Mobility Times

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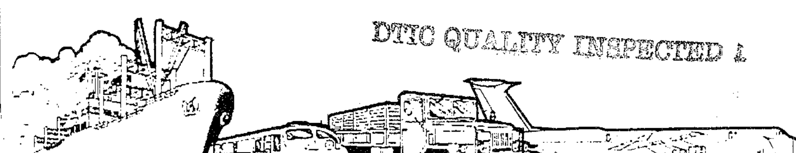
The Mobility Concepts Agency (MCA) periodical is published quarterly. MCA is a multi-Service organization sponsored by the Army Training and Doctrine Command (TRADOC) and the Air Mobility Command (AMC). The periodical is governed by Army Regulation 25-30, chapter 10. It is intended to be a vehicle for disseminating current mobility information and for discussing new concepts and ideas in the mobility arena. Since the periodical is an open forum, the articles, letters, and opinions expressed or implied herein should not be construed to be the official position of TRADOC, AMC, or MCA. Articles, letters, and opinions are welcome and should be sent to Mobility Concepts Agency, ATTN: ATDO-MCA, Ft. Monroe, VA 23651-5000.

Feature Articles: **Page:**



DIRECTOR'S COMMENTS

Happy New Year to all! Hope everyone enjoyed the 1995 holiday season as much as we did here in the Tidewater Area. The Mobility Concepts Agency is looking forward to the challenges and opportunities of 1996 as we enter our third year here at Ft Monroe and the second year of our "Mobility Times" publication. Yes, time flies when you are having fun!

I guess if MCA had but one holiday wish for 1996 it would be that all mobility deployment, employment, and redeployment operations in the exercise arena and for real world contingencies will be completed with the speed, efficiency, and agility of a gazelle. Of course, MCA's new years resolution closely parallels our mission--work hard to facilitate the development and implementation of new mobility programs, procedures, concepts, requirements, capabilities, and publications as well as help to resolve any multi-Service mobility issues and complete any projects which will enhance this nations ability to move our forces rapidly and efficiently, whenever and wherever they are needed. To turn this resolution into reality, we will continue to work hard the projects we are presently involved in as well as any new projects that come our way in 1996.

We hope everyone enjoys this issue of the Mobility Times. For those of you interested in the sea Services or sea Service mobility to be precise, three of the six articles deals with developing or future sealift programs. These include Army Prepositioned Afloat, Landing Ship Quay/Causeway, and the Automated All-weather Cargo Transfer System (AACTS). The AACTS article gets into the weeds a little but it will make you technical experts happy who like to get into the nuts and bolts of a system. Not to forget us "land lubbers," we have included articles on the need for an advanced theater transport as well as the need for full time arrival/departure airfield control groups, also known as A/DACGs. Last but not least is an update on the Air Mobility Warfare Center and how this organization enhances the Nations global reach.

Again, we at MCA wish all our readers a happy and joyous 1996. Best of luck and continued success in whatever field of mobility or logistics you are engaged in. A particular thanks goes to LTC Tony Leach (Ret) who helped us get this project off the ground last year and then worked as editor for the Mobility Times. After he retired, he even edited two more issues, including this one, while working another full time job. His expertise will be sorely missed. As usual, we would like to hear from you about any comments, positive or negative, you may have regarding the content of any of these articles. Also, if you hear about or are involved in a mobility process or project that will be of interest to the mobility community, please give us a call.

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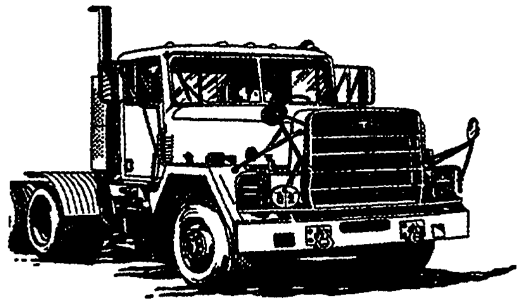
Secretary of the Army: Mr. Togo D. West, Jr.
Commander, Training and Doctrine Command: General William W. Hartzog

THE NEED FOR FULL-TIME DEPARTURE AIRFIELD CONTROL GROUPS

Major Larry Stephens, USAF
Mobility Concepts Agency



High Speed, Low Drag

One of the great lessons documented during the Korean War, over forty years ago, was the need for units to be "air transportable", lifted "quickly and simply, without fuss, to a new location, remaining operational through the move."[1] Today, with our smaller and largely U.S.-based Army, the requirement for swift mobilization and movement, both strategic and tactical, is as true now as it was then.

