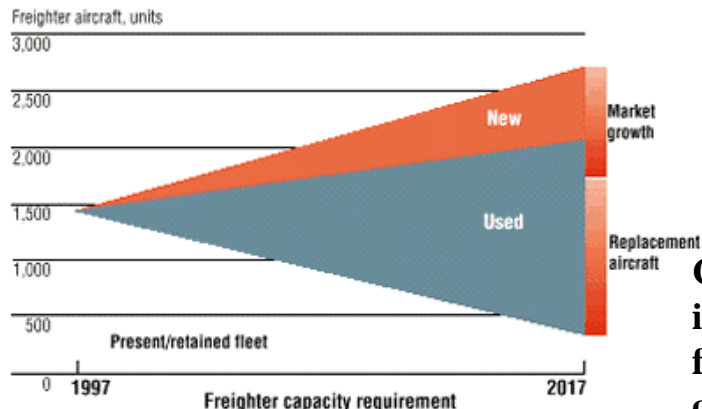
Worldwide aircraft fleets will double, but retain an increasing 747 size or larger base around 7%...

The World Fleet Will More Than Double Over the Next 20 Years

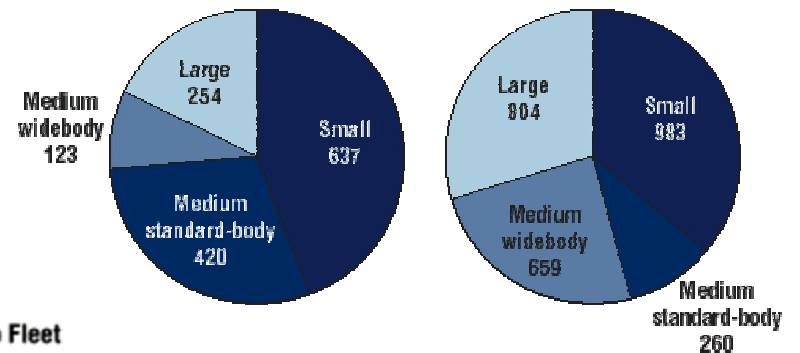


As new PAX AC displace older Pax AC, the Pax AC will be converted into freighters and become a greater portion of fleet...

Over 70% of the Future Fleet Will Be Modified Aircraft

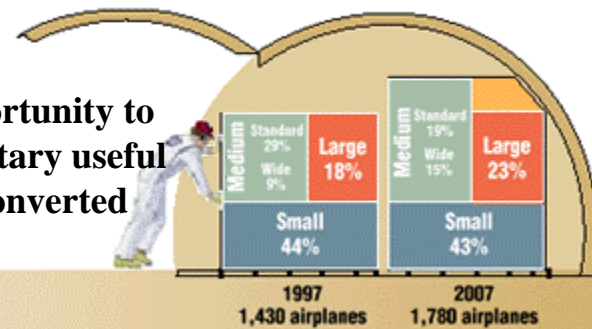


Enabling Rapid and Decisive Strategic Maneuver for



World All-Cargo Fleet 1997-2007

Creates the opportunity to improve the military useful features of the converted craft



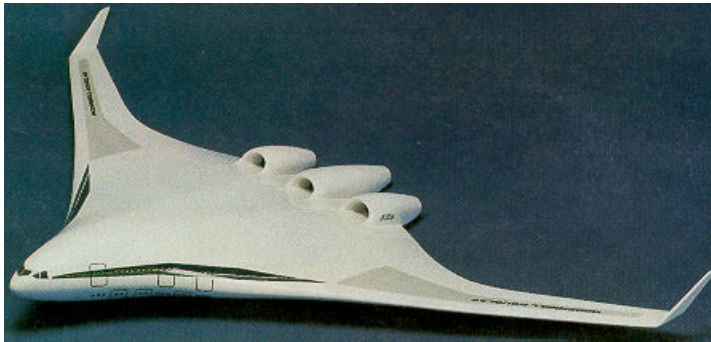


## Mobility and Sustainment **COMMERCIAL FREIGHTERS ARE AN EMERGING OPPORTUNITY**

- **World large freighter fleet will quadruple**

<u>1995</u>	→	<u>2015</u>
1219 Freighters (224 Large)		2261 Freighters (884 Large)

- **Advanced passenger and cargo aircraft are entering design stage**



**BLENDED WING-BODY**

*Up to  
1 million lb  
cargo  
capacity*

**Proprietary**

**HEAVY PAYLOAD AIRLIFTER**

- **The opportunity to leverage the commercial airlift fleet requires**
  - DoD engagement and stimulation
  - Early and continuing Army involvement with developers and their customers
  - Cooperatively developed changes or appliques
  - Changes in Army platforms, etc., to accommodate constraints to meet airline needs

***Future air freight fleet capabilities offer strategic capabilities to transport  
Battle Forces and selected Army elements and sustainment***

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## Scenarios

S-5R

# Trends: Integrated Commercial Deployment / Sustainment Trends

- Overall
  - Higher Speed
  - Reduced Touch
  - Meshed Intermodal Operations
- Packaging
  - Modular, Sub-Container
  - Tags
- Hubs / Agile Ports
  - Focus is Fast Load - Unload
  - At Air Hubs: Load time 20-30 Min., Unload 5-10 Min.
  - At Agile Ports: Load 6-12 Hours, Unload 6-8 Hous (container or RORD)
- Modularity / Containerization
  - FedEx, UPS, DHL are the Innovators
  - Head toward one touch/stop with matched intermodal containerization
- Command Control
  - Uses all source information
  - will use NRT tracking of Platforms
  - Will be very skilled at Maximizing Throughput



## **Freedom of Access - Air Mobility (Strategic)**

# **Employing Commercial Air Transport Capabilities will Require Army (DoD) Adaptation, Simulation and Innovation**

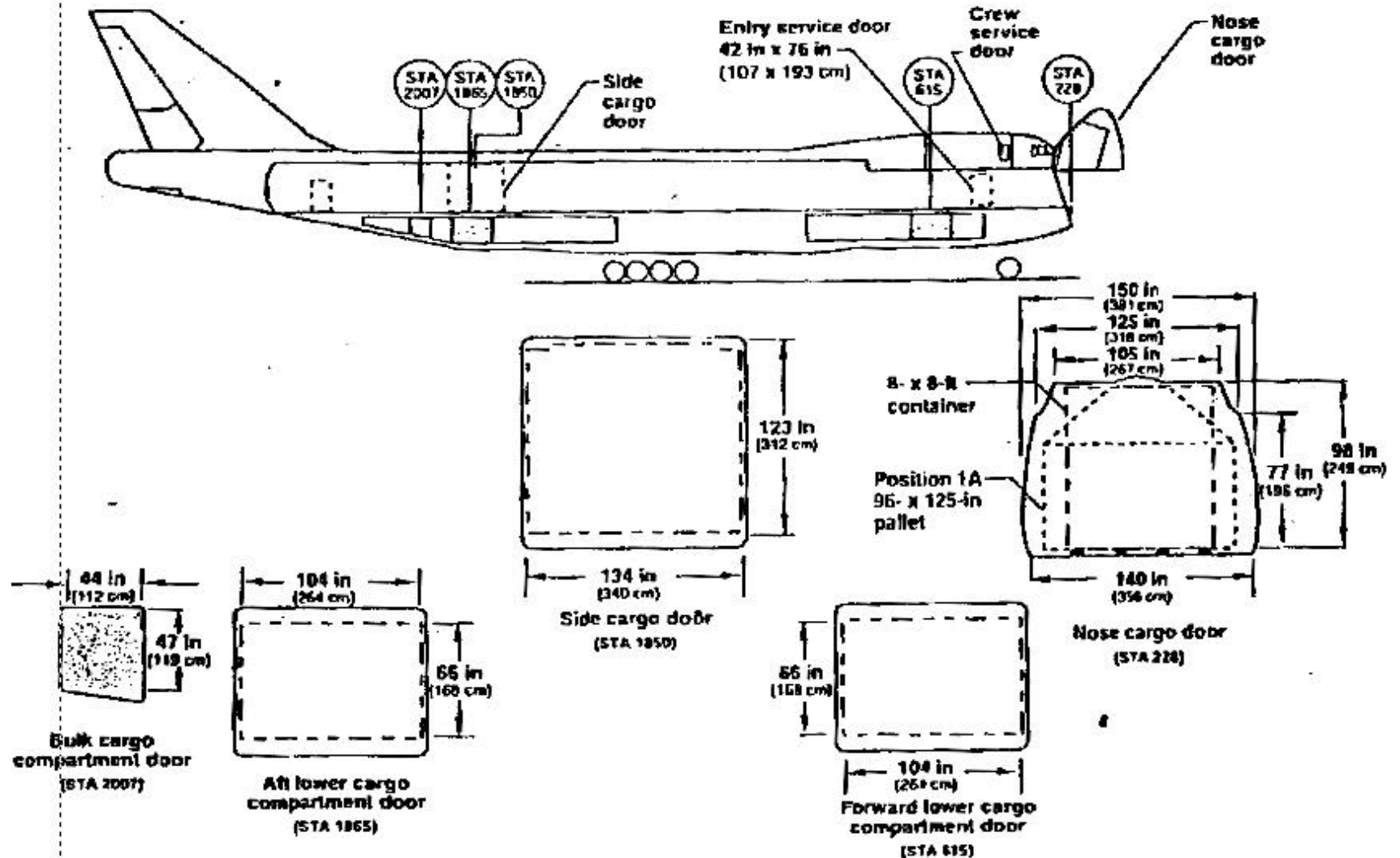
- Technical Challenges
  - Door Limitations
  - Floor Strength Limitations
  - Rapid Load/Unload Handling Equipment
- CRAF Policy and Implementation Improvements
- Innovations Such as Virtual Airlines





# Freedom of Access - Air Mobility

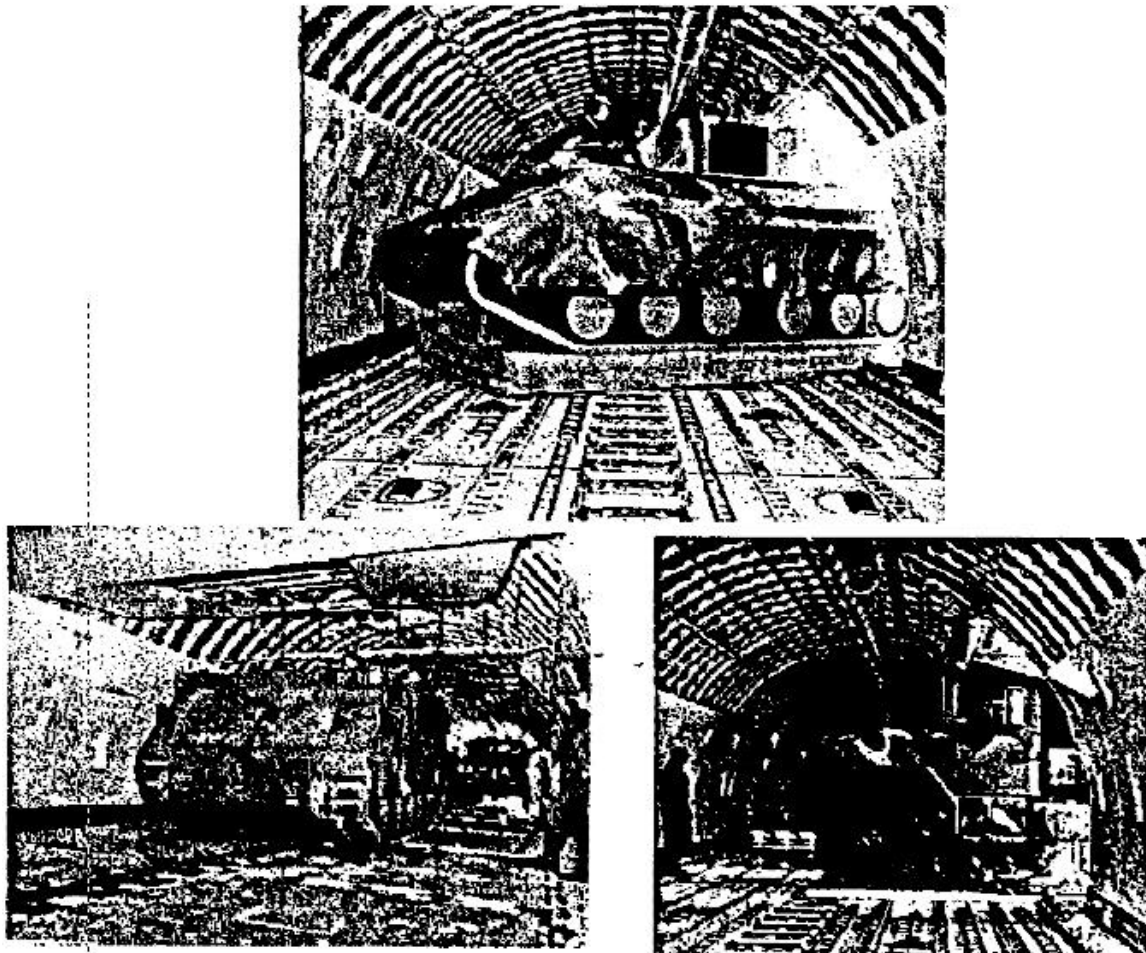
## 747 Freighter Cargo Door Arrangement



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## Freedom of Access - Air Mobility Payloads



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## Freedom of Access - Air Mobility **CRAF Policy Should Be Improved and Include Innovations...**

FA-4L

... Such as Direct Use and Virtual Airlines

- **DARPA Virtual Airline Initiative**
  - Derived from Successful Collaboration Between FAA and Airlines
  - Initial Focus on Passenger Movement
  - Information Technologies to Find and Schedule Available Aircraft without Imposing CRAF Constraints
- **Results are Promising:**
  - SWA Scenario: Virtual Airlines Provides Needed Throughput (~5k people/day) without CRAF I or II Activation. Surge of 15k people/day accommodated
  - Built on Success of Win-Win FAA CDM Program
  - Could provide Tools to TRANSCOM and Army
- **Should be Extended to Air Freight**
- **TRANSCOM Needs to Modernize its IT and C2 Systems to take advantage of Virtual Airline and DARPA “ALP”**



## Suggested MTMC - TEA Initiative

### Provide Solutions

- 1) Find Applique Solution to Improve  
    Capability of 747, 767, 757, MDC-10, MD-11, etc.  
    To carry 9, 15, and 20 ton single vehicles  
    To Full Aircraft Payload Limit (less weight of applique)
- 2) Minimize Space Penalty for Above
- 3) Define Loading and Unloading Strategies and Means of Implementation
- 4) Define the Transfer Time Impacts and how these can be Minimized
- 5) Adapt Virtual Airline Tools for Army Needs



# Freedom of Access - Air Mobility Distribution of African Airfields Size Suitable for C-5 or 747 and C-17

## Notes:

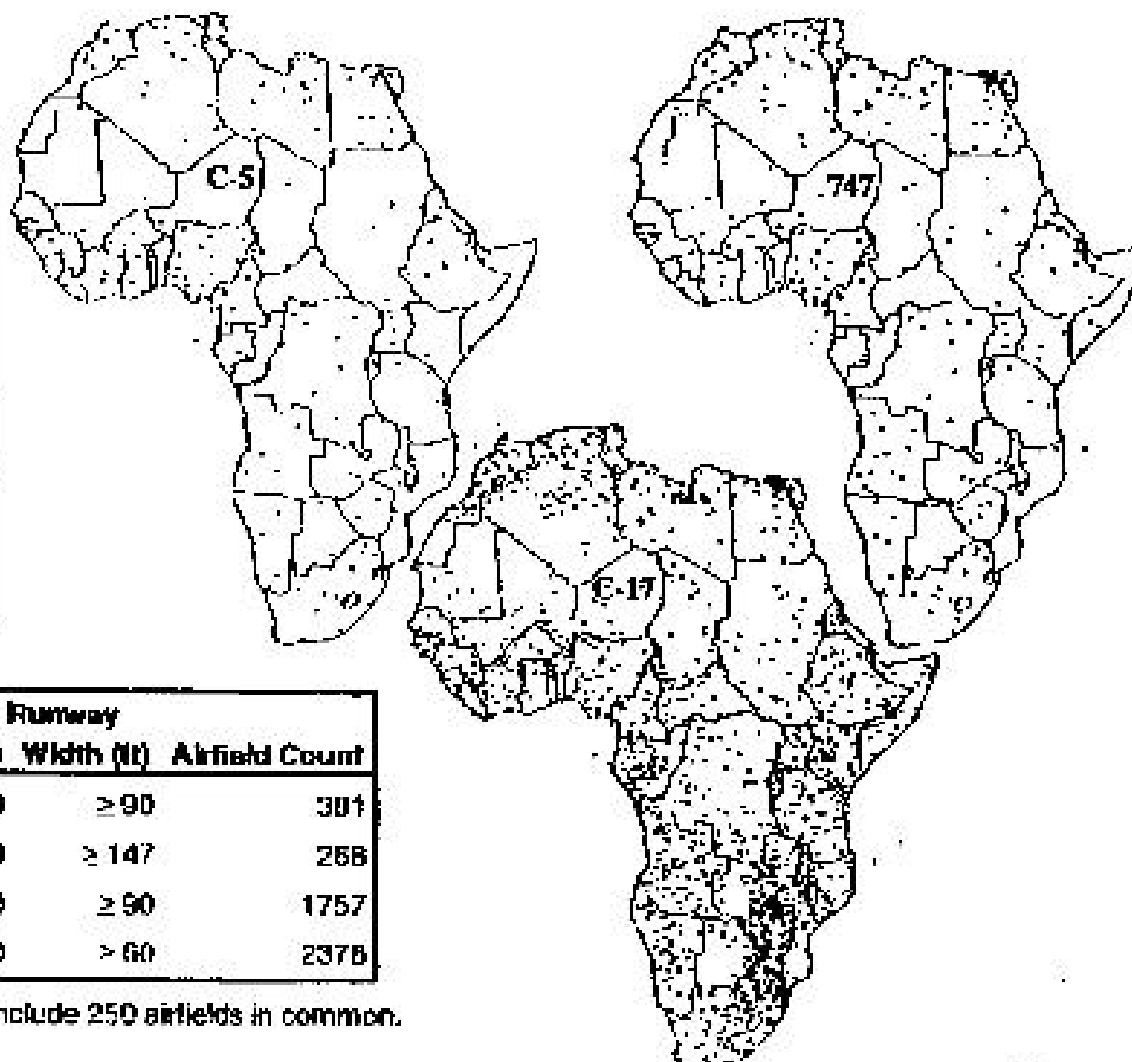
Airfield data: NIMA AAFIF,  
March 1998

Determined by aircraft minimum  
landing criteria (length and width  
only) from AMC Mobility Planning  
Factors

Permanent surface runways only  
for 747 and C-5

No LCN/CBR considerations

Multiple runways may exist at an  
airfield



Airfield Capability	Primary Runway		Airfield Count
	Length (ft)	Width (ft)	
747*	≥ 6600	≥ 90	301
C-5*	≥ 6000	≥ 147	258
C-17	≥ 3000	≥ 90	1757
C-130	≥ 3000	> 60	2378

\*The 747 and C-5 airfield counts include 250 airfields in common.

# Non-US Airfield LCN Data Available in AAFIF

Total Non-US Airfields 26321

Length  $\geq$  3000 ft. & Width  $\geq$  60 ft. 12557

LCN data available 9585

Validity Code "D" (40)

Validity Code "T" (75)

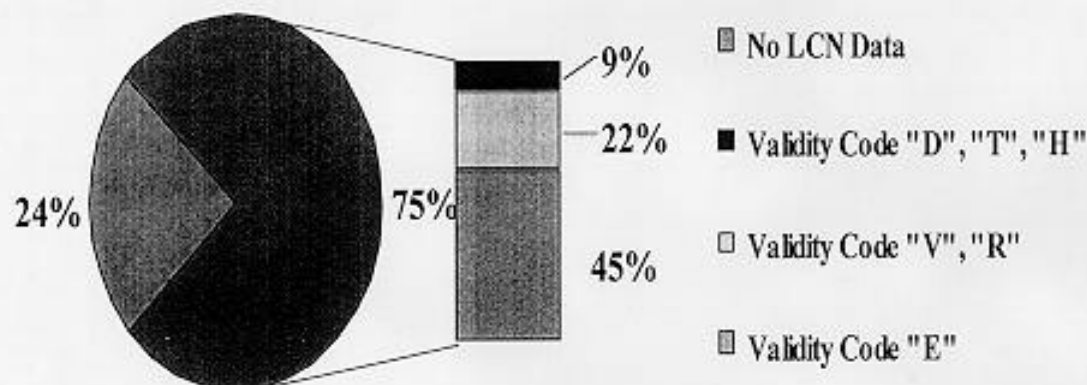
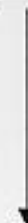
Validity Code "H" (995)

Validity Code "V" (46)

Validity Code "R" (2690)

Validity Code "E" (5739)

Decreasing LCN Reliability



12557 Airfields with Length  $\geq$  3000 ft. & Width  $\geq$  60 ft.

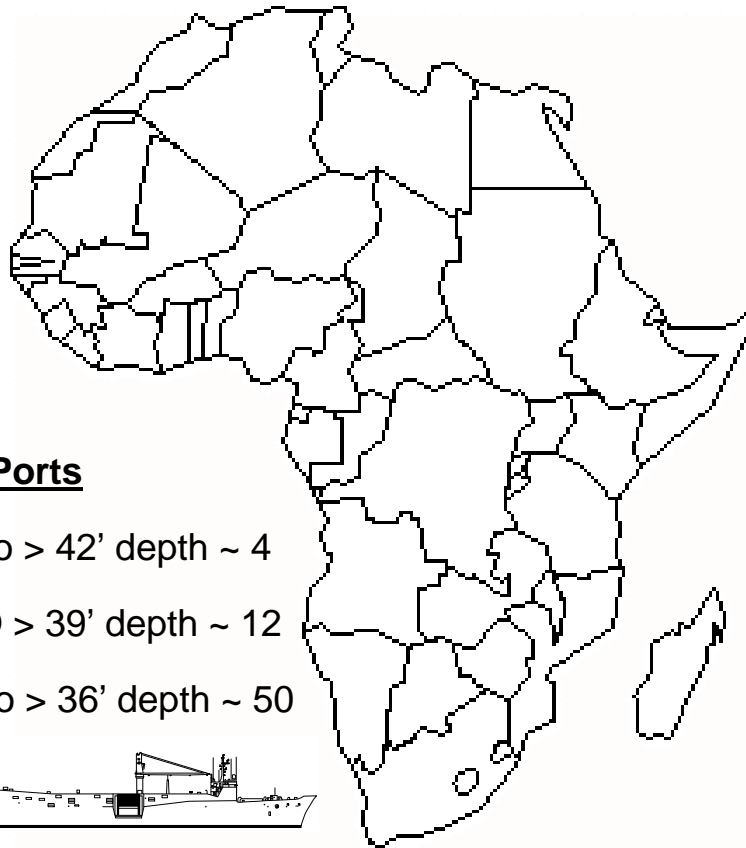
# DRAFT

Source: March 1998 AAFIF





## Limitations on Access

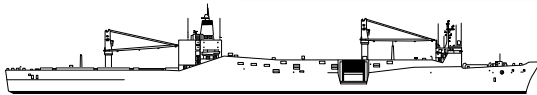


### Ports

LMSR Prepo > 42' depth ~ 4

Older RORO > 39' depth ~ 12

Smaller Cargo > 36' depth ~ 50

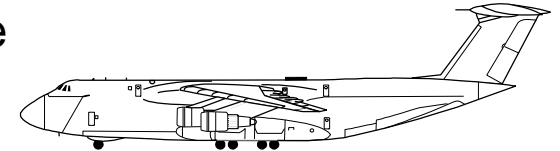


### Landing Sites

~ 60 Approvable

~ 300 Potential

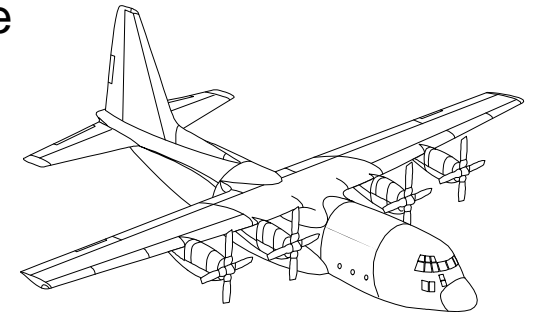
C-5, 747



C-17, C-130

~ 300 Approvable

~ 1500 Potential

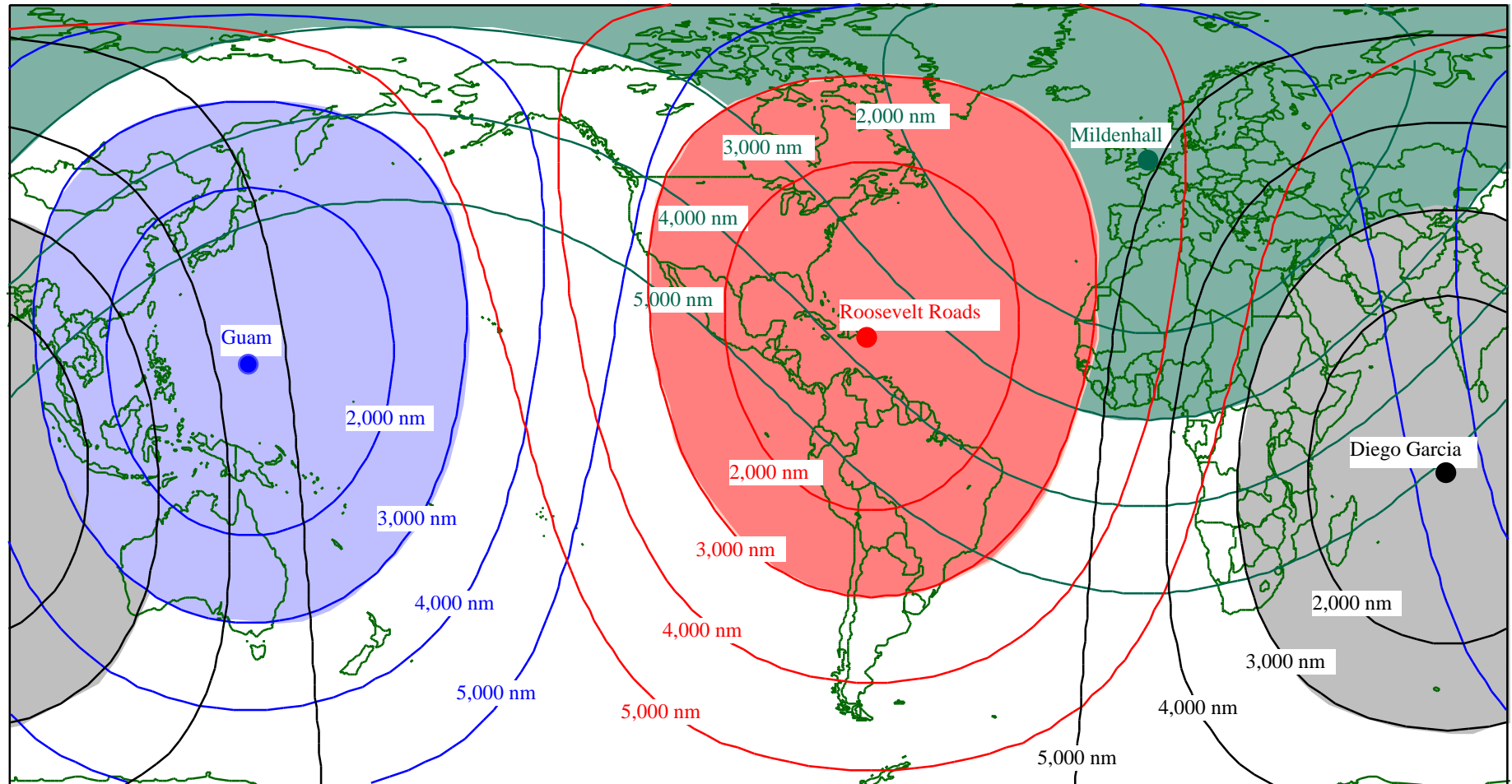


**Need Far Better Characterization of Potential Landing Sites and Sea Ports to Allow Expansion of Entry Points**



## Scenarios

# World Operational Coverage from Four Politically Secure Ports

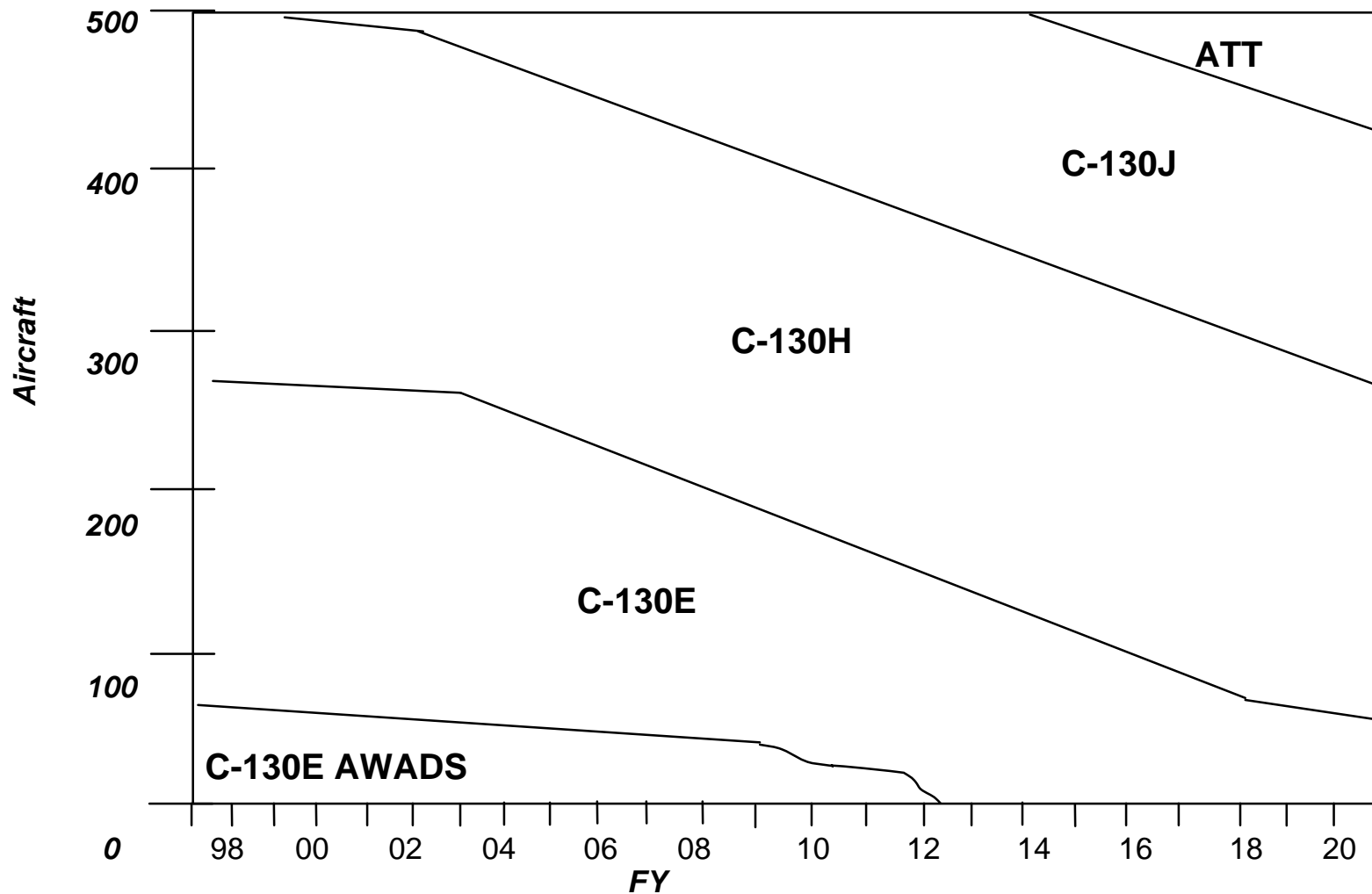


***Enabling Rapid and Decisive Strategic Maneuver for the Army After 2010***





## Freedom of Access - Air Mobility C-130 MODERNIZATION SCHEDULE



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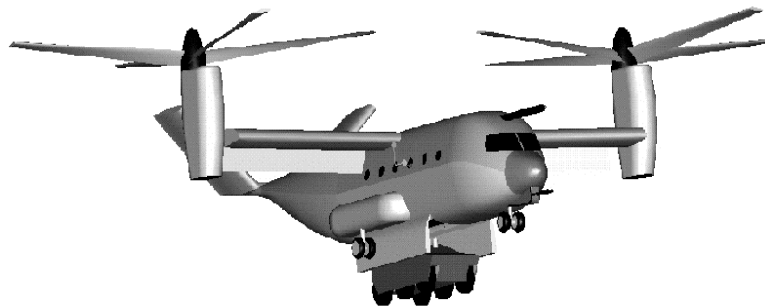


Mobility and Sustainment

## TACTICAL AND OPERATIONAL MOBILITY SOLUTIONS

- **No commercial counterpart found**

- Near vertical insertion/extraction missions, will require DOD unique design and a major investment in new technology and systems
- Means to be considered should include:
  - Rotorcraft: Modernized CH-47D, Adv Helicopter, Adv Tilt-Rotor, ...
  - V/STOL: Adv Tilt-Wing, Vectored Thruster, ...
  - Conventional: C-17, C-130J
  - Concept tradeoffs should be considered



***Operational-tactical airlift for beyond C-130/C-17 Battle Force mobility will require major DoD investment***

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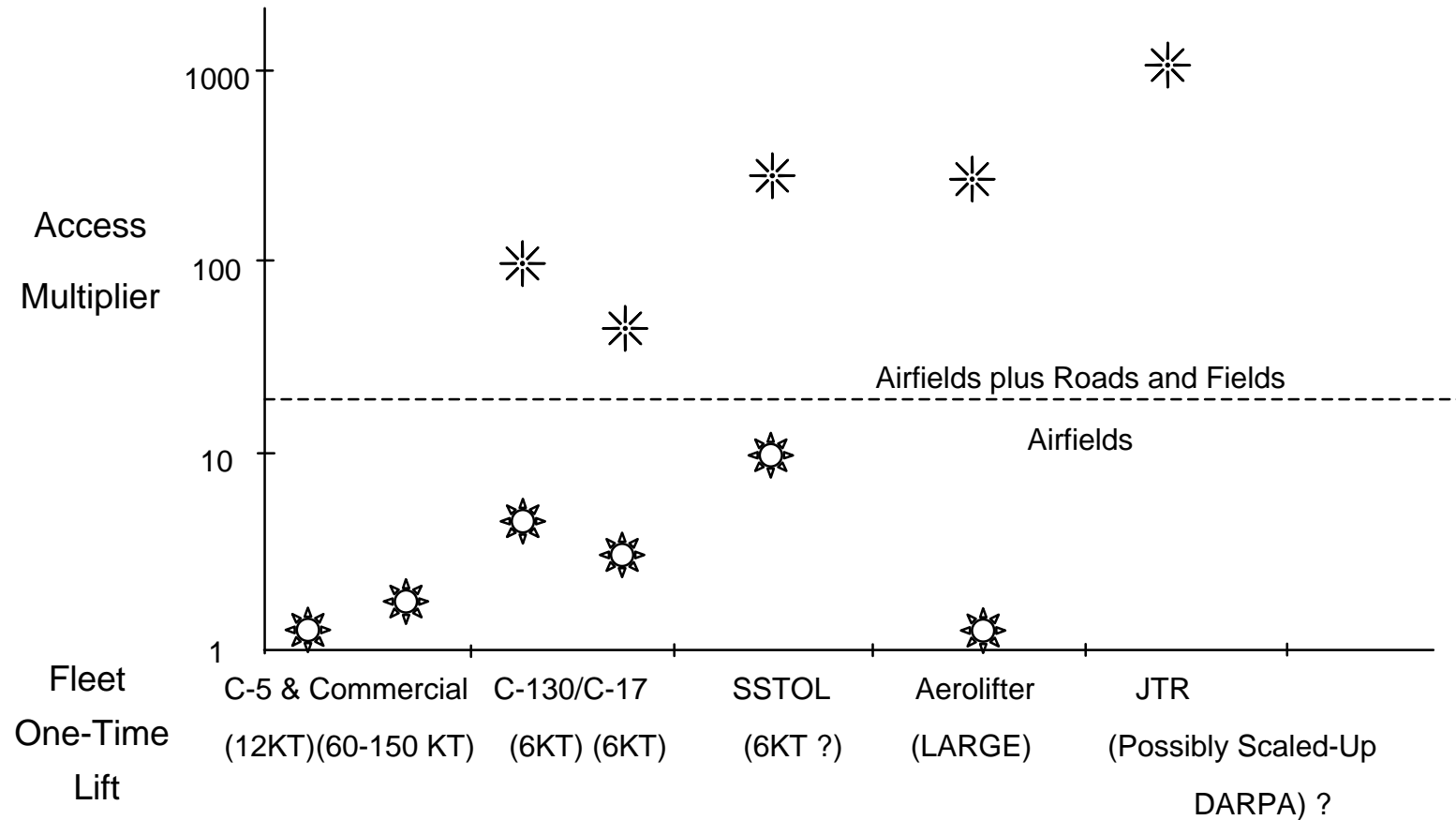


## **Freedom of Access - Air Mobility (Operational-Tactical) Alternative Access and Related Means**

- Use Road Segments and Appropriate Open Fields
  - C-17 (existing)
  - C-130 (existing and Improved)
  - SSTOL (could be developed and acquired)
- Use Above Plus Smaller, Non-Linear Areas
  - CH-47 (existing and/or upgrades)
  - CH-53 (existing and/or upgrades)
  - Joint Tilt-Rotor (could be developed and acquired)
  - Non-Traditional Rotary Wing (DARPA prototype)
  - Aerolifter



