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Dominating Maneuver Workshop VI Summary Report

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Dominating Maneuver Workshop VI Summary Report

Table of Contents

Executive Summary

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Background

Since August 1994, OSD/NA and the U.S. Army have co-sponsored a series of workshops and wargames exploring the character and conduct of maneuver in future warfare. These workshops and wargames are part of a larger study currently being conducted by OSD/NA to explore the nature and implications of a potential Revolution in Military Affairs (RMA). The fundamental premise of the RMA study is that several unique "warfare areas" are emerging or will emerge from the confluence of new operational concepts, organizational concepts, and technologies. The intent of the Army-sponsored RMA events is to explore the role of *maneuver*, integrated with precision strike, information warfare, and space operations, in the emerging environment.

Each workshop and game explores a series of questions intended to inform and define the development of a subsequent wargame. Analysis of the outputs from each event has in turn identified key issues to be explored in follow-on events. Issues explored in the Dominating Maneuver workshop and game series to date include:

- Logistics and battle support concepts
- Soldier-Leader issues
- Force protection and survivability
- Air superiority and aerospace control
- Integration of precision strike, IW, and maneuver
- Measures of effectiveness
- Tempo of operations
- Battlespace awareness
- Future role of SOF
- Compression of friendly and enemy OODA cycles
- Defeat mechanisms
- Tactical concepts and organizations
- Strategic deployment and early entry
- Integration of allied forces in RMA operations
- Complex adaptive systems as a paradigm for future organizations
- Operational-level battle management and C2
- Linkages/discontinuities between Army XXI and notional future Army forces

The overall objectives of the Dominating Maneuver event series are to:

- Develop new, innovative operational and organizational (O&O) concepts, and assess how these may have revolutionary military impact.
- Explore how O&O concepts reflect emerging processes & trends in warfare.
- Continue defining and exploring the characteristics of Dominating Maneuver as a potential RMA warfare area, and explore integration of Precision Strike and Information Warfare in Dominating Maneuver concepts.

A number of broad insights have also been derived from the Dominating Maneuver events. A number of capabilities have been identified as the "essence of revolution." To succeed in the posited future warfare environment, it appears, will require: greatly enhanced strategic mobility; new small, fast, lethal, hyper-mobile combat units; offensive Information Warfare (IW); de-massed logistics (distribution from CONUS to combat, mobile real-time rationalization of priorities versus resources); a battlefield awareness architecture capable of providing commanders with the *certitude* to conduct precision maneuver, fire, and sustainment; and a

new command and control paradigm incorporating function-based command at the joint and combined level, de-massed and destructured battle command at the tactical level, and an *Aegis*-like battle management system.

A key characteristic of future ground warfare will be the *compression of timelines*. This may be an important driver of decisions on unit design, organizations, technologies, and other critical battlefield operating systems. Maneuvering *effects* or *"energy"* may be more salient than maneuvering mass (multiple large units) in a coordinated manner; distributed small units each bringing their individual, enhanced lethal effects to bear in an accelerated cycle of mass, de-mass, re-mass will disrupt an enemy's OODA cycle and provide a critical operational advantage. More broadly, this line of thought suggests that *temporal* positioning of forces (or their effects) may have greater salience on the future battlefield than *spatial* positioning, and that positioning of Blue forces relative to each other and the enemy may be more critical than *geographic* positioning, even in a fight over geography.

Workshop VI

Workshop VI utilized the same scenario and forces used in Workshop V and Game V. This was by design. The scenario uniquely stresses all the Services across their full range of core competencies and, thus, strongly highlights joint expeditionary operations as the core of the RMA. In addition, basing options, even in the best of circumstances, are limited and generally austere; the distances, terrain, and climate present additional difficulties for planners. The Red opponent in the scenario is both competent and potentially capable of developing asymmetrical counters to U.S. military power. Workshop VI was intended to help focus issues and vet materials for Game VI, which will be conducted 30 June to 2 July at the Army War College.

With the scenario and forces held constant, Workshop VI focused on three broad research areas: soldiers and leaders, logistics, and technology capabilities. The players were provided with a Commander's Intent, an overall Concept of Operations (derived from previous games), a basic primer for tactical concepts in the RMA, and a Joint Logistics Concept of Operations. With these basic tools, the players were asked to address the research topics in the context of the operational scheme of maneuver. The players were provided with "vignettes" to focus their ideas and conclusions.

While Game VI will have similar research objectives, the specific analytic aims of Workshop VI were to prepare for Game VI in the following ways:

- Continue exploring, at the *operational and tactical level,* promising O&O concepts developed in earlier RMA workshops and wargames.
- Explore logistics integration issues and add detail to previous RMA logistics management and battlefield management concepts.
- Examine technology requirements in the RMA environment: Describe enabling and key technologies or technology capabilities that exist now or are in development which can lead to an RMA. Identify technology requirements in terms of basic capabilities. Review the technology basket used in RMA games to date and eliminate systems not feasible or useful and establish a list of core systems.

- Consider soldier/leader requirements and military culture issues in the context of the RMA regime: discuss the role of the Reserves and National Guard in the RMA total force; identify military functions and missions that do not need to be performed by soldiers; and describe future military functions and skills, and new groupings of functions and skills, which will figure strongly in the RMA environment.

Specific research questions asked each group appear in Annex A to this report. In some cases not all questions were thoroughly answered because of time constraints on the workshop. These questions will be posed again in Game VI.

Key Findings From The Soldier-Leader Group

The initial set of questions wrestled with by this working group recognized that envisioned forces seemed to demand a very skilled, high-tech soldier. Once in the force, the Army could ill afford to lose these soldiers--because of the accession, training, and unique skills development investment in them--either in combat or to other careers. The group did not want to acquire two levels of soldiers at initial entry--a basic skills soldier and one who would be significantly developed over time. The group also said that generally they would discourage soldiers who had only one term interests; they wanted career soldiers who would develop a warrior ethos no matter their basic specialty. The group felt that the Army might need the ability to offer significant enlistment incentives for longer terms or specialty skills. Generally the group rejected the notion that we might want to recruit more experienced individuals--mature and technically sophisticated--preferring to grow our soldiers. Values socialization is probably more time consuming and difficult than understanding and mastering the high technology of the future. Having said this, though, the group recognized that some high technology positions (i.e. information warriors) might have to be directly recruited. An analogue from today's force would be medical professionals.

The group began a definition of the skill sets needed by both soldiers and leaders for future forces. Chief among these skills are communications skills in multiple media. The group indicated that soldiers and leaders would have to master the technology at their fingertips--key word, master--and be extremely adaptable. Flexibility and adaptability are keys to operational and organizational concepts emerging from RMA studies, and institutional training and culture must learn to embrace this reality and act on it. The concepts also put an absolute premium on mental and physical fitness and endurance--principally directed at coping with and adapting to stressful, rapidly changing environments. In these latter situations, the Army must have imbued its soldiers and leaders with an absolute and unshakable trust in the Army as an institution and the Nation that it serves. Combined with the cohesion that will be developed at the unit level, this trust will provide the foundation for the flexible, adaptable soldier and leader required.

Management of branches of service could be simplified even if consolidation still allows for traditional branch differentiation for tradition's sake. The group arrived at a suggestion not unlike that being advanced by OPMS XXI, albeit a little more radical, and all held together by the creation of a future analogue to the "General Staff." This General Staff is like that used by

the German General Staff or as envisioned in the School of Advanced Military Studies: it is an operational General Staff that integrates functional activities for commanders, Fig 1.

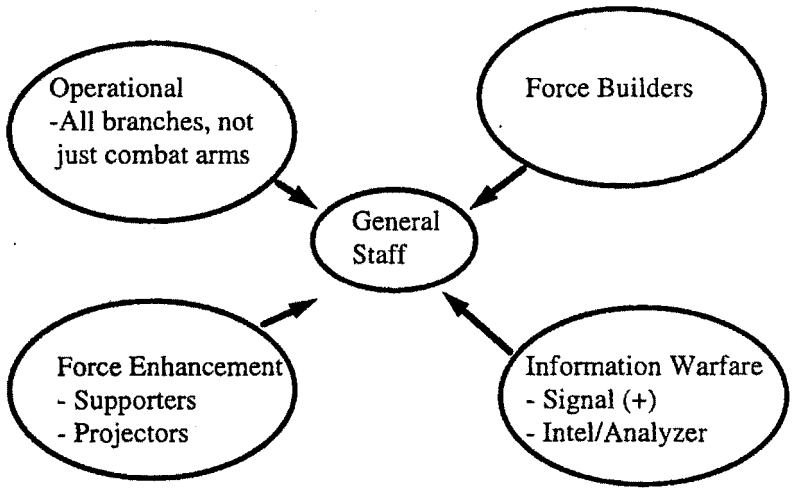

Figure 1 - Management of Future Branch Structures follows Operational Patterns

An issue that was discussed at the 16 January planning session for this workshop, but arose in the Postlude analysis of Game V was the supposition that technology and specialization would require inordinate preparation time to establish core competency. One of the team leaders at Game V, an experienced air force officer, opined that it took in the neighborhood of 15 years to prepare a combat command pilot and that we in the Army needed to think about the ramifications of that as we imagined more and more sophisticated fighting platforms and support systems in the battlespace. The working group considered the issue and felt that movement in this direction was probably inevitable for future soldiers and leaders, but that 15 years was not in the cards. They felt that if we combined skills of leaders into maneuver arms, for example, and reduced secondary assignments, while striving for as much commonality as feasible in maneuver and support platforms and battlespace operating systems, this problem could be managed.

In terms of training and education, the work group easily reached consensus that a PC, whatever that would be in twenty years, would be a standard issue item for each soldier and leader. The PC would be used to facilitate distance learning on a methodical basis and as a precondition to advancement, A standard syllabus for each specialty--leaders included--would direct a continual grounding in the basics and advanced tenets of the specialty. PCs would also facilitate Internet-like chat groups and Email networks for specialty discussions, mentoring, and other professional activities. Distance learning fully realized could help hold down significantly the number of soldiers tied down in school house learning away from units and unit support structures and quality of life systems.

The group did not spend as much time with some mobilization issues, though they did do some discussion of AC-RC integration. They did suggest doing an analysis of significant specialty fields that in the future might be necessary to mobilize for contingencies across the spectrum of conflict. One might have numerous practitioners of these specialties available for mobilization for relief missions, for example: medical personnel, linguists, civil affairs, civil

engineers. In these cases **functional mobilizations or capabilities mobilizations** might be undertaken to support these missions rather than deploying large numbers of combat units. Numerous IW functions could be virtually "cross-desk" mobilizers.

The group suggested that Team Black units would be better served by a kind of unit replacement system. Team Gray could use a unit replacement system or Blue-Gold Crews. Team Black units are so highly specialized and individually cohesive that some kind of unit replacement either at company or force level (i.e. Tiger Force, Eagle Force, etc.) would have to be designed into the force.

Key Findings From The Logistics Group

The logistics Group provided a major service in making professional estimates of the logistics stockage rates of the Gray and Black Forces relative to Army XXI Forces, Fig 2. Additionally, given that Gray and Black have identical fighting systems (and likely will use the same amount of things) and that Team Gray units are roughly three times the size of Team Black, actual amounts of things will be significantly reduced for Gray relative to Gold and some significant number more for Team Black. These calculations will go into providing usage rates and stockage rates for the Game. Usage calculations will provide a conditioning process for planners during Game VI.

Key technical leverages for the logistics function include the ability to center on a single propulsion system type for all major systems. This would tend to simplify both Class III and IX provision. Designing for "ultra-reliable" operation, like we do for current space systems, would also contribute significantly to ease logistics management. Designs should strive for as much commonality as is feasible, given the various mission profiles of deployed systems.

SUPPLY CLASS	TM GREY	TM BLACK
CL I/VI	50%+	50%+
CL II	50%+	50%+
CL III	50%	50%
CL IV	75%	75%
CL V	35%	37%
CL VII	N/M	N/M
CL VIII	80%	80%
CL IX	60%	80%
Water	~	~
Trans	+	++
Maint	-	--
Services	~	--

Figure 2 - Logistics Stockage Rates for Notional Forces Compared to Army XXI

The group had a significant discussion about the nature of the Five Paragraph Operations Order. Recognizing the fairly canonical nature of the OPORD, the logistics community has been fairly unanimous in suggesting throughout our game series that the logistics plan needed

to be part of Paragraph 3, not a separate Paragraph 4. The point has less to do with changing the OPORD as it does with emphasizing a mindset that sees logistics as a central part of operations. This suggestion was made most emphatically at the 16 January Planning Session, attended by senior logistics planners and staff, that was set up after Game V made such a "to do" about logistics. The specific suggestions for change to the OPORD will be more completely described in the final report.