With the largest deployment requirement in the Department of Defense (DoD), the future success of the U.S. Army resides in its collective ability to mobilize, deploy, and be operational upon arrival. To borrow a phrase from the aerial delivery experts, the process must be "high speed, low drag" to be truly successful. For Army units, a critical piece in the airlift process is supported by Arrival/Departure Airfield Control Groups (A/DACG), which provide the link between the force being moved and the airlifters. This article focuses primarily on the deployment piece as supported by the DACG function.

From Whence They Came...

The vast majority of Army A/DACGs are actually only "part-time" airlift experts. Generally, the DACG's mission is performed by Army personnel on an additional duty basis. This means the unit tasked to perform the A/DACG mission usually re-learns the function each time the tasking occurs. Although it may have been expedient to assign the A/DACG function to these units in the past, air movement is increasingly less sympathetic of the inefficient methods and false starts caused through lack of knowledge and proficiency.

In May 1987, a Government Accounting Office (GAO) study published findings of a formal review of the Services' mobility infrastructure and doctrine.[2] In it, the GAO questioned the number of air cargo personnel the Air Force said were necessary to support the airlift mission given the Services' responsibility for their own deployment preparation, documentation, and aircraft loading support.

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1 Thompson, Annis, G., Capt, USA, The Greatest Airlift, The Story of Combat Cargo, Dai-Nippon Printing Co., Tokyo, Japan, Jan 1955, p. 185.

2 *"Military Airlift, Requirements for Aerial Port Personnel in Wartime Need to Be Determined"*, Report to the Secretary of Defense, Government Accounting Office, GAO/NSIAD-87-115, May 1987.

The Military Airlift Command (today's Air Mobility Command) supported the Air Force position by referring to past experience, saying they [did] "not plan to fully rely on the Services to perform their unit and nonunit move responsibilities during wartime because it [did] not believe that they [could] accomplish these tasks without causing operational delays."[3] The airlifters' concern rested "on the willingness and capability of the Army to assume its responsibilities" with regard to moving via air.[4] Simply put, they did not believe the Army could meet its airlift responsibilities efficiently and effectively.

The GAO study concluded with several recommendations, the most notable being the need for formal joint doctrine expressed in FM 55-12, "Movement of Units in Air Force Aircraft". This multi-service regulation very clearly placed the responsibility on the moving force for preparing and documenting deploying personnel, cargo and equipment, and accomplishing loading operations under Air Force supervision.[5]

The impact on deploying units and A/DACGs was immediate. Units required more extensive hands-on training to familiarize themselves with airlift requirements and procedures, and tasked units needed more training and experience performing their A/DACG function. In reality, training was sporadic for both deploying units and units which continued performing A/DACG duties in addition to their standard responsibilities.

Although doctrine had been formalized and coordinated, nothing has improved. Question is, are we doing any better today?

[3] Ibid., p. 16.

[4] Ibid.

[5] FM 55-12/AFR 76-6/FMFM 4-6/OPNAVINST 4630.27A. This regulation was recently incorporated in its entirety into the new Defense Transportation Regulation (DTR), Mobility Volume, currently pending publication. OPR: USTRANSCOM/J4.

The Changing Environment

Not long ago our strategic lift requirement was easily defined based upon a largely singular threat. Working within the framework of our North Atlantic Treaty Organization (NATO) partnership, the Army prepositioned materiel in large quantities throughout Western Europe, planning on airlifting troops to marry-up with the equipment, and moving them forward by surface assets or theater airlift. Drawing on the lessons learned during annual Return of Forces to Germany (REFORGER) exercises, deployment operations became rote, with units going to the same or very similar places.

The overall deployment requirement just a few years ago was therefore fairly stable. Most training was accomplished in linear fashion, i.e., units almost always knew where they were going based on long-established plans. They also knew and were comfortable with the equipment and materiel taken. They were very familiar with the aerial ports of debarkation (APODs), the support provided or required, and the recurring problems.