## Freedom of Access - Air Mobility (Operational-Tactical) Access Enhancement using Alternative Means

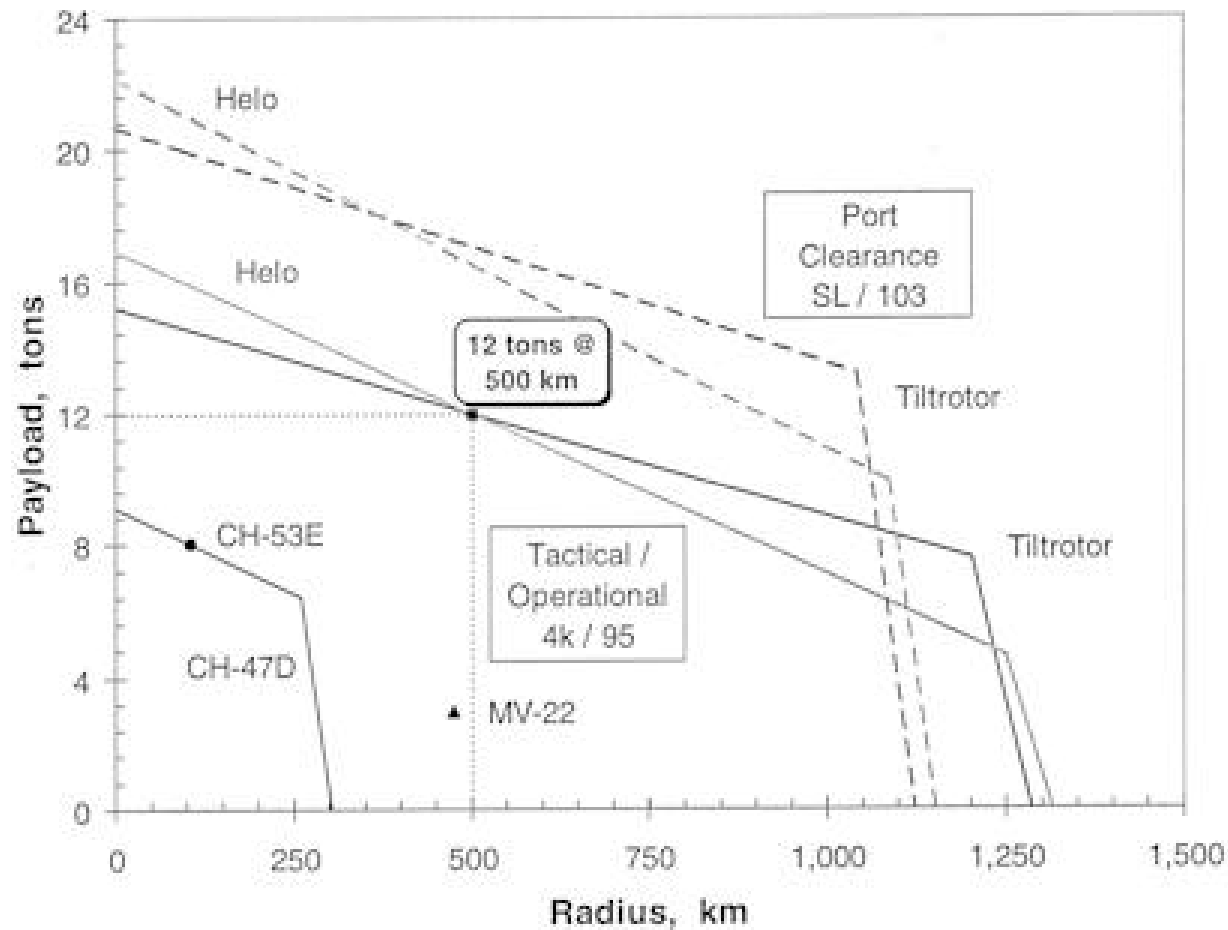


Base Case is Africa with C-5 Access of 268 Airfields

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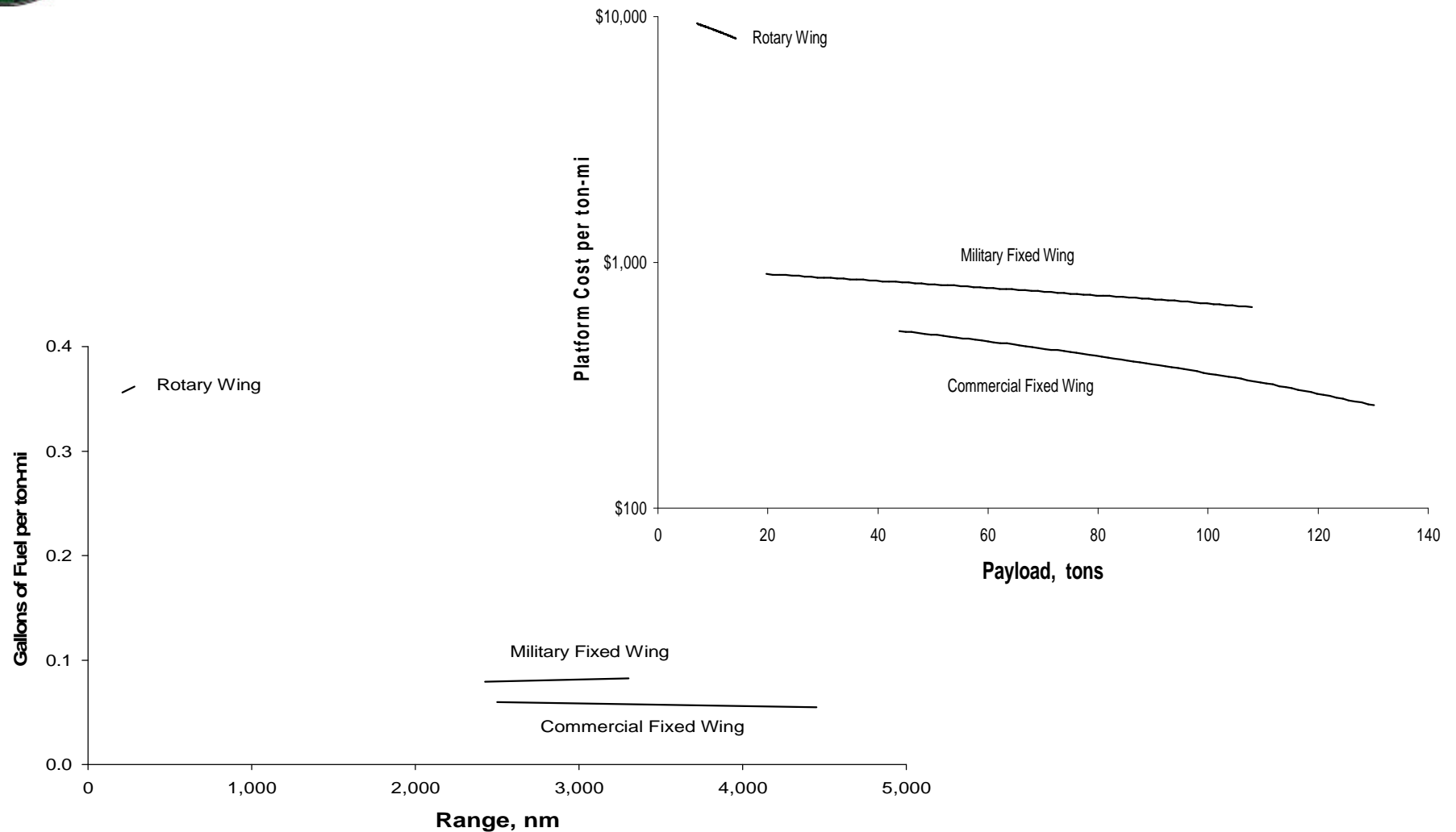
## JTR Payload versus Radius Tactical/Operational & Port Clearance



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## Relative Performance Rotary Wing, Military and Commercial Fixed Wing



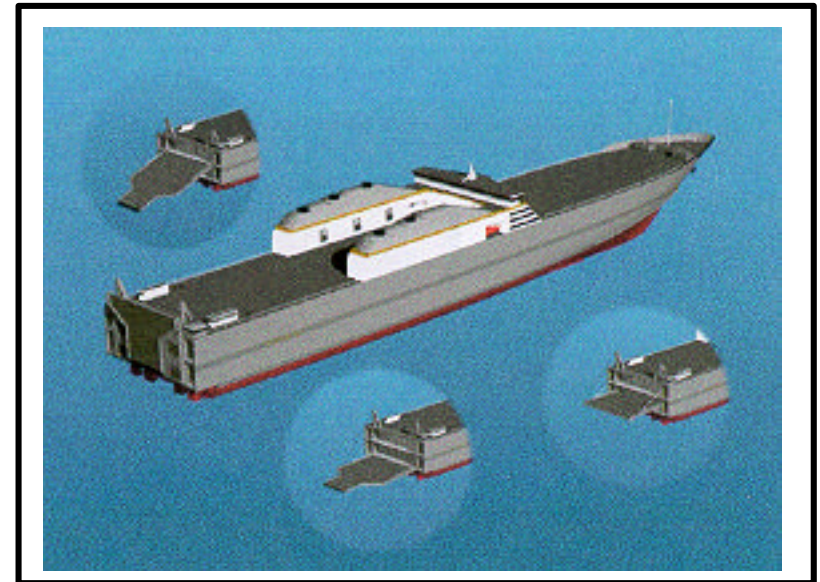
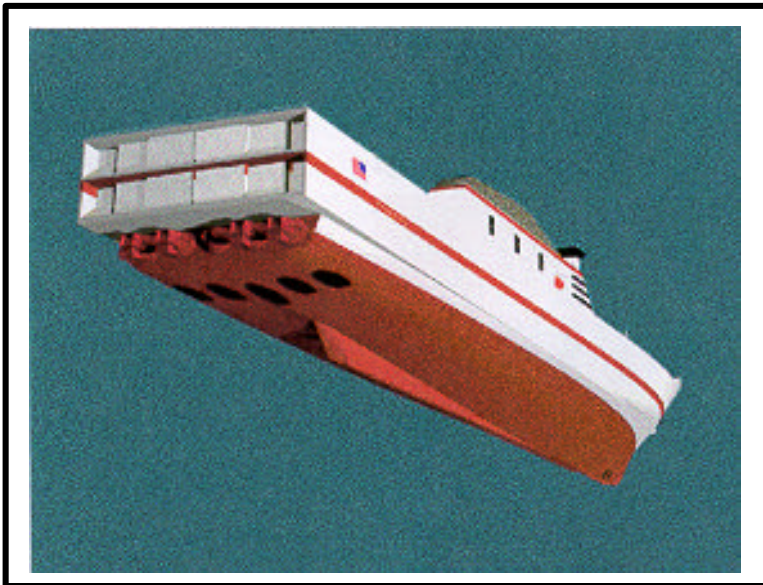
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## Freedom of Access - Sea Mobility Emerging Commercial Technologies

FS-1L

- 40kt performance (nearly sea-state independent)
- Design is optimized for rapid RO-RO or container load/unload
- Important DoD/Army features yet to be considered
- DoD (Army) action needed now



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## Freedom of Access - Sea Mobility

FS-1R

# There are Other Possibilities which require Either DoD Acquisition of DoD Leveraging

### DoD Acquisition

Joint Mobile Offshore Base (JMOB) graphic

### DoD Leveraging

- Defense Features for Fast Ships and Ferries for Austere Ports
  - Short Deployable Causeways which are Strut Supported
  - Bouyant but Tethered Causeway
  - Commercial JLOTS





# Strategic Maneuver Leveraging Commercial Sealift

- **Problem**

- DOD shipping is too slow, takes too long to load and offload, and requires too much water
- Commercial shipping, useful to the Army, is too slow, takes too long to load and offload, but does have more potential port access.
- Neither DOD nor commercial shipping has fast, austere port off load capabilities
- Lack of consistent packaging and modularization standards in military at odds with increased commercial utilization

- **Discussion**

- Sealift has been and will continue to be the primary transportation means for large army forces, equipment, and supplies
- VISA is decreasing in utility due to dwindling US shipping sector
- Army has an opportunity to improve load / unload time by 75% and the port to port time by 40%
- Time window to influence High Speed Ships (HSS) opportunity is short and issues are complex

- **Recommendations**

- Forward to the Navy revised Army requirements for Strategic Sealift to include HSS
- Enter into partnership with the Navy and DOT to pursue actively Title XI support for HSS and the incorporation of National Defense Features (NDF) to support military cargo and austere port operations
- Work with DARPA and Navy to develop technology alternatives to offload ships rapidly in austere ports
- Advocate (Army Executive Agent) DoD-wide packaging standards consistent with best commercial industrial practices and have TRADOC develop and promulgate the associated TTPs for improving outload using containers, flat racks and other intermodal devices. (Equally applicable to air)

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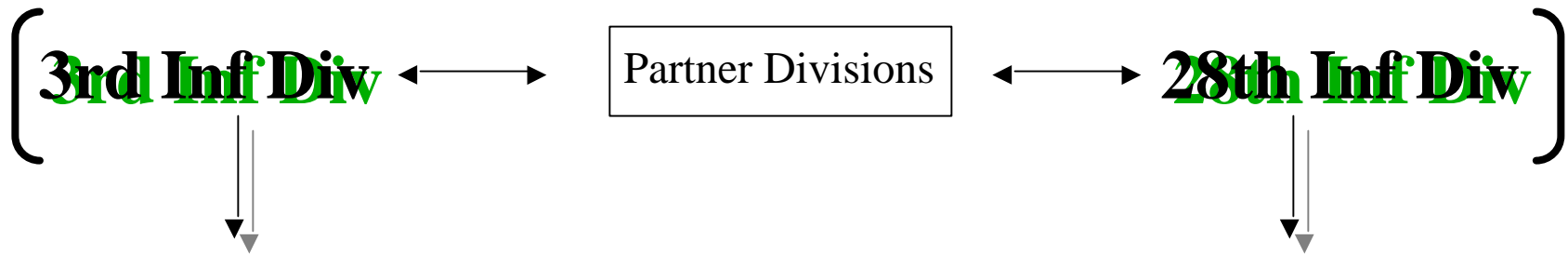


# ARNG Heavy Forces (Divisions & Enhanced Brigades)

Seattle/Tacoma



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--APS-Kuwait = Bde Set (1)

--APS @ Port Of Philadelphia = Bde Set (2)

--APS@ Ft.Stewart and Hunter  
AAF = Bde Set (3)

*Three brigade sets to mobilize the full combat power of the 3rd Infantry Division.  
Uses total Army resources to improve combat power projection.  
Partner divisions cooperate to improve combat power.  
With minor adjustments would not impact the ability to train.  
Improved storage enhances readiness and preparedness.*



**Governor**



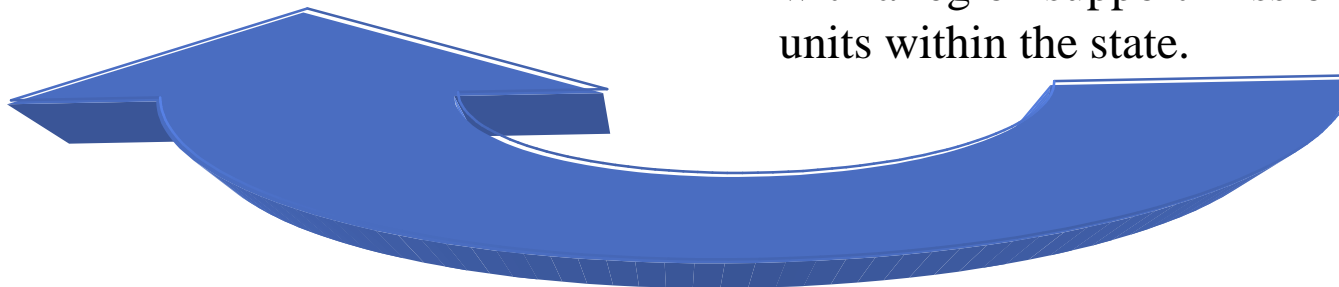
**The Adjutant General**

Department of Military Affairs

Department of Commerce  
Department of General Services  
Department of Labor  
Port Authority/Airport Authority  
Department of Transportation  
State Emergency Mgmt Office  
State Police  
Other State Agencies available to  
support Mobilization and Deployment

**STATE AREA COMMAND**  
Army National Guard  
Air National Guard

The STARC resembles an “installation” organizational command, including reserve liaison officers. This installation organizational structure facilitates home station mobilization and deployment, along with a region support mission for all RC units within the state.





# Strategic Maneuver

## Reducing Mechanized Brigade Deployment Times

- **Problem**

- Most active Army mechanized brigades are too far from ports

- **Discussion**

- Many National Guard mechanized brigades are stationed along CONUS coast lines with unit equipment being stored in controlled humidity warehouses
- ARNG equipment could be stored at CONUS ports and could be immediately loaded without requiring surface transportation
- Active unit could deploy by air and reserve units would fall in on the departed active unit's equipment, leveraging the CSA "Division Partnership Program" -- an "Army" solution
- PA ARNG and proposed Philadelphia agile port may be an ideal test case
- Use of ARNG equipment may require a modification in the Army's modernization plan, but would preclude the purchase of an additional set of equipment

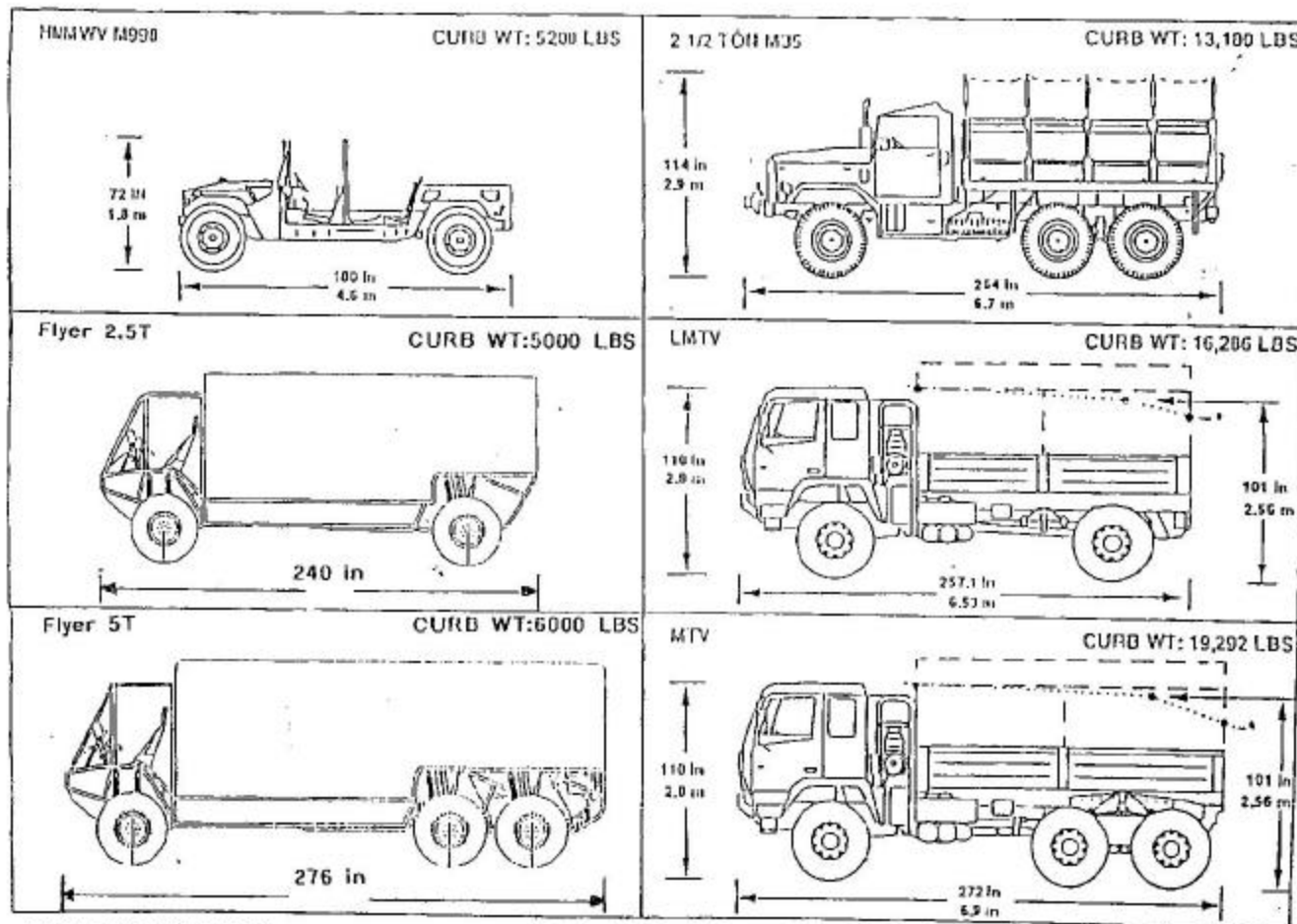
- **Recommendation**

- Have Army staff, with FORSCOM and NGB, develop operational concept for "NG APS" and within 6 months report back with an implementation plan



# Freedom of Access - Land Mobility Vehicle Candidates

FL-1R



\* VEHICLE MUST KNEEL TO ATTAIN THIS C-130 LOADABLE PROFILE.

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## Freedom of Access - Air Mobility (Operational-Tactical) Findings and Formative Recommendations

- Make Commercial Adaptation and Stimulation a First Line Army Activity
- Most Cost Effective Support for Strategic Maneuver is Derived from
  - Adapting and Stimulating Commercial Airlift, Both Traditional and Non-Traditional
- Implications for Strike Force are
  - Limit Weight/Cube of Vehicles to Limits Imposed by Existing Commercial Assets (9 tons in less than 8' x 8' x 20') or Develop Appliques to Allow for 18 tons in the same volume
- Develop Both Bases and Intellectual Infrastructure to Optimize use of ISB and Theater Access Points and Leverage US but non-DoD Investments
- Make Transfer and Intermodal Swiftness a Top Line Vehicle Design Parameter

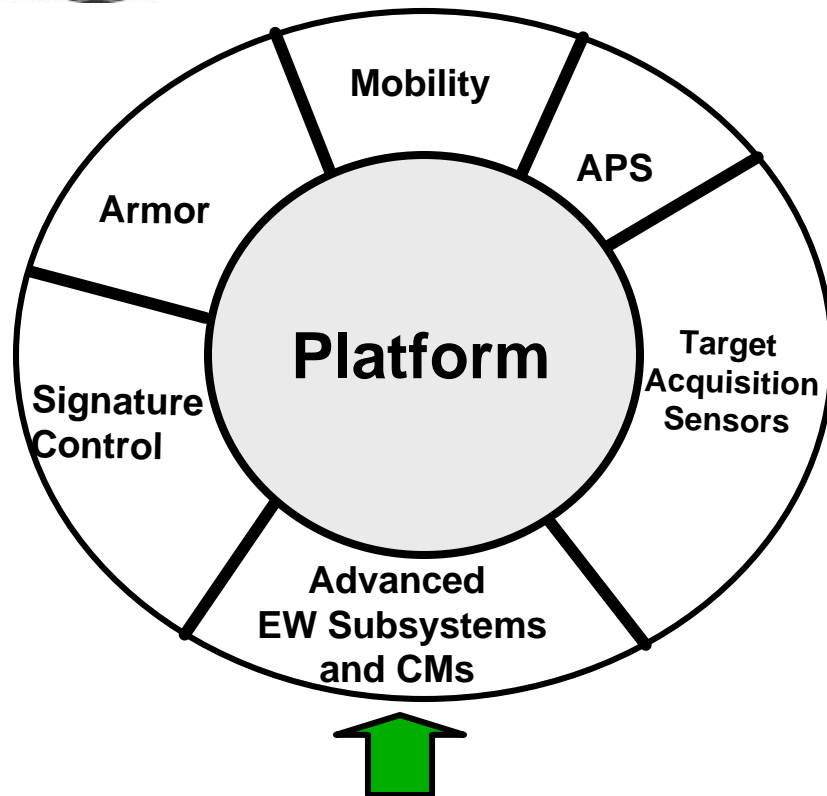




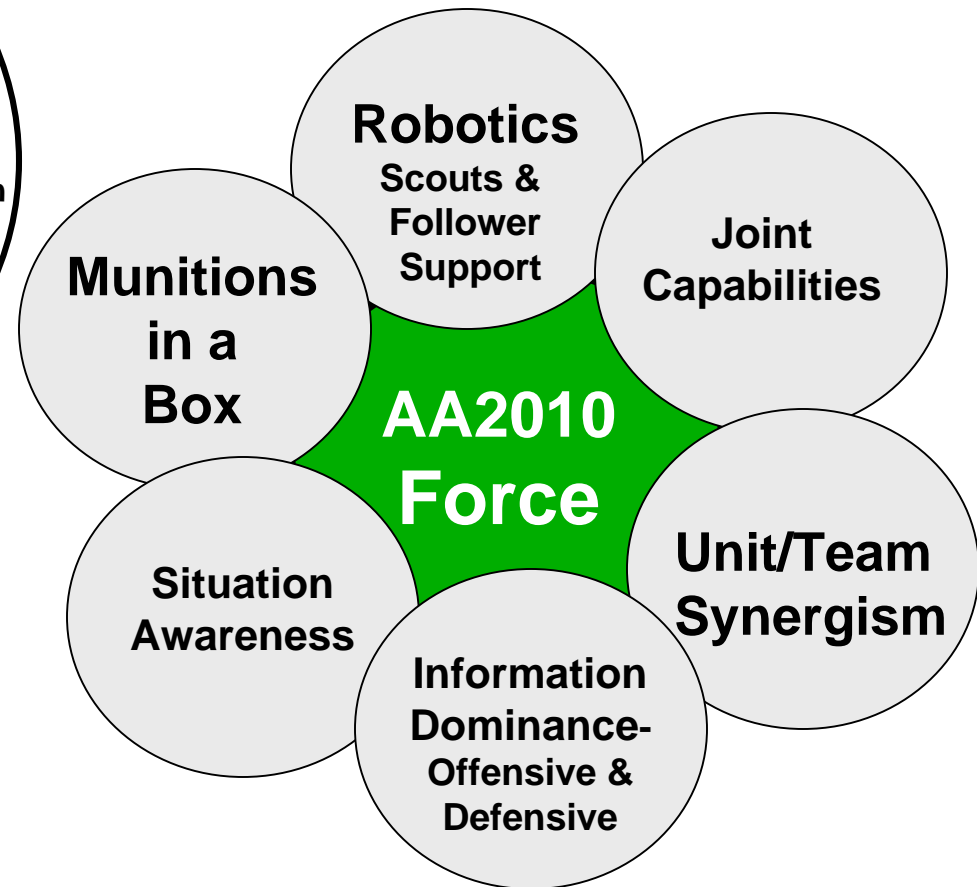
Integration

IGN-2R

# CHANGING SURVIVABILITY STRATEGY



**Force Focus**

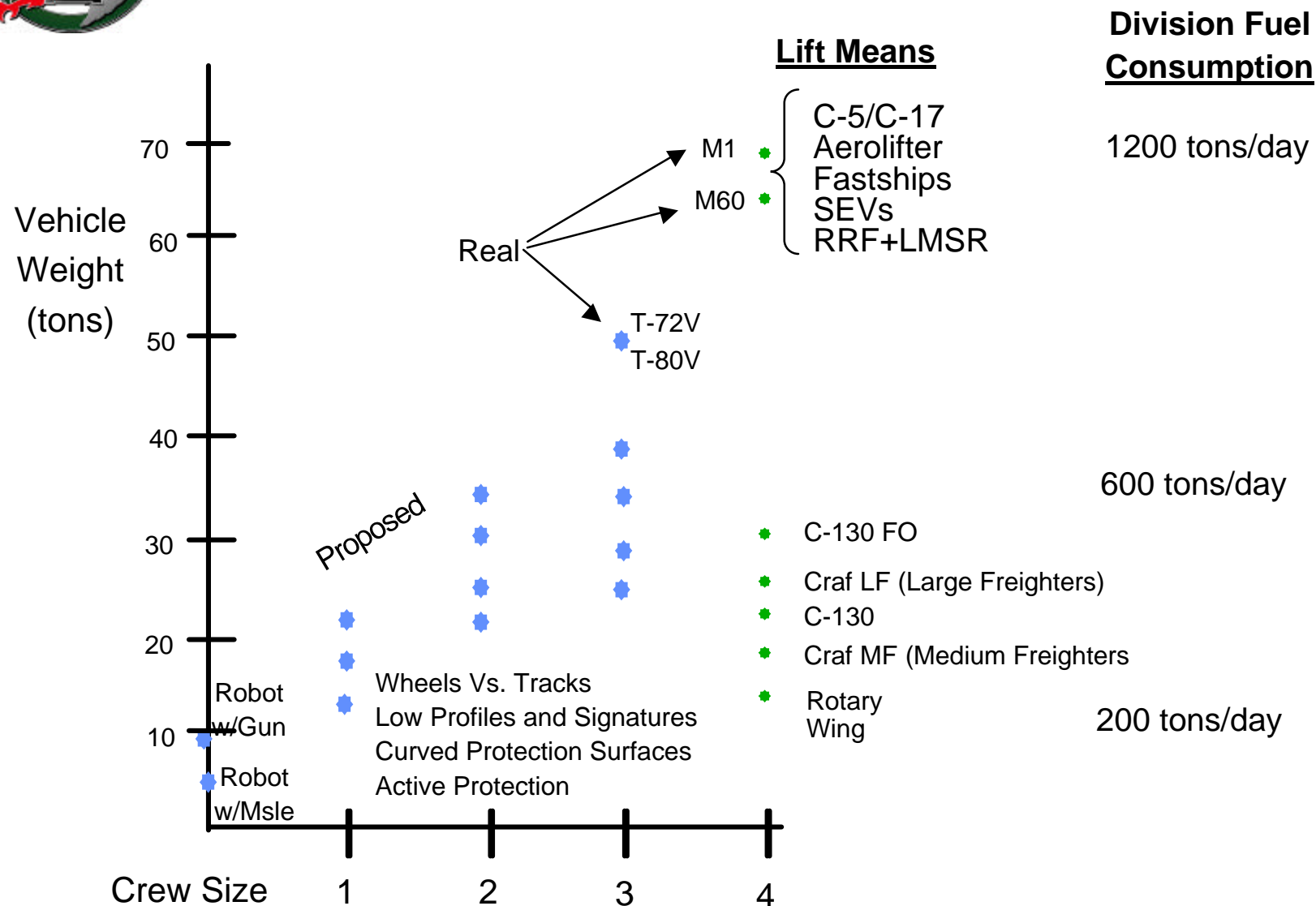


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# Integration FUTURE COMBAT VEHICLE POSSIBILITIES AND TRADEOFFS



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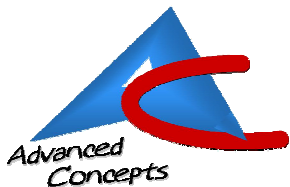


## Integration Examples

- Platform Centric (Single, Integrated Platform)
  - M1, M2, F-16 (Inner Zone)
- Team Centric (Man or Platform and Robot)
  - Mine Clearance Platforms
  - Ordnance Disposal Devices
  - Hazardous Waste Handling Machines
- Network Centric (Men and /or Platforms share Robot(s))
  - Satellite Communications
  - AFSS
  - Missile Launchers of All Kinds



# 10 Ton Vehicle Generic Characteristics Study



8 July 1999

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Tank-automotive & Armaments **COM**mand

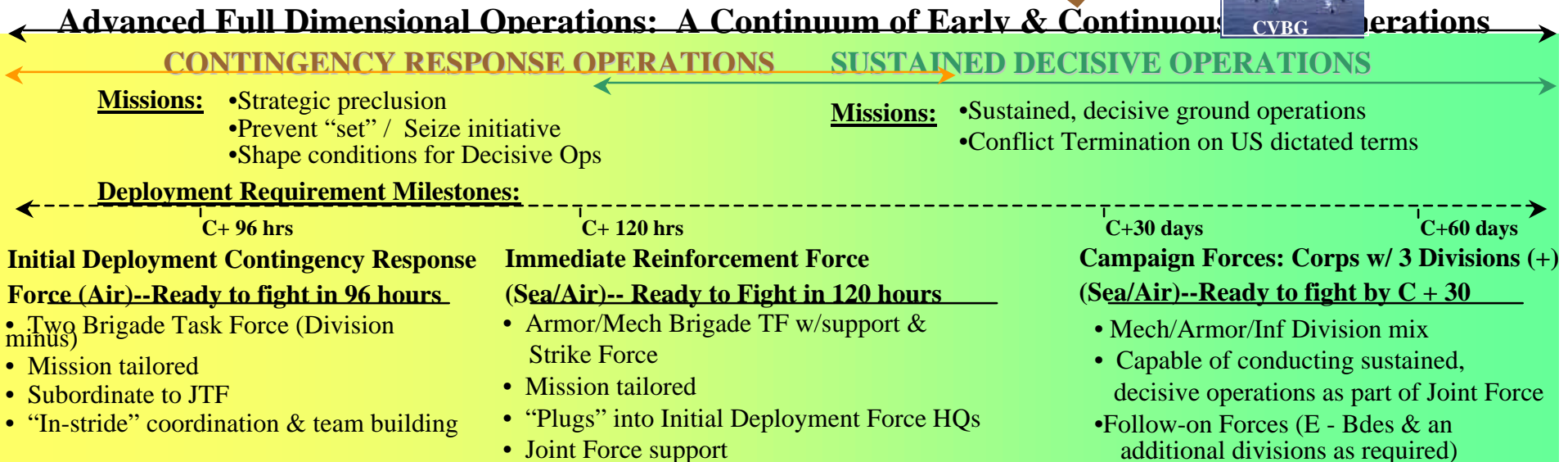
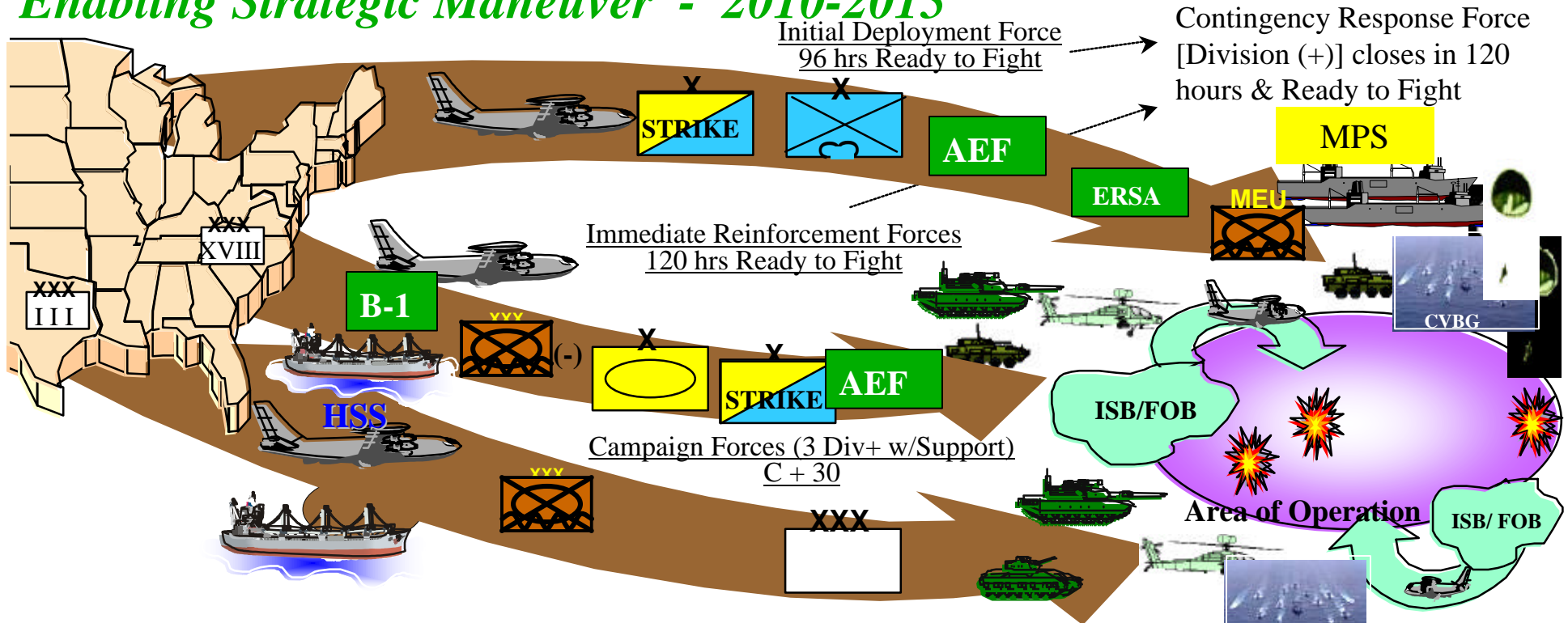


## Vehicle Weights

<u>Vehicle</u>	<u>Weight</u>
<b>Manned/necessary protection</b>	<b>9 tons</b>
<b>Manned/medium protection</b>	<b>12 tons</b>
<b>Manned/M1 level protected</b>	<b>20 tons</b>
<b>Unmanned/weapon platform</b>	<b>11 tons</b>
<b>Armored Gun System</b>	<b>18 tons</b>
<b>M-113 APC</b>	<b>9 tons</b>
<b>C<sup>2</sup>OTM</b>	<b>4 tons</b>
<b>Flyer w/5 ton AFSS</b>	<b>10 tons</b>
<b>Flyer, 5 ton resupply</b>	<b>10 tons</b>
<b>Robotic rotorcraft</b>	<b>Self ferry</b>

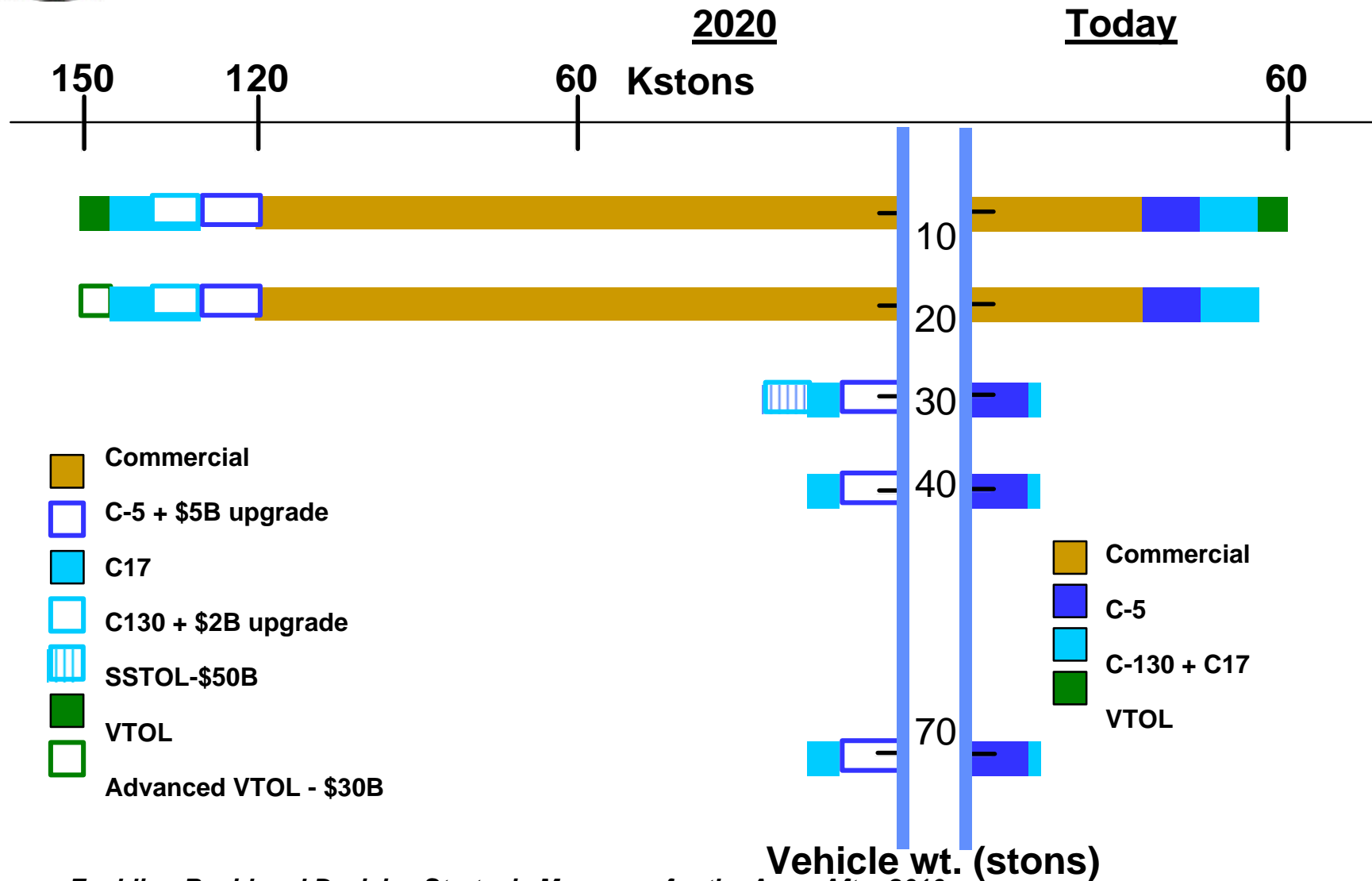
# Joint Force Projection Concept/Requirement -- AXXI