The Work Group looked carefully at the logistics concept and "vignettes" provided as part of the Workshop materials. They did not change any of the concept except to define more completely the echeloned force design associated with the logistics concept, to wit: the Forward Support Unit, Rear Support Unit, and Joint Theater Support Unit, Fig 3. The Joint Theater Support Commander provides and C2 and management functions. Headquarters may or may not be in theater.

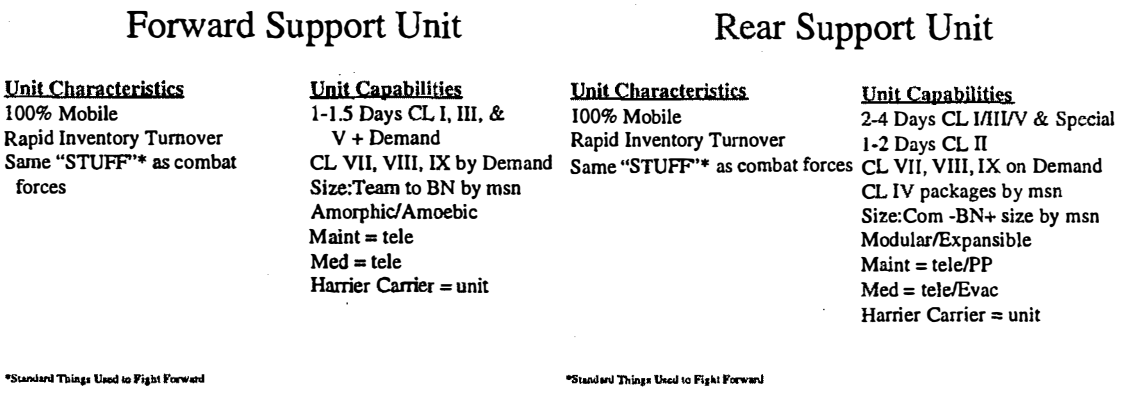

Figure 3 - Description of Forward and Rear Support Units

Key Findings From The Technology Group

The Technology Working Group mobilized a very broad-based collection of technology specialists who accomplished several critical tasks. They scrubbed the technology basket that we have used in the Dominating Maneuver Games since 1994, per the suggestion of the CSA at the Game V Final Plenary. The group identified "core" technologies for focused development. They suggested several technologies to drop, either because of feasibility or a marginal utility or both. They articulated some 21 new technology concepts that have potential for Dominating Maneuver and other warfare areas in the RMA Venue: Space Warfare, Information Warfare, and Precision Strike. Figure 4 is a summary of the Group's scrub of the Technology Basket.

- Reviewed 22 Systems in Technology Basket
- Proposed 21 New Candidate Technologies

• Identified 7 as Core • Adv Combat Vehicle • Adv Fast Atk Vehicle • Harrier Carrier • LR Indirect Fire Sys • UAV Family • Fast Surface Effect Ship • Tempest IW Defense	• Eliminated 4 Systems • Anti-Materiel Agents • Lampreys • GPS Fuzzer • Supersonic Heavy Transport Aircraft

Figure 4 - Technology Basket Scrub*

Figure 5 is a representation of the Group's analysis of the core systems. They accomplished this analysis for all systems in the Technology Basket, a summary of which will be included in the Workshop Report. They also redefined characteristics of some core systems, notably the A2CV, to bring it into line with what they felt were feasible capabilities. They began a generalized description of the systems technology capabilities as opposed to the sometimes quite specific descriptions that existed. Many players felt that by being so prescriptive in our descriptions, we were losing the ability to look more broadly at technology descriptions. What is intended now is to provide a capabilities description for each system played in the games that the players feel are both feasible and required. These descriptions will then be briefed as needed capabilities for the Army leadership's consideration in the September Leader Conference.

System	WF Utility	Plausibility	Remarks
ACV	10	5	High-risk, high-payoff; power source, weight, complexity concerns.
AFAV	10	10	Unrefueled range? Survivability?
Harrier Carrier	10	9	Should be more like *Osprey* (heavy-lift tilt rotor); range/speed inadequate; EM gun?; landing, power source concerns
LRIFS	10	4	Range/lethality vs. size?; Joint potential; why on MLRS chassis?
UAV	10	10	Micro-UAVs range?
FSES	10	10	Complements airlift.
Tempest	10	10	Defensive IW.

Figure 5 - Assessment of Core Technologies Required*

Prior to nominating specific concepts for the warfare areas (Fig 6), the group undertook to provide a generalized set of feasible technology goals for all four RMA Warfare Areas, not just Dominating maneuver. In the case of precision strike, all shots were to be shoot-to-kill. Each shot should produce one or more kills. In Information Warfare, we should seek to know all, see all, and defend against all, providing automatic encryption and tempest protection. In Space, systems should cut launch costs and time by 50%. Launch payload should be increased by

* The Harrier Carrier was renamed as a result of Workshop deliberations. It is now the Advanced Aviation Combat Vehicle (A2CV).

100%. In Dominating Maneuver, systems should reduce Class III, V, IX requirements by 50%. Smaller units will demand less Class I and water. Systems and soldiers should operate 24 hours a day in all weather.

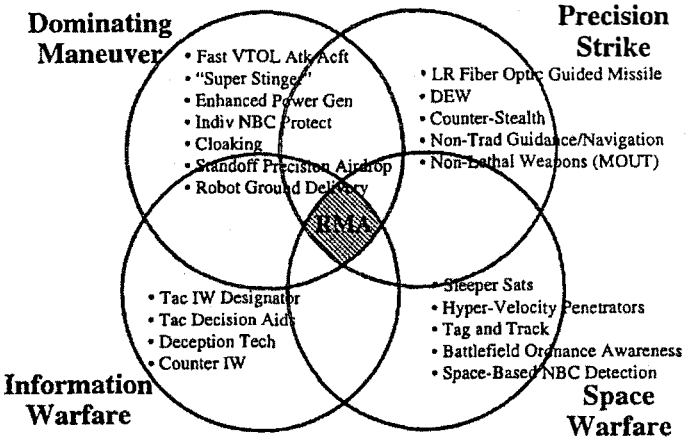

Figure 6 - Suggested Technologies for Other RMA Warfare Areas

In Figure 6, then, the Technology Work Group undertook to suggest concepts that would apply not only to Dominating Maneuver but to the other RMA Warfare Areas as well.

Future Events

Future Dominating Maneuver events will be developed based on guidance from the Army Leadership and OSD/NA, informed by inputs from workshop and wargame participants. The broad objectives of the FY97 series are to: continue refining and adding to other O&O concepts developed in RMA workshops and wargames; articulate the tactical-level "how to fight" for these concepts; address soldier and leader issues; refine organizational design concepts; logistics organizations and concepts; and explore the implications of these concepts and organizations for the technology base.

ANNEX A: Research Questions

Dominating Maneuver Workshop VI
US Army War College, Carlisle Barracks, PA
2-3 April, 1997

Soldier/Leader Questions

Who is the High Tech Soldier or Leader of the Future?

- Will we recruit two categories of soldiers--a utilitarian, low-skilled soldier who is primarily used for one tour of duty only, and a more highly qualified soldier who serves and then is given expanded training and education? Will soldiers grow into high-tech slots or will we recruit directly for them?

- How might leaders be different in 2020-2025 than today? Can some officers be leaders and others skilled functional managers? Or will all officers be trained leaders whether slotted in leader positions or managing functions?

Functions and Skills for High Tech Soldiers and Leaders?

- List significant future soldier skills individually; then group by function if possible: e.g., leader, shooter, integrator, supporter, transporter.

- List significant future leader skills; then group them appropriate to echelon of command: e.g., fighting unit, integrated unit, integrated force; joint-combined force. Must we rely on career tracks to grow leaders and high level managers; if so, how can we build unit stability for fighting effectiveness? Is this a trade space?

- Does the RMA imply or demand that commanders have the ability to manage a larger span of control, thus leading to larger numbers of units under them and likely fewer intermediate levels of command?

Branches for High Tech Soldiers and Leaders

- List separately missions and functions in today's terms that will figure strongly in the RMA; then group these functions logically into new RMA branches: e.g. shooter, integrator, supporter, transporter, you pick.

- Does the USA need a separate general staff to cultivate strategic/operational thinkers and tactical/operational thinkers -- i.e., a career field for general staff "integrators?"

- Migration of military skills to the civilian sector and contracting out for services:

- Do we need uniformed soldiers to perform functions that are currently done in theater but which can be done in CONUS rear? For example, in the logistics arena, some management functions do not need to be done in theater. Likewise, personnel administration can be done in CONUS. Removing these functions minimizes the support footprint in theater.

- How do we militate against the negative effects of divesting ourselves of uniformed resources that, once gone, will be difficult to regenerate? What functions must be uniformed? Under what circumstances? How do we guarantee civilian support for combat operations?

Training of High Tech Soldiers and Leaders

- Implications of length of education for high tech leadership (15 years for USAF command pilot):

  - Will education of comparable length be necessary for future ground soldiers and leaders?

  - If necessary, how do we reduce this time? (e.g. black box high tech, simulation training, etc.).

  - Will the need to invest in more training and professional education development throughout the life of the soldier require perhaps the need to "age" the force to amortize the training investment (i.e., implications of older soldiers)?

  - Does a broadened mission spectrum require increased knowledge for the individual soldier? In the aggregate, should this mean a larger TTHS account for the Army? Would a larger proportion of the force in this status mean a smaller operational Army? Describe a distance learning and unit manning system to minimize this problem.

Retention of High Tech Soldiers and Leaders

- The implications of the RMA suggest the desire for a more experienced, long term force; what institutional capabilities allow gaining and retaining an experienced force?

- As tactics become more de-massed, there will be more psychological requirement for reliance on the team. One implication may be to form the team, then keep it together for as long as possible--return soldiers to same units or parent unit after training or simply train soldiers in their units so that relationships develop and mature for several years. Is this concept viable? Expand on it or expand an alternative.

- The need for Internet access for soldiers for professional networking--create networks similar to the BG mentoring network that the CSA has--perhaps for installations, for

branches, for specialties, etc. Chat rooms for various professional development topics and topics of the day. Is this concept viable? Expand on it or expand an alternative.

Functions for the RMA Organizations: AC-RC

- Have we discounted or "written off" the need to ever mobilize? Will all future conflicts be "come as you are, use what you've got?"

- Are there functions best accomplished by the Reserve Component and the National Guard? What functions overlap? How do we integrate the three force elements into a common, professional military culture-- i.e., a homogeneous and cohesive force?

Individual Soldier and Leader Replacement Systems

- Given that unit cohesion and high-tech force designs will place a premium on having trained, acculturated soldiers available to replace soldiers or units standing down and casualties, discuss advantages and disadvantages of following replacement systems for the scenario, operational concept, and force designs: Blue-Gold Crews, Unit Replacement Systems, other. Describe how they would work.

Technology Questions

Technology Basket Review

- Eliminate or revise the description of technologies not technically feasible in the time frame, exclusive of fiscal constraint; offer alternatives which fulfill the envisioned missions.

- Add any technology or groups of technologies deemed available and possible but currently unrepresented in the Technology Basket. What missions do these technologies fill in the RMA regime?

- What general technical goals are feasible and how might they be realized with the systems highlighted in the Technology Basket? With technologies you have added? -- i.e.:

    - Fuel Use Reduction of 50%

    - Soldier Water Requirements Reduced 60% - Recycling

    - Ammunition Sizes (Weight/Cube) Reduced 40%

    - Are these goals useful metrics? Are there others?

- What is achievable in component/system commonality - particularly in supply items?

- Can we have similar gun calibers and munitions for the Services (Navy 5" Gun, Marine VGS 155 Gun, Army 155 SP Gun, Army/Marine LWH)?

- Can we have multi-function munitions: not only standardize within each Service, but produce multi- vice single-function systems standardized across all the Services: JTACMS, EFOGM/HELLFIRE, THAAD, SM-2, Corps SAM)?

- What does a move to commonality mean to the ability of the industrial base to provide these items? What about R&D costs and development cycles? Do they go up and lengthen, or decrease?

Technology Descriptions

- Describe technologies as a set of *capabilities requirements* to support operations in the RMA regime rather than saying you have 15 ton ACV, say we require ground maneuver at *x* Km/h, direct fire range of *y* Km etc.

- Describe technologies as a set of logistics demands. (How much fuel will you ground maneuver system use? How many bullets will it carry and shoot?)

- Describe technologies as a set of special training demands, if any. (Will demassed formations linked via information technologies require added, specialized training to use and maintain?)

Technology Base

- Are we doing the R&D to support the items in the Technology Basket? What should be our priority in investing in R&D given the concepts and scenario?

- What is the foreign arms or off-the-shelf potential to enhance an RMA force?

Logistics Questions

Logistics Concepts

- Review the support concept provided you from DM Game V. Modify, adjust, and comment as you see fit as long as the logistics concept continues to support the operational concept.