Where Is The U.S. Army Going?

The problem is todays world has changed dramatically from bipolar cold war confrontation to a multipolar geographical focus, presenting us with a totally new set of challenges. The Army is in the process of implementing its strategic vision for its 21st century land force. Entitled "Force XXI", the concept defines a versatile and tailorable CONUS-based force, which must rapidly deploy and be capable of achieving decisive victory across the continuum of 21st century military operations.[6] To achieve this, the Army has defined force closure requirements as follows:

- Lead brigade in 4-days.
- Lead light division in 12-days.

[6] From briefing entitled "The Army Prepositioned Afloat (APA)," OPR: U.S. Army Training and Doctrine Command (TRADOC), War Plans Division, ODCSOPS.

- Heavy brigade afloat in 15-days.
- Two heavy divisions (CONUS) in 30-days.
- Five-division corps with associated combat support (CS) and combat service support (CSS) in 75-days.

To reach these objectives, Army planners, using the Mobility Requirements Study Bottom-Up Review, and current force realignment actions as a baseline, have devised a strategy whereby light infantry and airborne troops deploy via air to meet C+4 and C+12 requirements. Accordingly, this will provide time for the heavier pre-positioned afloat forces to make port and marry-up with troops sequentially airlifted into theater to meet the C+15, 30, and 75-day requirements.

Not specifically stated, but implicit in the requirement, is the need for flexibility in the mobility process. We must have the ability to move whatever the supported CINC deems necessary to meet his/her requirement. But can part-time A/DACGs meet the challenge?

Doing It More Does Not Mean Doing It Well

Our forces today are coping with a consistently high operations tempo. Unfortunately, although we are deploying *more* we are in reality spending less time training to deploy *well*. After all, it is standard practice during short-notice air deployments for the participants to conveniently ignore standard FM 55-12 requirements and procedures because "this is for real!"

Units with A/DACG responsibilities find themselves in a similar quandary. With fewer resources, they are being required to do more, but have less time to train on A/DACG mission essential tasks such as planning, coordinating, establishing, and controlling a call forward area, alert holding (marshaling) area, unit holding area, and loading ramp area. Then there is the process of establishing prompt and effective liaison with the deploying unit command post, Tanker/Airlift Control Element (TALCE), or strategic aerial port.

A standard practice for most deploying Army units is to have the supporting A/DACG conduct a pre-Airlift Joint Inspection (JI), running the unit's vehicles, equipment, and pallets through to identify and correct errors before the actual JI with the Air Force. Unless A/DACG personnel are well trained, knowledgeable and *proficient*, this process can actually be a case of the blind leading the blind.

The point is, we cannot afford to continue doing business this way - it is frustrating, marginally effective, very inefficient, and dangerously unsafe. There must be a better way.

What's Needed

Part of the answer would be the creation of full-time A/DACGs with mobility as their primary focus. These full-time A/DACGs would keep pace with transportation configuration and documentation changes because it would be their primary business. They would be known throughout the Army as "the experts". Focus, knowledge, and proficiency would make these A/DACGs true *enablers* in the deployment process, and a force multiplier in the 21st century Army because getting there faster will be a critical factor in winning future wars.

There are several options, or configurations, available in terms of how these A/DACGs can look organizationally. For example, the Army could choose to test the concept by selecting four units (i.e., transportation companies), two on each coast, and assigning them full-time A/DACG duties. After a short organizational planning and training period, these A/DACGs would be tasked to travel anytime, anywhere, in order to help prepare and move the force. Although primary focus would be in the deployment process, they would be equally capable of performing the Arrival Airfield Control Group function.

Another option is to consolidate two or three company sized units, creating a single A/DACG battalion. In either case, teams could be configured based on the size and requirements of the unit(s) being moved, and would deploy as required to provide direct assistance.

One key to the success of these full-time A/DACGs is personnel stability. Today, the Army, perhaps unrealistically, expects their part-time A/DACGs to be experts in the air deployment process when training is sporadic at best. By establishing full-time A/DACGs with personnel stability, the Army would be creating an environment for positive action and success.