## Enabling Strategic Maneuver - 2010-2015





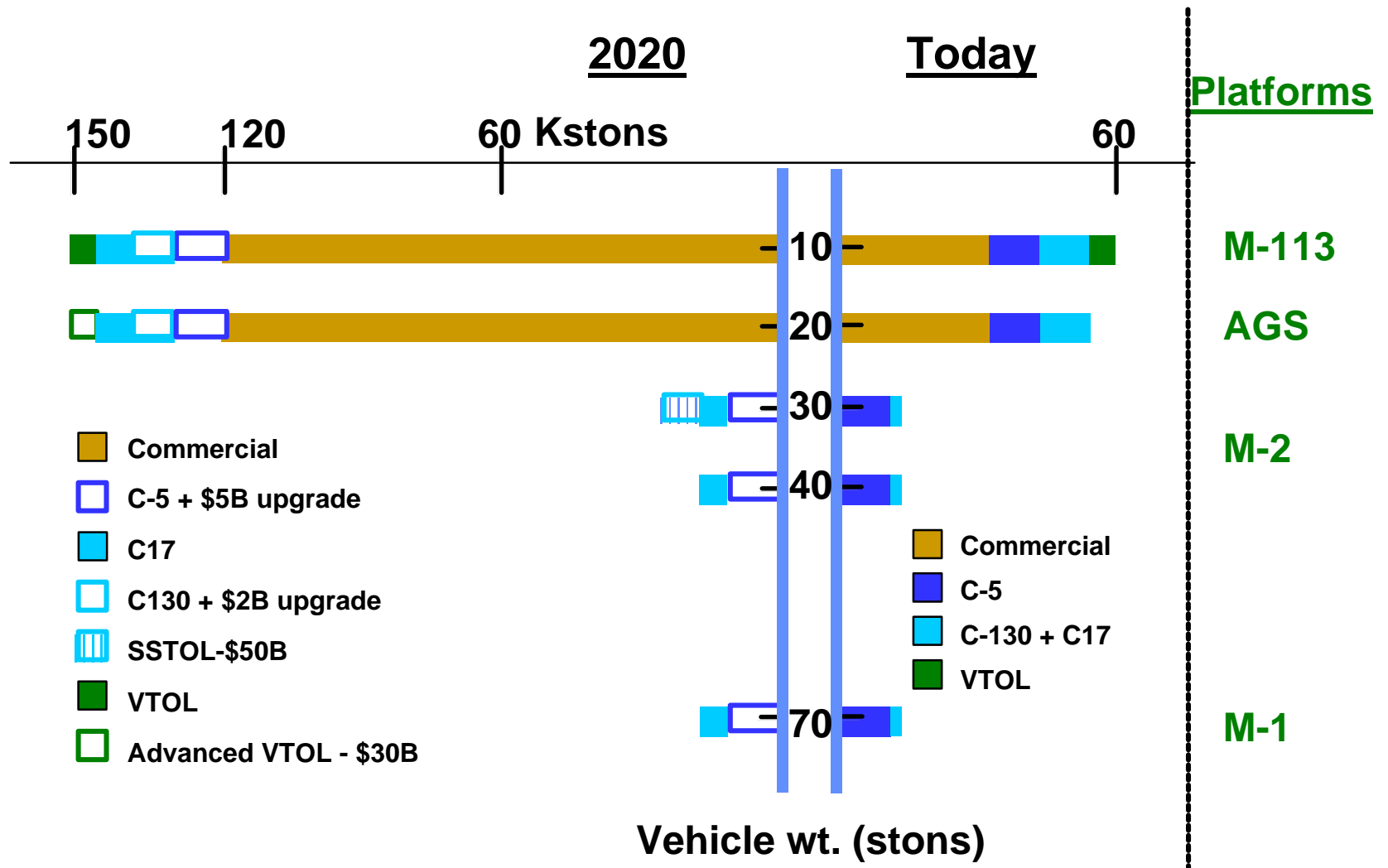
# Fleet Lift Comparison (Kstons)



*Enabling Rapid and Decisive Strategic Maneuver for the Army After 2010*



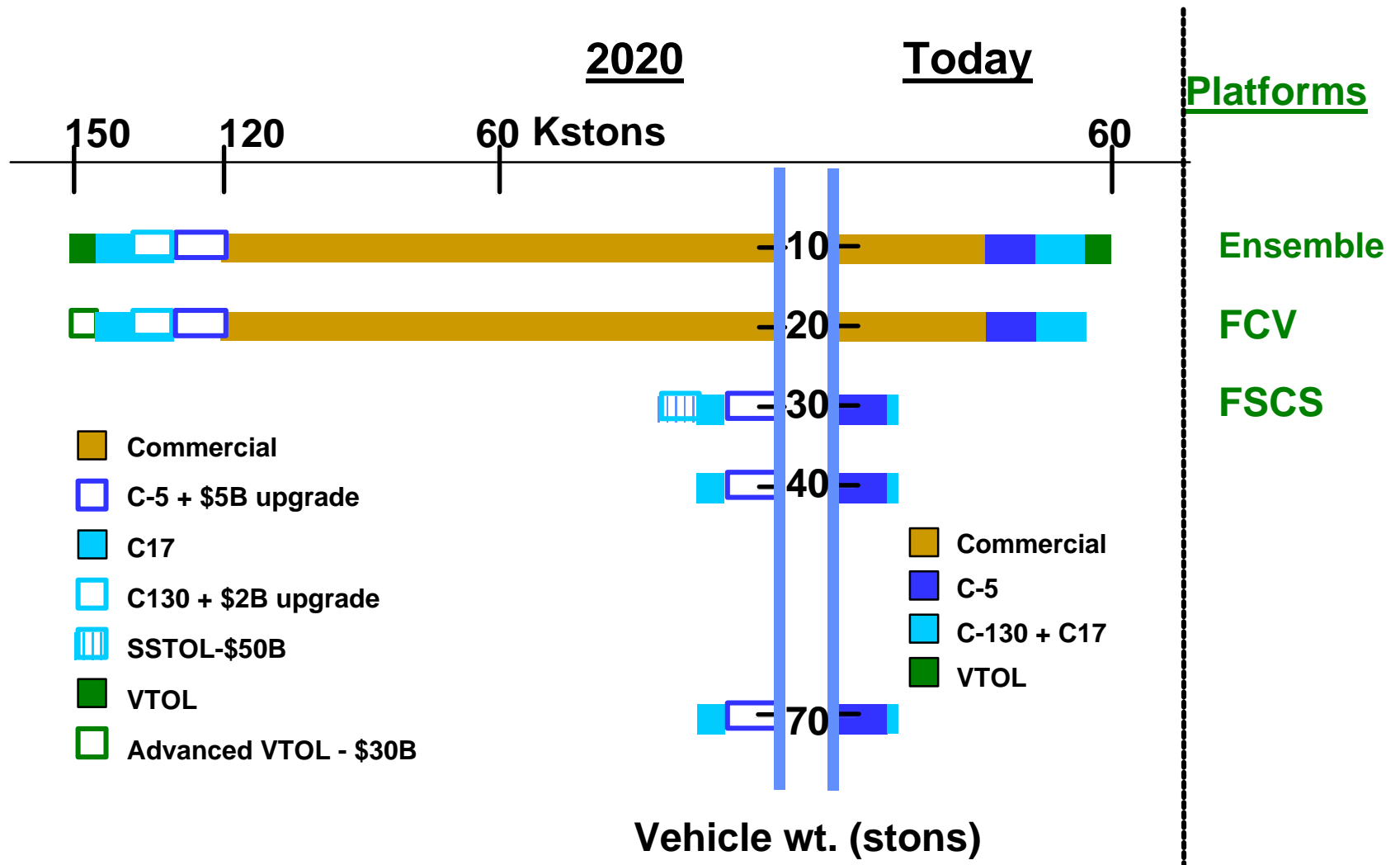
# Fleet Lift Comparison (Kstons)



*Enabling Rapid and Decisive Strategic Maneuver for the Army After 2010*



# Fleet Lift Comparison (Kstons)

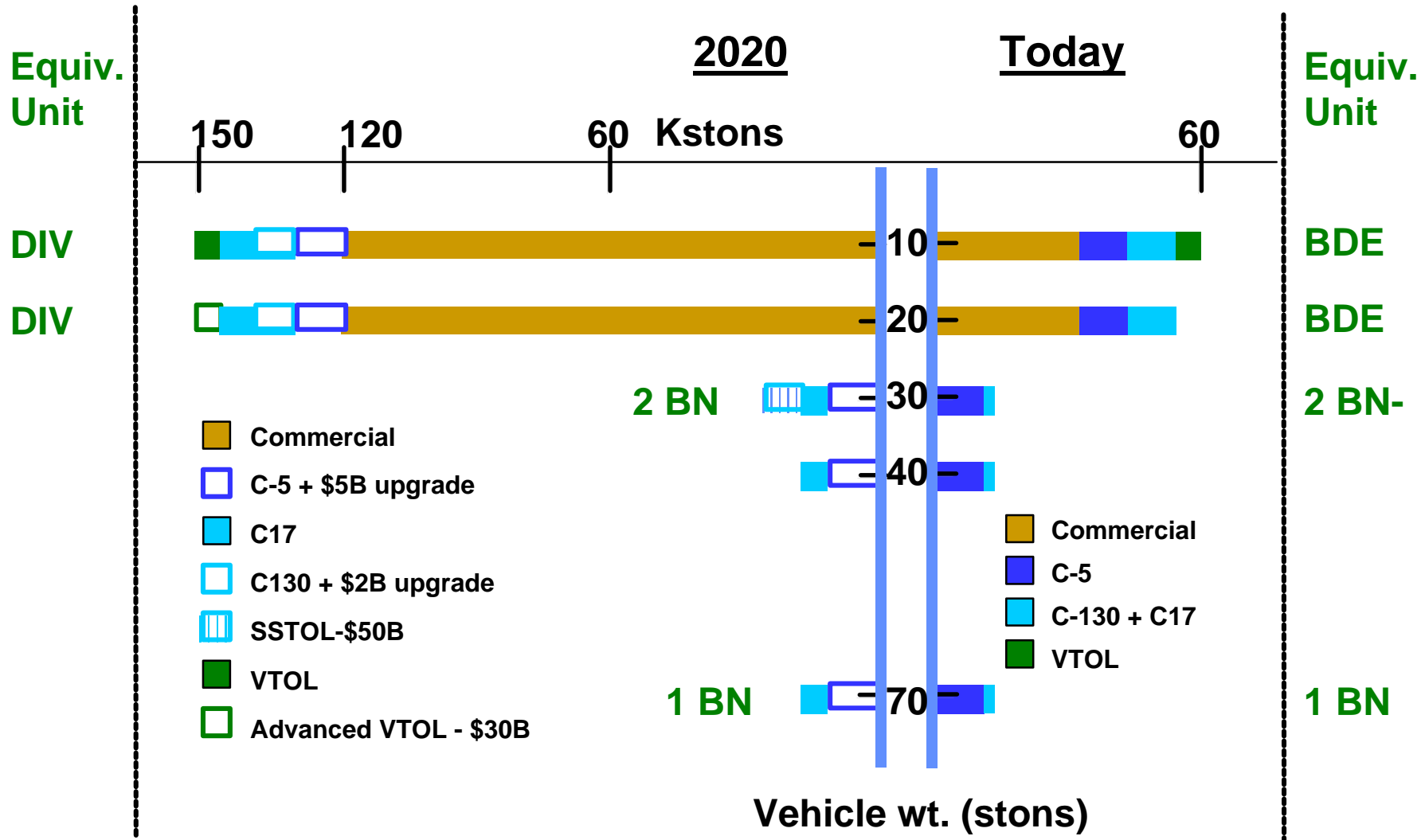


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# Air Fleet Lift Comparison (Kstons)



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# Performance Comparisons

Platform	Payload	Load-Transit Unload	Port Depth	Payload	Load-Transit Unload	Port Depth
<b>DoD LMSR</b>	BN+	23 Days	42 Ft		Same	
<b>Commercial Truck RORO</b>	BN+?	25 Days	38Ft	2 BN	19 Days	42 Ft
<b>Commercial HSS RORO &amp; Containers</b>				BN	9 Days	34 Ft
<b>Aerolifter (w/Vertical Landing)</b>				Aviation Co	4 Days	0
<b>Commercial Containership</b>	Cargo Only	19 Days	45 Ft	BDE (Containerized)	19 Days	53 Ft
<b>DoD Containership</b>	Cargo only	21 Days	42 Ft	BN (Containerized)	21 Days	42 Ft
<b>Commercial Container &amp; Breakbulk Ships</b>	Company*	27 Days	22 to 36 Ft	Same		

*Enabling Rapid and Decisive Strategic Maneuver for the Army After 2010*



# Get There Firstest with the Mostest Effect

OBJECTIVE	APPROACH	INITIATIVES
<b>Increased Punch per Pound Forward</b>	<ul style="list-style-type: none"> <li>• Lighten Early Entry Force Manning and Equipment</li> <li>• Reduce Sustainment Consumption Rates</li> <li>• Increase Lethality</li> <li>• ground vehicles:               <ul style="list-style-type: none"> <li>down-man</li> <li>down-size</li> <li>down-weight</li> <li>up fuel efficiency</li> <li>up lethality</li> </ul> </li> <li>• air vehicles:               <ul style="list-style-type: none"> <li>augment RAH-66 with long endurance lethal/ISR VTOL UAVs</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• require new ground vehicles to have loaded GVW &lt;10 tons and dimensions that fit within an 8'x8'x20' container</li> <li>• initiate aggressive air-transportable combat ground vehicle development program (hybrid-electric, manned/ robotic ensemble)</li> <li>• adopt newly emerging high payload to GVW support vehicle options</li> <li>• initiate an Army long endurance VTOL UAV exploratory development program</li> <li>• equip 2 ACR with available combat systems and technologies to be rapidly air insertable and sustainable using <u>all</u> of the following</li> <li>• strategic: 747,767, DC-10, MD-11 and C-5</li> <li>• operational: C-17, C-130</li> <li>• tactical: CH-47, Ch-53</li> </ul>
<b>More "Fast" Lift to Theater</b>	<b>Exploit Commercial Lift</b> <ul style="list-style-type: none"> <li>• leverage civil air freighter fleet</li> <li>• participate in outsized airlifter and rapid sealift venture formulation process</li> </ul>	<ul style="list-style-type: none"> <li>• require all future early entry equipment be designed for commercial air compatibility (9 tons desired, 20 tons max, 8'x8'x20', standard commercial MHE interface)</li> <li>• require new Army aircraft be globally self-deployable</li> <li>• partner with commercial activities to achieve Army strategic lift capabilities</li> <li>• contact and exploration (e.g., future air freighters)</li> <li>• national defense features (e.g., aerolifter)</li> <li>• - Army influence (fast ship)</li> </ul>



# Get There Firstest with the Mostest Effect

OBJECTIVE	APPROACH	INITIATIVES
<b>Faster Nodal Transfer (at both both ends)</b>	<b>Tailor MHE &amp; Standardize Packaging</b> <ul style="list-style-type: none"> <li>plan for distributed ISBs and Tactical Entry Points and means to load, transfer and unload those sites without indigenous support</li> <li>exploit Reserves and Guard to accelerate CONUS-end load-up</li> <li>test loadability of all equipment onto commercial carriers and adopt commercial packaging standards where possible</li> </ul>	<ul style="list-style-type: none"> <li>establish MTMC linked movement facilitation teams within State Area Readiness Commands</li> <li>position brigade equipment sets at sites that eliminate or minimize the fort to port challenge (24 hr outload)</li> <li>structure and execute several deployment-sustainment exercises (CPXs, FTXs) using only commercial means, processes, modularity, containerization, manning, tracking, command and control (could be a joint ACTD)</li> </ul>
<b>Assured Access within Theater for:</b> <ul style="list-style-type: none"> <li><b>Entry</b></li> <li><b>Follow-on, and</b></li> <li><b>Sustainment</b></li> </ul>	<b>Reduce Dependence on Large Airfields and Ports</b> <ul style="list-style-type: none"> <li>recognize growing need for airfield and port-independent entry due to increasing threats to known "improved" entry sites</li> <li>pre-identify and characterize usable short fields, road segments and beach sites worldwide</li> <li>re-emphasize use of C-130 and C-17 for 2,000-3,000 ft soft field runways for contested or austere entry conditions</li> </ul>	<ul style="list-style-type: none"> <li>initiate aggressive technology program (DARPA/ATD) to narrow the flyaway cost per ton-mile gap between SSTOL/VTOL and military fixed wing from 10 times to 2 or 3 times and to increase operating radius to ~1000 nm</li> <li>search for and examine non-traditional concepts and technologies to provide rapid unloading and port clearing at austere ports and beaches</li> <li>initiate and regularly update Army sponsored CINC surveys of airfields, ports and austere surrogates</li> <li>use C-17 in intratheater role when ISBs are activated</li> </ul>



# Countering Enemy Options and Actions Recommendations

- **What:** Prepare and regularly update a multi-theater survey and characterization of ISB, airfields, ports, austere surrogates for both and commercial services available. Employ to optimize survivable deployment and sustainment and provide data bases and tools for executors

**Why:** Needed for rapid deployment of current army and design of future army (new and legacy) and to vector and leverage expenditures for SSTOL, aerolifter, surface effect ships, etc.

**Who:** DCSOPS tasks Army War College to form “regional desks” with appropriate support from relevant TRADOC schools. Organization becomes counterpart of and analog to Air Force “checkmate,” ties are established with TRANSCOM.

**When:** Prepare two scenarios per regional CINC by end of CY 99. Formulate schedule to do remainder with CINCs on a continuing basis. Fold results into next spring war game (Spring 2000).

- **What:** Search for and examine non-traditional concepts and technologies to provide rapid unloading at austere and non-ports. Engage DARPA as a partner in this endeavor because it should address both non-traditional and high risk possibilities.

**Who:** SARDA with support from Army and TRANSCOM specialists. DARPA would provide industry (possibly globalized) outreach.

**When:** Establish program so that it can start early in FY 00. Review at six month intervals to achieve closure in possibilities within a year. R&D to follow depends upon outcome.



## Recommendations

- **Counter Enemy Options and Actions**

**What:** Search for and examine non-traditional concepts and technologies to provide rapid unloading at austere and non-ports. Engage DARPA as a partner in this endeavor because it should address both non-traditional and high risk possibilities.

**Who:** SARDA with support from Army and TRANSCOM specialists. DARPA would provide industry (possibly globalized) outreach.

**When:** Establish program so that it can start early in FY 00. Review at six month intervals to achieve closure in possibilities within a year. R&D to follow depends upon outcome.

- **Leverage Commercial Capabilities**

**What:** Improve Army and DoD ability to leverage commercial land, air and sea capabilities through a collaborative experimentation program whose finding would lead to improved policy and performance on behalf of DoD by this large and growingly efficient sector of our economy. Structure and execute several deployment-sustainment exercises (CPXs and FTXs) using only commercial basing means, processes, modularity, containerization, manning, tracking and command control (could be a joint ACTD) It would extend virtual airline to land, sea and intermodal aspects.

**Who:** A joint Army-TRANSCOM-DARPA regional desk team led by a three or four star General officer.

**When:** For team before end of FY 99: organize, plan, staff and prepare for first experiment starting in FY 01, continue program for 3 years, undertake CRAF, VISA, etc. improvement along the way.



# Recommendations

- **Leverage Commercial Capabilities**

**What:** Improve Army and DoD ability to leverage commercial land, air and sea capabilities through a collaborative experimentation program whose finding would lead to improved policy and performance on behalf of DoD by this large and growingly efficient sector of our economy. Structure and execute several deployment-sustainment exercises (CPXs and FTXs) using only commercial basing means, processes, modularity, containerization, manning, tracking and command control (could be a joint ACTD) It would extend virtual airline to land, sea and intermodal aspects.

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- **Leverage Commercial Capabilities**

**What:** Promulgate policy that the Army:

-Will assure its ability to employ both commercial, traditional and innovative transport and its related modularity and containerization along with DoD transport means through as appropriate adaptation, stimulation integrations as contrasted with only exploitation.

-Partner in various ways with commercial activities to achieve these objectives through adaptation stimulation and using Army influence.

Near action required relative to:

-Contact and exploration (e.g., future air freighters)

-National defense features (e.g., aerolifter)

-Army influence (fast ship)

**Who:** Army Acquisition Executive

**When:** Now



## Leverage/Improve Military Capabilities

- **(Near Term Rapid Deployment Initiative)**

**What:** Use CONUS Port and Near Port prepositioned Brigade to deploy within a day and marry with active unit troopers airlifted to theater. NG Troopers fall in with active unit equipment.

**Who:** VCSA task CG FORSCOM, CNGB, and CG AMC to form action group to use PA NG and Port of Philadelphia to develop initiative by experimentation and plan its extension.

**When:** Form group and initial plan by 30 September 1999. Undertake experimentation and complete by Spring 2001. Have plan for extension available for upcoming Fiscal Year.

**Payoff:** Save days to a week in deployment time. Reduce dependence on rapid reaction rail assets. Reduce political dependence and time for OCONUS prepo deployment.

**Who:** DCSOPS, along with ACOM, should sponsor a JWCA to address underwriting strategic maneuver for 2007, 2012 and 2020 employing advanced capabilities along with traditional military and commercial airlift, addressing air and sea access to include distributed ISB AUBA as well as austere insertion locales and including interagency participants with influence in OCONUS ports and infrastructure funding and construction. It should include RD&A expenditures which could influence capabilities in those time frames.

Military Rotor Craft, SSTOL, Surface Effect Ships and commercial capabilities should be considered. The executing team should have permanent members drawn for defense and commercial industry as well as the normal cast of participants. Army and ACOM might take DAMO-SS works as a starting point.

**When:** Assessment by end of CY 99, formulate, complete JWCA by end of CY

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## Recommendations

- **Leverage/Improve Military Capabilities**

**What:** Re-establish role of C-17 as intratheater airlifter. Make C-17 and C-130 available for experimentation with 2ACR and for contingencies which may occur.

**Who:** DCSOPS as OPSDEP

**When:** As soon as 2ACR experimentation is approved and scheduled

- **Improve Force Deployability Along with Lethality, Survivability and Tactical Air Mobility**

**What:** Capitalize on XVIII Airborne Corps addition of 2ACR. Explore/procure currently available vehicles that are C-130 and commercially deployable. Examples: Armored Gun System, Flyer Trucks, M-113, Light Weight HIMARS, C2 On the Move (A2C2 for Secret Service). Select, Redesign and Test units for: Unit Deployment Integrity, Split Basing, Packaging, Modularity, and Containerization. TRADOC should support this activity with experimentation of alternative available equipment.

**Who:** Commander XVIII Airborne Corps, supported by AAE, SARDA, and TRADOC

**When:** within 12 months.

**Leverage/Improve Military Capabilities**

**What:** Expand 2ACR “lessons learned” (from above recommendation) and conduct necessary experiments in split basing, modularity, and containerization for the remainder of the Army.

**Who:** DCSOPS, TRADOC, and AMC.

**When:** As soon as results are available from 2ACR experimentation.



## Backup



# Comparisons

Comparisons		
	Heavy ACR	Light ACR
<b>Mobility</b>	25% Tracked	0.3% Tracked
	40% on-Wheels	63% on-Wheels
	31% Towed	33.4% Towed
	3.5% Air	2.5% Air
	0.5% Other	0.9% Other
<b>Armored Cav SQDN</b>	7369 Tons	1886 Tons
	330 Total Vehicles	336 Total Vehicles
	154 Tracked	0 Tracked
	120 on-Wheels	239 on-Wheels
	56 Towed	97 Towed



## Background Information

Background Information						
UNIT	Personnel	Weight (tons)	Deck Area Req'd. (sq.ft.)	Ground Vehicles	Air Vehicles	TEVA
<b>Heavy ACR</b>	4555	31,267	433,608	2022(546)	76	140
<b>Light ACR</b>	3765	11,764	295,204	1925(6)	43	154
<b>2<sup>nd</sup> ACR(89)</b>						
<b>2<sup>nd</sup> ACR(99)</b>						

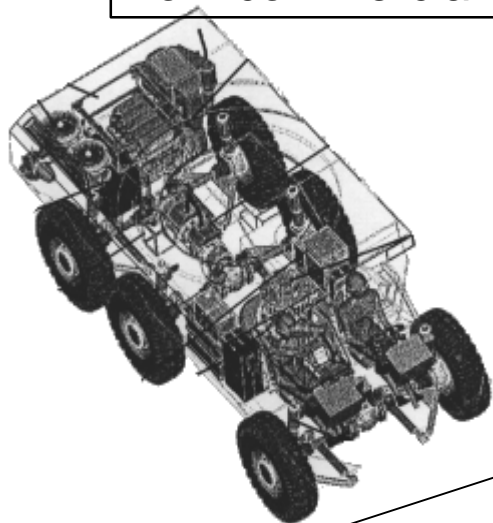
Reference Transportation Data				
DoD Assets	Payload (tons)		Stowage Area (sq. ft)	
C-5/C-14/C-17	125/60/60	~200		
LMSR			243,000	19
FSS			149,868	
<b>Commercial Assets</b>				
747,767,MD-11,DC-10	125/60/90/90	?		
ROROs			200,000	
Container Ships				



## Platforms and Weapons

# SUSTAINMENT EFFICIENCIES

**Hybrid electric drive** available from commercial developments



### Numerous advantages

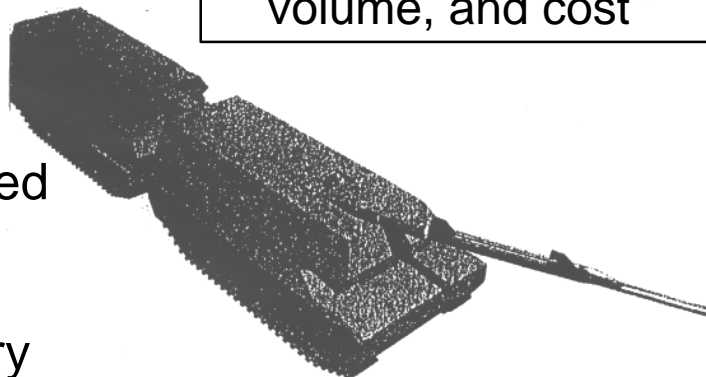
- Fuel efficiency
- Low weight
- Low signatures
- Dash power
- Simplicity

### EM Launch

- DoD unique, high risk
- Payoff: reduced weight, volume, and cost

### Ongoing R&D effort

- Major challenges remain in pulsed power, launch physics, lethality
- Most promising applications – medium caliber guns and artillery



***Force efficiency/sustainment:  
requires high fuel efficiency and increased stowed kills***



# **Enabling Rapid and Decisive Strategic Maneuver for the Army After 2010**

## **Command and Control Panel Report**





# Command and Control for Strategic Maneuver



21 July 1999

## Panel Members

John Cittadino (Co-Chair)  
Charles Otstott (Co-Chair)  
William Neal  
Everett Greinke  
Carl Fischer  
Donald Kelly  
Gary Glaser  
Errol Cox (Government Advisor)  
Kurt Kovach (Government Advisor)



## Mission Statement

- The assignment of the Command and Control (C2) panel is to investigate and recommend the appropriate Information Technology (IT) required to implement strategic mobility for the Army After 2010
- The objective of the Command and Control system in support of mobility is to provide accurate and timely:
  - Planning, scheduling, monitoring and rescheduling
    - With coverage from fort-to-port, en route and port-to-TAA (Tactical Assembly Area)
    - Must be joint and eventually include coalition
    - Must encompass military units, equipment, personnel and supplies
  - Split-Based Operations
  - En Route Mission Planning and Rehearsal

*The Critical Problem: Without Improved Command and Control Systems, We Cannot Achieve a Revolution in Military Logistics!*

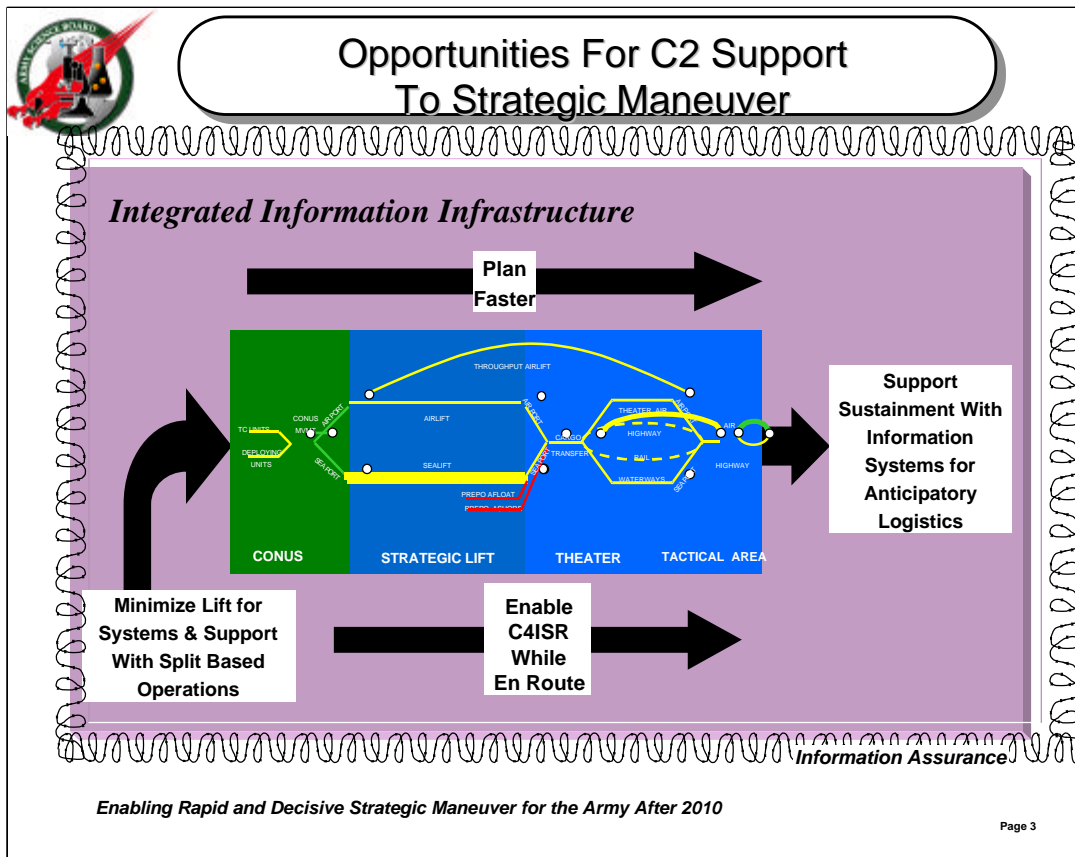
*Enabling Rapid and Decisive Strategic Maneuver for the Army After 2010*

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The mission for the Command and Control panel for the 1998-99 Army Science Board Strategic Mobility Study is to investigate and recommend the appropriate Information Technology (IT) required to implement strategic mobility for the Army After 2010.

The objective of the command and control system in support of strategic maneuver is to provide timely and accurate planning, scheduling, monitoring, and rescheduling. This inherently includes the following: 1) coverage from fort-to-port, en route, and port to TAA (Tactical Assembly Area), 2) joint and coalition operations, and 3) military units, equipment, personnel, and supplies.

Whereas, existing systems provide a degree of automation and integration, in order to achieve the Revolution in Military Logistics envisioned by Joint Vision (JV)-2010, the Army and DoD must embark on an enterprise effort to emulate the information technology implementations of commercial industry.



In order to meet the shorter strategic maneuver timelines needed for Army After 2010, significant improvements in Command and Control are necessary. These C2 improvements will allow planners to

- plan deployments faster,
- minimize lift for systems and support with split-based operations,
- re-plan while en route,
- support sustainment with information systems for anticipatory logistics, and
- minimize forward sustainment needs with information systems.

The barbed-wire border on this graphic represents the need for absolute two-way information assurance in all phases of command and control support to strategic maneuver. This need for information assurance is described later in this presentation.



## Commercial Information Technology

- IT has been the driver for establishing and maintaining the current economic boom
- Revolutionary IT methods have directly contributed to major cost savings in most logistics areas
  - Just-in-time and anticipatory logistics
  - Shorter cycle times
  - Real-time scheduling and re-scheduling
  - Rapid dissemination of timely, critical information
  - Total asset tracking

### IT Has Revolutionized Commercial Processes

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It is widely accepted that revolutionary advances in information technology has been a significant driver, if not the major driver, of the recent economic boom in the United States. Revolutionary IT methods have directly resulted in dramatically improved business efficiency and productivity. It has been the catalyst for major cost savings, notably in the areas of just-in-time (JIT) logistics, shorter and shorter cycle times, real-time or near real-time scheduling, and the rapid dissemination of timely, relevant information.



## Enabling IT Technologies

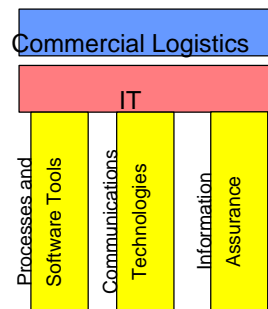
Processes and software tools for improving

- *Routing*
- *Warehouse product flow*
- *Just-in-time logistics*
- *Schedule optimization*
- *Anticipatory logistics*
- *Stockage minimization*

Communications technologies in

- *Cellular and mobile phones*
- *Land lines and cable*
- *Satellite communications*
- *Wireless LANs*
- *Fiber optics*
- *Ultra Wide-Band*

Information assurance methods for providing timely, reliable, secure, protected data and C2.



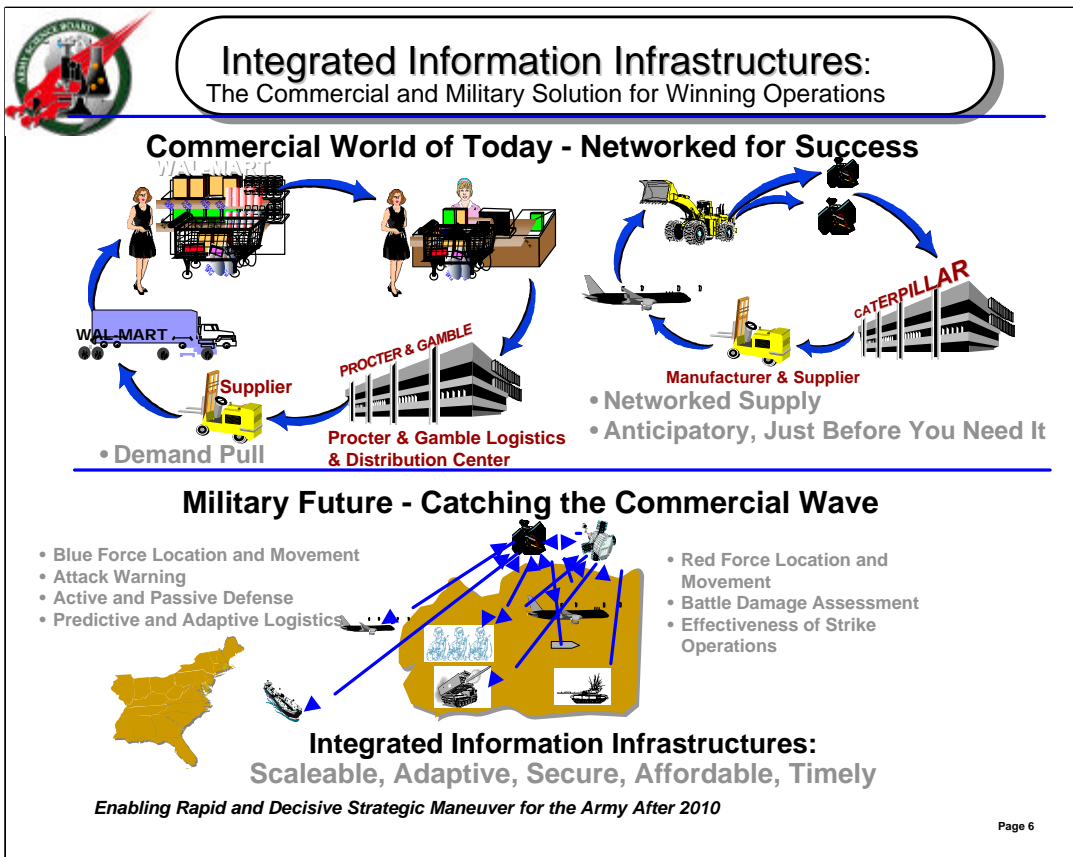
**Many Opportunities Exist for Leveraging Key Commercial IT Enablers**

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The revolution in information technology has been driven by major advances in several related technologies. One might divide these technologies into the following three primary categories: processes and software tools, communications technologies, and information assurance.

Advances in business processes and the development of sophisticated software programs have provided commercial industry with the necessary tools to revolutionize business efficiency. Likewise, improvements in communications technologies have provided higher bandwidths and greater reliability. Finally, information assurance methods and means have allowed businesses to move information around in an increasingly safer and faster manner.



World-class commercial corporations such as Wal-Mart and Caterpillar are in the vanguard of organizations that use digital tools to reinvent the way they work. To enhance their competitive advantage, corporations striving to master the digital universe are employing integrated information infrastructures (I.I.I.s) which Bill Gates has likened to the human nervous system. Companies need to have the same kind of nervous system so they can: 1) run smoothly and efficiently; 2) respond optimally and quickly to emergencies and opportunities; 3) get valuable information and knowledge to all in the company and the company's partnership base (suppliers, distributors, customers, etc.) who need it; and 4) adjust to keep the system running with synchronized action everywhere in the supply value chain to delight customers.

Two commercial examples are provided to show how commercial integrated information infrastructures are being used to gain competitive advantage. Today, when a shopper selects a product at Wal-Mart and purchases the product at the 'point of sale' computer (check out register) information is flashed in real time to not only the essential stakeholder groups within Wal-Mart, but also the original suppliers of the purchased product. The virtual corporation (Wal-Mart and its entire supply value chain) react to this stimulus and assure that the replacement product arrives at the needy shelf just in time. Such a system guarantees the freshness of product on the shelf, minimizes inventory (and thus cost) and guarantees product on demand.

The second commercial example is Caterpillar, which has nearly 2 million pieces of equipment in the field all over the world with some equipment items nearly 30 years old. Caterpillar's newest high value product offerings offer instrumentation and GPS packages that allow anticipatory logistics and service "just before you need it". When a worldwide construction company procures a major earthmover from Caterpillar, they know that Caterpillar will know exactly where in the world that equipment is being used (via GPS readout to Caterpillar) and the state of health of major subsystems and components. Repair assemblies will arrive before the equipment breaks, often resulting in lower cost repairs and no loss of essential operations.