- What would a combined OPORD Para 3 look like if it integrated operations and support concepts? -- i.e., no Para 4. What changes in staffing, organization of staffs, and procedures would be necessary to fully integrate the logistic plan with the operational plan? Do we need to train differently than today to support integrated staff planning?

- What are the key items of supply in terms of critical dependencies at each phase of an expeditionary operation (deployment to conflict, conflict, post conflict)?

- A joint battle management system has been often postulated in previous games. What must the logistician have in terms of outputs from and access to such a system in order to operate?

Logistics Capabilities Required

- Beginning with an initial assumption that Team Gray Units will use 50% (Team Black will use 40%, they are so much smaller) of Army XXI planning factor quantities in major supply categories for each team's operational concept, ***profile in detail*** a pure CONUS-to-Combat logistics support scheme. (Additionally, assume that Team Gray can carry seven days supply, and Team Black ten).

    - What does it look like on the ground? Where is the force structure and what is it?
    - Calculate unit mean times of transit, how long to package, what failure rate is; which classes of supply fit the concept, which will have to be managed by exception.

    - Provide a gross estimate of the lift (air and sealift) required for the whole force. Make whatever other assumptions are required; define them in your briefing -- i.e., tactical logistics UAVs transport stock from point *a* to point *b*; they must carry *x* tons *y* distance per unit of time to support a particular type of unit.

    - Provide an estimate in terms of gross lift and supply demands for each of the brigade size units in both Team Gray and Team Black. You can do this as a comparison with current Army 21 forces -- e.g. a Team Gray air maneuver brigade requires half the demand and lift of a current air assault division when engaged in combat operations.

- Can we assume a 50% reduction in current per unit planning factors as baseline for units like Gray and Black? Can they carry 7 and 10 days of supply respectively? What other estimate can be used? In the high intensity operations envisioned in the RMA environment, are such a reductions and estimates realistic?

- Is possible to leverage common items of supply -- i.e., can we go to one fuel for all systems given hybrid combustion-electric drive or other propulsion systems?

    - Are there propulsion systems, ammunition, items of supply not yet discussed which aid commonality across services and systems? If so, what are they? What do we gain, what do we lose?

    - What munitions capabilities could be standardized across services and systems currently under development (e.g. Navy 5" gun, Marine VGS 155 gun, Army 155 SP gun, Army/Marine LWH, etc.)?

    - What does a move to commonality mean to the ability of the industrial base to provide these items? What about R&D costs and development cycles? Do they go up and lengthen, or decrease?

Workshop Report

Introduction

On 2-3 April 1997 a group of approximately thirty convened for the first Dominating Maneuver event of FY 97, Workshop VI. The workshop was one in an ongoing series on the Revolution in Military Affairs (RMA), begun in August 1994, that is sponsored by the OSD (Net Assessment) and the Army Deputy Chief of Staff for Operations and Plans (DCSOPS). The basic premise of the RMA study is that several new warfare areas will emerge from a convergence of new operational and organizational (O&O) concepts and technologies. Dominating Maneuver is one of the four preconceived warfare areas. The purpose of the Dominating Maneuver workshops and games is to establish a more concrete understanding of the role of maneuver as it relates to the warfare areas of precision strike, information warfare, and space operations.

Each workshop has explored a series of questions intended to inform and define the development of a subsequent wargame. Analysis of the outputs from each wargame has in turn identified key issues to be explored in a follow-on workshop. This iterative intellectual process has been repeated throughout the series. Issues explored in the Dominating Maneuver series to date include:

- Logistics and battle support concepts
- Force protection and survivability
- Integration of precision strike, IW, and maneuver
- Air superiority and aerospace control
- Measures of effectiveness
- Tempo of operations
- Battlespace awareness
- Future role of SOF
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- Tactical concepts and tactical organizations
- Strategic deployment and early entry
- Defeat mechanisms
- Integration of allied forces in RMA operations
- Complex adaptive systems as a paradigm for future organizations
- Operational-level battle management C2
- Linkages and discontinuities between Army XXI and notional future Army forces

The approach taken in Workshop VI was somewhat different than that of the first RMA workshops and games. While the scenario was kept constant and the forces under analysis were retained (please refer to force summary in Figure 1) the groups, rather than work through each step in the campaign planning process, started with a common CINC's concept already in hand. With this they were tasked to look at specific research areas with the purpose of developing concepts to a greater level of detail. The focus was

on three broad research areas and the participants were divided into panels as follows: Soldiers and Leaders; Logistics; and Technology Capabilities.

TEAM GOLD	• **Army 21** • **Ground Maneuver Division:** modeled on current Army XXI unit designs with heavy systems (M1, M2, M3, Crusader, MLRS/ATACMS) and digitization • **Air Maneuver Division:** air assault division based on Army XXI design principles • **Armored Cavalry Regiment::** modeled on current unit design
TEAM GRAY	• **Army XXI+** • **Brigade-based force (Ground Maneuver and Air Maneuver)** composed of battalions, employing RMA systems (e.g., ACV replaces MBT and AIFV; LRIFS replaces cannon artillery) • **Eagle Force:** hyper-mobile, lethal RISTA unit for independent operations or battlespace shaping for maneuver units; shares conceptual underpinning with USMC Sea Dragon
TEAM BLACK	• **Dominating Maneuver Wargame Army:** Smaller, modular brigade-based force composed of maneuver companies (no battalion structure), employing RMA systems as above • **Tiger Force:** (ground maneuver) • **Cobra Force:** (air maneuver) • **Eagle Force:** (hyper-mobile RISTA) • **Scorpion Force:** (hyper-mobile infantry)

Figure 1 – Force Concepts

The general analytical aim of Workshop VI was to continue exploring, at the *operational and tactical level*, promising O&O concepts developed in earlier RMA workshops and wargames. Each panel also considered specific analytical aims:

- The Soldier/Leader panel considered soldier and leader requirements and military culture issues in the context of the RMA regime. In their discussion they considered: the role of the Reserves and National Guard in the RMA as part of the total force; identified military functions and missions that should or could be civilianized, and those that should not; and described future military functions and skills, and new groupings of functions and skills, which will figure strongly in the RMA environment.

- The Logistic panel explored logistic integration issues and added detail to previous RMA logistics schemes in terms of specific sustainment requirements for Team Gray and Team Black, logistic

unit designs, and the integration of logistics management and battlefield management concepts.

- The Technology panel examined technology requirements for the RMA environment. They described enabling technologies for the operational scheme of maneuver, identified key technologies or technology capabilities that exist now or are in development which can lead to RMA technologies, and identified significant technologies and R&D efforts that do not exist now but need to be contemplated to achieve the RMA.

After consideration of these analytical aims, the groups reported their insights back to a full plenary session at the conclusion of the second workshop day. This plenary was linked by video-teleconference and GroupSystems™ software to Army Staff principals.

Soldier-Leader Panel Summary

Introduction

The workshop developers provided a set of questions, divided into areas of focus, with which the group was to find guidance in accomplishing its primary task of defining the soldier and leader of the future. The group tackled a wide range of issues including matters ranging from recruitment to training to soldier retention.

Future High Tech Soldiers

Deliberations were begun by focusing on questions dealing with the character of the future soldiers and leaders. The group first turned to a consideration of the recruitment of these soldiers. The idea that the future force would recruit from two categories of soldier—one low skilled who would be selected primarily for one tour of duty, and the other a highly skilled soldier selected for the longer term—was resoundingly rejected. The group claimed such an approach would create a service society of "haves and have-nots." Besides, it was noted, high skills will, of necessity, be the norm throughout the future force. The group envisioned that the only reason for even considering the possibility of recruiting low skilled soldiers would be potentially constrictive budgets, through which high tech soldiers could not be afforded. During the briefings, however, some comments were made to the effect that low skilled workers could be recruited, if necessary, with the knowledge that they would be placed in environments of user-friendly technologies. The group further added its concern that the Army should act to project itself more as a values based institution. Instead of sloganeering on "For myself, for my future," a mentality of "For my country" should be invoked. This concern also raised a significant response during the briefings. While most agreed that such a mentality was more desirable, some pointed to the harsh realities of our modern culture, and those realities say that patriotism does not fuel the recruitment engine.

In considering where these high-tech soldiers would be found (i.e. promoted from within the force or recruited from the civilian sector) the group noted that it would be desirable to both 'grow' our own soldiers and recruit high-tech people. The benefit of growing our own high-tech soldiers was found in the opportunity to imbue them him/her to the Army culture—not to overlook the fact that the Army has always had the responsibility of developing its soldiers. The benefits of recruiting, on the other hand, were noted in the likelihood that the civilian sector would produce many more technically knowledgeable people than the military could.

Future High Tech Leaders

The group then turned to a consideration of the necessary characteristics for the future leader. Communication skills and technological capabilities were deemed in the greatest need of enhancement. Vast influxes of information will drive this need for greater communication skills. Interpretation of the most accurate intelligence will require an understanding of how to draw from multiple sources of media. Outside sources will likely have as much, if not more, relevance than sources found within the compound. The ability to command the future force will also require greater technological capabilities. This does not necessarily refer to an understanding of the internal workings of a system, it refers to the proper application of advanced technologies within the force structure. Further, the leader of 2020-2025 will need to achieve greater physical fitness. The necessity for this characteristic is based on the belief that the future battlefield will be increasingly stressful. Endurance will be a key factor since longer hours will be required to process and manage massive amounts of information. While enhancement will be necessary in these characteristics, the group stressed the need to maintain the foundations upon which leadership is based. Promoting the highest principles, morals, and values will remain a primary role of the leader. Imbuing, in the individual soldier, an unflappable trust in the institution is inherent to this role. The group further envisioned consistency in the transformation from soldier to leader. A leader will still have to be developed by going from basic, to the garrison, through training, and into combat.

In approaching questions on the similarities and differences between leaders and managers, the group pointed to faults in the current thinking. Generally, an officer is viewed in higher regard if in a leadership position rather than in a management position. This thinking has to be changed. While people are led and things are managed, it must be understood that the development of a leader is not unique to combat arms. Diversity in development should be accepted while a common leadership foundation is maintained.

The group noted concern in the consideration of such concepts as a leader laterally moving to and from the civilian sector. A breakdown in the institution's core values was viewed as a possible negative outgrowth from such a concept, as was a continuous removal of officers from their proving grounds. When developing a leader, the process should always begin with the foundational notion of "a soldier first." Some members of

the audience, however, disagreed with the groups assertions. Noting the volatility of the job market, and the fact that virtually no one stays with a single company for 20+ years, a couple of different options were posed with regard to civilian recruitment. The first option considered the possibility of allowing former soldiers to reenlist after they had left the service—thus, the Army would consider a revolving-door job market and its prevalence over lengthy careers. The second point made in the briefings was of a similar tone in the suggestion that the Army should take advantage of the job market's volatility and hire people laterally who have already been trained in the civilian market.

Functional Skills

The next set of questions focused on the functional skills of the future soldiers and leaders. The group found that, in the case of soldiers, many of the necessary skills would remain the same; there would simply be different emphases as a result of technological advances. Soldiers will still need mechanical skills, a knowledge of first aid, and so on. Thus, functional groups such as shooters, sensors, controllers and enablers will remain the norm. However, skills of information interpretation will have to improve dramatically. So too will the ability to adequately communicate--conveying and comprehending.

The leader of the future was considered at various echelon levels by the group. Noting that the more disaggregated the battlefield gets, the more important the individual soldier becomes, it was found that skills of the motivator would be more important at the company level and less important at the JTF level. Conversely, skills of the integrator of information were seen as likely to have less importance at the company command level, but more importance at the JTF command. Skills of the organizer would retain its level of importance across the echelon spectrum.

When asked if the group felt that the RMA implied or demanded that commanders have the ability to manage a larger span of control, thus leading to fewer intermediate levels of command, the group replied with a short answer of no. Elaborating on this, it was noted that the force would continue to be limited by human capability—the human is still the bottleneck in the process. Technological advancement will aid in establishing a larger span of control, but the speed with which operations will be conducted will add to an overload of human capacity. The group noted that this would lead to the greater need for trust down through the chain of command, as it would require greater reliance on the lower echelons to convert data to information, to cognition, to knowledge, and then to action.

Branches

The group was then asked to turn to a consideration of how the missions and functions of today's force would be allocated into new RMA branches, thus simplifying management. A structure was devised which divided functions into four RMA categories. Operational type missions, including all branches (not just combat arms) were condensed into one category. Staff types were grouped into a Force Builder category and combat support types were described as Force Enhancers. Finally, an Information Warfare group encompassed the military intelligence forces. These groupings were envisioned to revolve around, and report to, a General Staff of integrators.