The most tangible benefits would be found in the expert services provided to moving units, and a more efficient and effective deployment process. These highly mobile A/DACGs would be the Army experts in documentation, tiedown, airlift joint inspection, and loading procedures. Proficient, qualified, tailorable, and efficient, A/DACG teams would be ready to deploy and provide expert service whenever and wherever they are needed..

Full-time A/DACGs would also enhance the working relationship with Air Force TALCEs, deployed by Air Mobility Command to provide airlift ground support. This, too, would speed up the process by dramatically shrinking the "coordination curve". These are all desirable results, but is the Army willing to initiate another change?

The drawdown has caused expansive change Army-wide, and leaders are understandably concerned that more change may adversely impact troop morale and scarce resources. Efforts to save money through reduction continue and there is a danger that commanders may become frustrated with shrinking resources and mission growth. Although additional change may not be desirable, failure to do so might ultimately prove more costly than maintaining the status quo.

There is an abundance of evidence from all airlift users that demonstrates the existing system is not working. Air deployments are no smoother today than they were fifteen or even twenty years ago. Simply glance through the Air Mobility Command Quarterly Joint Readiness Training Center (JRTC) Update to see that the same problems - lack of knowledge, experience, continuity, and training - continue to occur. These chronic problems can also be seen in any of the documented "lessons learned" found in the Joint Uniform Lessons Learned (JULLS) or Center for Army Lessons Learned (CALL) data bases or publications. The observations go back decades, and the problem descriptions change very little as the chronology moves forward. It is a sure bet that the airlift of U.S. forces deployed as part of the International Force (IFOR) in Bosnia experienced the same problems.

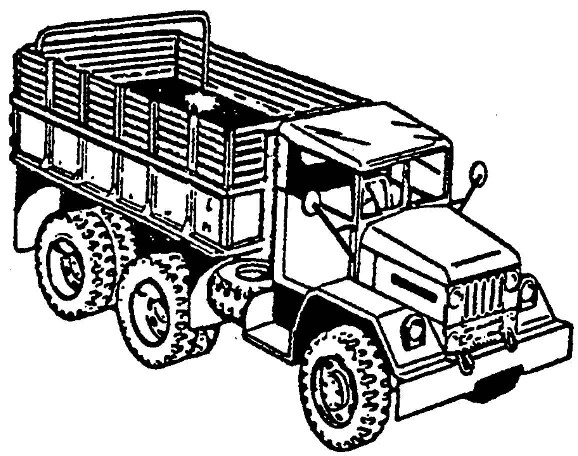
The fact is, the situation is not self-correcting. The status quo is not working and is not realistically correctable without a massive change in cultural attitudes across the entire leadership spectrum. The Force XXI vision will create a more compact, lethal, robust, quick reacting combat force, and there is no doubt that they will be used at some point in the future. Indeed, the requirement for rapid air movement will certainly increase, not decrease, as Force XXI matures and becomes reality.

Finally and unfortunately, future air deployments are not likely to become easier. Cargo preparation and documentation requirements are constantly changing. Much of the change is due to safety concerns, i.e., Performance-Oriented Packaging (POP), and the realities of moving via any combination of organic military and commercial aircraft. The only way to beat this dragon is by continuous attention, although you will never completely slay the beast. The best weapon, I believe, is full-time A/DACGs.

Where To Start

There are two examples where full-time A/DACG operations have proven not only workable, but critical to conducting effective and efficient air deployments. For many years the 82nd Airborne Division at Fort Bragg, NC, and the 101st Air Assault Division at Fort Campbell, KY, have employed what amounts to full-time A/DACG operations. Both have worked to achieve the personnel stability, training, and full-time focus necessary to effect air deployments in clockwork fashion.

For example, the 403rd Transportation Company at Fort Bragg, NC, has established a full-time A/DACG function comprised of approximately 15 soldiers and currently led by an officer. This team is co-located with Air Mobility Command's 3rd Aerial Port Squadron (3 APS) "Checkpoint" team on the "Green Ramp" at Pope AFB. Team members are cargo documentation or movement specialists who complete the 82nd Airborne's Air Mobility Operations course prior to being assigned. This course teaches hazardous cargo preparation, load planning, and documentation requirements and is also attended by the division's unit mobility officers. According to the 3 APS, air deployments would be much more difficult without their "trained and capable" full-time A/DACG team.[7]