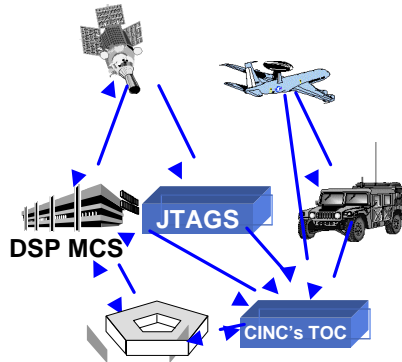
It is recommended that the United States Army master the digital universe of the 21<sup>st</sup> Century to gain a decisive competitive advantage over all potential adversaries. Specifically, it is recommended that the Army accelerate and increase its focus on the use of digital communications and commercial information technology to create an integrated information infrastructure. Like the human nervous system with its brain, synapses, nerves, and compensating mechanisms, the I.I.I. has sensors, communication paths, decision-making capabilities and response initiators. It collects information of importance to decision making. It moves information and command orders to any destination with need. The fused, tailored information is shaped to be intuitively recognizable and decision support tools offer advice on the alternatives for action. The I.I.I., like its human model, is dynamic, adaptive and self-reconfiguring. Commercial and DoD technologies assure security. With "all source" fusion, which takes full advantage of all data sources to provide highest quality knowledge, the I.I.I. can provide real time knowledge on both the blue and red forces and allows both predictive and adaptive logistics. As with the commercial models, the objective would be to minimize both CONUS and Theater inventory levels, to optimize the shipment and receipt of equipment and to guarantee the "Just Before You Need It" arrival of product to assure that the tempo of sustainment meets the warfighter's needs.



## Integrated Information Infrastructures

### Today's Reality:

Mission Specific, Stovepipe Communications

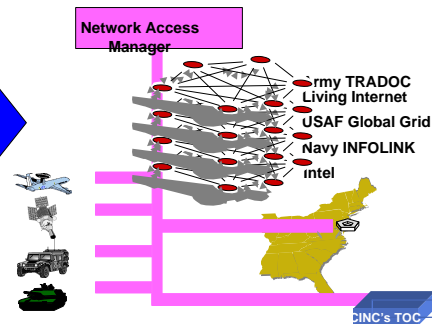


- Service Centric Mentality
- Stovepipe Architectures
- Mission Specific Communication Systems
- Cacophony of Messages
- Fused Knowledge in it's Infancy

VS

### New Way:

Integrated Information Infrastructure



- CINC and Joint Centric Culture Versus Service Centric
- Network Centric Architecture - A Seamless, secure Network That Unites the Entire Team and Impels Synchronized Operations
- Catches the Commercial Wave by Exploiting COTS and Commercial IT
- Shared Awareness
- Real Time Data Exchange
- Optimal Use of All Information to Frame Knowledgeable Decisions
- Assured Information Superiority
- Revolutionary Improvement in War Fighting, Logistics and Supply

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From the beginning of C4ISR activities, the predilection of program teams was to develop mission-specific systems with stovepiped communications. While efficient for the stated task, these legacy systems, with their narrow views of the world, often fell short of their full potential by failing to exploit information from parallel systems. “All-Source” fusion--currently in its infancy and difficult to implement because of the uniqueness of legacy system protocols and standards--is attempting to blend information from surveillance sensors, intelligence sensors, weather systems, imaging and mapping systems, weapon platform radars, UAV’s and even “in-flight weapon” sensors to provide the best view of the world. Wisely, most steps toward “all source” fusion are in the direction required by the I.I.I. Even if all vectors aren’t perfectly aligned, they are all, at least, in the correct quadrant. By using the standards and protocols of the Joint Technical Architectures (JTA) and demanding strong reliance on COTS and commercial technology, these fledgling I.I.I. efforts are attempting to provide multi-functional architectures that capitalize on the growing availability of bandwidth and digital communications technology to form network-centric communication infrastructures which tie existing C4ISR assets together. These efforts are to be applauded for their recognition that the old paradigm of business (stovepiped communications) will not provide all decisionmakers, commanders, and warfighters with the requisite real-time access to “all-source” knowledge required to achieve the desired revolution in warfighting capability. The axiom, “Knowledge Is Power” will evidence itself more fully when existing “all-source” fusion programs provide hardware to the field and most fully when a ubiquitous I.I.I. unites Joint and Coalition forces and



facilitates high speed, synchronized, instantly adaptive conflict over the entire non-linear battlefield. “Real-time” and complete awareness of the entire conflict situation will multiply force effectiveness by providing the commander with the knowledge required to optimally project all forces.

To assure that “All-Source” fused information is not a cacophony of messages, expert systems and decision aids are being developed to assure that decision makers and warfighters receive knowledge that is intuitive and user-friendly.

However, even this leap in exploiting the advantages of communications and information technology is shortsighted. The full potential of Information Technology is achieved when an Integrated Information Infrastructure (I.I.I.) is used to tie the entire warfighting team (Army, Joint, Coalition, Maneuver, Logistics, Supply, etc.) together as an integrated whole.

The Integrated Information Infrastructure (I.I.I.) is not a new idea. It was recommended in the Army Science Board 1994 Summer Study Final Report: “Technical Information Architecture for Command, Control, Communications and Intelligence”, and in the numerous ASB and DSB writings of Dr. Michael S. Frankel. It is reported here as a recommendation for emphasis. It is strongly recommended that the Army increase its commitment, focus, and velocity toward achieving the I.I.I.

Army (TRADOC Living Internet), USAF (Global Grid), Navy (IT-21 Infolink), Intel and DSB (I.I.I.) architectures are attempting to capture the vision of I.I.I. Also, the J-6, director of Command, Control and Communications on the Joint Staff is promulgating a version of the I.I.I. called the Global Information Grid. The fact that there are so many visions of tomorrow is a sign of inefficiency and a source of concern. Nevertheless, all agree that the goal is a network centric architecture that unites the entire team and impels synchronized operations. Employing an integrated, scaleable, fully distributed processing and transport environment, the I.I.I. will:

- Move information and command orders from any source to any destination
- Use intelligent software agents to provide tailored information automatically as required
- Be dynamic, adaptive, self-reconfiguring, robust and secure
- Combine appropriate legacy C4ISR systems with modern information technology (IT), COTS and commercial systems

The I.I.I. will also:

- Permit full exploitation of sensor, weapons platforms and processing capabilities to allow sensor-to-sensor cueing and self-tasking, thus assuring optional sensor-to-shooter/commander knowledge.
- Permit predictive and adaptive logistics assuring that the maneuver and warfighting teams can maintain the tempo of battle required to win decisively with minimal casualties.



## Requisites for Success



### Army Integrated Information Infrastructure (I.I.I.) Integrated Product Team (IPT)

- Clear and Complete Vision for the TRADOC "Living Internet"
- Technical Architecture That Meets Army Requisites and the Requirements of Joint/Coalition Forces
- Control of Architectural Structure
- Promulgation of Requirements to Assure Success of Individual Programs Within the System of Systems Architecture
- Development of Simulation and Test Tools to Insure the Integrity of the Entire Architecture and the Proper Certification of New Systems



### OSD LED Overarching IPT for the Integrated Information Infrastructure (I.I.I.)

- DOD Wide I.I.I. Vision
- Policy and Procedures to Exploit Commercial IT
- Assure Compatibility of Joint and Service Architectures
- Ensure JTA is Promulgated Within All Services
- Ensure Coordinated Time Phase Implementation Plan
- Ensure Architecture Proceeds in a Controlled Fashion From CCBed State to CCBed State

**The Ubiquitous Need for Information Demands Joint Leadership to Facilitate the  
Affordable, Reliable, Timely and Secure Supply of Knowledge to All Stake Holders**

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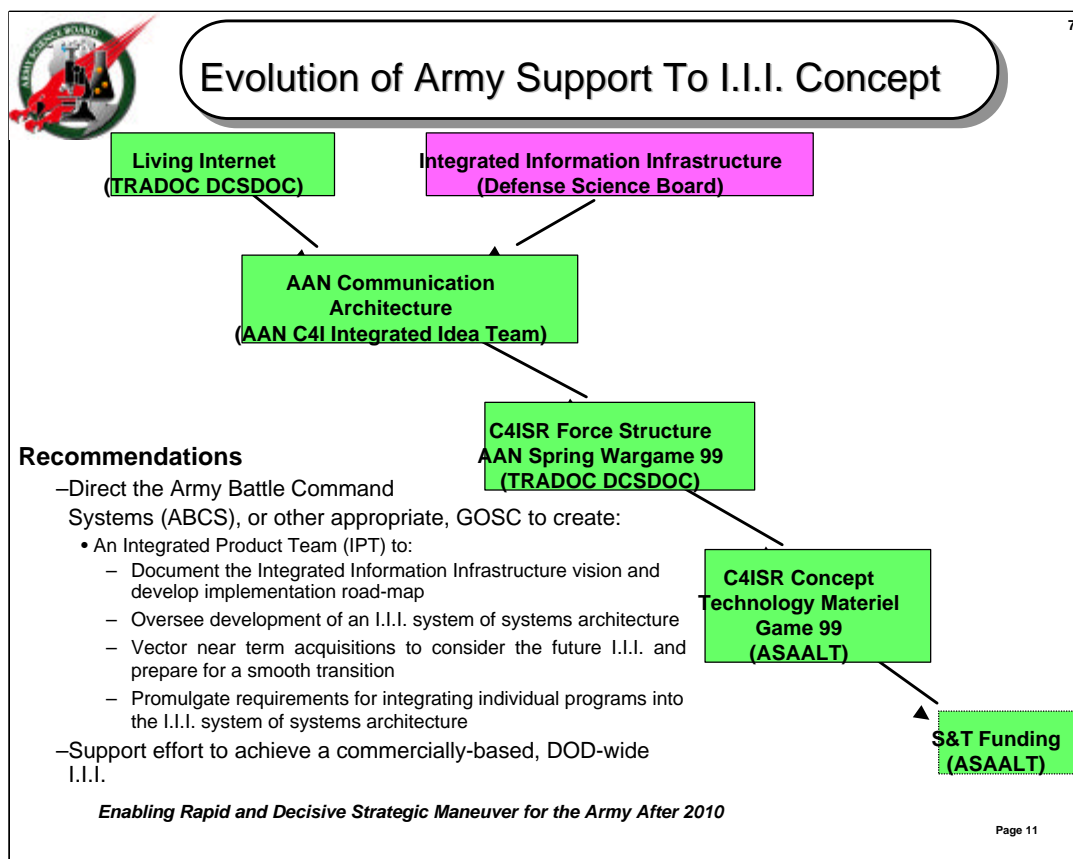
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There are many uncertainties and problems that must be overcome to arrive at an affordable, efficient and effective I.I.I. Few are technical. Most are cultural and people specific.

As stated earlier, each Service has its own view of the I.I.I. The Army's version is called the TRADOC Living Internet. While there has been some effort to rationalize service architectures, it is strongly felt that the unification activities must have increased focus and emphasis. Without a unified DoD-Wide I.I.I. vision, the affordable, the synchronized system all services and joint/coalition forces must have will be jeopardized.

Focusing solely on the Army, problems with the implementation of I.I.I. still abound. There is not an Army-wide clear understanding of what the TRADOC Living Internet is or how this vision should affect current and future decisions. It is recommended that this be corrected immediately.

To solve the two problems identified above--namely (1) no unified DoD-Wide I.I.I. Vision to serve as a 'guide-on' for the services and (2) a lack of clarity within the Army as to its version of the I.I.I.--the ASB offers the above requisites for success which we encourage the Army to champion.



Originally a Defense Science Board (DSB) concept, the Integrated Information Infrastructure was picked up by the Army through its Army After Next (AAN) project. The notion of a “Living Internet” was developed to limit any vulnerabilities to communications. The Living Internet concept is to manifest as robust communications capabilities that remain functional even under a variety of simultaneous attacks and network fragmentation. The AAN C4I Integrated Idea Team (IIT) being led by the Communications Electronics Command Research, Development and Engineering Center (CECOM RDEC) developed the AAN Communication Architecture. CECOM RDEC documents identify the I.I.I. as providing the foundation concepts for the architecture which was adopted by TRADOC DCSDOC for use in all FY99 games. The blue C4ISR force structure used in the AAN Spring Wargame 99 leveraged the AAN Communication Architecture. The results of the Spring Wargame will impact the upcoming Technology Materiel Game (TMG) 99. Results of the TMG are anticipated to be used as input for deciding upon Army S&T funding by the Assistant Secretary of the Army for Acquisition, Logistics and Technology (ASAALT).

The I.I.I. should continue to be refined by the Army. The Army must prioritize S&T and fielding efforts to achieve the AAN Communications Architecture. Many of the concepts found in the I.I.I. and AAN Communications Architecture are far reaching and deserve additional evaluation through the conduct of experiments in Joint activities. Because the Army, among the Services, faces the most formidable communications challenge, needing to assure communications for thousands of individual fielded units, future Army communications solutions will strongly influence the development of future Joint solutions.



## Areas For Improvement

- Advanced Logistics Planning
- En Route Planning
- Anticipatory Logistics
- Split Based Operations
- Information Assurance/Survivability

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The C2 Panel identified several key C2 areas for improvements. We believe that advances in these five areas will significantly enhance the Army's ability to meet the faster strategic mobility timelines as needed by the Army After 2010.

The five areas of improvement are

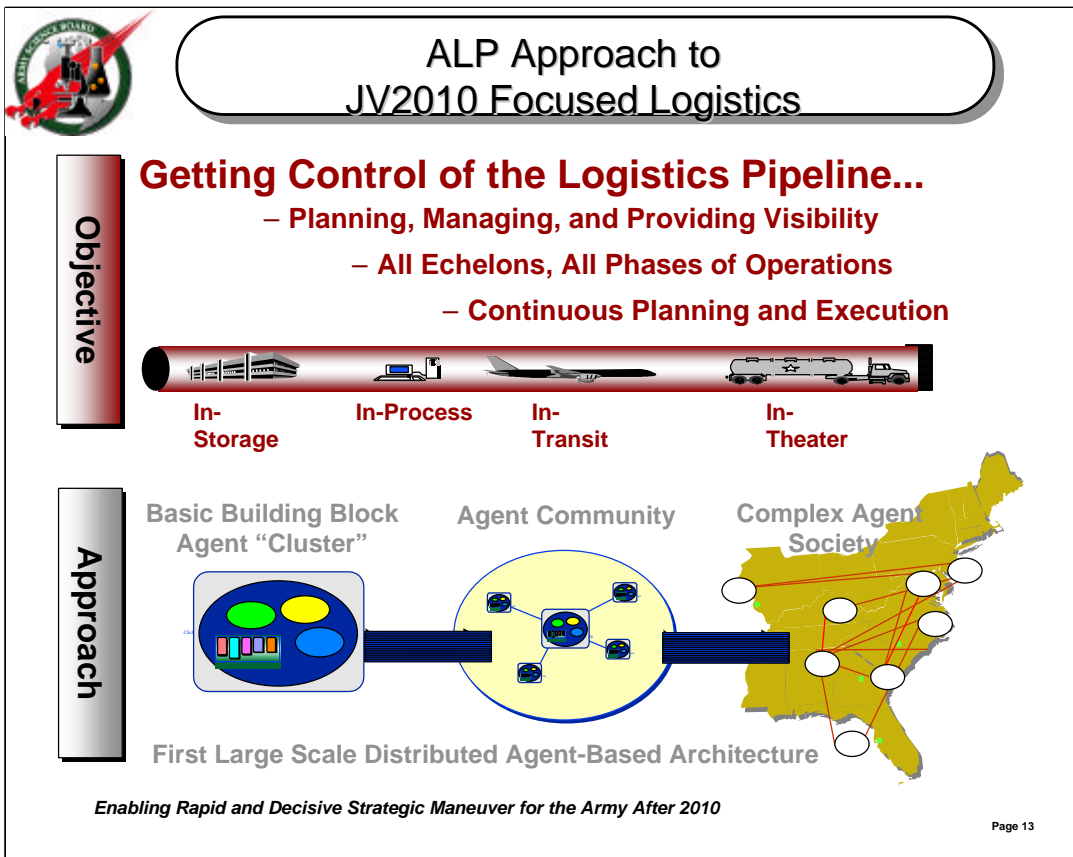
Advanced logistics planning,

En route planning,

Anticipatory logistics,

Split-based operations,

Information assurance and survivability.



### The Advanced Logistics Project (ALP)

The Advanced Logistics Project (ALP) is a jointly funded initiative between the Defense Advanced Research Projects Agency (DARPA) and the Defense Logistics Agency (DLA) in partnership with the U.S. Transportation Command and the Joint Staff/J4.

The ALP is focused on developing and demonstrating advanced information technologies that will allow us to get control of the logistics pipeline and the entire logistics business process. It will define, develop and demonstrate fundamental enabling technologies that will allow logistics and transportation assets to be deployed, tracked, sustained and redeployed more efficiently than ever before.

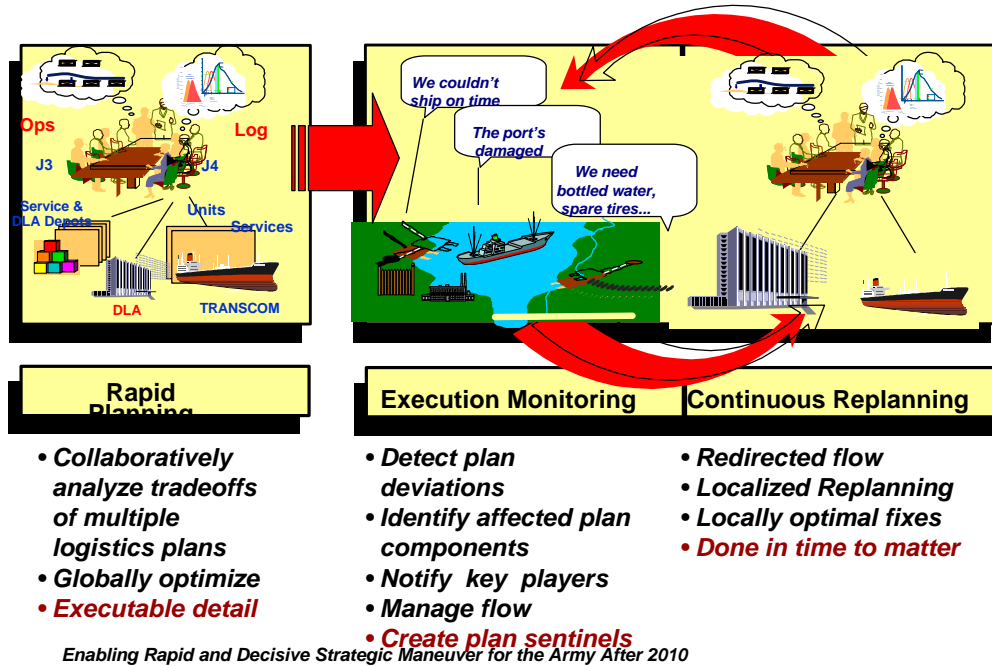
The technical approach being pursued uses a distributed agent-based architecture. The system's basic building block is the "cluster." Each cluster is made up of a similar set of components and functions in a manner modeled after the human cognitive process.

While clusters are structurally similar, they can be specialized to accomplish specific functional behaviors using software plug-ins. For example, a cluster in a truck battalion may do the scheduling of truck assets, while a similar cluster with different plug-ins may operate at HQ TRANSCOM to do global mode selection for the shipment of units and equipment. Individual clusters performing similar and complementary functions can be grouped to form "communities" representing a specific organization.

Communities can be grouped to form "societies." In this way the entire logistics business process can be represented.



## ALP Operational Vision



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### ALP Operational Vision

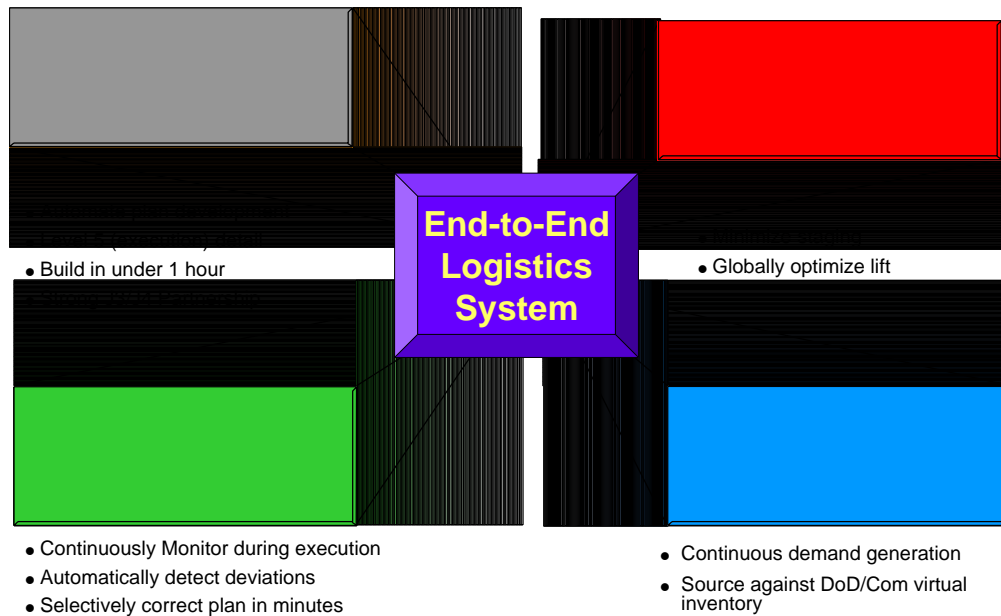
ALP is building an information technology infrastructure that will enable operators and logisticians at any echelon, to work together with the Services, the Defense Agencies and support organizations to quickly develop plans to level 5 detail based on real, rather than notional, data.

With this execution level of detail, we can transition seamlessly from planning into execution with confidence. Using plan sentinels against real world data feeds, we can monitor execution to predict and detect deviations to the plan in a timely manner and automatically begin replanning.

The ALP system will automatically do plan repair routines and present recommendations to commanders, which would modify the plan in an optimum fashion to keep the operation on track.



## ALP Project Vision Grand Challenges



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### Grand Challenges & Metrics

ALP is focused on four areas to achieve an end-to-end totally integrated logistics system. These Grand Challenges and their associated metrics are:

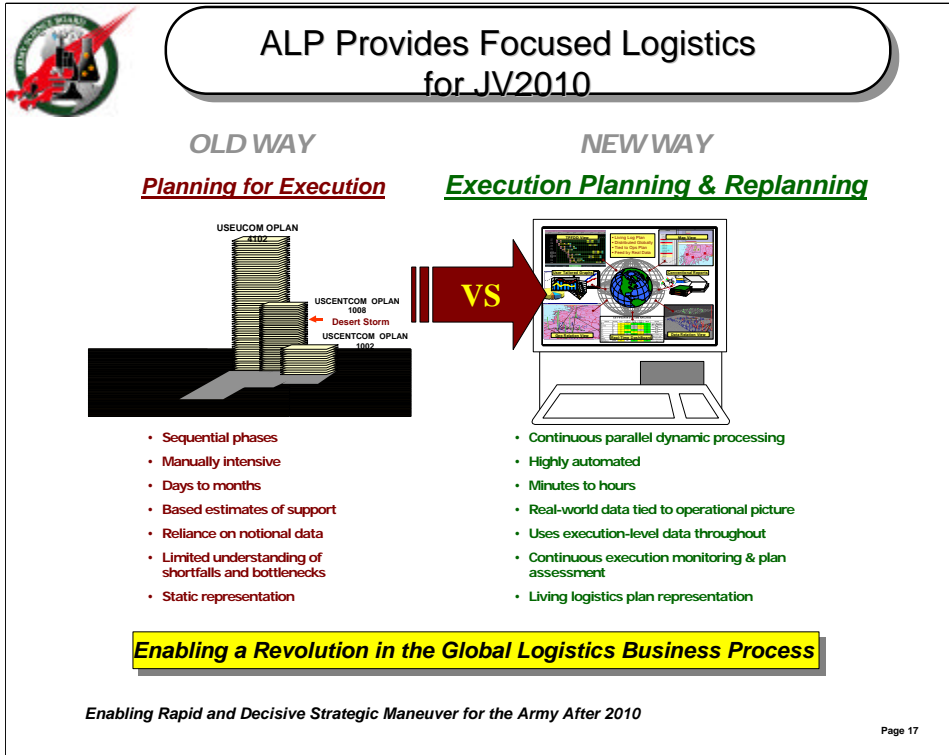
**Automated Logistics Plan.** Tightly link J3 and J4 planning and execution processes to produce an executable "Level-5" TPFDD in one hour. This will provide the capability to automatically generate highly accurate, timely, level 5 detail logistics plans in response to operational objectives and identify those elements of the plan which are logistically un-supportable under given constraints. Using automation technology, detailed plans are developed the bottom up by applying real world data, rather than notional data.

**End-to End Movement Control.** Achieve minimal staging while globally optimizing air, land and sea-lift resources across the spectrum of movement activities. This will provide the capability to maintain end-to-end control of the transportation/logistics pipeline through the automated development of responsive transportation plans, schedules, and the continuous monitoring of plan execution. This incorporates both military and commercial assets and ensures the most timely and cost-effective employment of transportation resources.

**End-to-End Rapid Supply.** Provide continuous demand assessment and "sourcing" against DoD and commercial inventories. Logisticians can ensure the right supplies are at the right locations when required while maintaining a minimal inventory. By managing supply channels across a virtual inventory of DoD and commercial vendors, suppliers, and manufacturers, DoD can realize improved materiel readiness while decreasing cycle times. In the end, unit demands will be filled faster and cheaper while enabling the DoD to dramatically reduce inventories and overhead costs.

**Real-Time Logistics Situation Assessment.** Identify plan deviations within 15 minutes and update a logistics plan within 10 minutes of the detected deviations. Advanced visualization coupled with plan sentinel technology will provide all users the capability to rapidly assess the logistics situation. By converting logistics data into intuitive information-rich visualizations, logisticians can begin to understand the current situation and project future states. By relating the operational and logistics components against a shared situation, linkages between operational events and logistics capabilities can be established.



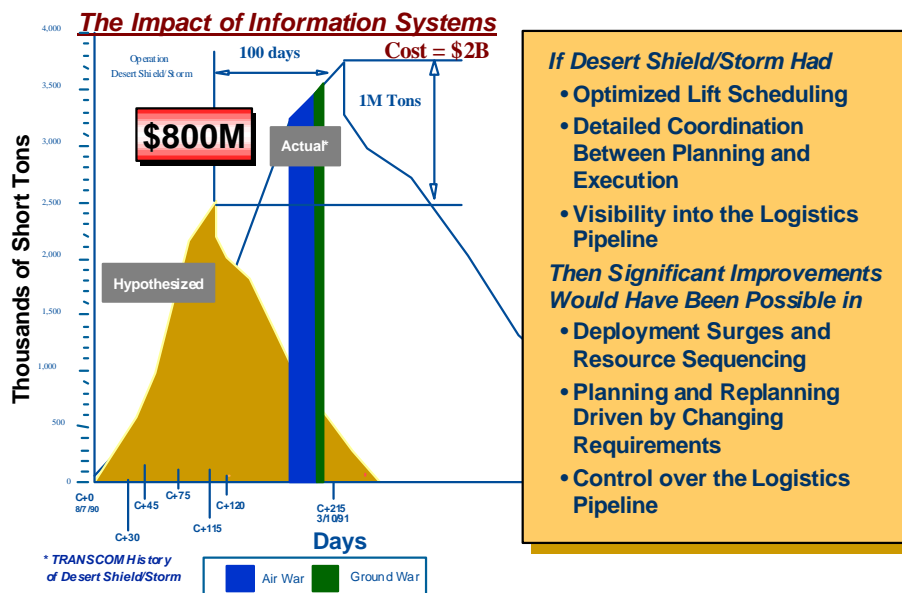


## Old Way vs New Way

- This revolutionary new architecture will enable a fundamental change in the way we do business in logistics. This moves us from an environment where we're planning for execution, that is deliberate planning; to an environment where we can do execution, monitoring, and replanning in real time against real information.
- This slide speaks for itself comparing the expected performance of a new ALP system to the performance of current systems:
  - Continuous parallel dynamic processing vs sequential phasing
  - Highly automated vs manually intensive
  - Cuts the time required to plan from days/months to minutes/hours
    - Deliberate deployment planning: 1 year +
    - Contingency execution planning: 8-10 days
    - Near Term Goal for execution planning: 72-108 hours
    - ALP Vision for continuous execution planning: 1-4 hours
  - Uses real execution-level data vs relying on notional data
  - Provides live continuous execution monitoring and plan assessment vs limited projection of expected bottlenecks and shortfalls
  - Living log plan representation vs static snapshot



## Dramatic Financial Reductions



- If Desert Shield/Storm Had**
- Optimized Lift Scheduling
  - Detailed Coordination Between Planning and Execution
  - Visibility into the Logistics Pipeline
- Then Significant Improvements Would Have Been Possible in**
- Deployment Surges and Resource Sequencing
  - Planning and Replanning Driven by Changing Requirements
  - Control over the Logistics Pipeline

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### The Impact of Information Systems

This chart is derived from a study of the sealift which supported the Operation Desert Shield/Desert Storm deployment. The potential impact of employing advanced information systems for command and control has been estimated to be a savings of about \$800 million stemming from the need to ship a million less tons of supplies and equipment and from getting force closure 100 days earlier.

### Requirements growth

The decision to deploy the VII Corps from Europe was made by the National Command Authority in late October 1990. This resulted in a significant change to the shipping requirement of 8 million square feet or 578,000 short tons. The CINC's demand for 60 days of ammunition on the ground before the start of the ground war resulted in significant changes to the required shipping. In total, about 900,000 short tons of ammunition were shipped to the theater from PODs. This amount exceeded the 120-day requirement for ammunition. Better visibility into what was being shipped could have reduced the tonnage considerably.

### Port optimization

Many units shipped out without optimizing the available port capacity. For example, the 24<sup>th</sup> Mechanized Infantry Division shipped out of only one port over 9 days when it could have used two other available ports nearby and made the deployment in four less days. Staging time of the units at the port resulted in significant inefficiencies at the ports where ships sat idle at dockside without conducting actual loading operations while units completed staging operations at the dock and elsewhere.

### **Unit sequencing and time phasing**

The decision to employ VII Corps was made very late in the deployment process. This resulted in the need to compress the deployment and to use all available assets to get the units and their equipment out of European ports and into the Saudi ports. This resulted in surge operations which caused delays at the PODs as shipments from multiple ports in Europe arrived at the PODs more rapidly than they could be efficiently off-loaded and processed through the ports. In addition, the rush to maximize the cargo on all ships from European ports resulted in the loss of unit integrity on a large scale. The average battalion sized unit was spread over 7 different ships. One signal battalion was split between 17 ships and took 37 days to close in theater.

#### **Summary**

Holding down requirement growth could have saved 578K short tons...	39 days
Reducing the amount of ammunition could have saved 400K ST...	24 days
Schedule optimization...	30 days

Together these amount to about 1 million short tons and about 100 days' earlier closure. The associated savings would be about \$800 million.



## Leverage DARPA's Advanced Logistics Planning (ALP) Program

- DARPA ALP project designed to automate the logistics processes with a distributed, intelligent-agent based architecture.
- Will be platform independent and operate over standard internet communications with low bandwidth.
- Will connect the operations (J3) and the logistician (J4) throughout the planning and execution of operations.
- Will produce automated logistics plan including a Time Phased Force Development Data within one hour of initiation.
- Will run continuously to control worldwide logistics operations and to do assessment of progress in the execution of operations and perform automatic plan repair when deviations from the plan are detected or required.
- Will provide joint interoperability by incorporating appropriate legacy systems and data bases of all services.

***Does not have enough Army level interface***

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### Summary of ALP characteristics

The ALP project features a revolutionary approach employing a very large scale intelligent, distributed, agent-based architecture to highly automate the logistics processes to achieve control of the world-wide logistics system supporting DoD.

ALP will be simple enough to play on mid-range computers, laptops, and even palm-sized computing devices. The data demands will be low enough to be transportable on normal internet communications.

ALP has as one of its key goals to provide a system that enable the operator (J-3) and logistician (J-4) to work together and cooperatively throughout the planning and execution processes.

ALP will produce a very rich automated logistics plan which will include the TPFDD, but have much more information contained in it than the normal TPFDD. It also produces a living log plan that is continuously updated in accordance with real world data feeds and situation assessment.

The system will run continuously to stay abreast of changing situations and to keep live control of the logistics processes. Execution monitoring will feed plan deviations to the system for automatic replanning and plan repair.

The ALP system will be able to take advantage of many current and planned systems by wrapping them and incorporating them and required current data bases into the ALP system. This will enable ALP to be a joint system from the beginning, as it must be.



## Advanced Logistics Planning: Recommendations

- Increase Army participation in ALP development
  - Place Army personnel in DARPA program office
- Provide funding to Army programs (e.g., GCSS-A, CSSCS) for integration of ALP architecture
- Encourage ACOM, DISA, and DARPA to incorporate ALP system products into the Joint Theater Logistics ACTD with objective of demonstrating readiness for early fielding



## En Route C2

- Decreased response time for strategic maneuver requires better en route mission planning and rehearsal capabilities
- Advanced communications will provide connectivity to air and sea-lift forces for situational awareness and intelligence updates
- En Route Mission Planning and Rehearsal System (EMPRS)
  - Experimental capability for air-lift being developed for Joint Contingency Force (JCF) AWE
  - Leverage progress for fieldable systems
  - Add sea-lift capability



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### En Route Command and Control

In order to meet the requirement for more rapid and responsive strategic maneuver there is a concurrent requirement for much better en route mission planning and rehearsal capabilities. This en route requirement has been recognized by the Army and experimentation on “En Route Mission Planning and Rehearsal System” (EMPRS) has commenced.

Advanced wide-band communications and information technologies provide much greater potential for increased connectivity among air, land, and sea-based logistics lift forces. This connectivity will create the ability to provide updated intelligence/situation awareness, updates and planning (schedule/reschedule) and rehearsal capabilities to en route forces.

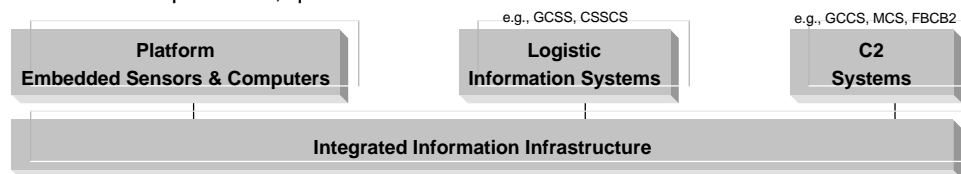
The EMPRS is planned as an experimental capability for testing as part of the airlift portion of the Joint Contingency Force (JCF) Army Warfighting Experiment (AWE) scheduled to start in the fall of 2000. While there are plans to coordinate with Maritime Joint Force activities, there is no plan to include sealift forces. This is not a realistic scenario since in nearly all deployments, both air- and sealift are involved.

**Recommendation:** The Army should add a sealift capability to its En Route Mission Planning and Rehearsal System which will be part of the Joint Contingency Force Army Warfighting Experiment.



## Enabling Anticipatory Logistics With Information Technology

- By integrating information systems and capabilities into an overarching “enterprise”, anticipatory logistics can be enabled
- Maintenance status and consumables for individual platforms are monitored with embedded sensors and computers and are broadcast for consolidation into a “common logistics picture”
- Information systems for quartermasters:
  - Develop the picture containing maintenance needs, needs for consumables (e.g., POL and ammo) and total asset visibility
  - Support logistics planning
- C2 systems for commanders and staffs allow planning of operations with knowledge of logistics status and plans
- An integrated information infrastructure facilitates the exchange of information between the platforms, quartermasters and commanders.



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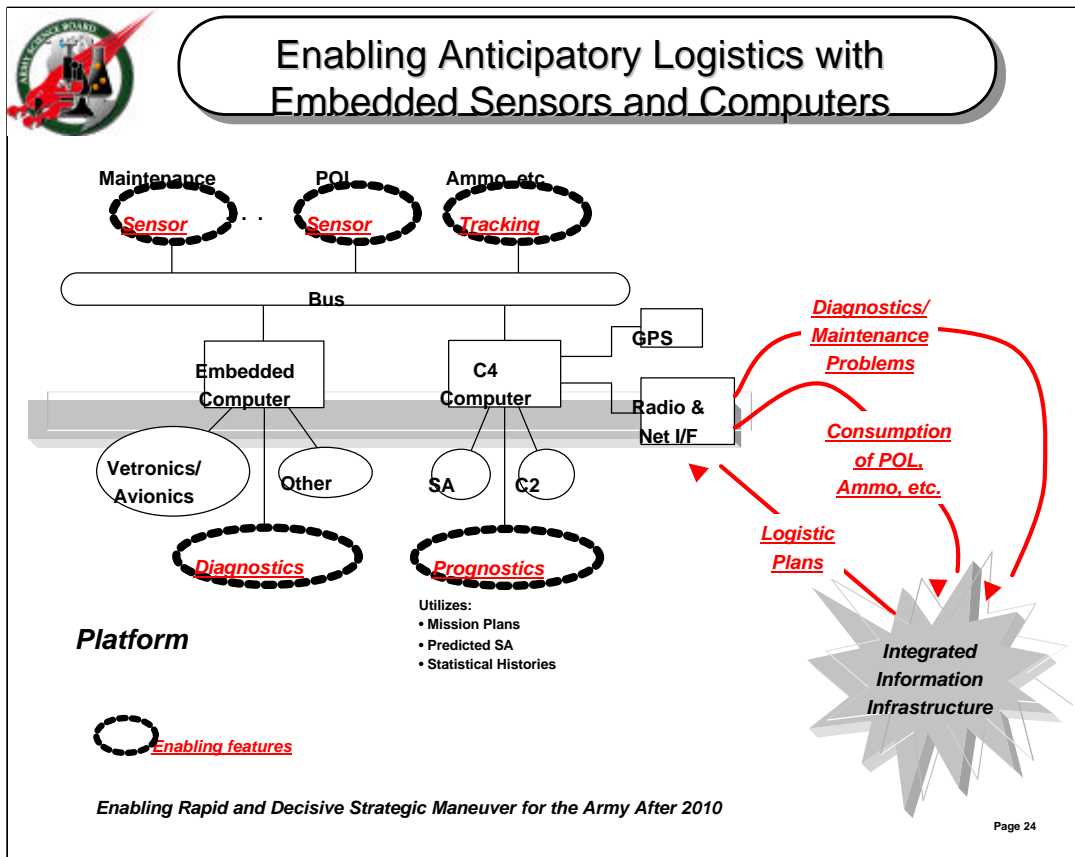
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Information systems are a key enabler of anticipatory logistics. They provide data and information on which planning and scheduling can be based. Information systems for anticipatory logistics are used from the fort to the tactical battlefield and are used throughout all echelons. As a result, information systems for anticipatory logistics must be integrated into an enterprise to ensure flow of information.