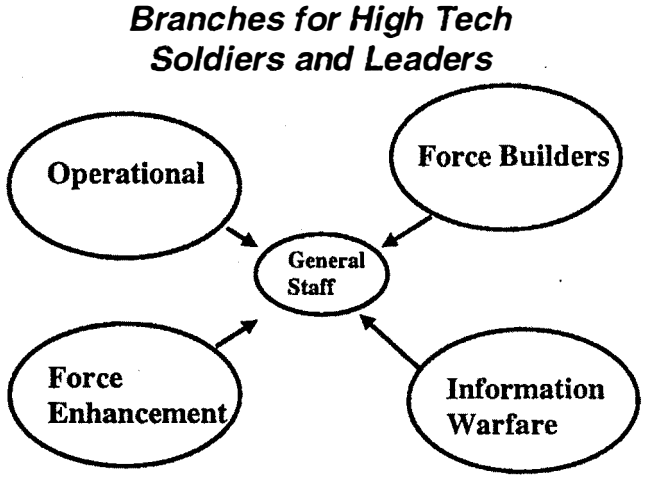

Figure 2 – Future Branch Structure and Organization for Combat

Training

Training high tech soldiers and leaders was a major consideration of the group. Asked how training could be better approached, the group found that overhead had to be reduced while capitalizing on technical advancements. Contracting out for teaching and other non-combat related activities would reduce overhead as well as wasteful years spent by leaders in assignments outside their chosen fields. The need to reduce secondary assignments (i.e. sending officers to ROTC, recruitment, etc) was similarly regarded as a training enhancer since it would otherwise draw the soldier from efforts aimed at a specific career path. The group determined that training for certain skills could be condensed through combination, where appropriate. Thus, infantry and armor training could be integrated to create a Combined Arms Officer. Increasing the commonality of equipment was further noted for its potential to ease training. Common

scopes, steering mechanisms, and cockpit layouts would obviously strengthen the soldiers cross-system understanding.

The need to capitalize on technical advancements was highlighted time and again by the group. Maximizing new innovations in simulations and distance learning was viewed as paramount to the development of future training. Simulations could span the spectrum from ACV maintenance and repair to situational crises at the JTF level. Distance learning could act to enhance unit cohesion as soldiers could train on PCs they were issued, through cybernetic classrooms they linked to from their homes, in their barracks, or even on the battlefield. The group also considered the possibility of directly importing civilians, but soon questioned how one could undergo immediate socialization into the Army's culture. This was considered a serious negative aspect of acquiring "Off the Shelf Soldiers."

Retaining

The two issues of training and retaining high tech soldiers were found, to a large extent, to play off one another. The group determined that proper training would often increase the probability that a soldier would stick with his/her career in the military. By developing a specialty (and this would be achieved through the greater coherence in training outlined above) and creating a soldier-friendly environment, with quality of learning and the possibility of home basing, the high tech soldier could be retained. Quality of learning, the group found, could be maintained by issuing PCs to all soldiers. Through these PCs it was envisioned that access could be gained to a DoD-wide internet for the enhancement of professional skills. "Chat groups" could also be developed through which soldiers would have greater access to their peers and leaders. This system would especially enhance mentoring.

Further findings of the group suggested that the military would need to compensate better the skill levels they would wish to maintain. There will be a great need, in the future, to become more competitive with civilian industry. The group conceptualized a possible compensation format similar to that of soldiers who go through language training. When the soldier completes training he/she gets a raise which is added to as proficiency rises. This form could be extended to many areas in the military, from computer technology, to vehicle maintenance, to operating weapons. It was also determined that the assignment system would have to become more soldier-friendly. Bringing an end to 18 month rotations, thus making it possible to stay in one place for a longer period, would result in healthier, happier families. Better health care and more adequate housing or housing allowances would also contribute to the welfare of families. The group wrapped up this question by admitting to the redundant sounds of many of their observations. However, the RMA world will increase the significance of such matters. If a soldier needs to go from Camp USA to the front-lines in 96 hours, it will be of vital importance that last minute headaches associated with deploying are kept to a minimum.

Functions of the AC-RC

The group then addressed questions pertaining to the mobilization of our forces. Asked whether we had "written off" the need to ever mobilize in favor of a future posture that posited "come as you are, use what you've got," it was found that mobilization would exist, just in forms with which we had little familiarity. The group postulated that portions of the force would be in a state of "constant, virtual mobilization" and that, in the future, more in-place mobilization would be the norm. This would be facilitated by new mission areas and the separation of sensors, deciders and shooters. The need for greater coalition participation was added to the possible ways to alleviate mobilization. Generally, though, the ability to mobilize was viewed as a future need. It was suggested that in a an RMA war we would need to mobilize simply so that we could perform other military missions. In addition mobilization is seen as a sign of national resolve and helps to win over the populace.

In considering the potential of the Reserve Components in the RMA the group generally found that its greatest functions would be in maintaining areas that had been easily translated from civil skills. For example, an IBM or Microsoft employee, sitting at his desk, could simply download military software onto a workstation provided by the Army and, within fifteen minutes, become mobilized. Targeting, and other activities that would not necessarily entail going overseas, were regarded as possible reserve missions. But the missions that required the greatest coordination and control would have to be left to the Active Components.

Finally, the group suggested potential replacement systems for Teams Black and Gray. It was found that the Team Black units would be best served by a unit replacement system, while Team Gray could be served by either a unit replacement system or Blue-Gold crews. Because of the level of specialization and individual cohesiveness of the Team Black units, it was suggested that they would need a unit replacement system designed into the force at either the company or force level (i.e. Tiger Force, Eagle Force,etc.).

Logistic Panel Summary

Introduction

The Logistic Panel was formed with the main task of analyzing logistical concepts from the Dominating Maneuver series (Dominating Maneuver Wargame V, in particular). Through their analysis, the group addressed such topic areas as: commonality in supply; restructuring of the OPORD; identification of key items of supply in terms of critical dependencies; and adjustment of the logistical concept to establish greater support for the operational concept. The group set out with its own goal of fleshing out true logistical concepts from the "bumper stickers" that usually arise during such discussions

and, thus, determined that some peripheral issues should be addressed before turning to the questions provided by the workshop's designers.

The group first noted that the ability to supply Just In Time (JIT) logistics was simply a matter of information awareness and how it is used. The example of Federal Express was raised with the point being that they had found their niche by asking what the customers wanted and thus designed a system which would fit their response. While this approach to delivery may be admirable, some group members warned of using too many business paradigms, in which there is always a fixed address to which deliveries are made—obviously not a possibility for the military. The true issue of supplying demands, it was noted, is found in distinguishing between what needs to be "Just In Time" and what is good enough.

Overcoming certain concepts which have become ingrained in the military culture will also prove to be a significant factor in achieving a Revolution in Military Logistics (RML). Matters of inventory were a foremost concern of the group. The idea that the whole system (i.e. design, production, order, stock, installation, etc.) has to be owned by the separate services, or that a commander must store for all contingencies, is in need of change. What is necessary, the group noted, is a system where the operator can "reach back" to get what he needs, without the organic tail. One participant commented that ultra-reliable equipment was a trade off between acquisition cost and life cycle cost. To save life cycle costs and operating efficiency higher acquisition costs would have to be allowed, which may not track with current acquisition policies.

Supply Commonality

At its preliminary analysis the group turned to the questions provided by the workshop designers. The first issue that was addressed had to do with the possibility of leveraging common items of supply to achieve technological overmatch. The group posited that this could be done, but certain advancements would have to be made. First, a single power source capability would have to be achieved. Second, ultra-reliable combat/CS/CSS systems would have to be developed as would embedded sensors. Finally, commonality among Classes III, V, VII, and IX, as well as in, what the group defined as, Standard Things Used To Fight Forward (STUFF) would be necessary (i.e. fuel, rations, ammunition, etc.). Some, outside of the group, took issue with these conclusions during the briefing. A few participants questioned the need for such a focus on commonality. Some argued that with total asset visibility, good communications, and reliable distribution systems, we could still be confident that resupply could be achieved with, or without, common fuel. Precision logistics and accuracy of information should make up for a lack of commonality. Others claimed that there was a potential for great inefficiencies in producing commonality. For example, there would be certain limitations in deciding upon the basic engine design for a single weapon system or a certain caliber ammunition for different guns. Commonality could likely be improved at the margins, but not for important systems.

A New Operations Order

In turning to consideration of a new Operational Order (OPORD) the group considered what changes would have to be made if support concepts were to be integrated with operations concepts. One group member gave the question perspective by noting the information overload that a CINC receives during a briefing. All the CINC wants to hear is the intelligence as it relates to the Joint Vision 2010 (JV 2010) areas of Precision Engagement, Dominant Maneuver, Full-Dimensional Protection, and Focused Logistics. Thus, the whole staff process needs to be considered. Paragraph 4 of the OPORD, where logistics now resides, is simply an afterthought. The group noted that for information to be a force multiplier, its packaging would have to be modified to ensure effective employment. To achieve this a new OPORD was derived. In the new OPORD it was determined that operations would be better described through the interplay of logistics, strike, maneuver, protection, and intent. Therefore, the group rolled all of the JV 2010 areas into paragraph 3 to emphasize that logistics will have more of a central role in operations.

Stockage Rates

Having posited their positions on the OPORD the group then offered their professional estimates of logistic stockage rates for the Black and Gray teams. This was done largely to provide more accurate stockage rates for Dominating Maneuver Wargame VI. The group found that a 50% reduction could be assumed for Classes I, II, III, and VI However, there was some internal disagreement to such reductions in Class III. Some members claimed that this could not be achieved with the current technology. As it now stands only a 25% reduction is likely. If fuel efficiency technology was funded though, a 50% reduction is possible. Class IV reductions could likewise be as high as 75% since items will have less bulk, there will be more mechanical effort, and local foraging will be increased. A potential reduction to 35% for Team Gray and 37% for Team Black was noted for Class V. Each group could achieve 80% reductions in Class VIII while Team Gray could realize a 60% reduction in Class IX and Team Black an 80% reduction. ***Despite these possible reductions, the group found that it would be impossible to deploy with seven days of all supplies for Team Gray and ten days for Team Black. Ten days of food was deemed possible, but not of Classes III and V. If the unit was self-deployable, the group stated, it would have to carry its own supplies.***

Redefining Force Designs

Forward Support Unit (FSU)

Though the group did not find any great faults in the logistical concepts of past

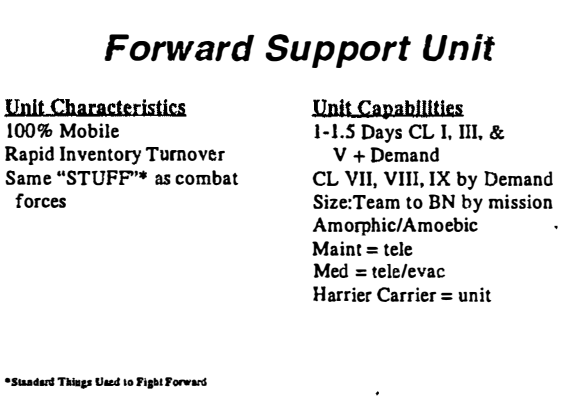

Figure 3 - Redefined Forward Support Unit*

Dominating Maneuver "vignettes," they did act to redefine those forces that are most closely associated with logistics—the Forward Support Unit (FSU), the Rear Support Unit (RSU), and the Joint Theater Support Command (JTSC). For both Teams Black and Gray, the group found that the FSU would have to be prepared to supply one to one and a half days' supply of Classes I, III, and V with some left in reserve. Classes VII, VIII, and IX would have to be available on demand. Maintenance and medical capabilities would need telecommunication links and medical would also require evacuation capabilities. The FSU would further need the capability to reinforce troops from a Team to a Battalion size. Both the FSU and the RSU would require the basic characteristics of 100% mobility with rapid inventory turnover. They would need the same STUFF (Standard Things Used to Fight Forward) that combat forces had. Both Support Units would also require A2CVs organic to their force.

Rear Support Unit (RSU)

The group anticipated that the RSU would require (for both Teams) two to four days' supply of Classes I, III, and V as well as one to two days of Class II. Classes VII, VIII, and IX would need to be ready on demand and Class IV packages would have to be prepared by mission. The RSU would further require the potential for modularity and expandability. Maintenance and medical support, like in the FSU, would require telecommunication links. Proper maintenance support would also necessarily be backed

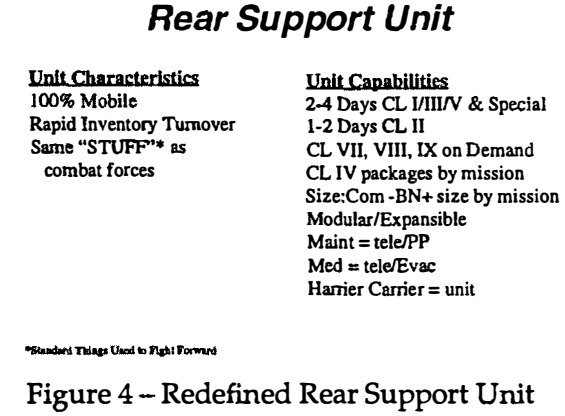

Figure 4 – Redefined Rear Support Unit

* The Harrier Carrier was renamed as a result of Workshop deliberations. It is now the Advanced Aviation Combat Vehicle (A2CV).

