NEW WORLD VISTAS
AIR AND SPACE POWER FOR THE 21ST CENTURY

MOBILITY APPLICATIONS VOLUME

This report is a forecast of a potential future for the Air Force. This forecast does not necessarily imply future officially sanctioned programs, planning or policy.

Executive Summary

The political changes around the world continue to reduce available overseas base support. As a result, US military forces are primarily based in the continental US, while global presence is still required. The potential conflict areas are not well defined, and may be anywhere in the world. Thus, while reduction in tensions with communist countries have brought about reductions in military forces, the demands on the mobility assets are as great or greater than ever. The Air Mobility Command (AMC) must be prepared to conduct global air mobility missions. AMC must also support peacekeeping and humanitarian missions where a hostile environment is possible. Further, the proliferation of cheap, heat-seeking missiles increases aircraft risk even in remote, poorly developed countries.

After examining the mobility missions and identifying their shortcomings, advanced technologies were reviewed to determine how they could solve these problems. A number of advanced systems were postulated to meet the mobility needs. These were then evaluated against criteria which included:

- Contribution to mobility mission effectiveness
- Affordability
- Supportability, including training
- Technology maturity
- Applicability of commercial development and/or dual use

The systems embodying the most revolutionary technologies for potential mobility improvements were then identified as follows:

- Information Dominance System
- Global Range Transport
- Precision/Large Scale Airdrop
- Directed Energy Self-Defense System
- Virtual Reality Applications

The key technologies recognized as needed were:

- Wideband, secure, world-wide information networks
- Multi-level data fusion and information distribution
- High temperature materials for advanced turbo fan engines
- Low cost composites for airframes
- Airborne lasers for self defense
- Synthetic sensory environment for virtual reality applications
- Airborne wind-measurement sensors

Information Dominance System

The US Air Force must erect a system to provide information dominance in the 21st century. The air mobility part of this system should consist of worldwide communication networks that are timely, accurate, and dependable. It should be a globally netted system with protected circuits and computers, which process fully automated fused intelligence and other on demand information. This capability can be provided by interconnected satellites in various orbits as

well as fiber optic ground nets. User friendly information will flow from surveillance/reconnaissance, weather, navigation and other information gathering assets. Then, it can be merged in fusion computers and provided to AMC's airborne and ground personnel. Near perfect real-time situational awareness will be integrated in the command, control, communication, computers and intelligence (C^4I) network. It will include threat updates, airfield information, refueling rendezvous and other mission-relevant data as well as intransit visibility as to cargo and passengers.

Global Range Transport

Improvements in engine materials will continue to permit higher cycle temperatures and better efficiencies. Present trends towards low-cost composite structures will also continue. Such technological advancements could lead to an unrefueled global transport. This aircraft could be equally attractive to the commercial market and thus doubly affordable (first as a commercial derivative, second by reducing the need for tankers). Alternatively, modular design and flexible manufacturing technology may achieve affordability breakthroughs without relying on the use of configurations driven by commercial requirements. This aircraft will be applicable to cargo, passenger, aeromedical evacuation, and combat aircraft refueling support.

This new transport is estimated to have a gross weight of approximately 900,000 pounds or less, and carry a 150,000 pound payload for 12,000 nautical miles. Ideally, the payload should be compatible with standardized containers to permit intermodal operation.

The technologies needed to get this capability are extensions of existing programs. The Integrated High Performance Turbine Engine Technology (IHPTET) program is directed towards 20-25% improvement in performance through higher cycle temperatures and better efficiencies. The developments with injection molded composite ribs for the F-22 gives promise of greatly reduced part count and simplified composite parts. These should lead to more affordable composites which in turn would permit higher aspect ratio designs. The field of Engineered Materials covers both of these key technology areas: 1) high temperature turbine materials for jet engines, and 2) the development of advanced composites. Other innovative concepts, such as dual fuselages, offer the promise of higher aerodynamic efficiency as well as improved structural efficiency. Improvements in all these technologies will result in the projected performance.