Army XXI is bringing digitization to lower echelons and is providing computers supporting situational awareness (SA) and command and control (C2) aboard all platforms. Sensors providing maintenance data must be added to platforms. New platforms must be developed including sensors and legacy platforms should have sensors integrated. Computers embedded in platforms can generate maintenance and diagnostic data and information about the platform that can be disseminated to higher echelons using messages generated by the digitization computer, i.e., Force XXI Battle Command for Brigade and Below (FBCB2). FBCB2 can disseminate update logistics messages using the I.I.I. The I.I.I. will ensure timely delivery of platform logistics information to information systems used by logistics warfighters on the battlefield, i.e., quartermasters.

Logistics information systems will develop a picture of the logistics environment that will be common at all echelons for all uses. The common logistics picture will contain maintenance needs, needs for consumables (such as fuel and ammo), and total asset visibility (TAV). Logistics information systems, e.g., GCSS, GCSS-A, and CSSCS, will also support planning by logisticians. Commanders and their staffs will use C2 systems, e.g., GCCS, GCCS-A, and MCS, will take information from logistics information systems to enable planning with knowledge of logistics status and plans. The I.I.I. is critical for linking information systems for logistics and C2.

Current information systems used by the Joint community and the Army can be augmented to support this implementation concept for anticipatory logistics, except for the embedded sensors and computers aboard platforms. New information capabilities and systems are needed to automate the collection of maintenance and logistics data.



In support of anticipatory logistics, sensors should be mounted at critical locations on platforms to measure parameters that can be used to predict maintenance needs. Sensors can measure mechanical stress and fatigue that can be recorded for comparison with statistical histories to assess maintenance requirements or predict mechanical failure. Sensors can monitor levels of fuel, oil and other consumables that will require replenishment through logistics support. Similarly, ammunition, batteries, food and other consumables use by operators can be tagged and tracked with sensors for replenishment. Sensors should be connected to embedded computers for diagnostic analysis. All new platforms should have sensors tied to embedded computers using standard on-board data buses, e.g., MIL-STD-1553 or 1760. Legacy platforms may need to have sensors hard-wired to embedded computers that have been added as an applique. Embedded computers will run software to control engines (e.g., vetronics and avionics), weapon firing and other hard real-time functions. In support of anticipatory logistics, embedded computers will use sensor data to run diagnostics for immediate maintenance and low supply warnings. The warnings can be directly displayed at crew stations.

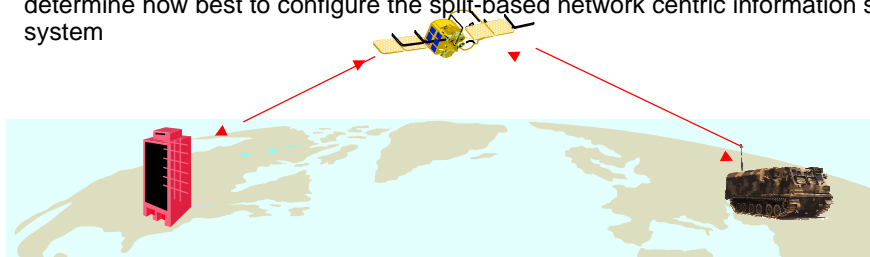
Although C4 computers supporting digitization will principally provide SA and C2 functions for the platform's leader, it can also run prognostic applications. Prognostics will generate predictions of maintenance and logistics needs. Diagnostic data from the embedded computer will be important input for prognostics, however C2 plans for missions involving the platform, SA predictions, and statistical histories about similar missions will also be used as inputs. Diagnostics and prognostic information will be disseminated to pre-designated logistics information systems in the enterprise using the III. Logistics plans from logistics information systems relevant to the platform will be sent to the C4 computer.





## Split-Based Operations

- Major opportunity to increase operational effectiveness of forward deployed units
- Utilizes network centric information technologies to provide numerous tactical command center staff functions from sanctuary in theater or from CONUS
- Readily accomplished with the introduction of wide band Global Broadcast Service (GBS) satellite communications and a viable Information Dissemination Management (IDM) capability
- Minimizes lift and sustainment logistics and increases forward unit survivability
  - Less personnel forward
  - Less vehicles/shelters forward
  - Increased forward unit mobility
  - Reduces electronic/spectral/image signatures of forward C4ISR units
- Recommendation: Army experimentation (ATD/ACTD) to refine concept and determine how best to configure the split-based network centric information support system



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### Split-Based Operations

Split-based operations is not a new concept. The idea of forward deploying only those facilities and personnel needed for day-to-day has been experimented with and utilized in a variety of areas many times in the past. A major objective of those past efforts was to reduce the logistics needed to sustain forward-deployed units without effecting their operational effectiveness. Other objectives were to reduce the electronic and spectral signature of those units for survivability as well as to provide timely high-quality rear-based intelligence support to those same units.

The ready availability of network centric information technologies provides the capability to provide numerous tactical command center staff functions to forward deployed command centers from sanctuary in theater or from the continental U.S. An example would be to utilize the Global Broadcast Service wide-band satellite communications to provide hourly detailed all-source situational awareness reports directly to forward-deployed tactical operations centers rather than having a plethora of forward-based reconnaissance and surveillance systems flooding the tactical units with volumes of situational awareness data they really cannot analyze or use effectively. Split-based information surveillance and reconnaissance (ISR) operations would permit the forward to concentrate their ISR resources on tactical targeting/immediate combat maneuver matters.

Split-based operations not only minimizes lift and sustainment logistics, it also increases forward unit survivability through:

- Less personnel forward
- Less vehicles/shelters forward
- Increased forward unit mobility
- Reduced electronic/spectral/image signatures

**Recommendation:** The Army should carry out a comprehensive split-based experimentation (ATD/ACTD) program to refine the concept and to determine how best to configure a split-based network centric information support capability.



## Information Assurance/Survivability

- Issues:
  - Information assurance is critical to information dominance
  - The threat to C4I systems is asymmetric and pervasive
  - Open system architecture approach increases potential vulnerability
  - Industry is increasing emphasis on information assurance
- Findings:
  - Information assurance (IA) not built into Army logistic systems
  - Most Army system administrators are not trained to recognize hostile penetration or disruption

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**Information Assurance (IA).** The U. S. Army's use of computer technology is the most advanced of any present day ground force. To assure computer technology aids the Army in defeating an adversary on the battlefield, the Army must have information dominance as set forth in Joint Vision 2010. In order to have information dominance it is critical that Army systems possess the ability to operate with excellent information assurance (IA). The components of IA are confidentiality, integrity, availability, and authenticity. Sender(s) must be confident that only the intended recipient receives the information (confidentiality/privacy); that the message arrive without being modified (integrity); the system is available when needed (availability); and that the correct recipient receives the message (authenticity).

**Threats to C4I systems are asymmetric and pervasive. Present Army logistical systems do not assure IA.** The asymmetric aspect of IA is demonstrated by Dorothy E. Denning, in her latest book on Information Warfare and Security. It stated that during Operation Desert Storm/Shield, five civilian information hackers from the Netherlands penetrated 34 American military sites where they obtained information about U.S. troop locations, weapons carried by the troops, and other logistical systems information. According to the program manager of computer crime investigation and information warfare, Office of Special Investigations, the targets included military supply systems.

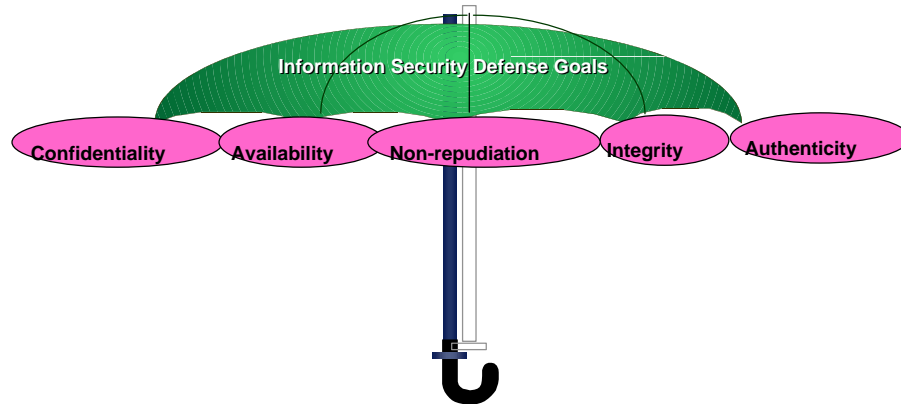
**Open system architecture increases vulnerability.** It makes economic sense for the Army to leverage commercial technology and concepts like open system architecture. The problem with this approach is that both friend and enemy know the architecture and probably how to exploit any vulnerability (weakness). Army must remain vigilant against open system architecture weaknesses and develop and/or apply patches to their logistics system immediately.

**Industry emphasis on IA.** Many civilian software developers are not presently incorporating security in their software. Some claim the public has not asked for it. However, there are commercial companies that have made security one of the critical success factors for their network. These companies (Federal Express, Walmart, Amazon. com., etc) are not in the security business but they understand that security is important to their survival.



## Recommendations for Information Assurance/Survivability

- Recommendation:
  - LIWA should participate on commercial IA/computer security standards panel to encourage adequate security is built into new systems
  - Army should place security requirements in all IT/logistics contracts
  - Army should establish or use available industry IA/IW certification program(s) for Army system administrators



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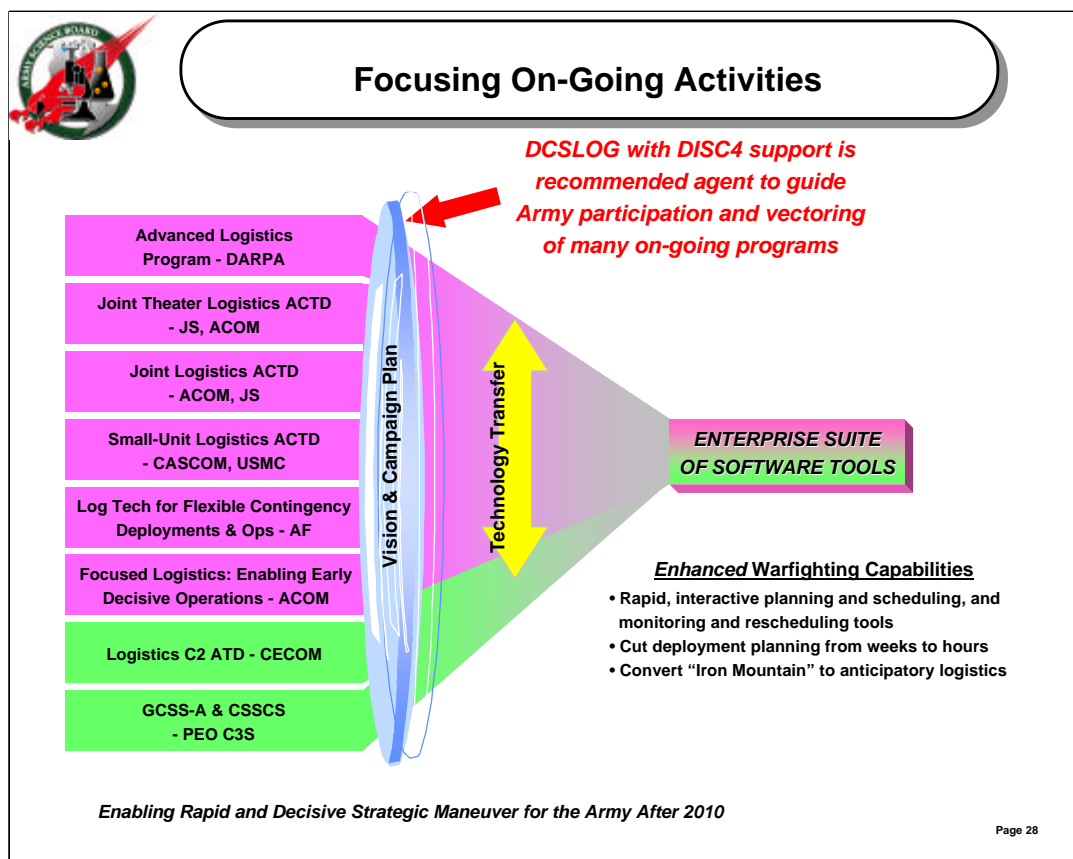
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### RECOMMENDATIONS:

LIWA participate on IA/ computer security standards panel. It should be the responsibility of LIWA to participate on all IA/computer security standards panel(s) to articulate Army security hardware and software concerns.

ASA (ALT) place Army security requirements in IT/logistics contracts. The Army should lead the nation in persuading the computer industry to design security and information assurance in their products by requiring it in logistic contracts.

DISC4 establish IA/IW certification program. DISC4 should establish a world-class system administrator training/certification program. This program should have several levels with each requiring various courses and skills. Military and civilian personnel entering the certification program must agree to stay employed with the Army for a certain amount of time i.e. two months for every week of training. To be compatible with salaries in industry, special skill pay should be established for individuals in the system administrator training/certification program.



There are many on-going science and technology (S&T) initiatives and new developments aimed at enabling more rapid deployment and efficient sustainment with modern information systems. The different efforts attempt to improve different aspects to information systems to strategic maneuver. These efforts are being undertaken by various organizations from throughout the Joint community, the Army, and other Service. The figure above highlights important Joint S&T and other Service programs, advanced concept technology demonstrations (ACTDs) and technology objectives. The figure also highlights an Army advanced technology demonstration and Army developments for information systems to be fielded. Although each effort will likely contribute to defense and Army needs, coordination and collaboration among all the efforts, and interoperability and synergy of resultant products is not clear.

Products from on-going efforts should be integrated into an *enterprise* suite of software tools. An enterprise approach is suggested to emphasize support to all logisticians and commanders at every echelon and across all phases of strategic maneuver. The tools must afford planning and scheduling, and monitoring and rescheduling that is rapid and interactive. The tools must cut deployment planning from weeks to hours and enable anticipatory logistics (rather than the build-up of an "Iron Mountain" as exemplified in Operation Desert Storm). Technology must be transferred across the related programs to ensure efficient use of limited Joint and Army funds.

For enterprise tools, a vision for the end-state is needed. A vision will document desired warfighting capabilities (versus specifying technical or programmatic requirements). It will provide focus for developing warfighting functionality in related systems by the disparate responsible organizations. With the vision, strategic unity of effort can be achieved without the overhead of an umbrella organization controlling the many programs. A vision will also

define what constitutes success and provide a basis for more detailed planning. With a vision, more effective expenditure of tens of millions of dollars being spent on the identified programs will result. A campaign plan will set the “stakes in the ground” for measurable improvement to capabilities supporting strategic maneuver. Relationships and timing between on-going efforts and upgrades to already fielded systems can be planned and

For enterprise tools, a vision for the end-state is needed. A vision will document desired warfighting capabilities (versus specifying technical or programmatic requirements). It will provide focus for developing warfighting functionality in related systems by the disparate responsible organizations. With the vision, strategic unity of effort can be achieved without the overhead of an umbrella organization controlling the many programs. A vision will also define what constitutes success and provide a basis for more detailed planning. With a vision, more effective expenditure of tens of millions of dollars being spent on the identified programs will result. A campaign plan will set the “stakes in the ground” for measurable improvement to capabilities supporting strategic maneuver. Relationships and timing between on-going efforts and upgrades to already fielded systems can be planned and synchronized. The DCSLOG is recommended as the Army agent to lead the preparation in an Army vision and campaign plan that will guide Army participation and vectoring of relevant information system programs for strategic maneuver. The Director of Information Systems for Command, Control, Computers, and Communications (DISC4) is recommended to support DCSLOG in helping with detailed plans for the enterprise tools.



## Recommendations (1 of 2)

- Integrated Information Infrastructure (I.I.I.)
  - Army establish a top level I.I.I. systems architecture based on commercial technology and prepare a transition plan to merging in existing stovepipe C4I programs
  - Establish an IPT for oversight management of I.I.I. chaired by DISC-4
  - Propose establishment of an overarching DoD-wide I.I.I. IPT chaired by ASD C3I
- Advanced Logistics Project (ALP)
  - Army support and invest in ALP architecture development
    - Place personnel in DARPA program office
    - Provide funding to integrate ALP architecture into Army systems
  - Align current and planned Army development efforts with ALP architecture, e.g.
    - GCSS-A
    - Log C2 ATD
  - Support the incorporation of the ALP architecture into the Joint Theater Logistics ACTD
- En Route Mission Planning and Rehearsal System
  - Leverage experimental results from the Joint Contingency Force AWE using EMPRS to support the development of a fieldable en route C4ISR system supporting air and sealift.

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## Recommendations (2 of 2)

- Split Base Operations
  - Army experimentation (ATD/ACTD) to refine concept and to determine how best to configure the split-based network centric information support system
- Anticipatory Logistics
  - Embed sensors and computers to support platform diagnostics and prognostics
  - Use logistic information system and I.I.I. to consolidate platform information into a “common logistics picture”
  - Enable capability with software integrated “enterprise-wide”
- Information Assurance
  - LIWA should participate on commercial IA/computer security standards panel to encourage adequate security is built into new systems
  - Army should place security requirements in all IT/logistics contracts
  - Army should establish or use available industry IA/IW certification program(s) for Army system administrators

# **Enabling Rapid and Decisive Strategic Maneuver for the Army After 2010**

## **Sustainment Panel Report**





## CHAPTER 1 - INTRODUCTION



### Army Science Board Sustainment Panel Report

#### **Panel Members:**

Mr. Buddy Beck  
Dr. Robert Howard  
Mr. Rob Quartel  
LTG (R) Don Holder  
MG Robert Ruth  
LTC Gary Engel  
Mr. David Payne  
Cadet Dan Herlihy

# CHAPTER 1 - INTRODUCTION



## Sustainment Panel Mission

To identify changes to doctrine, organizations, and equipment to provide more efficient and rapid force sustainment.

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The sustainment panel of the Army Science Board study called, “Enabling Rapid and Decisive Strategic Maneuver for the Army after 2010” consisted of members from the Army Science Board as well as experts from the Army and the commercial sector. The panel focused on changes to Army doctrine, organization and equipment that would efficiently sustain a rapidly deployed force while improving the integration of sustainment operations with force deployment operations.

Sustainment of strategic maneuver operations is a key constraint on how fast decisive combat forces can be employed in an area of operations. The current approach to force projection effectively establishes a minimum time of several weeks between the decision to employ ground combat forces and their availability in theater for combat operations. This two to three week delay is required to deploy the support forces necessary to open the port and force reception facilities, and deploy and then manage enough sustainment supplies for the entire planned force for one to two months. Recent Army planning for lethal light force operations seeks to shorten this reaction time to a week or less. This requires a different approach to sustainment..

# CHAPTER 1



## Today's Sustainment Shortfall

- Initial deployment of large support forces and supplies displaces combat forces.
- Results in 2-3 week lag before significant combat operations can begin.
- Strategic maneuver requires a different approach.

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Currently, a typical force projection operation begins with the insertion of a small combat force possessing a limited capability to seize and hold a minimal number of key port facilities and other key terrain in the area of operations. These early entry forces then establish security to allow entry of a large theater opening force. This force, made up primarily of logistical support personnel, is required to establish an infrastructure to receive the bulk of ground forces, help them reorganize into effective fighting formations, and sustain all US (and often many coalition partner) forces. Additionally, the theater logistics organization is typically tasked by the operational CINC to acquire, receive and store enough supplies for 30-60 days of combat operations for all the US forces planned to be deployed in theater (as well as possibly some or all coalition forces). These two initial logistical actions consume a large proportion of the early lift assets, displacing combat units and their equipment. However, without the initial support force, the combat units would find it difficult if not impossible to link up with equipment, unload it, and make it combat ready. Additionally, even if the combat units had the training and equipment to handle the initial desired stockpile of sustainment supplies, they would find that this was a full time job, precluding any chance of early combat operations. Even if more ships and aircraft were employed the lag time would not be significantly reduced. As demonstrated in recent war games, limited port availability and throughput in the theater of operations proved to be the limiting factor.

# CHAPTER 1



## Sustaining a Lethal Light Force (LLF)

- Tailor split-based logistics support; reserve units should locate and partner with commercial logistics organizations.
- Design containerized unit pre-configured loads for resupply that fits both military and commercial aircraft.
- Acquire commercially available logistics management information management systems as employed by FEDEX, Wal-Mart, UPS, etc... to improve inventory control, stockage, and scheduling.
- Ensure new equipment for LLF have built in diagnostic sensors and reduced fuel and maintenance requirements with more lethal ammunition.
- Establish joint logistical exercises to validate this approach.

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Lighter but more lethal forces and faster, more plentiful lift assets are part of the solution to rapid strategic maneuver. Changes in the way strategic maneuver operations are sustained complete the solution. Extensive use of split-based support would provide enhanced sustainment capability very early in the operation as well as reduce sustainment requirements in the theater. Wide spread use of unit pack shipments designed to move easily through commercial and military transportation systems further speed and streamline the flow of supplies. Best-in-class logistics management systems used by today's leading corporations provide an immediate solution to precisely control the flow of sustainment. Reduced fuel and ammunition consumption need to be primary design requirements for new systems acquired or developed for light lethal forces. Reliability and supportability improvements should also be required. All of these opportunities need to be tested in one or joint logistical exercises prior to adoption.

The rest of this report annex covers corrective actions in detail.

## CHAPTER 2 - ANALYSIS



### Sustainment Issues

- Intermodal Distribution
- Split-Based Operations
- Anticipatory Logistics
- Reducing Fuel and Ammunition Requirements
- Joint Logistical Exercises

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The entire intermodal transportation chain must be harmonized and optimized, from the inland road and rail links in the United States, through our ports, through the global intercontinental transportation links and finally through the ports and transportation infrastructure in the theater. The final leg provided by the United States military, and specifically by the Army, must also mesh seamlessly with the existing and rapidly evolving civilian commercial transportation network.

Deployment can be accelerated by performing as many support operations as possible out of theater (split based support). In the early days of a deployment, competition for lift and throughput will be fierce. This argues against large support forces in theater in the early phases of strategic maneuver.

By having a very good idea of what supplies and services are required by each unit on each day of the operation, support operations can be made more efficient and the size of the deployed support force minimized. (Anticipatory Logistics.)

Any technologies that reduce the the amount of fuel, ammunition, and other supplies required by the deployed force enhance rapid deployment by reducing competition for lift as well as the number of support units required to provide support.

Logistical exercises will be needed to validate each of these approaches.

## CHAPTER 2



### Intermodal Distribution

**Issue:**

- DOD is not keeping up with changes in the commercial and domestic intermodal transportation system

**Findings:**

- Availability of commercial rail surge capacity may be questionable
- Trend toward fewer, larger container ships and outside CONUS hub ports will reduce flexibility.
- Lack of consistent packaging and modularization standards in military at odds with increased commercial utilization.
- DOD does not use best commercial practices and technology

**Recommendations:**

- DCSLOG should establish a project to track Army issues in intermodal distribution. Prepare a position paper to TRANSCOM on the issue.

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Changes in both the domestic rail infrastructure and in domestic and global shipping markets is resulting in less potential access and flexibility. This directly reduces the potential surge capability that could be generated from regular commercial markets in support of future Army operations. The first significant trend is in the rapid globalization of the intermodal shipping industry driven in part by rapidly increasing vessel sizes. Ironically, the nature of the evolving global transportation system does not tend to support uniform access nationally or globally. Ships, ports and inland transportation systems are focused on efficiently linking a few key regions of suppliers and markets through major hub and spoke systems similar to those developed in the passenger airline industry. Outside these areas, the underdeveloped or aging transportation infrastructure is rapidly becoming inaccessible to the fastest growing segment of the container ship fleet. It is not unlikely that regional trouble spots emerging in the next century will most likely be in the underdeveloped or regressing areas poorly connected to the global economy, rather than in the regions favored by market-driven development. Thus the best transportation is rapidly shifting to the most stable areas of the globe and is deteriorating in those regions where future strategic maneuver operations seem most likely. Therefore we recommend that the Army take an active and aggressive role in national and international transportation policy decisions. Issues such as rail mergers, highway and port improvements, and maritime policy directly bear on the Army's ability to deploy swiftly. If satisfactory policy solutions cannot be found, the Army will be well positioned to seek funding of alternative transportation sources.

## CHAPTER 2



### Intermodal Distribution Infrastructure Capacity

**Issue:**

- CONUS transportation infrastructure and availability of commercial surge capacity to meet future deployment requirements.

**Findings:**

- CONUS transportation infrastructure rapidly changing due to deregulation, mergers, and drive towards operating efficiencies.
- Generally good for economy but may reduce surge capacity and/or flexibility in commercial and intermodal shipping.
- Military today has no means of spotting or tracking specific rail or shipping capacity on a real time basis unlike aviation.
- DARPA has concept that identifies and uses hidden airlift capacity.

**Recommendations:**

- Fund DARPA initiative to extend their "virtual airline" technology to both sea and rail/container slots.

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Current economic merger and acquisition trends and demand patterns in the American rail industry especially concern us. In addition to numerous startup problems that have snarled the rail system mergers on both coasts, the fewer merged rail carriers are striving for better optimization of their fleet size to their markets. Thus more rail cars and engines are in operation every day, driving the system towards maximum load factors, while excess trackage capacity is identified and removed from service. Unless Army planning guidelines are updated to reflect this new market, the Army will likely find that assumed widespread surge capacity no longer exists. Demand in commercial rail markets is quite obviously affected by the lack of sufficient competition from other modes, most especially in deepwater domestic shipping. Compounding this problem is a lack visibility of the rail car inventory. The Defense Advanced Research Products Agency (DARPA) developed an information system that identifies excess capacity in the the commercial air fleet and determines how that excess capacity can be harvested through consolidation of demand. The result is the identification of a hidden pool of aircraft available to support military transportation requirements. We recommend that the Army support research aimed at extending this technology to the rail and maritime industries to rapidly identify and efficiently task hidden rail car and container slots assets in the commercial fleets. This could provide an initial mitigation of the constrained market we now see developing in the American cargo transportation infrastructure.



## CHAPTER 2



### Intermodal Distribution Standardization and Packaging

**Issue:**

- Lack of packaging/modularization/tagging standards slows and inhibits both joint commercial and sustainment operations

**Findings:**

- Numerous unrelated sizes and standards in use
- Handling of containers in forward areas is problematic
- No consistent strategy to allow seamless shipment of military equipment via commercial means
- No apparent consistent Army position on standardization
- Numerous theater Material Handling Equipment (MHE) deficiencies have been identified

**Recommendation:**

- The DCSLOG should advocate DOD wide equipment, materials, and MHE design standards consistent with best commercial industry practices

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Establishing packaging, containerization and modularization standards would allow greater use of commercial transportation. The current unpredictability of packaging, palletizing, and/or containerization frustrates efficient cargo handling operations throughout the transportation pipeline. It also unnecessarily requires a multiplicity of materiel handling equipment and the proliferation of large labor pools as an ultimate recourse to bulky and noncompatible shipment packaging. These standards must also extend to tagging and tracking of shipments and the entire inventory.

Establishing these standards would ease the transition of shipments between commercial modes of transportation, between commercial and military transportation providers, between the various military services transportation systems and ultimately to more austere cargo handling capabilities of field units. Smaller packages must nest inside larger packages and then in containers. More specifically, pallets should be modified to fit into standard containers, or standard "multipack" boxes should be used in conjunction with a standard materiel handling machine that would efficiently transfer modules from pallet to container and back. Modules should be packed by unit destination and modularized into bigger shipments on a regional basis. This would allow containers to be sent forward to central support units and then rapidly broken out into smaller shipments to units. Containers and packages must be consistent with unit cargo handling capabilities throughout shipment.

## CHAPTER 2



### Unit Pack Throughput

**Issue:**

- Split-based operations can enhance innovations like *Unit Packing* (i.e., consolidated multi-class shipments tailored to specific field operating units).

**Findings:**

- Early deployment of unit packed shipments minimize cargo handling in theater, reducing in-theater manpower overhead.
- More responsive to CINC requirements.
- Increases efficiency and reduces logistical vulnerability.

**Recommendation:**

- Task CASCOM battle lab to develop concepts for unit pack throughput. Test concepts in the joint contingency force experiment and the Army Force Projection war game.

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Rather than sending large quantities of bulk supplies to a deployed logistical unit for storage, repackaging, and eventual delivery to using units, unit pack keeps the storage and repackaging labor back in the United States, reducing both in theater labor and logistics requirements absolutely. The unit pack service currently offered by the Defense Logistics Agency can be leveraged and extended by streamlining the delivery of the unit pack containers once they leave the container consolidation point. In this way a full box, multipack, pallet or container can be throughput directly to a deployed unit with little or no intermediate handling. Toward this end, we recommend that the Army fully explore the potential of guided precision airdrop of large packages. If the C5 fleet is used to deliver these packages, hidden capacity in the air lift fleet is released by avoiding congested in theater air fields entirely. Unit packs are more responsive to CINC requirements by ensuring that units receive all of the supplies they need. This will improve the current situation where some supplies in theater are invariably short while others are in excess, representing wasted lift assets. By moving the bulk of the cargo handlers out of theater and into improved facilities, efficiency is increased while the number of troops at risk is reduced.

## CHAPTER 2



### Intermodal Distribution Joint Delivery System

**Issue:**

- Lack of standardization, compatibility, and integration within commercial and military transportation systems create bottlenecks which slow sustainment operations.

**Findings:**

- Modern transportation systems provide efficient movement of shipments with a minimum of delay and handling.
- Commercial shippers use a tightly integrated system of information and materiel handling systems and platforms resulting in speed, reliability, and a minimum of "touches" and labor.
- DOD transportation has largely not adopted these efficiencies.

**Recommendation:**

- DCSLOG should identify a set of commercial distribution management and cargo handling practices and seek DOD-wide acceptance and compliance.

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Lack of standardization, compatibility, and integration within commercial and military transportation systems create bottlenecks which slow sustainment operations. For example, there is often a lack of the correct material handling equipment to move transiting containers. Also, the military information management systems used to identify, route, and track shipments often do not properly interface with commercial shippers, again leading to delays. A joint tactical air-ground intermodal delivery capability (Joint Delivery System) would provide a key enabler for lethal light force operations. This would require a closely coordinated effort between the services and commercial air express carriers to allow a seamless handoff of cargo from air to ground, ground to air, and commercial to military carrier. If such a capability existed, commercial air and sealift could deliver shipments to a regional port. Tactical airlift could then quickly pick up the shipments and deliver them to distribution centers near to forward-based units. Typically, this could save up to three days in delivery times.

## CHAPTER 2



### Split-Based Operations

**Issue:**

- Deployment can be accelerated and in-theater logistical footprint reduced through increased use of *split-basing* (i.e., maximum rear-basing of transportation, intel, engineering, finance, QM, personnel, medical, MP and other functions).

**Findings:**

- Limited *split-basing* successful in operations (Haiti, Bosnia)
- Innovations adopted or easily implemented by Army units and installations, AMC, DLA, industry, and the Reserve Components allow for increased *split-based* support
- War games and plans not reflecting successes or full potential.
- Reserve components could be key to *split-based* operations.

**Recommendation:**

- Prepare specific validation standards for CSS aspects of split-based operations. Evaluate performance during the Force Projection war game.

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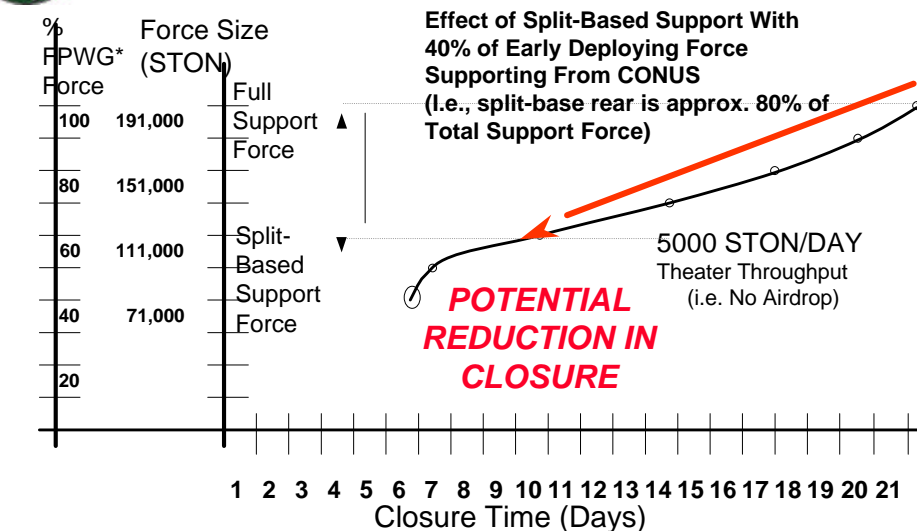
The purpose of split-based support operations is to transfer out of theater all services that can be performed elsewhere, as well as to reduce labor “touch-points”. This approach is already being applied to many combat, combat support, and combat service support management and analysis tasks. Tasks as diverse as intelligence analysis, signal intercept, communications network management, materiel management, finance services and personnel administrative support can be done out of theater using current communications capabilities. Transfer of labor, also needs to be pursued vigorously (e.g. unit pack concept).

Split-based support operations also allows for the reduction of the logistics footprint within theater. This action is critical to the future battlefield as demonstrated during the Army After Next Spring war game recently conducted at Carlisle Barracks. During the game, the red forces conducted cruise missile attacks, using both conventional and chemical munitions, against possible logistical support facilities such as ports, pipelines, rail, highways, and bridges. The white team assessed the degradation of blue sustainment capability from 65-70 percent. Clearly, reduction of the forward-based logistics infrastructure will minimize future vulnerability to attack.

Precise logistics management and communication are required to support split-based support operations. Leveraging the existing logistical command, control and management infrastructure resident primarily in the Army Reserve can meet this requirement. Reserve component forces and their command structure should be actively engaged early in the support operation, deploying first to local split-based support locations.



## Split Based Support



\* 1999 Force Projection War Game (FPWG)

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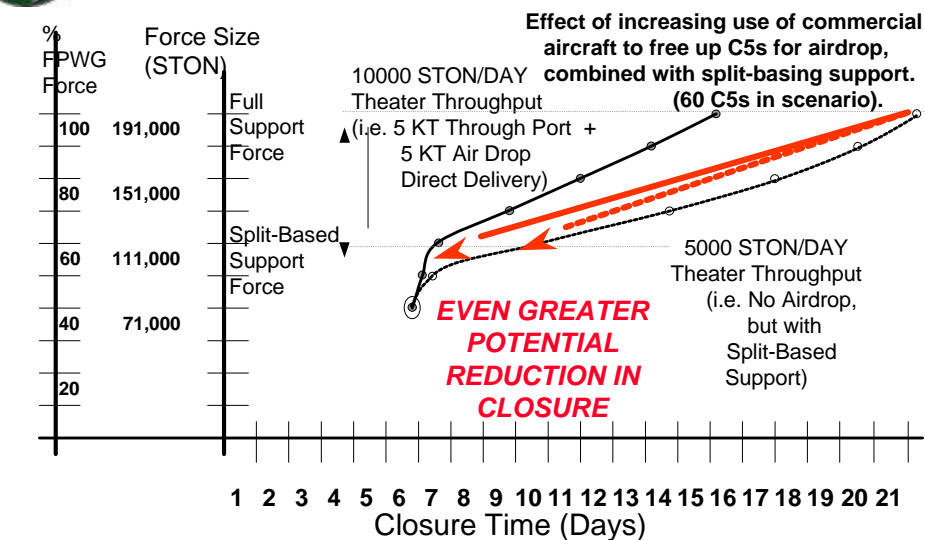
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This chart illustrates possible savings in closure time for early deploying forces resulting from split based support, as predicted by Army force deployment models. Assuming that (1) the support component is roughly half the total early deploying force and that (2) split basing would require only 20% of the support force to be forward deployed, split basing would reduce the size of the deployed force by 40%. This 40% savings is within the range estimated by the sustainment team at the February 1999 Force Projection War Game at Fort Eustis. The units identified as split based candidates included heavy repair units, repair parts and other bulk supply units, logistics management units, and a number of combat support units providing a range of analysis and management services. The result is a 50% decrease in force closure time from 21 to 10 days.



## Split Based Support & Unit Pack Direct Delivery



\* 1999 Force Projection War Game (FPWG)

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This chart illustrates the combined savings in closure time by using unit pack direct delivery along with split based support. The combined effect is a nearly 75% decrease in force closure time from 21 to just over 6 days.

## CHAPTER 2



### Split-Based Operations Reserve Component Roles

**Issue:**

- Reserve capabilities could be exploited to fully implement split-basing.

**Findings:**

- Reserves could manage logistical interface of split-based operation and free up active Army resources.
- Split-based ops transfer labor from theater back to CONUS
- Peacetime logistical workforces are fully tasked at current level of workload
- High payoff at little cost; and increases CINC control.

**Recommendation:**

- Assign responsibility for CONUS/OCONUS split-based combat service support to USAR from the *onset* of hostilities.

Although soldiers from any component of the Army could be assigned to the support command rear, the benefits of using primarily Army Reserve personnel for this mission seem especially attractive. First, most of the support command deployed strength is currently owned by the United States Army Reserve including individual replacements. Currently, active and active reserve personnel do the initial planning and then hand the mission off to the operational units when they arrive. In fast paced strategic maneuver operations there is no longer time for a delayed deployment of theater support forces. However, by operating from a number of regional locations within the United States, Reserve Component personnel can come on line in direct support of the deployed CINC very rapidly, since their mobilization process is simpler and their movement to duty locations is much shorter. This allows future planners to utilize the Reserve and their resident civilian acquired skills to a greater degree than they can now. We recommend that the Army institutionalize this approach to Theater Support Command manning and deployment.

## CHAPTER 2



### Anticipatory Logistics

**Issue:**

- Large potential savings from advanced accurate estimate of requirements from integrated planning

**Findings:**

- Universal imbedded diagnostics would increase readiness
- Timely, accurate, or integrated planning information *decreases* logistics demands
- Disconnect between operations and logistics planning
- No systematic identification of critical shortages

**Recommendations:**

- Identify and adopt best practices and technologies of other services and commercial sector for data gathering, analysis, and logistical planning.

Thinking ahead provides for a better logistics management process. There is a large potential savings system wide from advanced, accurate, timely estimates of requirements derived from integrated planning. This anticipatory logistics process requires extensive fleet instrumentation, diagnostics, systematic identification of critical shortages and an effective connection between operational and logistical planning. The Army has fallen substantially behind the commercial sector and some of the other services in both technologies and practices. Much of the technology to do this can be bought now off the shelf.



## CHAPTER 2



### Anticipatory Logistics Sensors and Diagnostics

**Issue:**

- The Army has not taken advantage of commercial advances in diagnostic and sensing technology.

**Findings:**

- Commercial industry now realizing substantial savings from increasing use of low cost sensors and diagnostics.
- Improvements in communications technology allow greater use of diagnostics information throughout the logistics system.
- Increased use of these technologies would allow more accurate planning factors, saving both dollars and people.

**Recommendation:**

- Include sensing and diagnostic technologies in all future Army systems; and integration of data collection through central logistics information network.

Embedded diagnostics is becoming virtually universal in the private sector. Such sensors and diagnostics provide advance warning of failure that allow the operators to both save money on repairs as well as to avoid or mitigate the effects of equipment failure. The Army substantially lags in the adoption of this technology. The Army should focus its efforts in three areas. First require standardized instrumentation of all new and rebuilt equipment. Secondly, establish a retrofit program. Thirdly, data should be collected from the Army fleet whether or not instrumented. This data should be analyzed across a centralized logistics network for trends and performance characteristics. The analysis results should then guide corrective action.