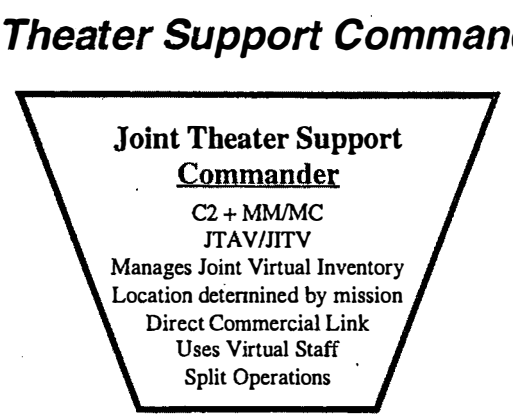

Figure 5 – Redefined Theater Support Command

by prepositioned supplies and medical support would need evacuation capabilities. The RSU would also require the ability to reinforce itself a Company to a Battalion+ size force by mission.

Joint Theater Support Commander (JTSC)

It was determined that the Joint Theater Support Commander (JTSC) would manage a joint virtual inventory and its location would be decided by mission. Through the use of direct commercial links and a virtual staff, the JTSC would not necessarily have to be located in the tactical theater, but would have to be in the operational area. The JTSC would also have to assume responsibility for materiel management and maneuver control.

Technology Panel Summary

The first task of the technology group was to review the Tactical and Logistical Concept Vignettes that had been included in the proceedings of Dominating Maneuver Wargame V. Using these concepts as a base, the group scrubbed the Technology Basket and described the capability requirements of the technologies. The group, after completing its review, proposed an additional 21 new technologies to be added across the spectrum of RMA warfare areas. ***The end goal of this course of analysis was to take initial steps toward defining the technological capabilities necessary for future warfare. The more immediate purpose was to provide the players of Dominating Maneuver Wargame VI with a set of givens for evaluation and gaming. Results of this workshop were used to modify Wargame VI inputs.***

The group began their scrub of the Technology Basket with a system by system review. It was suggested that the review should be put in context by thinking of what radio/television was like in 1950 and what it was like now. With this in mind, the technologies were addressed for their plausibility and their utility. After a discussion touching on each of the systems, the group decided which technologies belonged in the Basket, which were core systems, and which had little or no plausibility for or utility in the RMA force. The group reviewed all 22 systems. Seven of the technologies were identified as core systems for the proposed RMA force. Four more were dropped; seven were added.

Core Systems

ACV

The group rated the Advanced Combat Vehicle (ACV) high in its utility, but risky to attain. The ACV was deemed a necessary inclusion in the Technology Basket and one of the seven systems that were eventually singled out as being at the core of the force. The group pointed out that the ACV had to be looked at in terms of the A2CV's capabilities as well, since both were central to an air mechanized force. Weight and speed were seen as integral considerations with the ACV. The requirement for speeds as high as 120 mph on road and 70 mph cross-country was deemed excessive. The power source was also a concern, particularly because of its logistical impact. Generating the hydrogen for the fuel cell and moving it around the battlefield was not viewed as an easy task. Overall, the ACV was deemed a high-risk, high-payoff system. The group generally found its specifications sound, but noted that it would need a range of 500 miles.

A2CV

The Advanced Aviation Combat Vehicle (A2CV) was likewise recognized as a core system. However, while the technology group ranked it both high in utility and plausibility, it was determined that there were many improvements that were necessary in bringing the A2CV into line with an RMA force. First, the range and speed had to be increased. Second, from the standpoint of air propulsion efficiency, the A2CV was deemed inadequate. The group found that it had to be more like an *Osprey* in that it needed greater lift, a tilt rotor, and greater hovering capabilities. As with the ACV, concerns of power sourcing were raised, particularly since the needs of the A2CV would be stressed by its guns and sensors. To this end, there was much doubt as to the need for an EM gun. Without a first generation weapon of the sort, its technical plausibility was put in question. During the workshop's plenary session, numerous participants, on other panels, expressed similar concern as to the need for this auxiliary system which would require significant power. In the end, an alternate armament was recommended.

AFAV

The Advanced Fast Attack Vehicle (AFAV) was rated highest in both utility and plausibility by the group. Regarded as a core system, questions were raised about the AFAV concerning its refueling range and its survivability (since it is not an armored vehicle). Some group members did attempt to offset survivability concerns by pointing to the AFAV's ability to get a fused picture of the battlefield. Through sensors the enemy could be seen while our forces could avoid him. Others saw its survivability as being derived from its speed and agility. In deciding upon a final description for the system, the group suggested that the AFAV needed greater agility and fuel compatibility with the ACV.

LRIFS

The Long Range Indirect Fire System (LRIFS) was likewise recognized as a core system of the future force. However, the group doubted the plausibility of its 500 km range. Because of its range, whatever it might be, one member of the group pointed out that it would allow you to fire from many distributed points without the enemy knowing where it was coming from.

UAVs

The technology group also found the family of UAVs to be among the seven core technologies. A very plausible and useful system, they only found fault in the potential range of the micro-UAVs. With questions regarding the plausibility of payload they could carry or the endurance of the system the group noted that, with access to larger UAVs, there may be no need for the micro version. The importance of the overall UAV force to the AAN ground battle force was further noted when certain members suggested that individual UAVs be 'slaved' to individual ground vehicles.

FSES

The Fast Surface Effect Ship (FSES) was similarly viewed as a core system. While considered very useful and plausible, the group noted that speed and how the ship would actually be stopped were concerns. On the whole, the Technology Basket definition was seen as adequate, but alternate hull concepts and in-stream off-load capability to Sea State 3 were noted as possible means for improvement. The group was also quick to note that the FSES would have to be complemented by airlift as it could not solve all of the future lift shortcomings.

Tempest Defensive IW System

The Tempest Defensive IW System was deemed the final core system of the Dominating Maneuver force. But, while the group envisioned it as a highly useful and plausible system there seemed some question as to what, exactly, it does. There is no doubt that the force of the future will require defensive IW, but how this will be achieved is of issue. It was noted that should development of such a system be successful it would also need to add an anti-detection device.

System	WF Utility	Plausibility	Remarks
ACV	10	5	High-risk, high-payoff; power source, weight, complexity concerns.
AFAV	10	10	Unrefueled range? Survivability?
Harrier Carrier	10	9	Should be more like *Osprey* (heavy-lift tilt rotor); range/speed inadequate; EM gun?; landing, power source concerns.
LRIFS	10	4	Range/lethality vs. size?; Joint potential; why on MLRS chassis?
UAV	10	10	Micro-UAVs range?
FSES	10	10	Complements airlift.
Tempest	10	10	Defensive IW.

Figure 6 – Core Systems Assessment*

Expendable Systems

Anti-Materiel Agents

The group, in addition to listing its choices for core systems, found reason to eliminate four technologies, due either to their lack of feasibility or lack of utility. The first among these were Anti-Materiel Agents. Their slowness of action, potential to harm friendlies as well as enemies, overriding treaty concerns, and their lack of plausibility or utility were included in the group's reasoning to suggest elimination.

Lamprey

The Lamprey, a parasitic system which attaches itself to satellites to evaluate and report on their functional capability, were likewise dropped from The Technology Basket. Legal and treaty concerns were an issue with the Lamprey as well, as was the realization that there are probably better ways to harm the enemy's satellites. For example, jamming is probably more feasible than inserting false information.

GPS Fuzzer

The GPS Fuzzer was also deemed excess in the Technology Basket. The basic concept of the Fuzzer is to provide false information to GPS constellations through quickly launched satellites. The group found that this could be achieved through much cheaper means then launching a satellite. Pre-programming our next generation of GPS satellites to send out false information might be one answer.

Supersonic Heavy Transport Aircraft

The final system slated for elimination by the Technology Group was the Supersonic Heavy Transport Aircraft. While plausibility was deemed relatively high, it was viewed as having only minimal utility. With high development costs and relatively low payoff the system was not regarded as a necessity for inclusion in the Basket.

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* The Harrier Carrier was renamed as a result of Workshop deliberations. It is now the Advanced Aviation Combat Vehicle (A2CV).

Other Systems of Note

Smart Land Mine Field and Mine Clearance System

Though not viewed as a core system or eliminated from the Technology Basket, the Smart Land Mine Field and Mine Clearance System were seen as highly plausible and useful technologies. The group felt the need to elaborate on the potential for numerous enhancements. It was determined that Smart Mines, as they are currently defined in the Technology Basket, need too much direction. In the groups opinion, they needed to become more autonomous, develop more stealthy communications, and the controllers needed to be given the ability to deactivate the mines. It was further noted that they should be capable of destroying low-flying aircraft and that the sensors needed extensive enhancement. Political concerns were also raised as an issue when considering Smart Mines. The group found fault with the Mine Clearance System due to its lack of inventiveness. Some members regarded the system as nearly obsolete. Others suggested improvements such as enhanced sensors and thinking in terms of autonomous swarms of microbots.

Robotics

The robotics included in the technology basket were not viewed as integral parts of the future force. While the group found utility in the unmanned system to serve as a wingman/pointman to ground combat forces, the robotic mule was viewed as expendable. Supply, for example, could just as easily be conducted through a UAV drop.

Biotechnologies

The group found great disparities in the utility and plausibility of technologies within the biotechnology section of the basket. Bio-Processing was faulted for the time it would take to process waste into a material of substance. The difficulty of creating a multi-fuel vehicle was also deemed problematic. Group members similarly found fault in the bio-materials of chameleon coating and bio-mimetic armor. Sighting the need for major breakthroughs in achieving both technologies, doubts were raised that chameleon coating could protect personnel or bio-mimetic armor could protect soft-skin vehicles. Anti-materiel agents were viewed in a negative light too and, in fact, were among the four technologies the group eliminated from the systems basket. Bio-sensors, on the other hand, were viewed as being both high in utility and plausibility. While the group's general reaction to biotechnologies was modest at best, many participants outside of the group expressed a good deal more enthusiasm. While some speculated that biotechnologies would be a rather cost effective way of modernizing the force, others took issue with the group's concerns of treaty violations (i.e. our enemies will not be concerned about developing such technologies).

Brilliant Moles

The Brilliant Moles system, though regarded as a relatively easy technology to create, was not deemed overly useful. The length of its battery life, the fact that it is not a multi-

sensor technology (participants noted that it would be a much more useful system if it could smell, hear, etc.) and the need for greater specifications were highlighted as concerns by the group. Despite these doubts, Brilliant Moles were kept in the technology basket.

Anti-ASAT

Our great reliance on space systems now, and a likely increasing reliance in the future, led to the group's determination that an Anti-ASAT technology would be critical to the RMA force. However, the group found that there were probably better ways of protecting satellites, which are vulnerable to numerous forms of attack (e.g. a missile which will not be easily stopped, or dodged because of kinematics, or a nuclear explosion in space).

MOLB

Consideration of the Mobile Overseas Logistical Base (MOLB) brought mixed reviews from both the group, during sessions, and other participants, during the briefing. While the group decided that the MOLB was a highly useful and plausible system, and some members suggested that it might send a stronger message than a carrier battle group since it would give the impression the troops would be on the ground, it was noted that its self-defense and lack of speed were concerns.

Technology Basket Candidates

Having completed a core assessment analysis of the present Technology Basket, the group then turned to the task of suggesting their own candidates for future inclusion in the Technology Basket. Considering capabilities that may have been overlooked, or which needed improvement, the group proposed new systems for all four RMA warfare areas. It was suggested that Precision Strike would be improved through the development of: a Long-Range Fiber Optic Guided Missile; Directed Energy Weapons; Counter-Stealth technology; Non-Traditional Guidance/Navigation; and Non-Lethal Weapons. Information Warfare could be improved upon largely through defensive means. Thus, Counter-IW and Deception Technologies were noted along with Alternative Decision Aids and a Tactical IW Designator. Space Warfare would be enhanced through the inclusion of Sleepers, Hyper-Velocity Rods, Tag and Track technology, Battlefield Ordnance Awareness, and Space-based NBC Detection. Finally, the group found that success in Dominating Maneuver would more likely be achieved through the introduction of seven new technologies to the force. They are: 1) Fast Vertical Attack Aircraft; 2) Stand-off Precision Airdrop; 3) Individual NBC Protection; 4) a "Super Stinger"; 5) Cloaking Devices; 6) Enhanced Power Generators, and 7) Robot Ground Delivery.