Conclusion

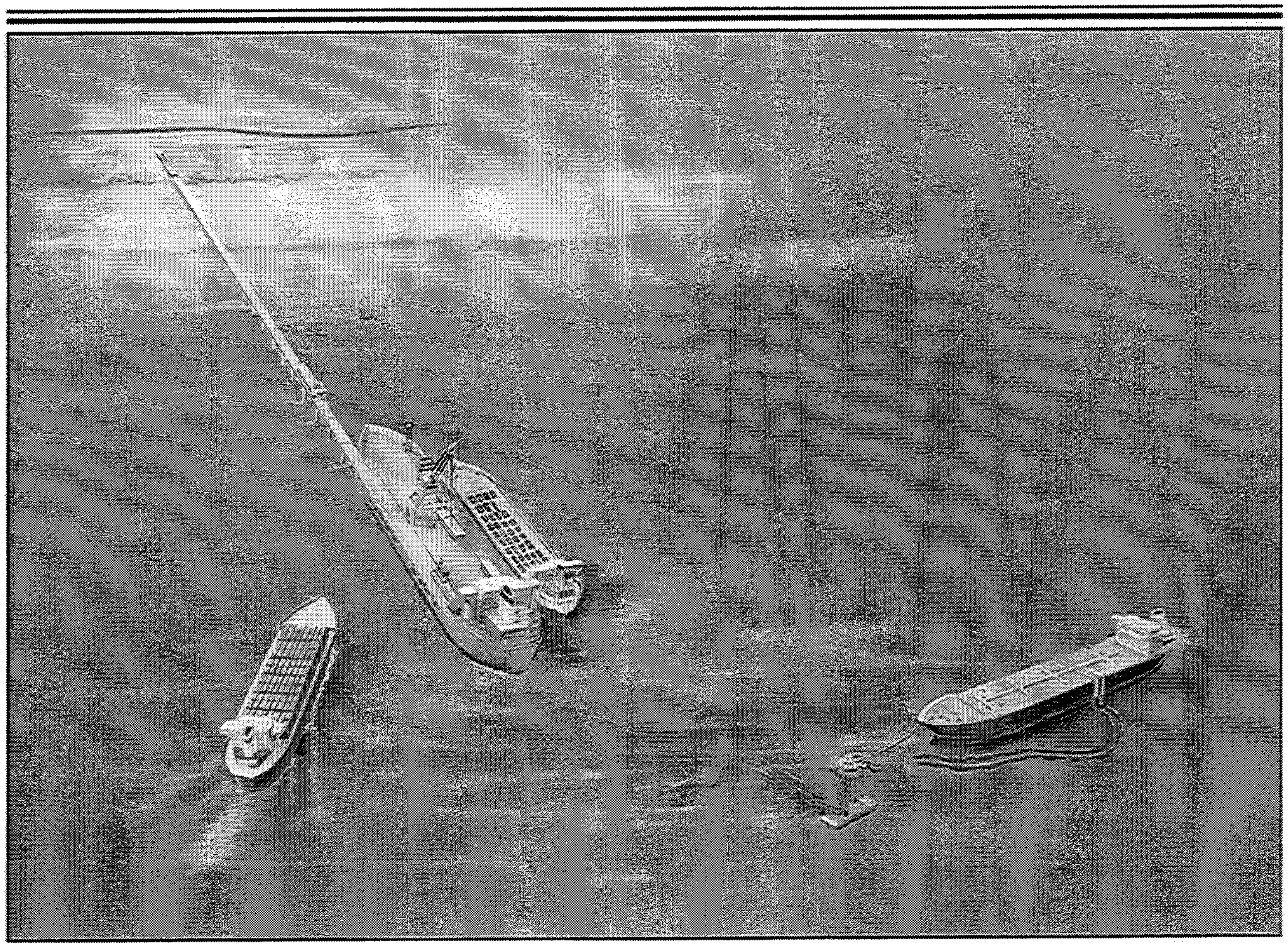
Contemplative leadership throughout the Army has fostered an atmosphere of progressive creativity. The Army's Force XXI vision, with its power projection platforms coupled with the Battlefield Distribution and Palletized Loading System concepts, are indicative of the current creative, motivated environment. They reflect the reality that power projection is directly related to our ability to deploy.