## CHAPTER 2



### Anticipatory Logistics Logistics Information

**Issue:**

- Lack of timely, accurate, integrated logistical information and integrated logistical and operational planning.

**Findings:**

- No single point of contact for logistical planning information about facilities, local conditions, etc. (i.e. transit rights)
- Current planning factors are *ad hoc*
- Joint force requirements appear to simply add, not integrate individual service requirements.
- No established link between operations planning, command and control, and logistics forecasting/ management systems.

**Recommendation:**

- Army should support an effort to develop a commercially based, DOD-wide integrated information infrastructure that supports operational and logistical planning.

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Commercial supply chain forecast accuracy and precision has overtaken and now far exceeds that of the Army's logistics systems. Army retail forecasting fails to take into account known future events that will change the historical consumption patterns. The Army's total inventory is not considered when making buy decisions. Army logistics managers do not have powerful forecasting tools that are now common in the commercial sector. Nor are Army logistical planning systems well linked to each other, tied to operational planning, and to command and control systems. Thus the logistics system does not adjust to plans of the war fighters until operations are under way. This reactive approach to logistics is unacceptable for support of rapid strategic maneuver operations. Supplies should be placed in motion in concert with force deployments, and operational planners need to be sensitive to supportability constraints. The Army should support an effort to develop a commercially based, DOD-wide integrated information infrastructure that supports operational and logistical planning. It should fully participate in the DARPA Advanced Logistics Project (ALP).

## CHAPTER 2



### Avoidance of Critical Shortages

**Issue:**

- Shortage of critical items to meet surge requirements

**Findings:**

- Lack of visibility and identification of pacing items of supply
- No automatic system to trigger requisitions of required stocks
- Lack of single logistics manager of critical shortages
- Increased warning times mitigates lead times for military unique items

**Recommendation:**

- Logistical data should be analyzed to identify potential shortages during force deployment periods. Establish surge capability or inventory for critically managed items to ensure sustainment.

Short notice, rapid response missions do not allow for shortages of long lead time items. Recently, the other services experienced mission impairing shortages of critical precision munitions. The Army could face the same problem. It is essential that potential shortages of key munitions and other long lead time supplies be identified and tracked at all times. Operational plans need to be evaluated by logistics planners to identify the possible requirements and then compare these requirements with stocks on hand and the lead time required to resume production. Alternative sources should be identified that could then provide key components on relatively short notice.

## CHAPTER 2



### Reduced Fuel and Ammunition Requirements

**Issue:**

- High fuel efficiency and increased weapons lethality can reduce sustainment requirements

**Findings:**

- Fuel and ammunition drive sustainment requirements
- Alternative fuel efficient power sources are under development: hybrid electric drive commercially available.
- Alternative lethal conventional munitions, such as aluminum hydride energetic materials, are being explored. Major challenges remain in pulse power and electro-magnetic launch.

**Recommendation:**

- Assure integration of these technologies into the future force. Make fuel efficiency an explicit requirement for all new systems.

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Reducing fuel and ammunition requirements is crucial to scaling back sustainment. New technologies are under development that show promise to accomplish these these reductions. The Army needs to support these efforts.

## CHAPTER 3

# RECOMMENDATIONS & CONCLUSION



### Recommendations

#### **Intermodal Distribution**

- DCSLOG should establish a project to track Army issues in intermodal distribution. Prepare a position paper to TRANSCOM on the issue.
- Fund DARPA initiative to extend their “virtual airline” technology to both sea and rail/container slots.
- The DCSLOG should advocate DOD wide equipment, materials, and MHE design standards consistent with best commercial industry practices
- Task CASCOM battle lab to develop concepts for unit pack throughput. Test concepts in the joint contingency force experiment and the Army Force Projection war game.
- DCSLOG should identify a set of commercial distribution management and cargo handling practices and seek DOD-wide acceptance and compliance.

## CHAPTER 3

# RECOMMENDATIONS & CONCLUSION



### Recommendations

#### **Split-Based Operations**

- Prepare specific validation standards for CSS aspects of split-based operations. Evaluate performance during the Force Projection war game.
- Assign responsibility for CONUS/OCONUS split-based combat service support to USAR from the *onset* of hostilities.

#### **Anticipatory Logistics**

- Identify and adopt best practices and technologies of other services and commercial sector for data gathering, analysis, and logistical planning.
- Include sensing and diagnostic technologies in all future Army systems; and integration of data collection through central logistics information network.

## CHAPTER 3

# RECOMMENDATIONS & CONCLUSION



### Recommendations

#### **Anticipatory Logistics (cont)**

- Army should support an effort to develop a commercially based, DOD-wide integrated information infrastructure that supports operational and logistical planning.
- Army should assign responsibility for defining and establishing a fully integrated logistics planning process that could be extended to joint planning.

#### **Avoidance of Critical Shortages**

- Logistical data should be analyzed to identify potential shortages during force deployment periods. Establish surge capability or inventory for critically managed items to ensure sustainment.
- Assure integration of these technologies into the future force. Make fuel efficiency an explicit requirement for all new systems.

## CHAPTER 3

### RECOMMENDATIONS & CONCLUSION



#### Critical Actions

- **Reduce forward support footprint by maximum relocation of support operations out of theater.**

*Key Actions:* Expand use of *split-based operations*; leverage Reserve components earlier; implement rear-based *unit packaging*; include modularization and containerization; apply *best commercial practices* to optimize command, control, and distribution. Need joint test to explore implications.

- **Identify operational vulnerabilities in CONUS-based and global intermodal systems that limit DOD use of commercial transportation system.**

*Key Action:* War game intermodal rail, truck, port, and international US and foreign-flag operations *under stressed commercial conditions* (from factory to foxhole).



## CHAPTER 3

### RECOMMENDATIONS & CONCLUSION



#### Critical Actions

- **Reduce *sustainment* requirements by anticipating *logistics* requirements.**

*Key Actions:* Adopt *best practices and technologies* of other services and commercial sector for data gathering, analysis and logistical planning; require inclusion of *diagnostic sensors* in all future Army systems; and integrate data collection through *central logistics information network which is available to all users*. Need joint test to explore implications.

- **Reduce demand for fuel and ammunition.**

*Key Actions:* Make *fuel efficiency* an explicit requirement for all new systems and more aggressively invest *research and development* in relevant technologies.

# **Enabling Rapid and Decisive Strategic Maneuver for the Army After 2010**

## **Analytics and Programmatic Panel Report**





## Analysis Subpanel Annex Report Army Science Board July 21, 1999

Marygail Brauner, Thom Hodgson (chair), Judith Liebman, Susan Lowenstam,  
Warren Morrison, Gabe Robins, Joe Rowe, Owen Spivey, Mike Williams

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## Executive Summary

The panel's goal was to provide an analytic framework to enable the U.S. Army to achieve a more effective and timely strategic maneuver capability. "Strategic Maneuver" is defined as the ability to rapidly project overwhelming military power worldwide. In particular, a range of enabling technologies and capabilities were evaluated to achieve the Army's strategic planning guidance with an early entry force closing in a theater within 4 to 7 days, with total force closure occurring in 30 days or less.

An analytic, time-stepped, network-flow based model was constructed in order to assess closure time sensitivity to various factors, including the number, type and speed of the ships, the port throughput capacity, transshipment times, and theater road and rail capacity. The model is general enough to allow cargo that is either air- or sea- transportable to be shipped in the most optimal way.

A fundamental tenet of power projection is the rapid closure of forces in the theater; rapid force closure reduces vulnerability of the forming forces, and enhances our national political goals by providing an agile, decisive, and credible threat. The time for total force closure is dependent on factors such as the planning cycle time (Fig. 6), the size and weight of force movement requirement, sea and air lift asset capabilities, port throughput capacity, and theater road and rail capacity.

The Army plans to increase early entry lethality by adding two strike forces to existing early entry forces. The improvement required can not be achieved by a single element. Rather, early entry speed depends on a number of factors such as the size and weight of the force movement requirement, sea and air lift assets, strategic airport capability, theater throughput capability, and air and pre-positioning mix.

Topics considered in the analysis include deploying assets faster, lightening and repackaging the force, improving military lift capability, exploiting commercial lift, increasing throughput and sustainment capacity, and increasing seaport capacity. Sustainment capability was addressed by varying the total weight of the deploying force.

The model was tested on a typical operational plan, broken into two phases consisting of an early entry force, followed by a follow-on force (weighing 193,000 and 566,000 tons, respectively). All forces were required to close within 30 days. The baseline closure times are 21.5 days for the early entry, and 75 days for the total force.

Using the optimization model, an early entry force closure time of 5 days was achieved, and 35 days for total force closure. The analysis shows that the time to total force closure can be reduced by half through the judicious use of mobility assets and process improvements. Once the sea lift ships begin arriving, their capacity far outweighs airlift capacity. In conclusion, total force closure time depends both on improved port processes and increased sea lift capacity.

The model demonstrates the utility of this network based linear programming technology for aggregate level planning and analysis. This will shorten the scenario evaluation time lines.

## Results and Recommendations

Using a time-stepped, network-flow model, a range of enabling technologies and capabilities were evaluated to achieve the Army's strategic planning guidance that required an early entry force closing in a theater within 4 to 7 days, with total force closure occurring in 30 days or less. We were able to meet the early entry goal and came within 5 days of the total force closure goal.

A series of scenarios were evaluated to assess the sensitivity of early entry and total force closure times to various factors: the dimensions, weight, and location of the forces to be moved, the number, capacity and speed of air and sea lift assets, the throughput capacities of seaports and airports, theater road, rail, and waterway capacities, split-base operations, and the use of intermediate staging bases. Figure 11 lists the transportation asset assumptions used in the scenarios.

**Early entry:** Our analysis demonstrates that the time to complete early entry depends on the dimensions, weight,

and location of the early entry force, the throughput capacities of CONUS and strategic airports, the number, capacity and speed of air lift assets, the availability of pre-positioned sea lift assets, theater area throughput capacity, and the use of pre-positioned forces. The use of intermediate staging bases was also examined. (See Fig. 9 and 10.)

**Recommendation:** To improve our early entry capabilities, we need to reduce the size (dimensions and weight) of the early entry forces, use split-base operations, use prepositioned forces, and improve throughput capacity at airports. These results are illustrated in Figs. 5, 6, 7, and 8. Airport throughput capacity can be improved by increasing material handling capabilities and using multiple and more capable airfields.

**Total Force Closure:** Our analysis also showed that the total force closure time is most sensitive to the dimensions, weight, and location of the forces to be moved, the throughput capacities and capabilities of seaports, the number, capacity, and speed of ships, and road, rail and waterway capacities in the theater. Once ships begin arriving, their capacity outpaces air capacity regardless of force mix and size. Loading and off-loading times at seaports can be improved by better material handling and redesigned ships. An examination of Fig. 7 shows that total closure time approaches but does not reach 30 days with the assets considered, including lightening the force.

**Recommendation:** To decrease the total force closure time, increases are needed in both sea lift and seaport throughput capacities.

In summary the Army can achieve early entry closure in 4-7 days and total closure in 35 days if it reduces the weight of early entry forces by 50%, decreases container ship load/unload time by 66%, decreases all other load/unload time by 50%, employs 66 CRAF, doubles SPOD and APOD throughput capacity, and employs 1.6M short tons of sea lift (80 container ships).

## Introduction

After reviewing the available models that depict the deployment process (see Fig. 4), it was clear that there were problems that would make it difficult to use them in the ASB project. Some of the models were extremely detailed. They had significant run times that could cause problems in obtaining sufficient data points for the pending experimentation. More importantly, they typically required the user to develop a detailed TPFDD for each run of the model. The ad hoc nature of TPFDD development makes sensitivity analysis of little use. The ASB study experimentation has used notional force structures, and requires extensive sensitivity analysis. It was decided to develop a relatively simple linear deployment model that could optimize the TPFDD process, and would be efficient computationally. While this model is not an *army-approved* model, it will allow us to engage in the extensive experimentation that we believe is necessary for the study. It has been validated against the detailed deployment models used by MTMC-TEA and USTRANSCOM.

The rest of this report describes the structure and use of a logistics (network flow) model developed to evaluate army deployment scenarios in the year 2010-2015 time frame. The model structure is depicted in Fig. 1.

The computer model being used in the analysis is essentially a pipeline model. Equipment and people are 'flowed' through the transportation system to their final destination (the staging area). Various nodes of the model (airports and seaports) are limited in their capacity to process people and equipment. These capacity limitations are the actual (or forecast) capacities of the facilities to be used, and are expressed in tons/day. Various transportation links (air routes, sea routes, roadways, and railways) are also limited in their capacities. These capacity limitations are a function of the specific assets available (number of and type of aircraft, and numbers of and types of ships), the distance involved in the deployment, and the capacity of the roadways and railways involved. In addition, the flow of material within the transportation links of the model is delayed by the length of time associated with the particular link (i.e., flight, sea, rail, and road times).

Since specific items of equipment are "blurred" in the process, flow relative to sea borne and air borne resources can be optimized, and as a side product, the issues of determining a TPFDD are circumvented. For a specific set of inputs (i.e. required troops and equipment to be moved, and the capacities of the available transportation equipment and infrastructure), the model finds the allocation of troops and equipment to the various available transportation assets which minimizes the time to close on the assembly area. Optimization is performed using a form of linear programming.

In achieving rapid computing times, the model necessarily neglects many factors such as costs, threats, and command and control factors. However, the effects of these factors normally are felt in limiting of the capacities of

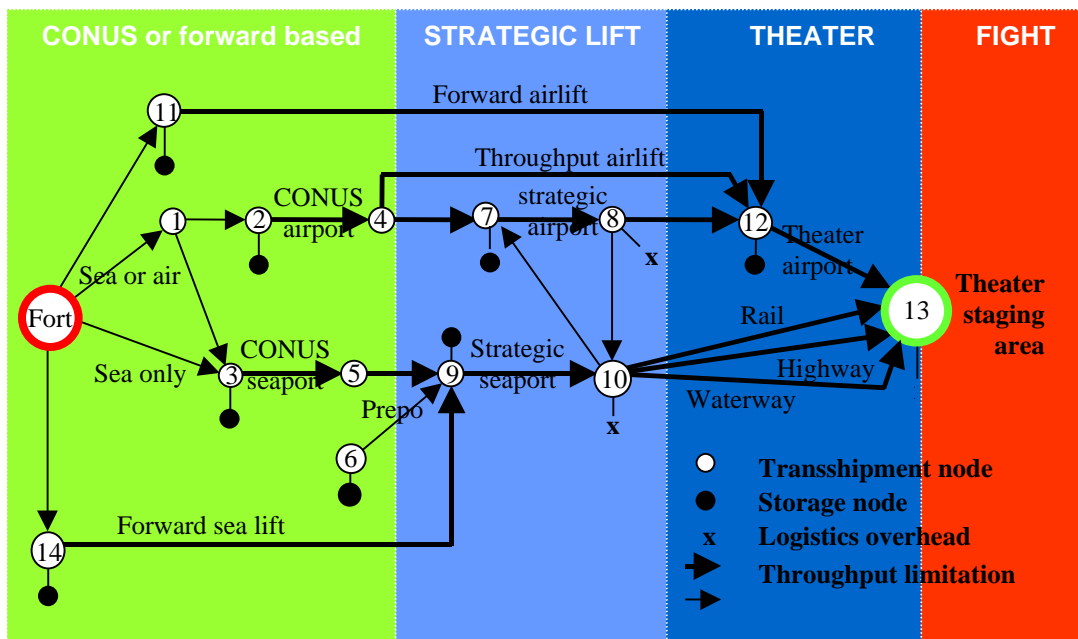


Figure 1: AAN Logistics Model Schematic

specific links in the network. Thus the issue, in terms of the model is; What is the sensitivity of the model to deterioration of the various elements (APOE's, SPOE's, APOD's, SPOD's, aircraft, road nets, etc.) of the model.

Since troops and equipment are 'flowed' to their destination, troops and equipment lose their identities. This 'biases' the model in that, for a given scenario, the time to close may be somewhat less than reality. In other words, if a specific set of transportation assets results in the model closing on the assembly area in say 15 days, then in reality the time may be longer. However, the sensitivity of the model to the inputs should be relatively close to reality. It should be noted that all models, by their very nature are biased. In this case the bias is clear in that the optimizer (linear program) allocates personnel and equipment in such a way as to most efficiently utilize the transportation resources, and port resources available. If the model indicates that a particular scenario cannot be executed successfully, then that scenario most likely is not possible in the real world either.

In order to use the model effectively, specific scenarios must be carefully constructed and evaluated to ascertain the sensitivity of the 'time to close' on the staging area to the available transportation asset levels and infrastructure capabilities. Tradeoffs between methods of delivery for a given level of assets to be delivered to the theater need to be made. Costs and other critical factors can be included in the various scenarios.

The model can be capacitated at a number of points. The CONUS airport of embarkation (APOE) (arc 2-4), the CONUS seaport of embarkation (SPOE) (arc 3-5), the strategic airport of debarkation (arc 7-8), the strategic seaport (arc 9-10), the forward APOE (arc 11-12), the forward SPOE (arc 14-9), and the theater airport (arc 12-13) all may be limited in their capacity to process personnel and equipment to a given tons per day. The transportation links in the network: strategic airlift (arcs 4-7, and 4-12), strategic sealift (arc 5-9), theater airlift (arc 12-13), forward airlift (arc 11-12), forward sealift (arc 14-9), highway (arc 10-13), rail (arc 10-13), and waterway (arc 10-13) all may be limited in their capacity to transport personnel and equipment to a given tons per day. In addition, transportation requires time (particularly sea transportation). This is factored into the model as flow is delayed by the specific transportation time on the arcs representing sea (arc 5-9), strategic air (arc 4-7), through air (arc 4-12), highway (arc 10-13), railway (arc 10-13), and waterway (arc 10-13).

The model inputs include (1) the delivery schedule of material to the POE's (both CONUS and OCONUS); (2) the required heavy equipment (primarily M1A1 tanks that are transported by sea, both CONUS and OCONUS); (3) the pre-positioned equipment delivery schedule; and (4) the logistics overhead associated with the SPOD, APOD, and the staging area. See Appendix A for an example of the input data sheet.

## The Network Model

The model is structured as a time stepped network. The basic time increment in the model is six (6) hours. For instance, equipment leaving the SPOE (node 5) in the middle of day 3 (i.e., day = 3.5) for a trip of 5.25 days, arrives

at the strategic seaport (node 9) in the last part of day 8 (i.e., day = 8.75). Linear costs are assigned to the various arcs. Using these costs, linear programming provides the allocation of flow in the model. Costs are assigned as follows:

1. A cost of 1000 is assigned to each unit of flow on overflow arcs (i.e., arcs that go beyond the maximum time allowed by the model). These arcs are used only if the delivery schedules cannot be met through normal flow. This is just a practical facet that insures the “mathematical feasibility” of the model.
2. A linearly increasing cost is assigned to the 13-98 arc. The cost goes up each day. Since flow in earlier periods is cheaper, it is insured that the time to closure of the force is minimized.

The overall result of running the model is that an indication how quickly the scenario can be brought to closure. Indications of bottlenecks are given with simple graphs provided to indicate where backlogging has occurred (see the output in Appendix B.) Critical flows in each time period are output for more detailed analysis (an \* indicates where these flows are at the arc capacity<sup>3</sup>).

## Model Input Parameters

An example of the form for entering model input parameters can be seen in Appendix A. The following expands, and hopefully clarifies, the definitions used on that form (the maximum time within which the system can be exercised is 100 days).

<u>Sea distance (SPOE):</u>	The distance, in nm, from the SPOE to the SPOD.
<u>Forward sea distance:</u>	The distance, in nm, from the forward SPOE to the SPOD.
<u>Number of ship types:</u>	Number of different ship types in the data.
<u>#Ships type i (strategic):</u>	The number of ships of type i available from CONUS.
<u>#Ships type i (forward):</u>	The number of ships of type i available from forward base.
<u>Ship speed i:</u>	The speed, in knots, that ships of type i travel.
<u>Ship capacity i:</u>	The carrying capacity, in tons, of ships of type i.
<u>Ship load time i:</u>	Ship load time (in hours).
<u>Ship unload time i:</u>	Ship unload time (in hours).
<u>Sea capacity i:</u>	The maximum number of tons/day that can be carried in strategic sealift by ships of type i ( <i>calculated</i> ).

$$Sea\ Cap = (\#\ ships) * (ship\ cap) / ((2 * sea\ distance) / (ship\ speed) + (ship\ load\ time) + (ship\ unload\ time))$$

Sea days i from CONUS: The time to transport equipment from the CONUS seaport to the strategic seaport by ships of type i (*calculated*).

$$Sea\ days = (sea\ distance) / (ship\ speed) + (ship\ load\ time) + (ship\ unload\ time)$$

<u>Strategic air distance:</u>	The distance, in nm, from the APOE to the strategic APOD.
<u>Through air distance:</u>	The distance, in nm, from the APOE to the theater APOD.
<u>Forward air distance:</u>	The distance, in nm, from the forward APOE to the theater APOD.
<u>Theater air distance:</u>	The distance, in nm, from the strategic APOE to the theater APOD.
<u>Number of aircraft types:</u>	Number of different aircraft types in the data.
<u>#Aircraft type i (strategic):</u>	The number of aircraft of type i available to be used for transport from the APOE to the strategic APOD.
<u>#Aircraft type i (through):</u>	The number of aircraft of type i available to be used for transport from the APOE to the theater APOD.
<u>#Aircraft type I (forward):</u>	The number of aircraft of type i available to be used for transport from the forward APOE to the theater APOD.



#Aircraft type i (theater): The number of aircraft of type i available to be used for transport from the strategic APOD to the theater APOD.

Aircraft speed i: The speed, in knots, that aircraft of type i travel.

Aircraft capacity i: The carrying capacity, in tons, of aircraft of type i.

Aircraft load time i: Aircraft load time (in hours).

Aircraft unload time i: Aircraft unload time (in hours).

Strategic-air capacity: The maximum number of tons/hr that can be carried in strategic airlift from the CONUS airport to the strategic APOD (*calculated*).

$$\text{Strat air cap} = (\# \text{ a/c}) * (\text{a/c cap}) / ((2 * \text{strat-air-distance}) / (\text{a/c speed}) + (\text{a/c load time}) + (\text{a/c unload time}))$$

Strategic-air time: The time to transport equipment from the CONUS airport to the strategic APOD (*calculated*).

$$\text{Strat air time} = (\text{strat-air-distance}) / (\text{a/c speed}) + (\text{a/c load time}) + (\text{a/c unload time})$$

Through air capacity: The maximum number of tons/hr that can be carried in military airlift from the CONUS airport to the theater airport (*calculated*).

$$\text{Thru air cap} = (\# \text{ a/c}) * (\text{a/c cap}) / ((2 * \text{thru-air-distance}) / (\text{a/c speed}) + (\text{a/c load time}) + (\text{a/c unload time}))$$

Through-air time: The time to transport equipment from the CONUS airport to the theater airport (*calculated*).

$$\text{Thru air time} = (\text{thru-air-distance}) / (\text{a/c speed}) + (\text{a/c load time}) + (\text{a/c unload time})$$

Theater air capacity: The maximum number of tons/hr that can be carried in military airlift from the strategic airport to the theater airport (*calculated*).

$$\text{Theater air cap} = (\# \text{ a/c}) * (\text{a/c cap}) / ((2 * \text{theater-air-distance}) / (\text{a/c speed}) + (\text{a/c load time}) + (\text{a/c unload time}))$$

Theater-air time: The time to transport equipment from the strategic airport to the theater airport (*calculated*).

$$\text{Theater air time} = (\text{theater-air-distance}) / (\text{a/c speed}) + (\text{a/c load time}) + (\text{a/c unload time})$$

CONUS seaport capacity: The maximum number of tons/hr that can be processed through the CONUS seaport and loaded on ships at the CONUS seaport.

CONUS airport capacity: The maximum number of tons/day that can be processed through the CONUS airport and loaded on aircraft at the CONUS airport.

Forward seaport capacity: The maximum number of tons/hr that can be processed through the forward seaport and loaded on ships at the forward seaport.

Forward airport capacity: The maximum number of tons/day that can be processed through the forward airport and loaded on aircraft at the forward airport.

Strategic airport capacity: The maximum number of tons/day that can be offloaded from strategic aircraft and processed through the strategic airport.

Strategic seaport capacity: The maximum number of tons/day that can be offloaded from strategic sealift and processed through the strategic seaport.

Theater road time: The transport time by road from the strategic airport (or seaport) to the staging area.

Theater road capacity: The maximum number of tons/day that can be carried by road from the strategic airport (or seaport) to the staging area.

Theater rail time: The transport time by rail from the strategic airport (or seaport) to the staging area.

Theater rail capacity: The maximum number of tons/day that can be carried by rail from the strategic airport (or seaport) to the staging area.

Theater water time: The transport time by waterway from the strategic airport (or seaport) to the staging area.

Theater water capacity: The maximum number of tons/day that can be carried by waterway from the strategic airport (or seaport) to the staging area.

Theater airport capacity: The maximum number of tons/day that can be offloaded from military aircraft and processed through the theater airport.

Lift profile: The lift profile is a way of detailing the availability's and requirements in terms of the delivery schedules and requirement schedules. Specifically, the model takes as input the delivery schedules of equipment to be delivered to the CONUS SPOE and APOE, and to the forward SPOE and APOE. The model allows the user to specify the total number of tons that are required to go by sea and, if required, the minimum delivery schedule (in tons) of sea born equipment to the staging area. The total requirement (in tons) has to be specified by the user. The user can specify the delivery schedule of Prepo equipment to the strategic seaport. Finally, the user can specify the logistics overhead usage (in tons) at the strategic SPOD and APOD, and at the theater APOD.

The model optimizer will find a schedule that minimizes the time for the total force to close on the staging area. Optimization is performed using a special purpose form of linear programming (in this case a minimum cost network flow out-of-kilter algorithm). A summary of base scenario assumptions is in Fig. 11.

## Using the Model

Using the model is relatively simple. The program can be run from DOS, or by double clicking from the file manager. Both the parameter file (Appendix A) and the executable file (aan9.exe) should be placed in the same directory. Edit input the parameter file to set the scenario you wish to run. Then from the DOS prompt in that directory, type "aan9" (the "9" is a number referring to the current version of the model). You will be asked to furnish the name of the parameter file (enter it). You will be asked to furnish the name of the output file (enter the name of your choice). The model is then assembled based on the parameter set provided and is executed. The output is stored in the output file. Typically, this process takes just a few seconds. You can then open the output file (Appendix B) to view the results. It is recommended that an improved front end and back end to the model be developed and packaged with the model to facilitate usage by others.

## An Example

The sample input and output (shown in the appendices) is an excursion from the USA to Omnia (who knows where). A notional battle force is being sent that is air and/or sea transportable. Both air and sea transportation resources are available. The parameters describing the excursion are contained in Table 2. Equipment is delivered to the CONUS and OCONUS POE's on the days shown. Pre-positioned equip is delivered to the strategic airport as shown. The model finds the quickest time to closure. Using a combination of sea and air transportation (see output in Appendix B), the force closes in 75.0 days. There is no logistics overhead scheduled.

The sensitivity of the output to various input parameters can be tested easily. With some thought you may be able to see some obvious experimentation that can be performed. The model provides a means by which intuition can be quantified quickly and accurately.

## Notional Scenario

A notional deployment scenario was developed by MTMCTEA to evaluate the linear model as well as serve as a structure to evaluate various proposed and existing transportation assets/concepts. The scenario is based on the emerging global trends projected to the year 2020:

- Increased global demand for limited resources
- Increased third-world nationalism
- Unstable third-world political structures
- Migration of “high tech” military technology/weapons to third world nations
- Increased possibility of use of weapons of mass destruction by smaller/undeveloped nations.

An additional criteria was to avoid security/political restrictions to allow distribution of data and discussions via email and public forums.

The scenario is centered around the notional country of Omnia, a third-world nation approximately twice the size of California in sub-Saharan Africa. In response to an escalating military threat from a neighboring country, the Omnian leadership requested military assistance from the United States. Since the threatening country, Klatch, has engaged in acts of terrorism including the assassination of the U.S. ambassador, the National Command Authority decided to deploy joint major military forces to stabilize the region as well as counter possible terrorist use of weapons of mass destruction.

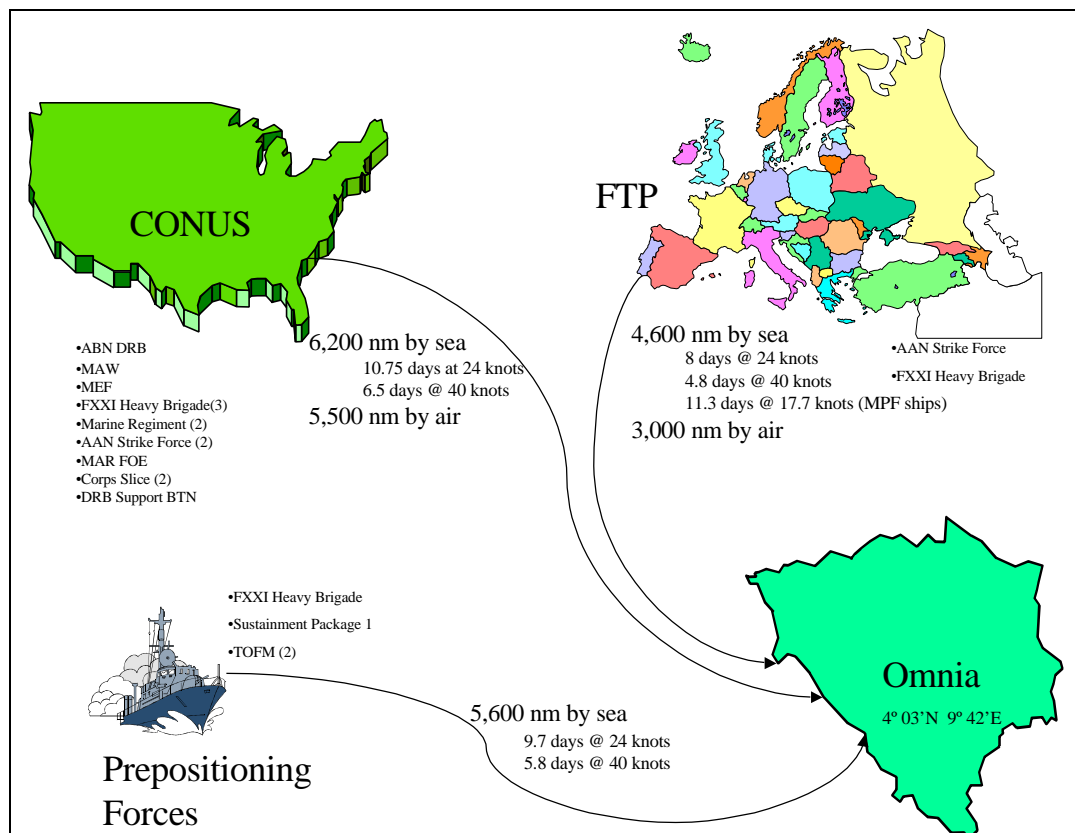


Fig. 2

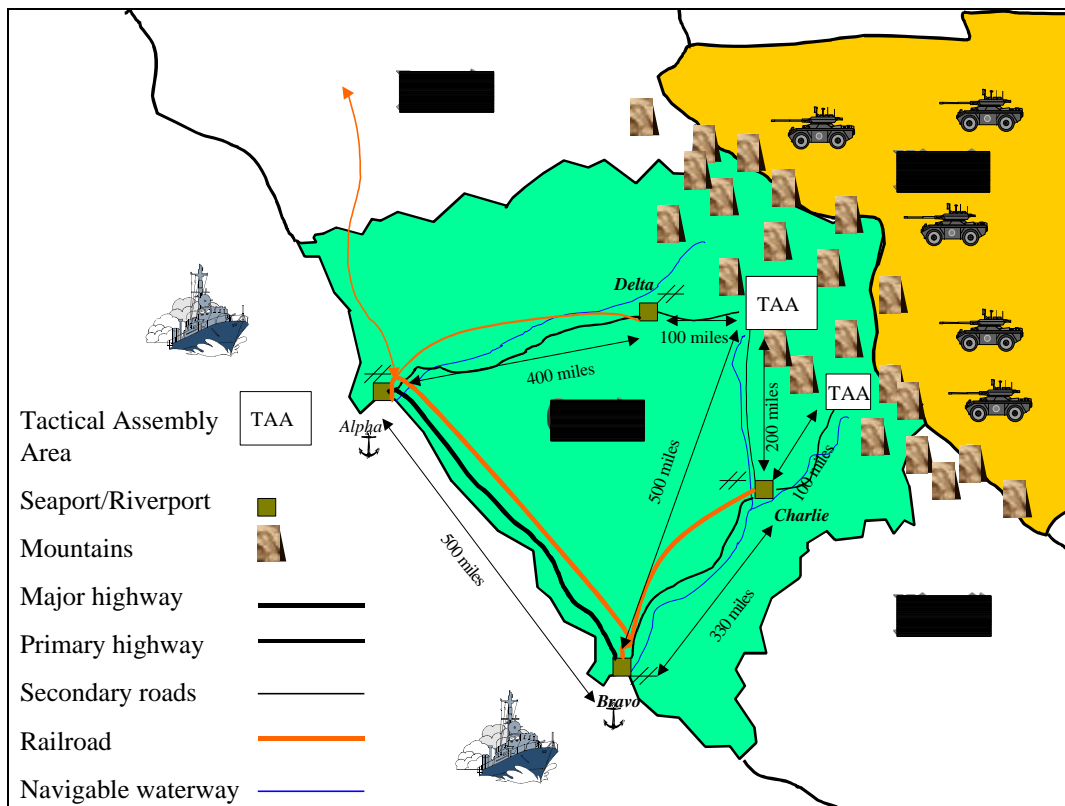


Fig. 3

As part of his crisis action plan, the regional CINC developed the following force requirement.

### Special Operation Forces

5AC-X gunships,  
5 MC-X "COMBAT TALON",  
24 CV-X tiltrotors,  
3 EC-X electronic countermeasure aircraft

#### USAF combat aircraft

One Fighter AEF (24 F-22C, 12 F-16C/D, 6 F-15E, 12 Strike UAV's, 6 KC-10 tankers)  
One UAV AEF (6 AWACS/JSTARS, 6 AIRNET, 6 DARKSTAR-equivalents, 6 REMORA)  
One B-1 AEF (48 B-1's, 24 KC-135's)  
One F-117 AEF (18 F-117's)  
One Airborne Laser AEF (6 a/c)  
Support A/C (16 KC-10's, 96 KC-135's)

#### Embarked USMC Forces

Amphibious Ready Group Marine Expeditionary Unit (1 LHA, 1 LPD, 1 LSD, 1DDG, 1ADC) – 2,000 Marines

#### USMC Amphibious Task Force

Marine Expeditionary Force (2 LHD, 3 LSD, 3 LPD) – 12,500 Marines

#### USN Carrier Battle Group

1 CVN (30 F/A-18's, 30 Joint Strike Fighters, 30+ support a/c)  
3 DD's  
2 DDG's  
2 CG's  
3 SSN's

2 fast supply ships

US Army Forces

1 Airborne Division Ready Brigade (CONUS)  
1 Airborne Division Ready Brigade Forward Support Battalion (CONUS)  
1 AAN Strike Force (FTP)  
2 AAN Strike Force (CONUS)  
1 FXXI Heavy Brigade (prepo)  
4 FXXI Heavy Brigade (CONUS)  
1 FXXI Heavy Brigade (FTP)  
Corps Support (CONUS)

The regional CINC then forwards the following operational deployment concept to CINCTranscom.

C+4 Airborne Division Ready Brigade (CONUS/15,333 stons), F-117 AEF (CONUS/1,397 stons), Fighter AEF (CONUS/1,619 stons), AAN Strike Force (FTP/42,924 stons), UAV AEF (CONUS/66 stons)

C+5 USAF Air Bridge (CONUS/9,564 stons), USAF Extended Range (CONUS/6,916 stons), FXXI Heavy Brigade (Prepo/59,549 stons), Marine Air Wing (CONUS/7,127 stons), MEF-Forward (CONUS/2,650 stons), AAN Strike Force (CONUS/42,924 stons), TOFM 1<sup>st</sup> increment (prepo/TBD), Airborne Division Ready Brigade Forward Support Battalion (CONUS/983 stons)

C+7 First Sustainment Package (prepo/10,468 stons)

C+8 Fighter AEF (CONUS/1,619 stons)

C+9 2<sup>nd</sup> Marine Regiment (CONUS/1,010 stons), 6<sup>th</sup> Marine Regiment (CONUS/1,010 stons), Airborne Laser (CONUS/1,534 stons)

C+10 FXXI Heavy Brigade (FTP/59,549 stons), MAR FIR (CONUS/3,435 stons), AAN Strike Force (CONUS/42,924 stons), UAV AEF (CONUS/66 stons), TOFM 2<sup>nd</sup> increment (CONUS/TBD)

C+14 Second Sustainment Package (CONUS/18,809 stons)

C+15 FXXI Heavy Brigade (CONUS/59,549 stons), B1 AEF (CONUS/10,765 stons), MAR FOE (CONUS/9,174 stons)

C+18 Corps Slice 1<sup>st</sup> increment (CONUS/99,993 stons)

C+21 Third Sustainment Package (CONUS/28,264 stons)

C+25 FXXI Heavy Brigade (CONUS/59,549 stons), FXXI Heavy Brigade (CONUS/59,549 stons), Corps Slice 2<sup>nd</sup> increment (CONUS/57,546 stons)

C+28 Fourth Sustainment Package (CONUS/42,718 stons)

***All forces are required to close by C+28 days***

CINCTranscom has the following transportation assets available to support the deployment.

Available AMC Airlift

60 C-5s (89.5 stons @ 3,250 nm/420 knots)  
80 C-17s (59 stons @ 3,250 nm /421 knots)  
33 CRAF B-747s (86 stons @ 3,250 nm/400 knots)

Available MSC Sealift

10 LMSR's  
CONUS  
24 knots

400,000 square feet  
 17,177 stons  
 9 LMSR's  
     prepo  
     24 knots  
     400,000 square feet  
     17,177 stons  
 8 Fast Sealift Ships  
     CONUS  
     28 knots  
     200,000 square feet  
     10,630 stons  
 2 Container Ships  
     prepo  
     18 knots  
     19,643 stons  
     1,700 TEU  
 10 leased RORO Ships  
     Europe  
     18 knots  
     4,800 stons

Available U.S. Army Lighterage

9 LSV's (6,500 nm @ 11.5 knots, 2000 stons)  
 47 LCU-2000's (6,500 nm @ 10 knots, 350 stons)  
 51 LCM-8's (271 nm @ 9 knots, 53 stons)  
 12 LARC-LX (75 nm @ 6 knots, 60 stons)  
 Modular Causeway System  
     7 RORO Discharge Facilities  
     17 Causeway Ferries  
     6 Floating Causeways

Available USMC Prepo Forces (MPSRON-1)

4 notional MPF(E) ships  
     prepo (Europe)  
     17 knots  
     125,000 square feet  
     6,645 stons  
     1,000 TEU

CONUS Rail Transport

566 DODX-40000 cars (150 stons)  
 256 DODX-41000 cars (100 stons)  
 334 DODX-42000 cars (95 stons)

Based on the regional CINC's J2 data, CIA Fact Book, and other classified/unclassified sources, planners determined the following Omnian transportation infrastructure.