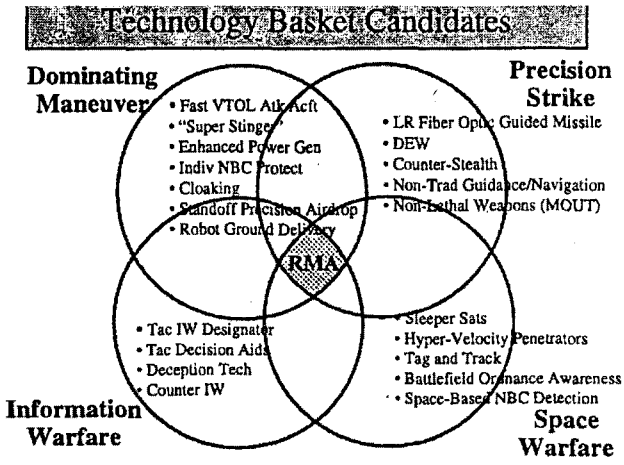

Figure 7 – Recommended Technologies for Other RMA Warfare Areas

General Technical Goals

With a completion of Technology Basket considerations, the group then approached its final task--an outline of the feasible technical goals for future technologies. It was found that goals should be defined not only for Dominating Maneuver, but for each RMA warfare area. For Precision Strike, it was determined that each launch would require multiple kill success. In the Information Warfare area the group found that we would need to achieve automatic encryption, the ability to get inside and stay inside the enemy's OODA loop, and, most importantly, we would need to know all, see all, and defend against all. Space Warfare would need to improve upon four main aspects: 1) a decrease in launch cost and time by 50%; 2) an increase in payload capacity by 100%; 3) a reduction in turnaround time by 50%; and 4) an all-weather launch/recover capability. In Dominating Maneuver the group found the need to reduce Class III, V, and IX requirements by 50%. It was also determined that it would likely be possible to reduce the number of soldiers, which would then reduce Class I and water requirements. The group also deemed all-weather capability and en-route fueling feasible goals.

Tab A

Agenda

Proposed Agenda
Dominating Maneuver Workshop VI
US Army War College, Carlisle Barracks, PA
2-3 April, 1997

2 April 1997

0730-0800	Check in and Registration/Coffee and Refreshments
0800-0900	Introduction and Briefings
0900-1230	Working Group Discussions (Focus: Review Team Gray)
1230-1330	Lunch
1330-1700	Working Group Discussions (Focus: Review Team Black)

3 April 1997

0730-0800	Coffee and Refreshments
0800-0930	Working Group Plenary Briefings
0930-1130	Working Group Discussions (Prepare Executive Briefing)
1130-1430	
(Lunch - 1230-1330)	
1430-1445	Workshop Participants to VTC Conference Area
1445-1615	VTC Briefing for ARSTAFF Principles

Leaders/Moderators	Working Group/Rapporteurs
• Review Executive Briefing	• Review Group Outputs
• Rehearsal for VTC	• Complete Survey

Tab B

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Tab C

Soldier-Leader Panel Outbrief Slides

Soldier-Leader Group

High Tech Soldier of the Future

- Recruiting Strategies
  - Maintain high quality
  - Capabilities, aptitude, potential
  - Belonging; Ownership; Cause
- Functional skills
  - Many of the same skills as today....just a different emphasis as a function of technology
    - Shooters, Sensors, Controllers, Enablers
  - Information interpretation
  - Communication - conveying and comprehending

High Tech Leader of the Future

- Not unique to the Combat Arms
- Lead people - Manage things
- "I am a Soldier first"
- Diversity in development, but a common foundation
- Functional Skills
  - Motivator
  - Organizer
  - Information Integrator
  - Effects Integrator

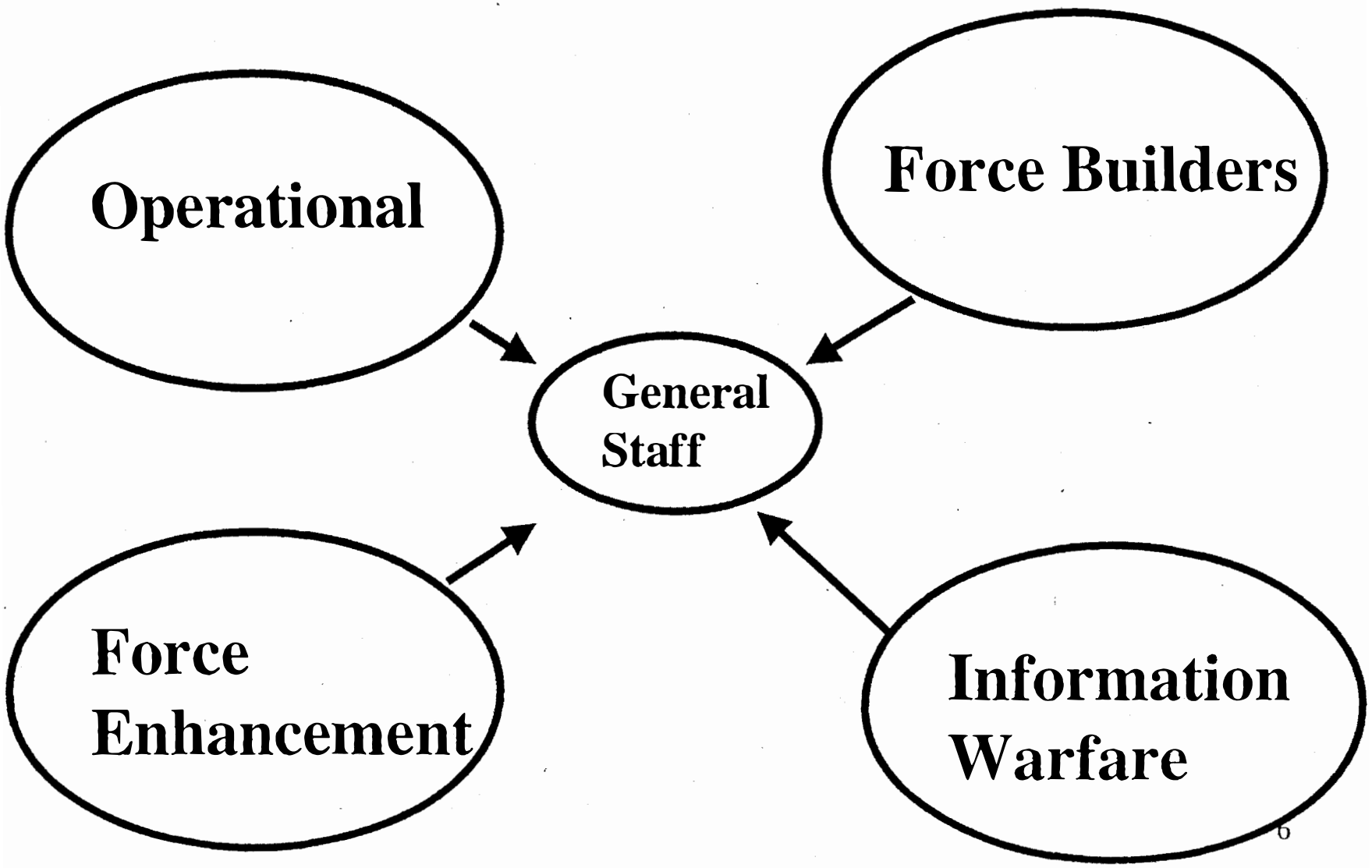
High Tech Leader of the Future (2)

- Characteristics
  - Surface
    - Communication skills
      - Multi media
      - Inside the compound and outside the wire
      - Wider knowledge base in employing capabilities
      - Fitness - aimed at enduring stress
    - Foundation
      - Principals, morals, values
      - Imbuing the autonomous soldier with an unshakable trust
      - "Transformation" - From Basic...to garrison...through training...to combat

High Tech Leader of the Future (3)

- Future challenge - Greater span of control
  - Technological assistance (AI); but
  - The human is still the bottleneck in the process: 1) Overload, 2) Micromanagement
  - New display of trust down the chain of command

Branches for High Tech Soldiers and Leaders



Training & Retaining High Tech Soldiers & Leaders

- "Building" a Bn Commander - shortening the journey
  - Staying the course
  - Maximizing technological advantages in training
    - Simulation - from ACV to the JTF Staff
    - Distance learning - the cybernetic classroom
- Combining the branches
  - The combat arms
  - The force enhancers
- Retaining
  - Leaving the soldier to do what he came for
    - "Up or out" implications
  - Incentives for proficiencies
  - Continue the focus on QOL
  - Maximize technologies for training -- apply many to mentoring

The RMA and the Total Force

- Mobilization
  - Manpower intensive
  - Capabilities mobilization
    - Demographic vs geographic
    - Constant virtual mobilization
    - In-place mobilization
  - Interoperability
  - Maximize Guard/Reserve for functions they can best perform

Concluding Remarks

• Army must imbue the soldier and the leader with an unshakeable trust in the institution, with values as a constant, from Basic to Garrison through Training to Deployment to War.

•No RMA without an RML; No RML without Technology and $ Enablers.

•Can never lose technology edge; must continue investment. If the RMA technologies even come close, we can be very different; we will be overwhelming.

Tab D

Logistics Panel Outbrief Slides

Logistics Group

Supply Commonality Issues

Leverage technological overmatch in logistics by achieving:

--- Single power source capability

--- Ultra-reliable combat/CS/CSS systems

--- Embedded sensors

--- Commonality of CL III, V, VII and IX

--- Commonality of "STUFF"*

*Standard Things Used to Fight Forward

New Operations Order

"If information is to be a force multiplier, its packaging must be modified to ensure effective employment."

1. **SITUATIONAL AWARENESS**
2. **MISSION**
3. **CONCEPT**
    - **A. Intent**
    - **B. Precision Engagement**
    - **C. Dominant Manuever**
    - **D. Full-Dimensional Protection**
    - **E. Focused Logistics**
4. **BATTLEFIELD INTEGRATION**

Forward Support Unit

Unit Characteristics

100% Mobile
Rapid Inventory Turnover
Same "STUFF"* as combat forces

Unit Capabilities

1-1.5 Days CL I, III, & V + Demand
CL VII, VIII, IX by Demand
Size:Team to BN by mission
Amorphic/Amoebic
Maint = tele
Med = tele/evac
Harrier Carrier = unit

*Standard Things Used to Fight Forward

Rear Support Unit

Unit Characteristics

100% Mobile
Rapid Inventory Turnover
Same "STUFF"* as
combat forces

Unit Capabilities

2-4 Days CL I/III/V & Special
1-2 Days CL II
CL VII, VIII, IX on Demand
CL IV packages by mission
Size:Com -BN+ size by mission
Modular/Expansible
Maint = tele/PP
Med = tele/Evac
Harrier Carrier = unit

Theater Support Command

Joint Theater Support
<u>Commander</u>

C2 + MM/MC
JTAV/JITV
Manages Joint Virtual Inventory
Location determined by mission
Direct Commercial Link
Uses Virtual Staff
Split Operations

RML Insights

- What is done does not change...
  ...how it is done...DOES!
- Operational Assessments
- Logistics Battlespace
- Having information does not obviate physical limitations.
- Evolutionary change to produce revolutionary effects !!
- Reduced Sustainment Requirements

RML Insights

- Start logistics planning with the desired effect---
  "*Know where you want to arrive....*
  ...before you depart."
- Characteristics
  - Ultra-reliable
  - Embedded sensors/sentinels
  - Semi-autonomous/predictive/prognostic
  - Access to stocks *vis-a-vis* stockage
  - Embedded in the Battle Management System

Tab E

Technology Panel Outbrief Slides

Technology Group

Technology Group Overview

- Reviewed 22 Systems in Technology Basket
- Proposed 21 New Candidate Technologies