Precision Airdrop

Current delivery airdrop suffers from large delivery inaccuracies. Precision airdrop (within 100 feet of target) facilitates delivery of cargo to forward areas. It would also be more compatible with flexible, precision strike systems. By reducing overseas and forward bases, ground handling equipment, ground vehicles, and associated personnel, the operation could reduce delivery cost and improve timeliness.

A family of delivery solutions, all integrated with a core support system on board the aircraft, will provide the most effective precision airdrop system. The precision airdrop system comprises the aerial delivery system in combination with the carrier aircraft, and includes the modifications, equipment, or techniques required to enable the aircraft to complete the specific airdrop mission. These components will include accurate aircraft and target location

(precision GPS), knowledge of wind profile, and knowledge of aerial delivery system flight characteristics. Both parachute and standoff delivery systems will be supported. The important task for technology is the integration of wind measurement (LIght Detection And Ranging), Global Positioning System (GPS) based navigation and targeting, improved aerial delivery systems, and many subsystem improvements. LIDAR also has significant potential for commercial in-flight air turbulence detection.

Directed Energy Self-Defense System

Surface-to-air, or air-to-air missiles, are a major threat to mobility aircraft performing cargo airlift, passenger airlift, airdrop operations, medical evacuation, special operations and refueling missions. A system needs to be developed to counter this threat. The key component of this system will be a laser (or high power microwave) system that can be fired to defend the air mobility vehicle. This will provide the aircraft with an ability to defeat advanced surface-to-air, or air-launched missiles. There must also be included in the system a means to provide missile warning, a dedicated high-performance computer to predict the in-coming missile's trajectory, and to establish fire control data for the directed energy device.

This application of a rapidly developing technology is most appropriate. Whereas tactical aircraft often have the maneuverability to evade ground-launched missiles, air mobility vehicles do not. In addition, tactical aircraft have space and power restrictions while mobility vehicles have the space and can provide the necessary power. Hence, they are a prime platform for a first application of this new technology.

Such a small, energy frugal system is estimated to weigh less than 500 pounds, be packaged in a 3' X 2' X 2' space, and be deployable internally or in a pod. Prime power requirements for the very short-duration of laser firing should be less than 150 kilowatts.

Virtual Reality Applications

Advanced Virtual Reality (VR) systems will complement traditional training simulators and enhance mission effectiveness. VR will be applicable to all types of training (flight, maintenance, loading, etc.), and will be extended to rehearsal training for important operational missions into remote areas. Since these missions will require worldwide data links, AMC must ensure their mobility needs are included in the communication nets.

As current VR systems are improved and computer capabilities expand, the systems will be of more and more benefit to AMC. This will be particularly true as wide band data links are developed which can tie worldwide locations together. Commercial and military data links will be used. Synthetic sensory environments (e.g. three-dimensional holographic displays), computational power, and computer generated images will be key technologies.

Summary

The mobility panel final summary was developed by assessing the selected systems against the panel charter (Appendix A). The charter complied with major elements of the charge to the SAB by the Secretary of the Air Force and the Air Force Chief of Staff. This summary is shown in Table ES-1.

Table ES -1: Mobility Recommended Systems vs Panel Charter

	Information Dominance	**Global Range Transport**	**Precision/ Large Scale Airdrop**	**Directed Energy Self-Defense**	**Virtual Reality Applications**
Importance to Air Force	Vital for C^4I, supports RTIC	Supports all global reach missions	Improves flexibility and survivability	Improves survivability	Joint exercises and training
Effectiveness benefit	Improves C^2 and survivability	Improves reaction time and reliability	Reduces forward infrastructure	Increases probability of mission success	Improves mission effectiveness
Affordability	Moderate	Good	Moderate	Moderate	No impact
Key Technical Issues	Wide-band global C^4 and Nav nets	Low-cost composites, very high performance engines	Wind Measurement	Low power laser and system integration	Synthetic environment generation, physical sensory systems
Commercial Development	Yes, but needs tailoring	Probably	Limited	No	Yes, but needs tailoring

Contents

Illustrations

Tables