Air

Omnia has the following airfield support:

Alpha 2 x 8000' runways (paved)  
 Bravo 2 x 8000' runways (paved)  
 Charlie 2 x 5000' runways (paved)  
 Delta 1 x 3000' runway (paved)  
 TAA 1 1 x 2000' runway (paved)  
 3 x 5000' runway (dirt)  
 TAA 2 1 x 5000' runway (dirt)  
     4 x 3000' runway (dirt)

The USAF will require the airfield at Alpha to support fighter and tanker support operations, as well as the field at Delta to support UAV and combat SAR operations. That leaves the airfields at Bravo and Charlie to support military equipment transport as well as sustainment flows. In addition, the fields at the TAA's can accept theater transport aircraft as well as some C-17 operations as well as SSTOL operations.

Bravo	3,800 stons/day
Charlie	3,500 stons/day
TAA 1	2,500 stons/day
TAA 2	1,500 stons/day

TAA's 1&2 can accept theater airlift from Bravo and Charlie as well as SSTOL flow from the Forward Staging Base.

### Sea

The Omnian government agreed to allow U.S. military use of three of their six deepwater ports

Alpha	1 port/18,000 stons per day
Bravo	2 ports/9,000 stons per day

In addition, Omnia has 3,200 miles of waterways navigable by vessels up to six feet in draft. The riverports of Charlie and Delta can handle up to 8,190 short tons/day via the existing piers and ferry docks.

### Highway

The Omnian highway system varies between modern 4-lane highways between the cities of Alpha and Bravo, to two-lane narrow shoulder (at times nonexistent) dirt paths between villages.

Based on preliminary surveys, the highway links between the seaports and the TAA can move 20,000 stons/day.

### Rail

The Omnian rail system is limited by available rail cars of sufficient capacity, yard support, track mileage, and track condition. Nevertheless, based on preliminary surveys, the rail links between the ports and the TAA can move 8,000 stons/day.

## Deployment Operational Issues

The first U.S. Army prepo ship will arrive at Omnia at C+4. All prepo ships and CONUS surge ships will arrive between C+4 and C+16.

The USMC MPF ships will arrive at Omnia at C+6. Because of port congestion, we'll assume that the Marines will offload their equipment in-stream and transport it over the beach; however, the beachhead will need to be in proximity to an airfield for MAGTF offload and marriage.

## Sensitivity Analysis

The analysis was based on a scenario developed by the Military Traffic Management Command – Transportation Engineering Agency (MTMC-TEA). Four different sets of sensitivities were generated. The following results emerged.

- Early entry sensitivity to weight, daily throughput, and airlift assets (Fig. 5 and 6)

In this class three different variations were examined. Days to close versus daily throughput were compared for today's airlift, twice today's airlift, and unlimited airlift. Figure 5 indicates that, with today's airlift, throughput greater than 10,000 stons/day provided no benefit because of a shortfall in aircraft. With twice the airlift, additional improvement was realized

up to 20,000 stons/day. With unlimited aircraft, improvement was realized up to 40,000 stons/day. Further improvement was limited by CONUS throughput capacities. If the early entry force is lightened by half, closure can be achieved in five days with sufficient aircraft, despite CONUS's limited capacity.

- Total force closure sensitivity to daily throughput, sea assets, and sea and air infrastructure capability (Fig. 7)

Total force closure sensitivity to port processes and sea lift capacities was examined. The early entry objective was fully realized and the total force closure achieved was 35 days against an objective of 30 days. Adding more container ships could substitute for fast ships . However, the final early entry objective required lightening the force by one-half.

- Total force closure sensitivity for POM 2005 and projected 2010/2015 forces to sea lift and air lift

In Fig. 8 we demonstrated, for both the POM 2005 and projected 2010/2015, that once the prepositioned ships began arriving, their capacity outpaced air capacity.

- Early entry force closure sensitivity to ISB placement, air assets, and early entry force weight (Fig. 9 and 10)

Early entry force closure depends upon increased airlift assets and minimizing ISB distance from the fight.



## COMPARING CRISIS ACTION PLANNING PROCEDURES WITH DELIBERATE PLANNING PROCEDURES

	<b>Crisis Action Planning</b>	<b>Deliberate Planning</b>
<b><i>Time Available to Plan</i></b>	Hours or days	18-24 months
<b><i>JPEC Involvement</i></b>	For security reasons, possibly very limited using close-hold procedures	Participates fully
<b><i>Phases</i></b>	6 Phases from Situation Development to Execution	5 Phases from Initiation to Supporting Plans
<b><i>Document Assigning Tasks</i></b>	WARNING ORDER to CINC; CINC assigns tasks with EVALUATION REQUEST message	JSCP to CINC: CINC assigns tasks with planning or other written directive
<b><i>Forces for Planning</i></b>	<b>ALLOCATED</b> in the WARNING, PLANNING, ALERT, or EXECUTE ORDER	<b>APPORTIONED</b> in JSCP
<b><i>Early Planning Guidance to Staff</i></b>	WARNING ORDER from CJCS; CINC's EVALUATION REQUEST	Planning Directive issued by CINC after planning guidance step of concept development phase
<b><i>Commander's Estimate</i></b>	Communicates recommendations of CINC to the CJCS/NCA	Communicates the CINC's DECISION to staff and subordinate commanders
<b><i>Decision on COA</i></b>	NCA decide COA	CINC decides COA with review by CJCS
<b><i>Execution Document</i></b>	EXECUTE ORDER	When an operation plan is implemented, it is converted to an OPORD, and executed with an EXECUTE ORDER
<b><i>Products</i></b>	Campaign plan (if required) with supporting OPORDs, or OPORD with supporting OPORDs	OPLAN or CONPLAN with supporting plans

Reference: Joint Pub 5-03.1 (to be published as CJCSM 3122.01), JOPES Volume I

Fig. 4

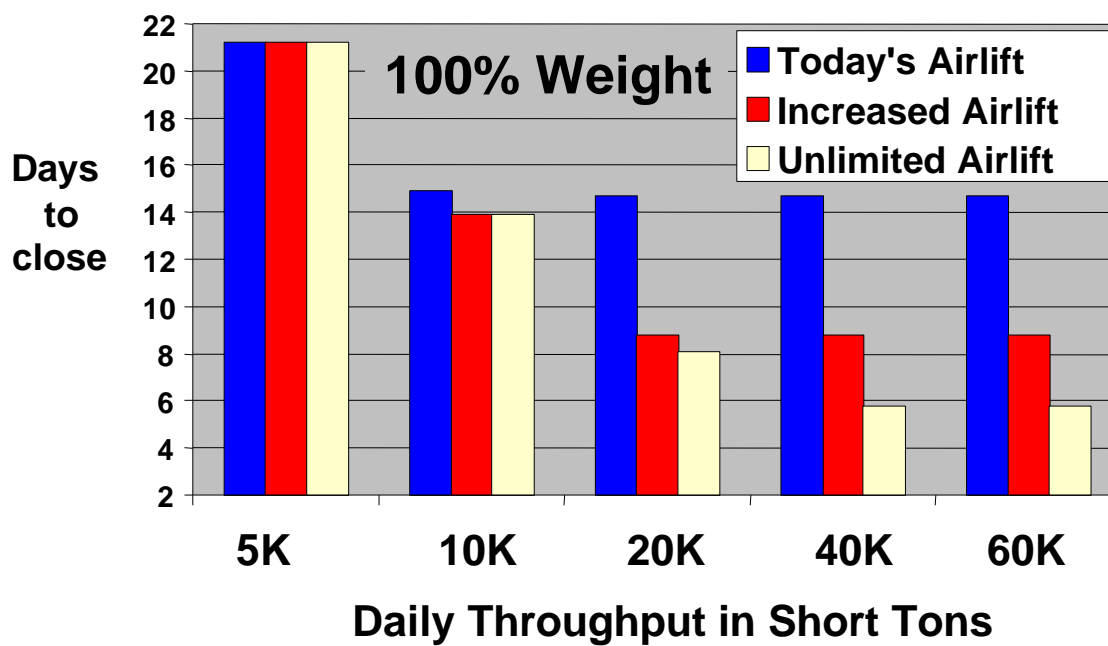


Fig. 5

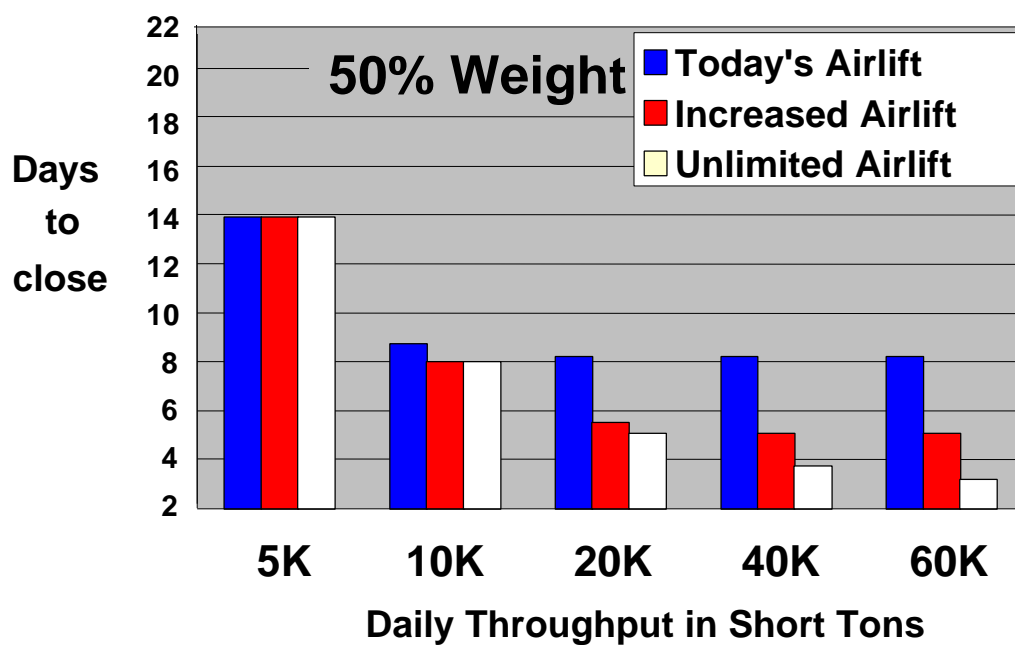


Fig. 6

## Analysis Results: Total Force Depends on Improved Port Processes and

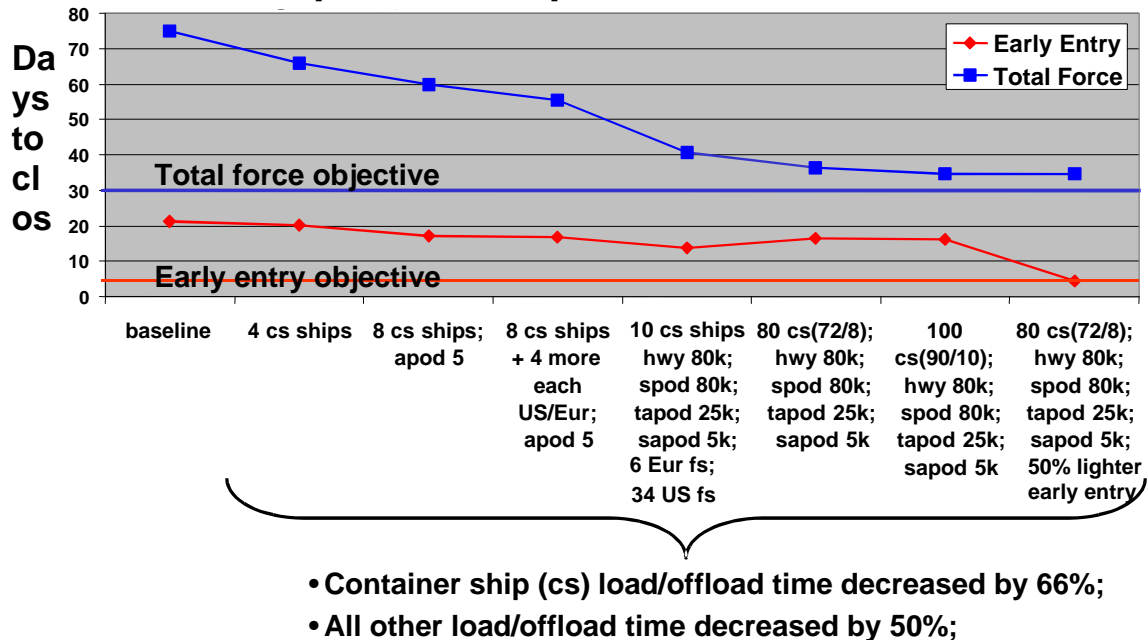
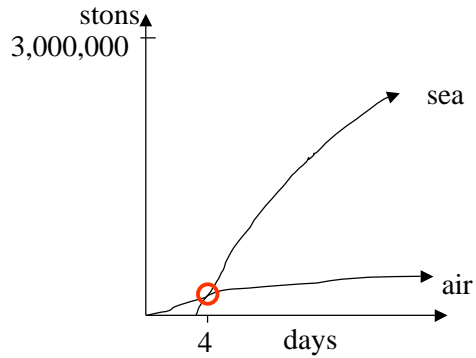


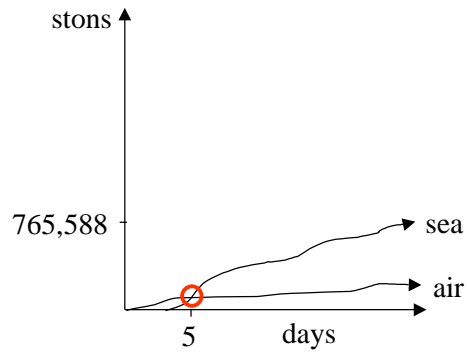
Fig. 7

# ***Air vs. Sea Capabilities***

**POM Force 2005**  
**10/90% light/heavy mix**  
**3,000,000 stons**



**Projected 2010/2015 Force**  
**25/75% light/heavy mix**  
**765,588 stons**



**Once prepo ships begin arriving, their capacity outpaces air capacity, regardless of force mix and size!**

Fig. 8

## 30K Strike Force Closure vs. ISB Range

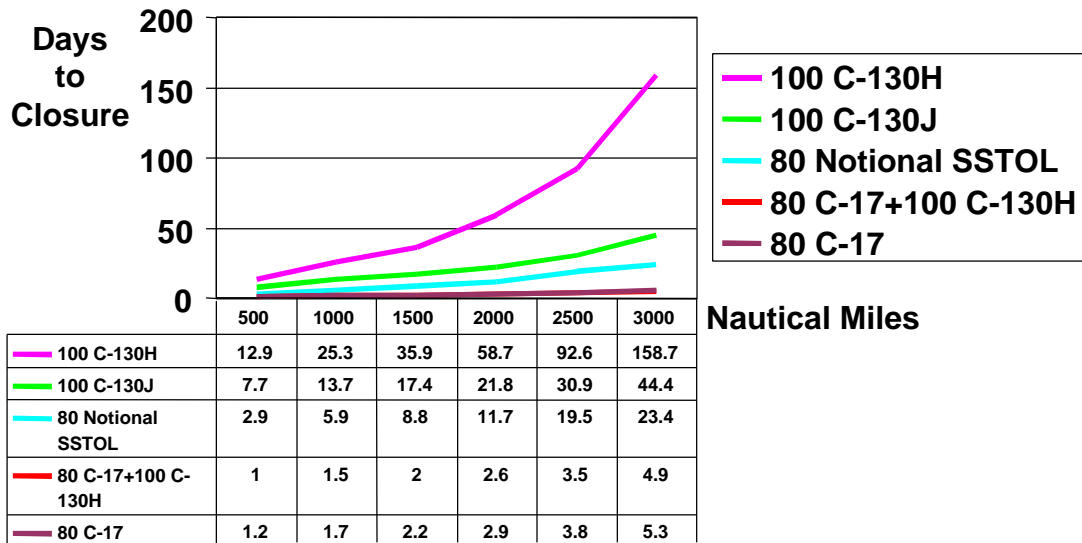


Fig. 9

## 42.9K Strike Force Closure vs. ISB Range

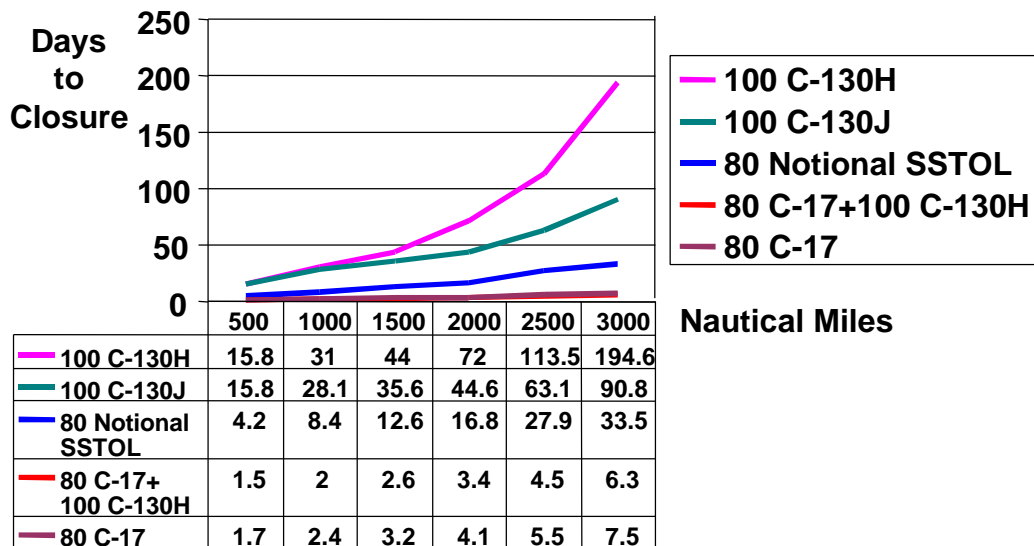


Fig. 10

## Transportation Assets

<b>Assets</b>	<b>Payload</b>	<b>Speed</b>
Large Medium-Speed Roll-on/Roll-off (LMSR)	17,177	24
Fast Sealift Ship (FSS)	10,630	28
Container Ships	19,643	18
Commercial RoRo	4,800	18
High Speed Sealift (HSS)	5,000	45
C17	59	410
C5	89	405
C130H/J	20	290
Commercial (747 equivalents)	86	400
Aerocraft	380	120
Super Short Take-off & Landing (SSTOLs)	30	320

Fig. 11

## APPENDIX A: SAMPLE MODEL INPUT

SEA DISTANCE SPOE->SPOD	(NM)	9010.
FORWARD SEA DISTANCE	(NM)	5121.
NUMBER-OF-SHIP-TYPES-----	(#)	9
LMSR	(STRATEGIC) (#)	10.
LMSR	(FORWARD) (#)	0.
LMSR SPEED	(KNOTS)	24.
LMSR CAPACITY	(TONS)	17177.
LMSR LOAD TIME	(HOURS)	48.
LMSR UNLOAD TIME	(HOURS)	36.
FSS	(STRATEGIC) (#)	8.
FSS	(FORWARD) (#)	2.
FSS SPEED	(KNOTS)	28.
FSS CAPACITY	(TONS)	10630.
FSS LOAD TIME	(HOURS)	48.
FSS UNLOAD TIME	(HOURS)	48.
CONTAINER	(STRATEGIC) (#)	2.
CONTAINER	(FORWARD) (#)	0.
CONTAINER SPEED	(KNOTS)	18.
CONTAINER CAPACITY	(TONS)	19643.
CONTAINER LOAD TIME	(HOURS)	72.
CONTAINER UNLOAD TIME	(HOURS)	72.
EUROPE RORO	(STRATEGIC) (#)	0.
EUROPE RORO	(FORWARD) (#)	10.
EUROPE RORO SPEED	(KNOTS)	18.
EUROPE RORO CAPACITY	(TONS)	4800.
EUROPE RORO LOAD TIME	(HOURS)	48.
EUROPE RORO UNLOAD TIME	(HOURS)	48.
LITTON HSS	(STRATEGIC) (#)	0.
LITTON HSS	(FORWARD) (#)	0.
LITTON HSS SPEED	(KNOTS)	45.
LITTON HSS CAPACITY	(TONS)	5000.
LITTON HSS LOAD TIME	(HOURS)	12.
LITTON HSS UNLOAD TIME	(HOURS)	12.
AEROCRAFT	(STRATEGIC) (#)	0.
AEROCRAFT	(FORWARD) (#)	0.
AEROCRAFT SPEED	(KNOTS)	120.
AEROCRAFT CAPACITY	(TONS)	380.
AEROCRAFT LOAD TIME	(HOURS)	12.
AEROCRAFT UNLOAD TIME	(HOURS)	12.
#SHIPS TYPE 7 (STRATEGIC)	(#)	0.
#SHIPS TYPE 7 (FORWARD)	(#)	0.
SHIP SPEED 7	(KNOTS)	0.
SHIP CAPACITY 7	(TONS)	0.
SHIP LOAD TIME 7	(HOURS)	0.
SHIP UNLOAD TIME 7	(HOURS)	0.
#SHIPS TYPE 8 (STRATEGIC)	(#)	0.
#SHIPS TYPE 8 (FORWARD)	(#)	0.
SHIP SPEED 8	(KNOTS)	0.
SHIP CAPACITY 8	(TONS)	0.
SHIP LOAD TIME 8	(HOURS)	0.
SHIP UNLOAD TIME 8	(HOURS)	0.
#SHIPS TYPE 9 (STRATEGIC)	(#)	0.
#SHIPS TYPE 9 (FORWARD)	(#)	0.
SHIP SPEED 9	(KNOTS)	0.
SHIP CAPACITY 9	(TONS)	0.
SHIP LOAD TIME 9	(HOURS)	0.
SHIP UNLOAD TIME 9	(HOURS)	0.
STRATEGIC AIR DISTANCE	(NM)	6494.
THROUGH AIR DISTANCE	(NM)	6994.
FORWARD AIR DISTANCE	(NM)	2822.
THEATER AIR DISTANCE	(NM)	500.
NUMBER-OF-A/C-TYPES-----	(#)	9
C-5	(STRAT) (#)	60.
C-5	(THRU) (#)	0.
C-5	(FORWARD) (#)	0.
C-5	(THEATER) (#)	0.
C-5 SPEED	(KNOTS)	405.
C-5 CAPACITY	(TONS)	89.
C-5 LOAD TIME	(HOURS)	6.
C-5 UNLOAD TIME	(HOURS)	2.
C-17	(STRAT) (#)	0.
C-17	(THRU) (#)	20.
C-17	(FORWARD) (#)	50.
C-17	(THEATER) (#)	0.
C-17 SPEED	(KNOTS)	410.
C-17 CAPACITY	(TONS)	59.
C-17 LOAD TIME	(HOURS)	4.
C-17 UNLOAD TIME	(HOURS)	2.
C-130	(STRAT) (#)	0.
C-130	(THRU) (#)	0.
C-130	(FORWARD) (#)	0.

C-130	(THEATER) (#)	150.
C-130 SPEED	(KNOTS)	290.
C-130 CAPACITY	(TONS)	20.
C-130 LOAD TIME	(HOURS)	2.
C-130 UNLOAD TIME	(HOURS)	1.
CRAF	(STRAT) (#)	60.
CRAF	(THRU) (#)	0.
CRAF	(FORWARD) (#)	0.
CRAF	(THEATER) (#)	0.
CRAF SPEED	(KNOTS)	400.
CRAF CAPACITY	(TONS)	86.
CRAF LOAD TIME	(HOURS)	5.
CRAF UNLOAD TIME	(HOURS)	3.
SSTOL	(STRAT) (#)	0.
SSTOL	(THRU) (#)	0.
SSTOL	(FORWARD) (#)	0.
SSTOL	(THEATER) (#)	0.
SSTOL SPEED	(KNOTS)	320.
SSTOL CAPACITY	(TONS)	40.
SSTOL LOAD TIME	(HOURS)	2.
SSTOL UNLOAD TIME	(HOURS)	1.
#AIRCRAFT TYPE 6 (STRAT) (#)		0.
#AIRCRAFT TYPE 6 (THRU) (#)		0.
#AIRCRAFT TYPE 6 (FORWARD) (#)		0.
#AIRCRAFT TYPE 6 (THEATER) (#)		0.
AIRCRAFT SPEED 6	(KNOTS)	0.
AIRCRAFT CAPACITY 6	(TONS)	0.
AIRCRAFT LOAD TIME 6	(HOURS)	0.
AIRCRAFT UNLOAD TIME 6	(HOURS)	0.
#AIRCRAFT TYPE 7 (STRAT) (#)		0.
#AIRCRAFT TYPE 7 (THRU) (#)		0.
#AIRCRAFT TYPE 7 (FORWARD) (#)		0.
#AIRCRAFT TYPE 7 (THEATER) (#)		0.
AIRCRAFT SPEED 7	(KNOTS)	0.
AIRCRAFT CAPACITY 7	(TONS)	0.
AIRCRAFT LOAD TIME 7	(HOURS)	0.
AIRCRAFT UNLOAD TIME 7	(HOURS)	0.
#AIRCRAFT TYPE 8 (STRAT) (#)		0.
#AIRCRAFT TYPE 8 (THRU) (#)		0.
#AIRCRAFT TYPE 8 (FORWARD) (#)		0.
#AIRCRAFT TYPE 8 (THEATER) (#)		0.
AIRCRAFT SPEED 8	(KNOTS)	0.
AIRCRAFT CAPACITY 8	(TONS)	0.
AIRCRAFT LOAD TIME 8	(HOURS)	0.
AIRCRAFT UNLOAD TIME 8	(HOURS)	0.
#AIRCRAFT TYPE 9 (STRAT) (#)		0.
#AIRCRAFT TYPE 9 (THRU) (#)		0.
#AIRCRAFT TYPE 9 (FORWARD) (#)		0.
#AIRCRAFT TYPE 9 (THEATER) (#)		0.
AIRCRAFT SPEED 9	(KNOTS)	0.
AIRCRAFT CAPACITY 9	(TONS)	0.
AIRCRAFT LOAD TIME 9	(HOURS)	0.
AIRCRAFT UNLOAD TIME 9	(HOURS)	0.
CONUS SEAPORT CAPACITY	(TONS/DAY)	247196.
CONUS AIRPORT CAPACITY	(TONS/DAY)	20000.
FORWARD SEAPORT CAPACITY	(TONS/DAY)	107652.
FORWARD AIRPORT CAPACITY	(TONS/DAY)	14000.
STRATEGIC S/P CAPACITY	(TONS/DAY)	36000.
STRATEGIC A/P CAPACITY	(TONS/DAY)	10722.
THEATER ROAD TIME	(DAYS)	.75
THEATER ROAD CAPACITY	(TONS/DAY)	20000.
THEATER RAIL TIME	(DAYS)	2.
THEATER RAIL CAPACITY	(TONS/DAY)	8000.
THEATER WATER TIME	(DAYS)	2.
THEATER WATER CAPACITY	(TONS/DAY)	8190.
THEATER AIRPORT CAPACITY	(TONS/DAY)	11300.

# LIFT PROFILE

	SPOE1	APOE1	SPOE2	APOE2	PREPO	S/P	A/P	THEATER
	DELIV.	DELIV.	DELIV.	DELIV.	USAGE	USAGE	USAGE	USAGE
DAY	(TONS)	(TONS)	(TONS)	(TONS)	(TONS)	(TONS)	(TONS)	(TONS)
1	0	0	0	0	0	0	0	0
2	0	18415	0	42924	0	0	0	0
3	0	67514	0	0	0	0	0	0
4	440606	0	59549	0	62199	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	10468	0	0	0
7	0	3153	0	0	0	0	0	0
9	0	49990	0	0	0	0	0	0
10	0	10765	0	0	0	0	0	0



## APPENDIX B: SAMPLE MODEL OUTPUT

```

INPUT FILE      = baseline.dat
TIME TO CLOSURE = 75.00 DAYS

```

CONUS A/P (BACKLOG)

Time (hr)	Location	Count
80690	X	
72621	XXXX	
64552	X XXXXX	
56483	XXX XXXXXXX	
48414	XXXX XXXXXXXX	
40345	XXXXXX XXXXXXXXXXX	
32276	XXXXXXXXXXXXXXXXXXXX	
24207	XXXXXXXXXXXXXXXXXXXXX	
16138	XXXXXXXXXXXXXXXXXXXXXX	
8069	XXXXXXXXXXXXXXXXXXXXXX	

Time (hr) vs. Day (DAY)

CONUS S/P (BACKLOG)

```

438480|      XXXX
394632|      XXXXXXXXXXXX
350784|      XXXXXXXXXXXXXXXXXX
306936|      XXXXXXXXXXXXXXXXXXXXXXXXX
263088|      XXXXXXXXXXXXXXXXXXXXXXXXXX
219240|      XXXXXXXXXXXXXXXXXXXXXXXXXXXX
175392|      XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
131544|      XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
87696 |      XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
43848 |      XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----> (DAY)
    3     6     9    12    15    18    21    24    27    30    33    36    39    42    45    48    51    54    57    60

```

STRATEGIC S/P (BACKLOG)

Iteration	Time (s)	Time (days)
5320	XXXX	3
10640	XX	6
15960	XX	9
21280	XX	12
26600	XX	15
31920	X	18
37240	X	21
42560	X	24
47880	X	27
53200	X	30

FORWARD A/P (BACKLOG)

Figure 1 is a Gantt chart illustrating the duration of the 10th, 20th, and 30th generations of the genetic algorithm. The vertical axis represents the number of individuals, ranging from 41750 down to 4175. The horizontal axis represents time in days, ranging from 0 to 60. The chart shows that the duration of each generation decreases as the number of individuals decreases.

Generation	Number of Individuals	Duration (Days)
10th	41750	~3.5
20th	37575	~6.5
30th	33400	~9.5
40th	29225	~12.5
50th	25050	~15.5
60th	20875	~18.5
70th	16700	~21.5
80th	12525	~24.5
90th	8350	~27.5
100th	4175	~30.5

STAGING AREA (BACKLOG)

```
765580|XXXXXXXXX
689022|XXXXXXXXXXXXXXXXXXXX
612464|XXXXXXXXXXXXXXXXXXXXXXX
535906|XXXXXXXXXXXXXXXXXXXXXXXXXX
459348|XXXXXXXXXXXXXXXXXXXXXXXXXXXX
382790|XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
306232|XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
229674|XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
153116|XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
76558|XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
```

+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+----->

3    6    9   12   15   18   21   24   27   30   33   36   39   42   45   48   51   54   57   60   63   66   69   72   75

```
58840 | XX
52956 | XXXXX
47072 | XXXXXXXX
41188 | XXXXXXXXXXXX
35304 | XXXXXXXXXXXXXX
29420 | XXXXXXXXXXXXXXXXXXXX
23536 | XXXXXXXXXXXXXXXXXXXX
17652 | XXXXXXXXXXXXXXXXXXXXXX
11768 | XXXXXXXXXXXXXXXXXXXXXXXX
5884 | XXXXXXXXXXXXXXXXXXXXXXXXXX
```

(\* indicates at capacity)

A-23

16.75	880*	7825*	128900*	0	36787*	3130	1104	218401
17.00	880*	7825*	131031*	0	37220*	3130	1104	220418
17.25	880*	7825*	133162*	0	37653*	3130	1104	222435
17.50	880*	7825*	135293*	0	38086*	3130	1104	224452
17.75	880*	7825*	137424*	0	38519*	3130	1104	226469
18.00	880*	7825*	139555*	0	38952*	3130	1104	228486
18.25	880*	7825*	141686*	0	39385*	3130	1104	230503
18.50	880*	7825*	143817*	0	39818*	3130	1104	232520
18.75	880*	7825*	145948*	0	40251*	3130	1794	234537
19.00	880*	7825*	147389*	0	40684*	3130	2917	236554
19.25	880*	7825*	148830*	0	40684*	3130	4040	238571
19.50	880*	7825*	150271*	0	40684*	3130	5163	241278
19.75	880*	7825*	151712*	0	40684*	3130	5596	244418
20.00	880*	7825*	153153*	0	40684*	3130	5596	247558
20.25	880*	7825*	154594*	0	40684*	3130	5596	250698
20.50	880*	7825*	156035*	0	40684*	3130	6831	253838
20.75	880*	7825*	156241*	0	40684*	3130	8066	256978
21.00	880*	6511	156447*	0	40684*	3130	9301	260118
21.25	880*	4946	156653*	0	40684*	3130	10536	264493
21.50	704	3381	156859*	0	40684*	3130	10536	268868
21.75	528	1816	157065*	0	40684*	3130	9301	273243
22.00	352	251	158506*	0	40684*	1816	8066	277618
22.25	176	0	159947*	0	40684*	251	6831	280679
22.50	0	0	161388*	0	40515	0	6831	282078
22.75	0	0	161594*	0	40082	0	8066	283477
23.00	0	0	161800*	0	39649	0	9301	284876
23.25	0	0	162006*	0	39216	0	10536	287510
23.50	0	0	162212*	0	38783	0	10536	290144
23.75	0	0	162418*	0	38350	0	10536	292778
24.00	0	0	162624*	0	37917	0	10536	295412
24.25	0	0	162830*	0	37484	0	10536	298046
24.50	0	0	163036*	0	37051	0	10536	300680
24.75	0	0	163242*	0	36618	0	10536	303314
25.00	0	0	163448*	0	36185	0	10536	305948
25.25	0	0	163654*	0	35752	0	10536	308582
25.50	0	0	163860*	0	35319	0	10536	311216
25.75	0	0	164066*	0	34886	0	10536	313850
26.00	0	0	164272*	0	34453	0	10536	316484
26.25	0	0	164478*	0	34020	0	10536	319118
26.50	0	0	164684*	0	33587	0	10536	321752
26.75	0	0	164890*	0	32878	0	10536	324386
27.00	0	0	165096*	0	32169	0	10536	327020
27.25	0	0	165302*	0	31460	0	10536	329654
27.50	0	0	165508*	0	30751	0	10536	332288
27.75	0	0	165714*	0	30042	0	10536	334922
28.00	0	0	165920*	0	29333	0	10536	337556
28.25	0	0	166126*	0	28624	0	10536	340190
28.50	0	0	166332*	0	27915	0	10536	342824
28.75	0	0	166538*	0	27206	0	10536	345458
29.00	0	0	166744*	0	26497	0	10536	348092
29.25	0	0	166950*	0	25788	0	10536	350726
29.50	0	0	167156*	0	25079	0	10536	353360
29.75	0	0	167362*	0	24370	0	10536	355994
30.00	0	0	167568*	0	23661	0	10742	358628
30.25	0	0	167568*	0	22952	0	10948	361262
30.50	0	0	167568*	0	22243	0	11154	363896
30.75	0	0	167568*	0	21534	0	11360	366736
31.00	0	0	167568*	0	20825	0	11360	369576
31.25	0	0	167568*	0	20116	0	11360	372416
31.50	0	0	167568*	0	19407	0	11360	375256
31.75	0	0	167568*	0	18698	0	11360	378096
32.00	0	0	167568*	0	17989	0	11360	380936
32.25	0	0	167568*	0	17280	0	11360	383776
32.50	0	0	167568*	0	16571	0	11360	386616
32.75	0	0	167568*	0	15862	0	11360	389456
33.00	0	0	167568*	0	15153	0	11360	392296
33.25	0	0	167568*	0	14444	0	11360	395136
33.50	0	0	167568*	0	13735	0	11360	397976
33.75	0	0	167568*	0	13026	0	11360	400816
34.00	0	0	167568*	0	12317	0	11360	403656
34.25	0	0	167568*	0	11608	0	11360	406496
34.50	0	0	167568*	0	10899	0	11360	409336
34.75	0	0	167568*	0	10190	0	11360	412176
35.00	0	0	167568*	0	9481	0	11360	415016
35.25	0	0	167568*	0	8772	0	11360	417856
35.50	0	0	167568*	0	8063	0	11360	420696
35.75	0	0	167568*	0	7354	0	11360	423536
36.00	0	0	167568*	0	6645	0	11360	426376
36.25	0	0	167568*	0	5936	0	11360	429216
36.50	0	0	167568*	0	5227	0	11360	432056
36.75	0	0	167568*	0	4518	0	11360	434896
37.00	0	0	167568*	0	3809	0	11360	437736
37.25	0	0	167568*	0	3100	0	11360	440576
37.50	0	0	167568*	0	2391	0	11360	443416
37.75	0	0	167568*	0	1682	0	11360	446256
38.00	0	0	167568*	0	973	0	11360	449096

38.25	0	0	167568*	0	264	0	10915	451936
38.50	0	0	167568*	0	0	0	10206	454776
38.75	0	0	167568*	0	0	0	9497	457616
39.00	0	0	167568*	0	0	0	8788	460011
39.25	0	0	167568*	0	0	0	8524	462142
39.50	0	0	167568*	0	0	0	8524	464273
39.75	0	0	167568*	0	0	0	8524	466404
40.00	0	0	167568*	0	0	0	8524	468535
40.25	0	0	167568*	0	0	0	8524	470666
40.50	0	0	167568*	0	0	0	8524	472797
40.75	0	0	167568*	0	0	0	8524	474928
41.00	0	0	167568*	0	0	0	8524	477059
41.25	0	0	167568*	0	0	0	8524	479190
41.50	0	0	167568*	0	0	0	8524	481321
41.75	0	0	167568*	0	0	0	8524	483452
42.00	0	0	167568*	0	0	0	8524	485583
42.25	0	0	167568*	0	0	0	8524	487714
42.50	0	0	167568*	0	0	0	8524	489845
42.75	0	0	167568*	0	0	0	8524	491976
43.00	0	0	167568*	0	0	0	8524	494107
43.25	0	0	167568*	0	0	0	8524	496238
43.50	0	0	167568*	0	0	0	8524	498369
43.75	0	0	167568*	0	0	0	8524	500500
44.00	0	0	167568*	0	0	0	8524	502631
44.25	0	0	167568*	0	0	0	8524	504762
44.50	0	0	167568*	0	0	0	8524	506893
44.75	0	0	167568*	0	0	0	8524	509024
45.00	0	0	167568*	0	0	0	8524	511155
45.25	0	0	167568*	0	0	0	8524	513286
45.50	0	0	167568*	0	0	0	8524	515417
45.75	0	0	167568*	0	0	0	8524	517548
46.00	0	0	167568*	0	0	0	8524	519679
46.25	0	0	167568*	0	0	0	8524	521810
46.50	0	0	167568*	0	0	0	8524	523941
46.75	0	0	167568*	0	0	0	8524	526072
47.00	0	0	167568*	0	0	0	8524	528203
47.25	0	0	167568*	0	0	0	8524	530334
47.50	0	0	167568*	0	0	0	8524	532465
47.75	0	0	167362	0	0	0	8524	534596
48.00	0	0	167156	0	0	0	8524	536727
48.25	0	0	166950	0	0	0	8524	538858
48.50	0	0	166744	0	0	0	8524	540989
48.75	0	0	166538	0	0	0	8524	543120
49.00	0	0	166332	0	0	0	8524	545251
49.25	0	0	166126	0	0	0	8524	547382
49.50	0	0	165920	0	0	0	8524	549513
49.75	0	0	165714	0	0	0	8524	551644
50.00	0	0	165508	0	0	0	8524	553775
50.25	0	0	165302	0	0	0	8524	555906
50.50	0	0	165096	0	0	0	8524	558037
50.75	0	0	164890	0	0	0	8524	560168
51.00	0	0	164684	0	0	0	8524	562299
51.25	0	0	164478	0	0	0	8524	564430
51.50	0	0	164272	0	0	0	8524	566561
51.75	0	0	164066	0	0	0	8524	568692
52.00	0	0	163860	0	0	0	8524	570823
52.25	0	0	163654	0	0	0	8524	572954
52.50	0	0	163448	0	0	0	8524	575085
52.75	0	0	163242	0	0	0	8524	577216
53.00	0	0	163036	0	0	0	8524	579347
53.25	0	0	162830	0	0	0	8524	581478
53.50	0	0	162624	0	0	0	8524	583609
53.75	0	0	162418	0	0	0	8524	585740
54.00	0	0	162212	0	0	0	8524	587871
54.25	0	0	162006	0	0	0	8524	590002
54.50	0	0	161800	0	0	0	8524	592133
54.75	0	0	161594	0	0	0	8524	594264
55.00	0	0	160786	0	0	0	8524	596395
55.25	0	0	159345	0	0	0	8524	598526
55.50	0	0	157904	0	0	0	8524	600657
55.75	0	0	156463	0	0	0	8524	602788
56.00	0	0	155022	0	0	0	8524	604919
56.25	0	0	153581	0	0	0	8524	607050
56.50	0	0	152140	0	0	0	8524	609181
56.75	0	0	150009	0	0	0	8524	611312
57.00	0	0	147878	0	0	0	8524	613443
57.25	0	0	145747	0	0	0	8524	615574
57.50	0	0	143616	0	0	0	8524	617705
57.75	0	0	141485	0	0	0	8524	619836
58.00	0	0	139354	0	0	0	8524	621967
58.25	0	0	137223	0	0	0	8524	624098
58.50	0	0	135092	0	0	0	8524	626229
58.75	0	0	132961	0	0	0	8524	628360
59.00	0	0	130830	0	0	0	8524	630491
59.25	0	0	128699	0	0	0	8524	632622
59.50	0	0	126568	0	0	0	8524	634753

59.75	0	0	124437	0	0	0	8524	636884
60.00	0	0	122306	0	0	0	8524	639015
60.25	0	0	120175	0	0	0	8524	641146
60.50	0	0	118044	0	0	0	8524	643277
60.75	0	0	115913	0	0	0	8524	645408
61.00	0	0	113782	0	0	0	8524	647539
61.25	0	0	111651	0	0	0	8524	649670
61.50	0	0	109520	0	0	0	8524	651801
61.75	0	0	107389	0	0	0	8524	653932
62.00	0	0	105258	0	0	0	8524	656063
62.25	0	0	103127	0	0	0	8524	658194
62.50	0	0	100996	0	0	0	8524	660325
62.75	0	0	98865	0	0	0	8524	662456
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# **Enabling Rapid and Decisive Strategic Maneuver for the Army After 2010**

## **Analytics and Programmatic Panel Briefing**





# ***Strategic Maneuver***

**ASB Summer Study**

*July 1999*

## ***Analytics Subpanel brief***

### ***Analysis Subpanel Members***

- Marygail Brauner
- Thom Hodgson (chair)
- Judith Liebman
- Susan Lowenstam
- Warren Morrison





## Goal

Provide analysis for enabling **strategic maneuver**: the ability to rapidly project overwhelming military power worldwide

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## Early Entry

**Early entry** speed depends on following factors:

- Size and weight (of force movement requirement)
- Lift assets (sea and air)
- Theater throughput
- Strategic airport throughput
- Air and pre-positioning mix

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The Army plans to increase early entry lethality by adding two strike forces to existing early entry forces. The improvement required can not be achieved by a single element. Rather, early entry speed depends on a number of factors such as the size and weight of the force movement requirement, sea and air lift assets, strategic airport capability, theater throughput capability, and air and pre-positioning mix.