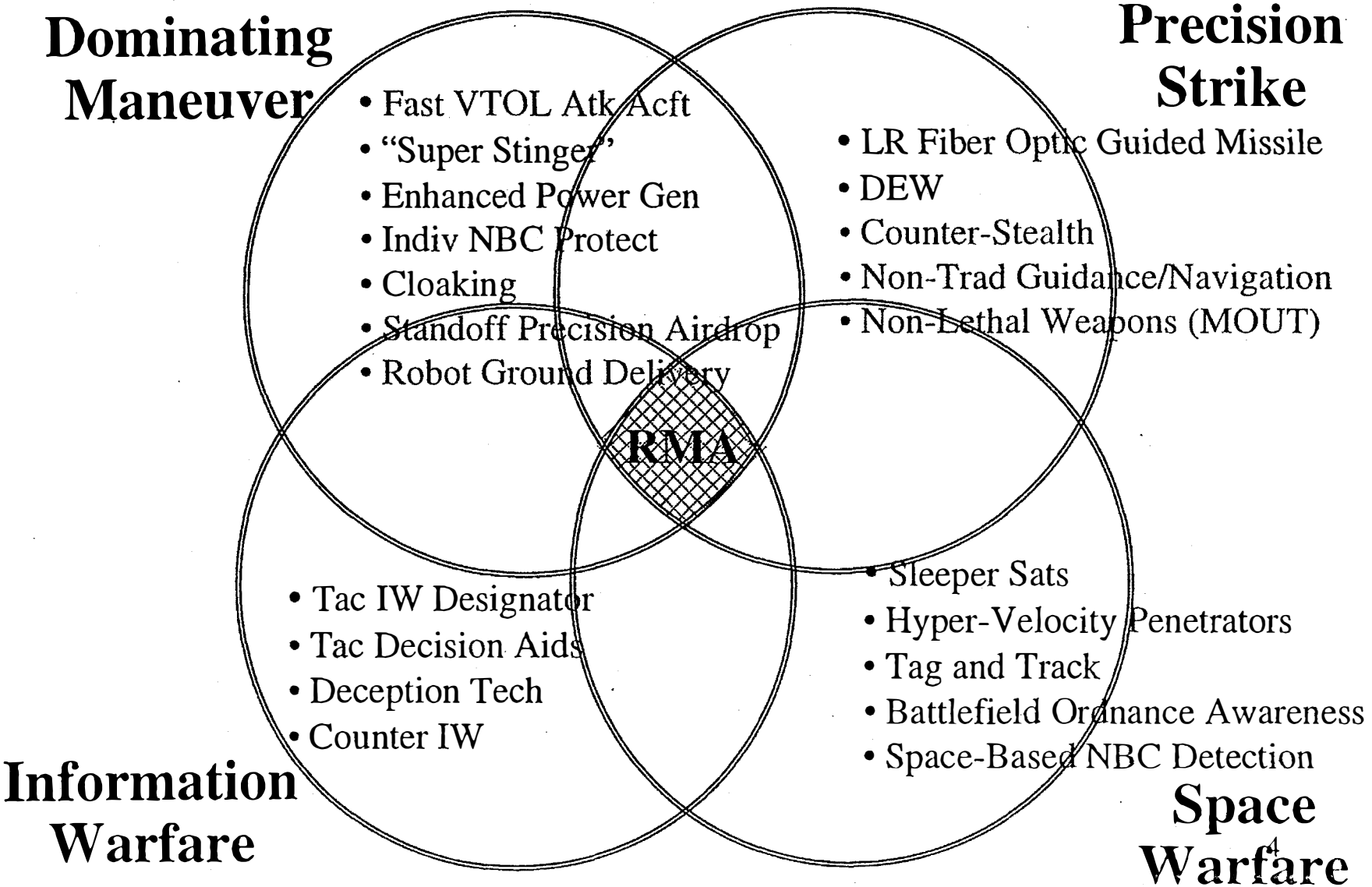
- Identified 7 as Core
  - Adv Combat Vehicle
  - Adv Fast Atk Vehicle
  - Harrier Carrier
  - LR Indirect Fire Sys
  - UAV Family
  - Fast Surface Effect Ship
  - Tempest IW Defense

- Eliminated 4 Systems
  - Anti-Materiel Agents
  - Lampreys
  - GPS Fuzzer
  - Supersonic Heavy Transport Aircraft

Core Systems Assessment

System	WF Utility	Plausibility	Remarks
ACV	10	5	High-risk, high-payoff; power source, weight, complexity concerns.
AFAV	10	10	Unrefueled range? Survivability?
Harrier Carrier (Fast VTOL Carrier Aircraft)	10	9	Should be more like *Osprey* (heavy-lift tilt rotor); range/speed i adequate; EM gun?; landing, power source concerns.
LRIFS	10	4	Range/lethality vs. size?; Joint potential; why on MLRS chassis?
UAV	10	10	Micro-UAVs range?
FSES (Fast Sealift Ship)	10	10	Complements airlift.
Tempest	10	10	Defensive IW.

Technology Basket Candidates



Tab F

Technology Basket

Systems Basket

ADVANCED COMBAT VEHICLE (ACV)

The ACV is a multi-purpose advanced combat vehicle. The several variants of the ACV are derived from a common component suite (an objective goal of the ACV development program was an 75% component commonality between versions). The ACV is highly mobile (road speed: 120-mph, cross-country speed: 70-mph), amphibious (20-knots in calm water), and air-transportable (12 per C-5; 6 per C-17; 1 per A2CV). The two-man crew occupies a ballistic/NCB/EMP 'survival cell' that also contains the vehicle's major electronic systems. The outer skin is made of lightweight composite materials with an electric armor appliqué that deforms when impacted, exciting an electro-magnetic reaction that deflects the impact of KE rounds and dissipates the plasma jet of CE rounds. The onboard multi-spectral RISTA and tracking system provides digital terrain data directly to the crew, and uses holographic projections to provide the them with a 360° view of the threat environment from a variable height surveillance and targeting mast. The ACV is powered by hydrogen fuel cells which drive super-capacitors that deliver energy on demand for propulsion, life-support, and weapon system functions. Onboard diagnostic sensors monitor ammunition and fuel consumption and the operational status of major sub-systems.

The primary version of the ACV (the ACV "MBT") weighs 15-tons and is equipped with an external, second-generation hybrid electromagnetic gun firing KE and CE ammunition. (KE round: segmented, long-rod penetrator -- LOS kill out to 7.5-kms; CE round: high explosive anti-tank with GPS assisted terminal guidance when cued by external sensor -- non-LOS kill out to 15-kms)

The second major version of the ACV is the mechanized infantry fighting vehicle configuration (MICV) from which several sub-variants are derived. All weigh approximately 15-tons. Each has a two man crew and up to four passengers. The main armament of the MICV version is a high velocity, externally mounted, fourth generation chain gun firing cased-telescope ammunition at both ground and aerial targets (2-km/4-km). The secondary armament of the MICV consists of a rocket/missile pod that can carry a variety of munitions – e.g., E-FOGM (counter air/ anti-armor), direct fire HE rockets (for MOUT/demolition), and other dedicated counter air or anti-armor munitions. Both the main and secondary weapons share the same fire control system.

ADVANCED AVIATION COMBAT VEHICLE (A2CV)

Advanced VSTOL aircraft, transports 40 troops 500 miles un-refueled at a speed in excess of 300 knots; with in air refueling, range is unlimited. Alternatively, the A2CV can transport one, 15 ton ACV or four Advanced Fast Attack Vehicles (AFAV) internally in the same de-mountable cargo/personnel container unit used to transport troops. The A2CV is optionally equipped with one second-generation EM gun mounted in an

ordnance container unit. The onboard multi-spectral RISTA and tracking system provides digital terrain data directly to the flight crew, and uses holographic projections to provide the them with a 360° view of the threat environment from a chin mounted sensor suite. Onboard diagnostic sensors monitor ammunition and fuel consumption and the operational status of major sub-systems.

ADVANCED FAST ATTACK VEHICLE (AFAV)

An advanced-materials, light-weight, high-speed cross country special missions vehicle (a.k.a., "dune buggy"). The AFAV is the primary mount for the Eagle Force and Marine recon and SOF units. The vehicle carries a total of five personnel and has an integral weapons/sensor suite station as part of the design (weapons and/or sensors displace passengers). Each vehicle is equipped with a digital terrain and threat display and additional sensor and targeting enhancements can be installed in a 'plug-and-play' mode as mission packages. The vehicle can also carry a variety of weapons systems, an E-FOGM launcher or a 40mm AGL being the most common.

LONG-RANGE INDIRECT FIRE SYSTEM (LRIFS)

Rocket-propelled projectile, 500 km range, CEP < 1m, pk = .9. LRIFS employs autonomous terminal guidance and can be integrated in a GPS/UAV network that provide targeting information and laser target designation. The rocket is 1/6 the size of the MLRS rocket and can achieve single-shot tank kills or deliver area-type sub-munitions with a lethal radius of 500m. LRIFS is fired from the Extended Range MLRS. Available: replace all ATACMS with LRIFS if chosen.

SMART LAND MINE FIELD AND MINE CLEARANCE SYSTEM

- ***Mine Field:*** Comprises a selectable mix of scatterable smart anti-personnel and anti-tank mines and sensors (seismic, thermal, etc.) that can be delivered by aircraft and artillery systems and controlled remotely from air or ground. A digitized control system tracks, classifies, and reports targets and selectively engages and kills. Selectivity includes activating all or part of the minefield (so as to create temporary lanes, or trap an enemy) or detonating in the presence of selected target-types. Total capability: block up to 10 avenues of attack (5 square km each).

- ***Mine Clearance System:*** This coordinated mine-countermeasure system provides sensing capabilities from both the air and ground that are digitally communicated back to an inter-vehicular information system responsible for defeating the mines. The actual destruction of the mine threat can be accomplished through standoff, scatterable detonations or armored plows. The integrated system can clear path up to 1 square km within 30 minutes.

UAVS

Stealthy, retrievable UAVs can remain aloft for extended periods at high altitudes. The UAVs employ on-board sensors in concert with satellite data to deliver PGMs, mines, supplies, or air-to-air missiles. Weaponized UAVs operate in either an air-to-surface or air-to-air mode. In air-to-surface mode, weaponized UAVs can operate against both land and sea targets and carry either PGMs or smart mines (these PGMs are especially effective against ships and fixed targets due to the weapon's high-velocity impact). In air-to-air mode, UAVs can carry improved air-to-air missiles. Logistics UAVs provide timely, accurate delivery of supply ahead of maneuvering combat units to support high tempo ground and littoral operations.

- ***Theater Ballistic Missile Defense UAV:*** The primary platform for missile defense is the Kinetic Energy Kill Vehicle (KKV)-equipped UAV operating over enemy territory. This UAV conducts boost-phase intercepts (BPI) of ballistic missiles as well as cruise missile intercepts, with a maximum intercept distance of up to 150 nm for BPI and 30 nm for cruise missile defense. Interception of leakers is accomplished by terminal, organic defenses (e.g., THAAD, PATRIOT). Strikes against TELs and unlaunched missiles are executed by ALCMs and PGMs launched from other UAVs and manned platforms. Provides coverage of known TEL operating areas; 36 hour on-station endurance at 40,000 and 80,000 ft; carries 2 HARM missiles and 4 KEKVs, and can deploy 2 miniature VLO hyper-spectral sensing vehicles tuned to detect hypergolic fuel; detection activates on-board high-resolution radar which relays target data to the "parent" UAV. In addition, the KKV can be used for anti-ASAT missions, intercepting enemy direct-ascent weapons in boost-phase but do not provide a hard-kill ASAT role, they are used for soft-kill of enemy satellites.

- ***Defensive Counter-Air UAV:*** Capable of autonomous operations; flies in a pre-selected 'race track' and engages targets of opportunity within detection range. The UAV carries 4-8 air-to-air missiles (load depends on desired endurance rate) and operates with 18-24 hour on-station endurance at 30,000-60,000 ft.(varies with missile load). Large aperture monostatic and bi-static radar sensors on-board.

- ***Multi-Mission"Mini" UAV:*** LO, capable of autonomous operations or operator controlled from ground station; ground launch and recovery under austere conditions. Endurance of 24 hours operating under 60,000 ft.; range 500 nm. Modular mission capable:
- EW, using HARM and low-power jammers
- ELINT, using varied sensor suites
- Strike (PGMs or mines)
- ASAT, using communication high-power jammers and laser-blinders which allow the UAVs to temporarily disable enemy space platforms

- ***Multi-Mission "Micro" UAV:*** VLO characteristics, capable of autonomous operations or operator controlled from ground station; ground launch and recovery under austere conditions. Endurance of 8 hours operating under 30,000 ft.; range 200 nm. Modular mission capable (single warhead per sortie):
- BDA/Recon, using electro-optical and IR sensors
- Decoy, using RF signature emulation

- SEAD, using HPM and HARM weapons
- Strike, using various brilliant sub-munitions

- *Unmanned Advanced Combat Delivery Vehicles (Logistics UAV):* Used for point-of-use delivery of supply both in the intra- and inter-theater sustainment roles; airdrop supplies and reinforcements directly to the user in the field -- including behind enemy lines -- using GPS-guided parafoils and LIDAR-wind profiles. Can operate from unimproved facilities (fields, roads, etc.); 50,000 lb. lift capacity and 1500 nm range. Using active measures (e.g., smart materials, active cancellation), the UACDV has LO characteristics.

Other UAV capabilities include:

- *UAV-Based Holographic Projector.* Holographic image projection system mounted on a long-endurance, high-altitude UAV. Projects three-dimensional, high-definition, highly-detailed images (e.g., a tank brigade, a several-ship naval surface action group) from 1 cubic ft to 1 cubic mile.

- *Signature Spoofer.* Reusable device that imitates the electromagnetic/IR signatures of any land, air, or naval force up to division, wing, or CVBG size. Can be mounted on a variety of platforms: UAV, remotely-piloted ground vehicle, remotely-piloted seaborne vessel, etc. Reprogrammable in 12 hours.

ROBOTICS

- *Robotic Wing/Point System:* Hybrid ground/aerial unmanned system designed to serve as wingman/pointman for ground combat forces. Three-and-one-half ton vehicle sensor slaved to ACV. 360 degree panoramic sight can see and zoom out to 10km. System can be set on automatic to designate targets to be prosecuted by manned direct fire or long-range precision strike systems. Same mobility characteristics (speed, etc) as ACV when in ground mode, and can be controlled by the ACV out to a range of 1km. VSTOL capability for aerial mode; top speed in air of 100mph. The system can employ AI to select its own route across the battlefield, in either ground or aerial mode.

- *Robotic Sensor:* Small and light (roughly 2 ft x 2 ft, < 50 lb) semi-autonomous system that can be picked up by a soldier and placed on a vehicle carrier (e.g., ACV). The system can then be off-loaded from the carrying vehicle and remotely driven to a location to employ its sensors (IR or visual). Alternatively, the system can select its own location for optimal sensing (based on user-programmed parameters) and select its own route to that location. Range is 10km or direct line of sight. Extreme rough terrain mobility capability (via articulated wheels). Can be made to look like relevant terrain features (e.g., large rock). Ability to withstand rollover and right itself. Sensor-based obstacle avoidance functions.

- ***Robotic Mule:*** comparable load-carrying, terrain-crossing, and speed abilities of a real mule. Extreme rough terrain mobility capability (articulated wheels for simulated "legged" motion). Mobility and payload configurations can be optimized for mission terrain conditions. Range 10-50 km depending on terrain. Ability to withstand rollover and right itself. Sensor-based obstacle avoidance functions. Armored in critical subsystem locations against light fire. Controlled via wireless connection to the soldier, with optional soldier manual control. Tasks might include: bringing combat consumables to the front line; serving as a autonomous-mechanized stretcher to evacuate wounded; dig foxholes; act as a battery charger; etc.

BIOTECHNOLOGY

- ***Bio-Processing:*** Portable/deployable bio-generator to process waste material feedstock (e.g., leaves) into usable substances. Employs microbes working at the molecular level (primarily carbon, hydrogen, nitrogen, oxygen) to re-arrange structures of the waste materials to create the new substances. Enables in-field generation of nutrient matter or fuel to power combat vehicles. *Does not eliminate* the need to carry these items, but reduces by 20% the amount that must be transported into theater.

- ***Bio-Materials:*** Two types of material. The first is a *Chameleon Coating* – a biochemical coating to provide chameleon-like camouflage capability for a wide range of environments. Can be applied to clothing, equipment or directly to human skin; lasts up to a week depending on the environment and the surface to which it was applied; makes individuals or items invisible to optical reconnaissance means. Available to SOF and INFOSOF troops only. The second is a *Bio-Mimetic Armor* – a material made up of lab-engineered biomolecules and based on the structural design of the beetle shell with alternating layers rotating in spiral to mutually reinforce one another and create a surface capable of deflecting most known anti-tank munitions. Applied to all "soft-skin" vehicles in the ground force.

- ***Bio-Sensors:*** Sensors employing organic/biological organisms as the detecting element, this detecting element reacts with extreme specificity (near-zero false alarm) to molecular quantities of particular target substances (e.g., BW agents, gasoline exhaust fumes, Kevlar). Biomimetic sensors also provide capabilities previously found only in non-human species, including: electrical and magnetic current detection, olfactory and aural sensing akin to canines; and hyper-color imaging (eight color pigments).

- ***Anti-Materiel Agents:*** Engineered bacteria which can "eat" very specific substances including: petroleum-based products (e.g., oil, rubber, fuel, etc.); metallic structures (e.g., steel, iron, aluminum, etc.); silicon (integrated circuitry); and depleted uranium. The bacteria must come in direct contact with the materiel to be effective. Administered by exploding agent-equipped projectiles in the vicinity of targeted systems (spreads by wind). The agent in one such projectile can destroy 10 gallons or 10 pounds of the target material in four hours. 500 projectiles available. Note: the

anti-materiel bacteria are vulnerable to ultraviolet radiation, which can kill them in 15 minutes.

BRILLIANT MOLES

Rapidly deployable reconnaissance/surveillance/BDA sensors (total of 1000 available; enough to cover 4-5 discrete, geographically-separated battlespace areas reliably), deliverable by manned or unmanned aircraft. Hard to detect as they bury themselves 5-6 ft deep (extending a camouflaged antenna) and only transmit when interrogated by coded signal. The moles store and transmit data to aircraft with a high-powered transmitter when a code is triggered. Battery life of 5-7 days.

ANTI-ASAT SYSTEM

IR and RF sensors placed on a satellite and combined with an artificial intelligence program to make it 'aware' of the presence of another system operating in its immediate vicinity or 'closing for a kill' using radar or external guidance commands. Includes ablative and reflective coatings to defend against energy weapons. Once a 'foreign' system is detected, an anti-ASAT-equipped satellite reports it to controllers and deploys decoys. If the satellite is attacked by a co-orbital threat, controllers can enable an onboard protective system that ejects a matchbox-sized defender designed to home on the intruder (speed permitting), attach, and disable it with a shaped charge explosive designed to contain potential debris inside the attacking system. Probability of survival 0.7 against co-orbital threats, .4 against impactor ASATs, and .25 against energy beams. Cannot be placed on commercial systems. Each anti-ASAT system carries 10 decoys and 'defenders.'. When placed on stealthy satellites, some stealthiness is lost, although ps increases to 0.9 against co-orbital ASATs and .6 for impactor ASATs and energy beams.

LAMPREYS

Miniature parasitic system that attaches to targeted satellites to evaluate and report on the functional capability of the system to which attached. Upon command, Lamprey can randomly inject large volumes of 'trash' into the targeted system's data stream. Difficult to detect; self-destructs when an attempt is made to remove it. Battery-powered with a life span of 60 days after which the system automatically detaches from the targeted satellite and de-orbits to burn up in the atmosphere. Can be launched within 12 hours of the decision to employ them and are fully operational 12 hours after launching. Inventory of 300, launched in 'shots' of 75 aboard a 'mother ship' which positions them in the vicinity of their 'target.' Deployed aboard the Pegasus or TAV (see below) for L/MEO targets (single 'shot') and the Shuttle or Titan V for L/M/GEO targets (can fire all 4 'shots' at once, if so desired, on these systems).

GPS FUZZER

A capability to quickly launch satellites into a GPS constellation to provide false data to users without a filter on their GPS receiver. Introduces random errors that degrade accuracies 10-20 fold (CEPs increase from <1 meter to >25 meters) on systems relying on GPS guidance. On-orbit lifespan of 30 days with a low probability of detection unless cross-checked with non-GPS systems. Once detected, fuzzers can be counteracted within 48 hours.

CRUISE MISSILE DEFENSE AEROSTAT

An unmanned, long-endurance, lighter-than-air aerostat with a radar system and airborne sensors providing improved detection of VLO cruise missiles compared to the *Aegis* and STARWACS systems. Extends outward the effective detection range of missile defenses. Capable of approximately 45 day endurance, and is tethered to either land or surface ships. Data is passed through the tether cable. Able to track hundreds of targets and execute fire control functions for engagement of several such targets simultaneously. Twelve (12) aerostats can be in service by 2020.

DIRECTED-ENERGY CLOSE-IN WEAPON SYSTEM (DECIWS)

Point defense system against sea-skimming missiles and aircraft. Uses a high energy laser to overload sensors, destroy electronics, or ignite fuel. Line-of-sight effective range of 10 miles, providing an outer layer of missile defense to supplement the Phalanx CIWS. Recycles quickly to enable multiple engagements. Can be installed in all naval surface combatants by 2020.

EMP/HPM RADIATOR

Conventional electro-magnetic pulse or high-powered microwave (selectable) radiator system deployed on artillery (500 shots), cruise missiles (250 shots), and on ballistic missiles (250 shots). Permanently disables electronic equipment, erases data banks, and impairs computers. Range as per the delivery vehicle, warhead 'lethal' radius of one kilometer (well within CEP of delivery systems) for a 1,000 foot altitude burst when employed against ground-based electronic systems. Causes negligible collateral damage. Not effective beyond the Earth's atmosphere.

FAST SURFACE-EFFECTS SHIP

A 25,000 ton, roll-on roll-off ship that can transport forces and equipment at speeds up to 100 knots. There can be 20 ships in the US inventory in 2020, 10 located on each coast of CONUS. Requires 10 ships to lift a MEB and its equipment. If the FSES is chosen, brigade-size units or six Tiger/Cobra Forces could arrive in theater in 4 days (in addition to other lift in inventory); an additional three brigade-size units or six Tiger/Cobra Forces could close in theater another 8 days after that.

MOBILE OVERSEAS LOGISTICS BASES (MOLB)

Stable platform modules (12 available), each with 500' by 300' flight decks, large cargo areas, ship-to-shore off-loading facilities, facilities for aircraft refueling, maintenance, and re-arming. Six modules can position the equipment of one MEB, one heavy brigade, or two Tiger/Cobra Forces. Can also be used to base a Single-Stage-to-Orbit Vehicle (SSTO) or Transatmospheric Vehicle (TAV) in theater (see below). Can be linked in any combination to create runways of various lengths. Capable of sustained speeds of 15 knots individually (5 knots with two or more linked). Equipped with the Phalanx CIWS (and with DECIWS if this is also chosen) for point defense. Extensive armor, blast-absorbing compartments, and styrofoam-like buoyancy give the modules an ability to withstand several cruise missile or torpedo hits without impairing flight operations.

QUICK-LAUNCH LIGHTSATS

Provides the capability to surge-build and quickly launch short term, single-mission replacement satellites (30 day) quickly from mobile launchers to low earth orbit. Satellite options include 3 meter SAR, 5 meter PHOTINT, Secure E/S/UHF COMSAT, or GPS "Minus" (100 meter CEP). The U.S. can launch 2 satellites in the first 24 hours, 12 in the first week, and 40 in 30 days.

SINGLE STAGE TO ORBIT (SSTO) VEHICLE

A vertical launch/recovery vehicle capable of launching within two hours of execution order. Six vehicles in the fleet with five operational at any one time. Capable of surge-launching up to 12 payloads in a 48-hour period and then maintain .6 sorties/vehicle/day for an additional 10 days. Capable of operating from any 'hard-stand' (*e.g.*, parking ramp or runway at any airport/airbase) its main operating bases are Cape Canaveral, FL and Vandenberg AFB, CA. Can recover to a Mobile Overseas Logistics Base (MOLB) in theater (see above). Each vehicle can lift the following payloads: 10,000 pounds to LEO; 8000 pounds to MEO; 5000 pounds to GEO.

SUPERSONIC HEAVY TRANSPORT AIRCRAFT

Two squadrons (12 per sqn) of rapid response lift aircraft, top speed Mach 2.5. The transports have an unrefueled range of 7000 miles and can transport as much as a C-17, including oversized equipment. If the SAT is chosen, one brigade-size unit or two Tiger/Cobra Forces could arrive in theater in 2 days vice 4 days (in addition to other lift in inventory); three brigade-size units or six Tiger/Cobra Forces could close in theater in 6 vice 12 days.

TEMPEST DEFENSIVE IW SYSTEM

Advanced, lightweight composite materials used to protect information systems. 90% successful in shielding against Van Eyck information retrieval measures and high-power microwave attacks. If selected, all battlefield and C2-node information systems would be equipped with TEMPEST.

TRANSATMOSPHERIC VEHICLE (TAV)

Single-stage, reusable, horizontal launch/recovery vehicle (requires 10,000 foot runways) for delivering a payload to the other side of the Earth <30 minutes after execute order. Rocket powered, TAVs fly an exo-atmospheric, sub-orbital profile to deliver brilliant munitions or carry 250 combat-loaded personnel or supplies in standardized payload modules. Can remain in orbit for only 24 hours due to life support limitations for its crew (*i.e.*, cannot remain in orbit with a troop payload). A single munitions payload can target 50 aim points with either composite penetrators (travel at Mach 25 and capable of penetrating to deep underground facilities with a CEP of <1 meter) or sensor-fuzed weapons (dispensers slow to Mach 2 to deploy weapons with a one square kilometer footprint). Penetrators have a 0.8 pk against fixed targets and .4 pk against mobile targets while SFWs have a 0.8 pk against mobile targets and are ineffective against DUGs. Alternate mission is to inject satellites into orbit during the exo-atmospheric phase of flight. Six vehicles with 5 operational at any one time with a surge capability of 0.8 sorties/vehicle/day (for 3 days) then 0.5 sorties/vehicle/day (for 10 days). Can recover to a Mobile Overseas Logistics Base (MOLB) in theater (see above).