## Force Closure

**Total force closure** time is dependent on following factors:

- Size and weight (of force movement requirement)
- Lift asset capabilities (mostly sea)
- Port throughput
- Theater road and rail capacity
- Fort to port transshipment

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A fundamental tenet of power projection is the rapid closure of forces in the theater. Rapid force closure reduces vulnerability of the forming forces, and enhances national political goals by providing an agile, decisive, and credible threat. The time for total force closure is dependent on factors such as planning cycle times, the size and weight of force movement requirement, sea and air lift asset capabilities, port throughput capacity, and theater road and rail capacity.



## Analysis Issues

- Deploy more capability faster
- Lighten & repackage the force
- Improve military lift capability
- Exploit commercial lift
- Increase throughput and sustainment capacity
- Increase seaport capacity

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The Army's goal is to deploy a more capable force more rapidly. In order to accomplish this goal the following issues must be addressed. Those issues are interdependent to achieve total closure within the stated requirements. For example lightening the force is the only way to achieve the early entry requirement of 5 days. Whereas improving military lift capability is required to meet the total force closure requirement of 30 days.



## Sensitivity Analysis

Q: What is closure time sensitivity to various factors?

A: Total closure time depends mostly on sea lift assets:

- Number and type of ships
- Port throughput
- Speed of ships
- Theater road and rail throughput

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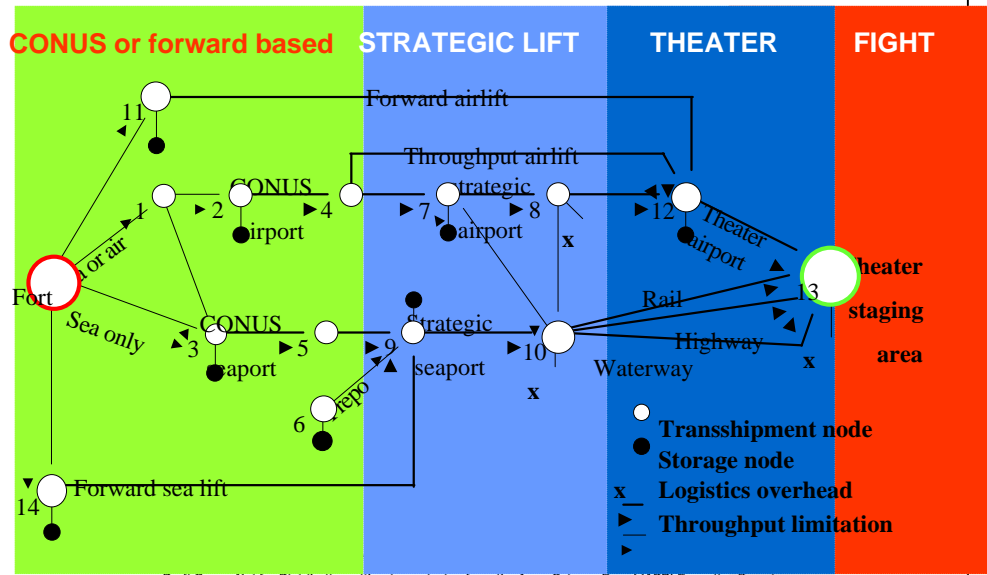
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Sensitivity analysis is performed by establishing a baseline which in this case was essentially a scenario developed by MTMC-TEA using guidelines from the Army Strategic Planning guidance - 1999. . Next by finding choke points and incrementally adding resources to establish the lower bounds required to eliminate the bottle-neck other chock points become apparent. The process is repeated until objectives are realized.



# Logistics Network Model



An analytic, time-stepped, network-flow based model was constructed in order to assess closure time sensitivity to various factors, including the number, type and speed of the ships, the port throughput capacity, transshipment times, and theater road and rail capacity. The model is general enough to, e.g., allow cargo that is either air- or sea- transportable to be shipped in the most optimal way.



## Sample Operational Plan

Early Entry Package: 193,000 tons

**All forces are required to close by C+30 days**

- **C+4** Airborne Division Ready Brigade (CONUS/15,333 stons), F-117 AEF (CONUS/1,397 stons), Fighter AEF (CONUS/1,619 stons), AAN Strike Force (FTP/42,924 stons), UAV AEF (CONUS/66 stons)
- **C+5** USAF Air Bridge (CONUS/9,564 stons), USAF Extended Range (CONUS/6,916 stons), FXXI Heavy Brigade (Prepo/59,549 stons), Marine Air Wing (CONUS/7,127 stons), MEF-Forward (CONUS/2,650 stons), AAN Strike Force (CONUS/42,924 stons), TOFM 1<sup>st</sup> increment (prepo/TBD), Airborne Division Ready Brigade Forward Support Battalion (CONUS/983 stons)

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This requirement was generated from the draft Army Strategic Planning Guidance 1999.



## Sample Plan (continued)

Follow-on Forces Package: 566,000 Tons

- **C+7** First Sustainment Package (prepo/10,468 stons)
- **C+8** Fighter AEF (CONUS/1,619 stons)
- **C+9** 2<sup>nd</sup> Marine Regiment (CONUS/1,010 stons), 6<sup>th</sup> Marine Regiment (CONUS/1,010 stons), Airborne Laser (CONUS/1,534 stons)
- **C+10** FXXI Heavy Brigade (FTP/59,549 stons), MAR FIR (CONUS/3,435 stons), AAN Strike Force (CONUS/42,924 stons), UAV AEF (CONUS/66 stons), TOFM 2<sup>nd</sup> increment (CONUS/TBD)
- **C+14** Second Sustainment Package (CONUS/18,809 stons)
- **C+15** FXXI Heavy Brigade (CONUS/59,549 stons), B1 AEF (CONUS/10,765 stons), MAR FOE (CONUS/9,174 stons)
- **C+18** Corps Slice 1<sup>st</sup> increment (CONUS/99,993 stons)
- **C+21** Third Sustainment Package (CONUS/28,264 stons)
- **C+25** FXXI Heavy Brigade (CONUS/59,549 stons), FXXI Heavy Brigade (CONUS/59,549 stons), Corps Slice 2<sup>nd</sup> increment (CONUS/57,546 stons)
- **C+28** Fourth Sustainment Package (CONUS/42,718 stons)

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This requirement was generated from the draft Army Strategic Planning Guidance 1999.

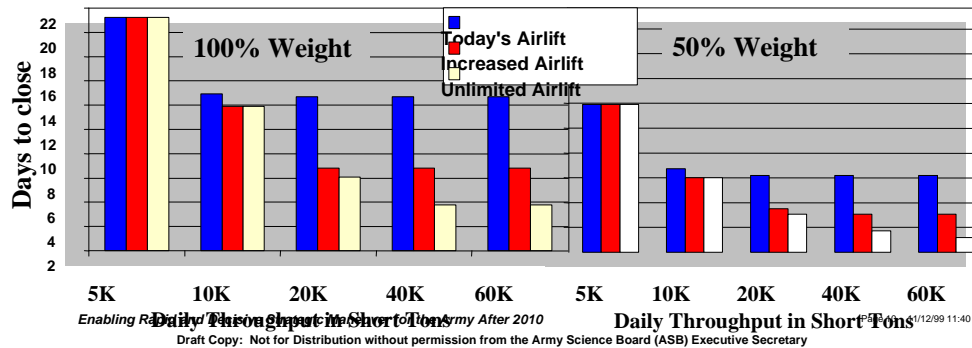




## Analysis Results: Early Entry

For **early entry** force, we need an optimal mix of:

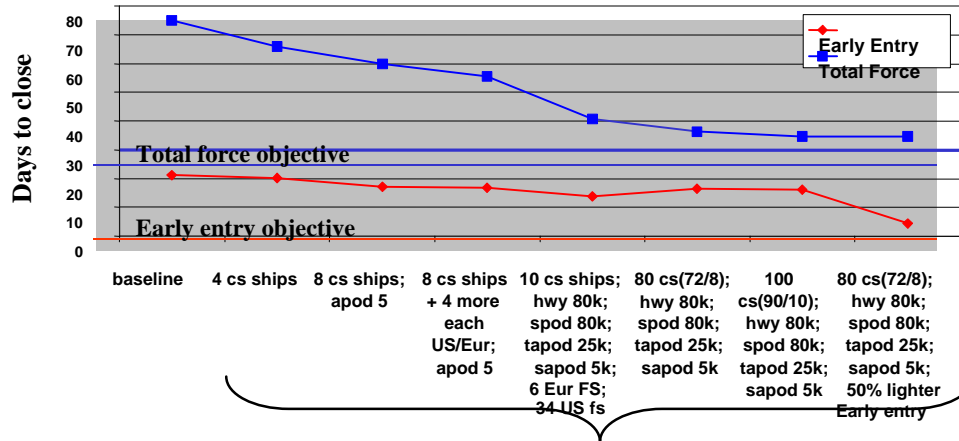
- Increased airlift assets
- Improved throughput/transshipment speed
- Lightened force
- Shortened planning and scheduling process
- Reduced movement requirement (i.e. split base, prepo, etc.)



This slide shows the tradeoff between increasing airlift assets and increasing airport throughput capacity. Note the leveling out of the days to closure at various levels of throughput capacity. For example, the blue bar, representing today's airlift capacity, shows no decrease in days to closure above a throughput capacity of 10,000 tons per day. Thus, the closure time is bottlenecked by airlift capacity rather than throughput.



## Analysis Results: Total Force Closure Depends on Improved Port Processes and Sea Lift



- Container ship (cs) load/offload time decreased by 66%;
- All other load/offload time decreased by 50%;
- 66 CRAF

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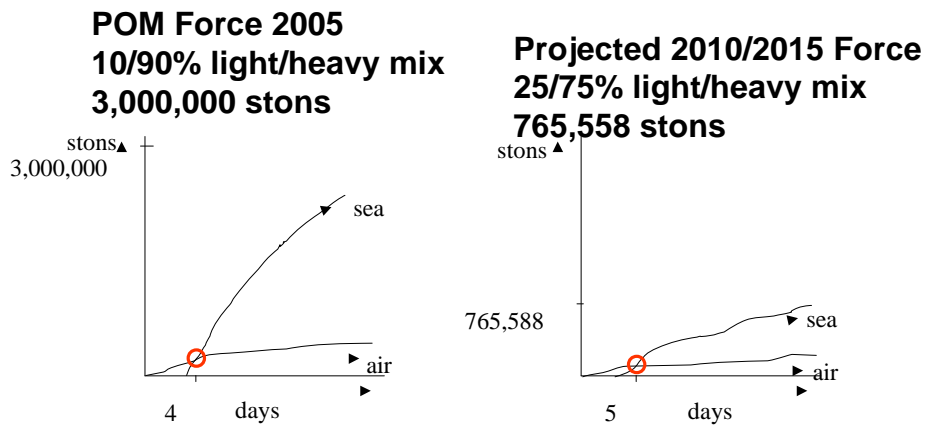
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There are currently 82 container ships available through commercial readiness agreements (source: Military Sealift Command, Strategic Sealift Inventory, July 1999). They provide the same benefit as 40 Fast Ships if the noted improvements in infrastructure handling capacity and 66 CRAF aircraft are provided



## Air vs. Sea Capabilities



**Once prepo ships begin arriving, their capacity outpaces air capacity, regardless of force mix and size!**

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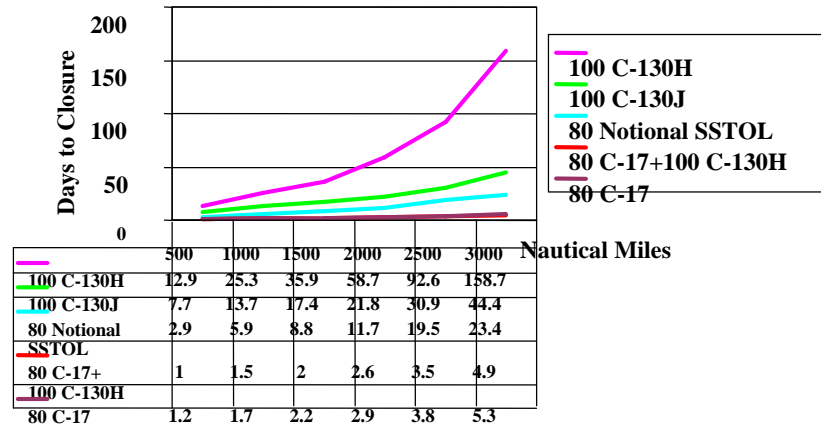
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WE demonstrated that for both the POM 2005 and projected 2010/2015, that once the prepositioned ships began arriving, their capacity outpaces air capacity. The bottom line is total force deployment requires sea-lift.



## 30K Strike Force Closure vs. ISB Range



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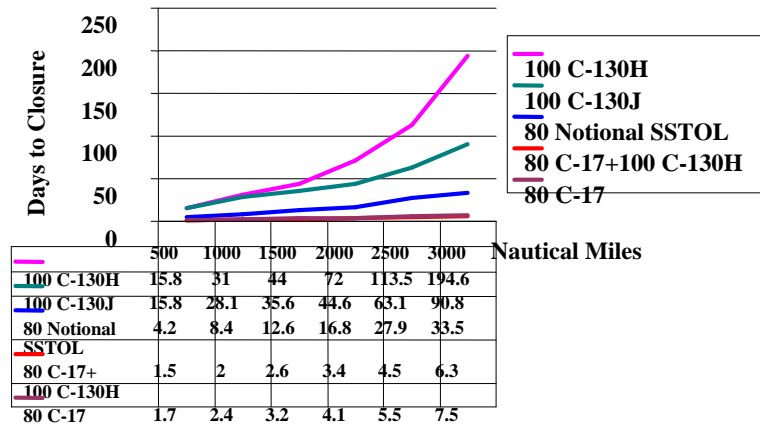
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Early entry force closure sensitivity to ISB placement, Air assets, and early Entry Force weight is shown in figures 9 and 10. The analysis shows that 80 C-17s are required to meet the Early Entry force closure requirements if the ISB is closer than 3,000 miles.

In general, placing the ISB closer and reducing the strike force weight reduces the Early Entry closure time.



## 42.9K Strike Force Closure vs. ISB Range



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## 4-7 Day Early Entry and 35 Day Total Closure Can Be Achieved if the Army:

- Reduces the weight of early entry forces by 50%
- Decreases container ship load / off-load time by 66%
- Decreases all other load / off-load time by 50%
- Employs 66 CRAF
- Doubles SPOD and quadruples APOD throughput capacity
- Employs 1.6 M short tons of sea lift (80 container ships)

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These state the panels conclusions which is that it takes at least all of these improvements and investments to achieve 35 days. To achieve 30 days requires improvements in CONUS port handling capability.

# **APPENDIX A**

## **TERMS OF REFERENCE**





Mr. Michael J. Bayer  
Chair, Army Science Board  
2511 Jefferson Davis Highway  
Arlington, VA 22202

Dear Mr. Bayer:

I request that you conduct an Army Science Board (ASB) Summer Study on "Enabling Rapid and Decisive Strategic Maneuver for the Army After 2010." The study should address, as a minimum, the Terms of Reference (TOR) described below. The ASB members appointed should consider the TOR as guidelines and may include in their discussions related issues deemed important or suggested by the sponsors. Modifications to the TOR must be coordinated with the ASB office.

#### Background

a. Relevance of our Army will increasingly depend on how rapidly we can maneuver strategically. Strategic maneuver is the ability to rapidly project military power from all points of the globe to converge simultaneously with overwhelming land, air, space, and maritime forces which paralyze and dominate the enemy. The objective is to wrest the operational initiative, achieve dominance, prevent or terminate conflict by defeating the enemy or set the conditions for sustained decisive operations of follow-on campaign forces if they are necessary. The key enablers are deploying rapidly and seamlessly at the strategic, operational and tactical levels, sustaining smartly and commanding and controlling confidently.

b. The United States has one of the largest collections of advanced military equipment and the best-trained Soldiers in the world. When Department of Defense (DOD) cannot deploy decisive landpower quickly where needed, many effective uses of military power are unavailable to support the nation's full spectrum security requirements. Moving Soldiers and required cargo is the role of strategic mobility--the system of equipment, personnel, and logistic know-how that allows the DOD to deliver forces over intercontinental distances. Once in theater, operational (or intra-theater) and tactical mobility assets are critically important for delivering equipment over shorter distances.

c. The Army, along with the JCS and the other Services, has proposed substantial conceptual innovations for future forces. The Army After Next (AAN) initiative incorporates conceptual and technological advances to achieve Full Spectrum Dominance. The Army must be able to utilize Dominant Maneuver, Precision Engagement, and Information Dominance, while protecting the force from the spectrum

of threats and sustaining it with Focused Logistics. However, the efforts to develop such a force will mean nothing if it can't be deployed rapidly and sustained smartly anywhere in the world. There remain significant challenges to achieving such capabilities. In many respects the most complex of these challenges are in the areas of mobility, sustainment and command and control.

#### Terms of Reference

a. Predict and describe solutions to the challenges inherent to achieving rapid and decisive strategic maneuver by:

(1) Identifying mobility enablers for early and continuous entry of forces and supplies into and within the theater of operations.

(2) Identifying enablers to realize the full potential of the RML pertaining to providing the required sustainment to employ the early deploying force.

(3) Addressing the implications of an enemy "anti-access" capability.

(4) Assessing the current programmed assets to meet these challenges and identify shortfalls.

b. Review previous efforts and assessments undertaken in these areas. Examples are: the 1996-1998 studies done by the ASB and the Defense Science Board; the series of Mobility Requirements Studies (MRS) conducted by the Joint Staff and DOD, recent studies conducted by the U.S. Transportation Command (TRANSCOM), Army Materiel Command (AMC), Training and Doctrine Command (TRADOC), and Logistic Integration Agency (LIA).

c. With respect to procurement and acquisition: review and assess contemplated mobility related experiments, Advance Technology Demonstration (ATD) and Advance Concept Technology Demonstration (ACTD) and comment on their value in contributing to the capabilities sought for 2025 in rapidly deploying forces and sustaining forces to an overseas theater of operations. Propose, as necessary, alternative demonstrations and experiments. Review and comment upon ongoing and planned DOD mobility related acquisitions. (An example is the J-7 Mobility Study scheduled to start in October 1998). Similarly, investigate and comment upon the Joint Staff programs and the Air Force, Navy and Marine Corps approaches to Force Projection and Sustainment. Assess those air and sealift initiatives planned or contemplated by the private sector, which the military should leverage. Seek out and assess alternative commercial solutions, particularly advanced technology solutions

that would allow the Army to rapidly deploy forces and supplies. Identify opportunities for government Research Development Test and Evaluation (RDT&E) investments to increase military utility of commercial capabilities.

d. Examine and make recommendations on the process of reengineering or improvements by which deploying forces are moved from Fort to Port – Port to Port – Port to Fight. Provide insights applicable to transition from the near term to 2025, with emphasis on building the transition through Army XXI to 2025.

e. Assess the impact of the following:

(1) The development and potential uses of new strategic and intra-theater lift platforms and related technologies, both military and commercial.

(2) The incorporation of ultra-reliability and predictive diagnostics within systems.

(3) The shape, size and weight of future combat vehicles. Recommend steps that can be taken with respect to more efficiently transporting existing fleet vehicles to an overseas theater of operations.

(4) Incorporate all aspects of the Revolution in Military Logistics (RML) with particular emphasis on sustainment improvements. Look at the RML domains to include technology acquisition and sustainment actions required that substantially impact on getting the force to the fight most rapidly.

(5) Information systems and pipeline architecture to facilitate C4I for RML enablers, Velocity Management (VM), and Total Asset Visibility (TAV).

(6) Specifically address Reserve Component integration within the entire deployment and sustainment process.

f. Coordinate this study with the ongoing DCSOPS Strategic Lift Workshop in developing broad Army requirements for 2015 and 2025. Link with the concurrently conducted ASB summer study, “Full Spectrum Protection for 2025 Era – Ground Platforms” so that the mobility and sustainment findings and recommendations of both efforts are congruent.

g. Suggest significant additions, deletions and/or modifications to planned initiatives, including Joint and non-DOD, which would provide major capability improvements in the joint and combined environments. Utilize models and simulations

to evaluate outcomes. Model and simulate strategic-operational-tactical mobility and sustainment issues to determine comparative outcomes. Specifically request U.S. Transportation Command, Forces Command, STRICOM and Concepts Analysis Agency, Logistics Integration Agency, Deployment Modernization Office (DPMO) at Fort Eustis for modeling and simulation support. Request Logistics Management Institute for specific analysis. Use the February Power Projection Wargame at Fort Eustis as an additional method to evaluate and test tentative recommendations. Funding will be required for analysis and simulation support.

h. Provide actionable recommendations, which have suitable POM and JROC implementation.

Study Support. Sponsor of this study is GEN Dennis J. Reimer, Chief of Staff of the United States Army. Other sponsors are LTG Thomas N. Burnette, Deputy Chief of Staff for Operations and Plans; LTG John Coburn, Deputy Chief of Staff for Logistics; and LTG Randall L. Rigby, Deputy Commanding General, U.S. Chief Army Training and Doctrine Command. LTG Paul J. Kern is the ASA(RDA) cognizant deputy and BG Gilbert S. Harper, Commanding General, U.S. Army Transportation Center and Fort Eustis, is the TRADOC cognizant deputy. The staff assistants are MAJ Paul Daniels, ODCSOPS; Mr. Mike Hendricks, ODCSLOG; and Mr. Zbig Majchrzak, TRADOC.

Schedule. The study panel will initiate the study immediately and conclude its effort at the report writing session to be conducted July 12-22, 1999 at the Beckman Center on the campus of the University of California, Irvine. As a first step, the study co-chairs will submit a study plan to the sponsors and the Executive Secretary outlining the study approach and schedule. Conclusion of this study group will result in a final report to the sponsors in September 1999.

Sincerely,

Paul J. Hoeper  
Assistant Secretary of the Army  
(Research, Development and Acquisition)

# **APPENDIX B**

## **PARTICIPANTS LIST**



**PARTICIPANTS LIST**  
FY1999 ARMY SCIENCE BOARD SUMMER STUDY  
**RAPID AND DECISIVE STRATEGIC MANEUVER  
FOR THE ARMY AFTER 2010**

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The Potomac Foundation

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**GEN David M. Maddox (USA, Ret.)**

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# **APPENDIX C**

## **ACRONYMS**



## Acronyms

A2C2	Army Airspace Command and Control
AA2010	Army After 2010
AAC	Army Acquisition Corps
AAE	Army Acquisition Executive
AAFIF	Automated Air Facilities Information File
AAN	Army After Next
AARs	After Action Reviews
ABCS	Army Battle Command Systems
ABN	Airborne
ACAT	Acquisition Category
ACOM	Atlantic Command
ACR	Armored Cavalry Regiment
ACTD	Advanced Concept Technology Demonstration
ADO	Army Digitization Office
AEF	Air Expeditionary Force
AF	Air Force
AFSAB	Air Force Scientific Advisory Board
AFSS	Advanced Fire Support System
AGCCS	Army Global Command and Control System
AGS	Armored Gun System
AI	Artificial Intelligence
ALP	Advanced Logistics Project
AMC	Army Materiel Command
AMCOM	Aviation and Missile Command
AOE	Army of Excellence
AOE ARTY BN	Army of Excellence Artillery Battalion
AOE BDE	Army of Excellence Brigade
AOE MLRS BN	Army of Excellence Multiple Launch Rocket System Battalion
APC	Armored Personnel Carrier
APOD	Aerial Port of Debarkation
APS	Army Prepositioned Stocks; Active Protection System
ARDEC	Army Research, Development, and Engineering Center
ARL	Army Research Laboratory
ARTY	Artillery
ASA(ALT)	Assistant Secretary of the Army for Acquisition Logistics and Technology
ASB	Army Science Board
ASD C3I or ASD(C3I)	Assistant Secretary of Defense (Command, Control, Communications, and Intelligence)
ASTMP	Army Science and Technology Master Plan
ASTWG	Army Science and Technology Working Group
ATD	Advanced Technology Demonstration
ATG	Anti-Tank Gun
ATGM	Anti-Tank Guided Missile

ATR	Automated Target Recognition
AUBA	
AWE	Advanced Warfighting Experiment
B2C2	Battalion and Below Command and Control
BAT	Brilliant Anti-Tank
BCIS	Battlefield Combat Identification System
BDA	Battle Damage Assessment
BDE	Brigade
BITS	Battlefield Information Transmission System
BLOS	Beyond Line of Sight
BN	Battalion
C2	Command and Control
C2E	Command Center Element
C2OTM	Command and Control On-The-Move
C2SID	Command and Control System Integration Directorate
C2T2	Commercial Communications Technology Testbed
C2V	Command and Control Vehicle
C2W	Command and Control Warfare
C3	Command, Control and Communications
C3I	Command, Control, Communications and Intelligence
C3IEW	Command, Control, Communications Intelligence and Electronic Warfare
C4	Command, Control, Communications and Computers
C4I	Command, Control, Communications, Computers and Intelligence
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance
CASCOM	Combined Arms Support Command
CC&D	Concealment Camouflage and Deception
CC&D	Camouflage, Concealment and Deception
CE	Chemical Energy
CECOM	Army Communication-Electronics Command
CHP	Controlled Humidity Preservation
CINC	Commander-in-Chief
CINCTRANS	Commander-in-Chief, Transportation Command
CKEM	Compact Kinetic Energy Missiles
CM	Countermeasures
COA	Course of Action
COTS	Commercial Off-The-Shelf
CPX	Command Post Exercise
CRAF	Civil Reserve Air Fleet
CSA	Chief of Staff, Army
CSSCS	Combat Service Support Computer System
CTC	Combat Training Center

DAMO-SS	Deputy Chief of Staff for Operations and Plans -
DARPA	Defense Advanced Research Projects Agency
DAS	Director of Army Staff
DAS(R&T)	Deputy Assistant Secretary for Research and Technology
DBBL	Dismounted Battlespace Battle Lab
DCS(RDA)	Deputy Chief of Staff Research Development and Acquisition
DCSD	Deputy Chief of Staff Combat Development
DCSDOC	Deputy Chief of Staff Doctrine
DCSINT	Deputy Chief of Staff Intelligence
DCSLOG	Deputy Chief of Staff Logistics
DCSOPS	Deputy Chief of Staff Operations
DDR&E	Director, Defense Research and Engineering
DEW	Directed Energy Weapons
DISA	Defense Information Systems Agency
DISC4	Director, Information Systems, Command, Control, Communications and Computers
DL	Distance Learning
DLA	Defense Logistics Agency
DMSO	Defense Modeling and Simulation Office
DoT	Department of Transportation
DPG	Defense Planning Guide
DS	Direct Support
DSB	Defense Science Board
DSWA	Defense Special Weapons Agency
DTAP	Defense Technology Area Plan
DTO	Defense Technology Objective
DUSA-OR	Deputy Undersecretary of the Army - Operations Research
EAD	Echelon Above Division
ECOM	Electro-Optical Countermeasure
EFOGM	Enhanced Fiber-Optic Guided Missile
EFP	Explosively Formed Penetrator
EM	Electro-Mechanical
EMPRS	En Route Mission Planning and Rehearsal System
EO/IR	Electro-Optical/Infrared
ERA	Extended Range Artillery
ERCEC	Edgewood Research, Development and Engineering Center
ETC	Electro-Thermal Chemical
EW	Electronic Warfare
FBC2	Force XXI Battle Command Brigade and Below
FBCB2	Force XX1 Battle Command Brigade and Below
FC	Fire Control
FCS	Fire Control Systems; Future Combat System
FCV	Future Combat Vehicle
FED EX	Federal Express

FLEEDO	
FOB	Forward Operating Base
FOG-M	Fiber-Optic Guided Missile
FORSCOM	Forces Command
FSCS	Future Scout and Cavalry System
FSV	Future Scout Vehicle
FTX	Field Training Exercise
GCCS	Global Command and Control
GCSS	Global Combat Support System
GCSS-A	Global Combat Support System – Army
GIS	Global Information System
GOSC	General Officer Steering Committee
GPS	Global Positioning System
GVW	Gross Vehicle Weight
HIMARS	High Mobility Artillery Rocket System
HMMWV	High Mobility Multi-purpose Wheeled Vehicle
HNS	Host Nation Support
HPM	High Power Microwave
HQAMC	Headquarters of the Army Materiel Command
HSS	High-Speed Shipping
I2R	Imaging Infrared
IA/IW	Information Assurance/Information Warfare
IFSAR	Interferometric Synthetic Aperture Radar
III	Integrated Information Infrastructure(s)
IO	Information Operations
IPT	Integrated Product Team
IR&D	Independent Research and Development
ISC/R	Individual Soldier's Computer/Radio
ISR	Intelligence Surveillance Reconnaissance
IT	Information Technology
IWS	Individual Warfighter System
J3	Operations Directorate, Joint Staff
J4	Logistics Directorate, Joint Staff
JCF	Joint Contingency Force
JCS	Joint Chiefs of Staff
JIT	Just-in-Time
JOPEs	Joint Operation Planning and Execution System
JROC	Joint Requirements Oversight Council
JS	Joint Support, Joint Staff
JSTARS	Joint Surveillance Target Attack Radar System
JTA	Joint Technology Architecture(s)
JWCA	Joint Warfighting Capability Assessment

KE/CE	Kinetic Energy / Chemical Energy
KEM	Kinetic Energy Missile
LADAR	Laser Radar
LAV	Light Armored Vehicle
LCLO	Low Cost Low Observable
LCMS	Laser Counter Measures System
LCPK	Low Cost Precision Kill
LIDAR	Light Detection and Ranging
LIWA	Land Information Warfare Activity
LMSR	Large Medium Speed Roll-on/roll-off
LOS	Line of Sight
LOTS	Logistics Over-the-Shore
LRIP	Low Rate Initial Production
LTL	Less-than-Lethal
LW	Land Warrior
M&S	Modeling and Simulation
MAGTF	Marine Air-Ground Task Force
MANPADS	Man-portable Air Defense System
MANPRINT	Manpower and Personnel Integration
MAVS	Micro-Autonomous Vehicles
MEM	Micro-Electro-Mechanics
MEMS	Micro Electric Mechanical System
MEP	Mobile Electric Power; Mission Equipment Package
METT-T	Mission, Enemy, Troops, Terrain, Time
MEU	Marine expeditionary unit
MHE	Materiel Handling Equipment
MILDEP	Military Deputy
MLRS	Multiple Launch Rocket System
MMCS	Multi-Mission Combat System
MMUAV	Multi-Mission Unmanned Air Vehicle
MOUT	Military Operations in Urban Terrain
MPS	Maritime Prepositioning Ship
MRDEC	Missile Research, Development and Engineering Center
MSTAR	Smart Tactical Rocket
MTI	Moving Target Indicator
MTI-SAR	Moving Target Indicator – Synthetic Aperture Radar
MTMC	Military Transportation Management Command
MTMC-TEA	Military Transportation Management Command – Transportation Engineering Agency
MVMT	Movement
MW	Mounted Warrior
NBC	Nuclear, Biological and Chemical

NDF	National Defense Features
NG APS	National Guard - Army Prepositioned Stocks
NGB	National Guard Bureau
NL	Non-Lethal
NLT	No Later Than
NLW	Non-Lethal Weapons
NMD	National Missile Defense
NRAC	Naval Research Advisory Committee
NRDEC	Natick Research, Development and Engineering Center
NSA	National Security Agency
NVESD	Night-Vision/Electronic Sensors Directorate
O&O	Operational and Organizational
OCONUS	Outside Continental United States
OOTW	Operations Other Than War
OPM	Other People's Money
ORD	Operational Requirements Document
OSD	Office of the Secretary of Defense
P3I	Preplanned Product Improvement
PA ARNG	Pennsylvania Army National Guard
PAC-3	Patriot Advanced Capability-3
PEO	Program Executive Office (Officer)
PEO/3C	Program Executive Officer for Command, Control and Communications
PGM	Precision Guided Munitions
PGMM	Precision Guided Mortar Munitions
POD	Point of Debarkation
POL	Petroleum, Oil and Lubricants
POM	Preparation for Overseas Movement
POS/NAV	Position/Navigation
PREPO	pre-positioned stocks
R/S	Reconnaissance/Surveillance
RC	Reserve Component
RDA	Research Development and Acquisition
RDT&E	Research Development Testing and Evaluation
RFPI	Rapid Force Projection Initiative
RHA	Rolled Homogenous Armor
RORO	Roll-on Roll-off
RRF	Rapid Reaction Forces
RSTA	Reconnaissance Surveillance, Target Acquisition
SAALT	Secretary of the Army for Acquisition, Logistics and Technology
S&T	Science and Technology
SA	Situation Awareness



SADARM	Sense and Destroy Armor
SAR	Synthetic Aperture Radar
SARDA	Secretary of the Army for Research Development and Acquisition – outdated, now SAALT – Secretary of the Army for Acquisition, Logistics and Technology
SAS	Situation Awareness System
SBIR	Small Business Innovation Research
SES	Surface Effect Ships
SIGINT	Signal Intelligence
SIMNET	Simulation Network
SINCGARS	Single Channel Ground and Airborne Radio System
SIPE	Soldier Integrated Protective Ensemble
SPOD	seaport(s) of debarkation
SRO	Strategic Research Objective
SSCOM	Soldier Systems Command
SSTOL	Super Short Take-Off & Landing
STARC	State Area Command
STI	Stationary Target Indicator
STO	Science and Technology Objective
STOW-E	Synthetic Theater of War-Europe
SUO	Small Unit Operations
SUOSAS	Small Unit Operations Situation Awareness System
SUSOPS	Sustained Operations
SWA	South West Asia
T&E	Test and Evaluation
TAA	Tactical Assembly Area
TAAD	Theater Area Air Defense
TACOM	Tank Automotive and Armaments Command
TAP	Technology Area Plan
TARA	Technology Area Review and Assessment
TARDEC	Tank Automotive Research, Development and Engineering Center
TDA	Table of Distribution and Allowances
TENCAP	Tactical Exploitation of National Capabilities (program)
TERM	Tank Extended Range Munition
TES	Tactical Engagement System; Tactical Engagement Simulation
TEU	20-foot-equivalent unit
TF	Task Force
THAAD	Theater High Altitude Defense System
TOC	Tactical Operations Center
TOR	Terms of Reference
TOW	Tube-Launched, Optically Tracked, Wire Command-Linked Guided
TPFDD	time-phased forces deployment data
TRADOC	Training and Doctrine Command
TRANSCOM	Transportation Command
TTP	Tactics, Techniques, and Procedures

TWG	Technology Working Group
TWS	Thermal Weapon Sight
UAV	Unmanned Aerial Vehicles
UGV	Unmanned Ground Vehicles
UHF	Ultra-High Frequency
UPS	United Parcel Service
USMC	United States Marine Corps
UWB	Ultra-Wide Band
UXO	Unexploded Ordinance
V/STOL	Vertical or Short Take-off and Landing
VCSA	
VCSA	Vice Chief of Staff of the Army
VISA	
VISA	Voluntary Intermodal Shipping Agreement
VSAT	Very Small Aperture Terminal
VTOL	Vertical Take-off and Landing
VTOL JTR	Vertical Take-off and Landing – Joint Tilt Rotor
WIN	Warfighter Information Network
WMD	Weapons of Mass Destruction
WRAP	Warfighting Rapid Acquisition Program

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