Perhaps the time is ripe for creating full-time A/DACGs. With shrinking force structure and an ever-increasing operations tempo highlighted by short-notice deployments, can the Army afford not to create them?

[7] Based on an interview with Capt McFarren, 3 APS, Air Freight Section and Checkpoint Officer-in-Charge.

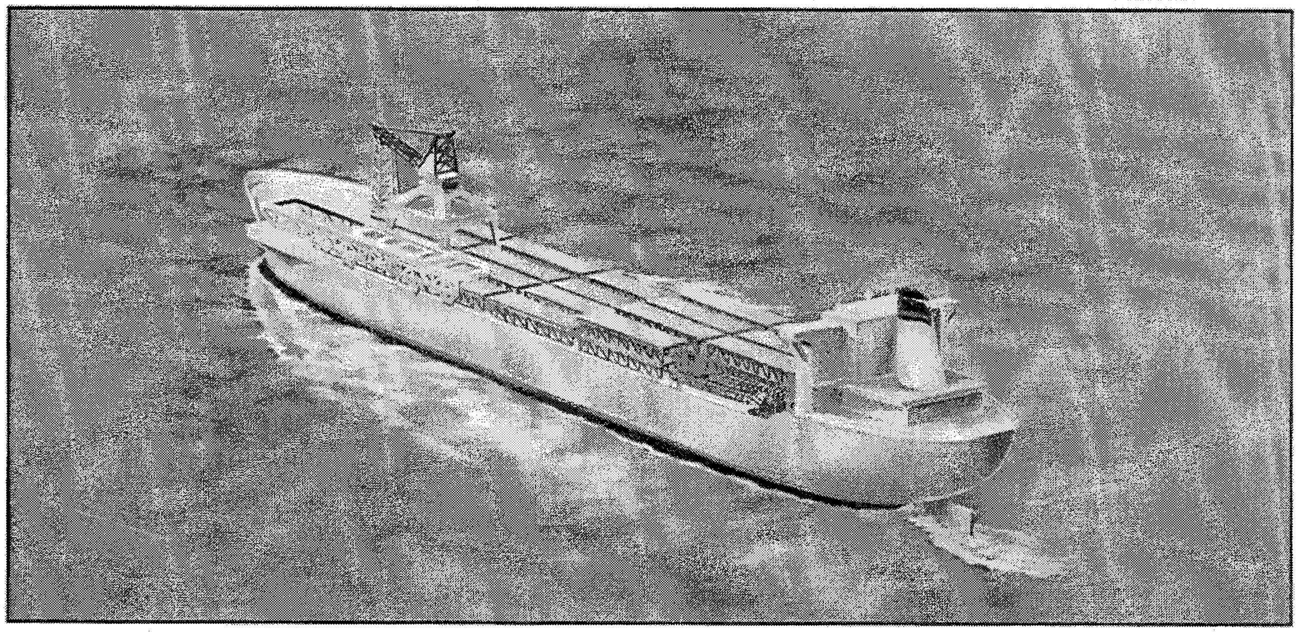
LANDING SHIP QUAY/CAUSEWAY (LSQ/C)

LTC Paul L. Barnard
Mobility Concepts Agency



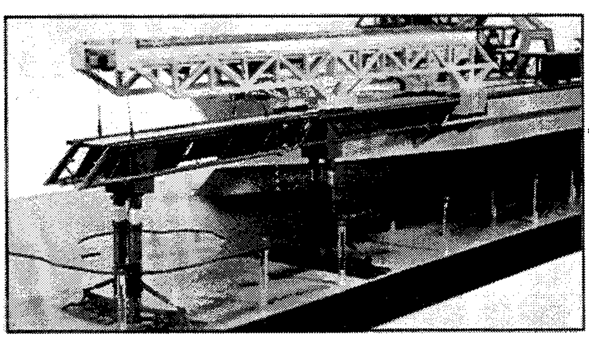
We all remember the quote regarding the need to remember history or have to repeat it. This adage applies today more than ever. In our current volatile military environment the need for responsive supply distribution or Logistics-over-the shore (LOTS) is more critical than ever before. In what was clearly the most complex and challenging LOTS effort in recent history, the Normandy invasion, we supported over 32 Army Divisions on a 60-mile beachhead with every possible amphibious logistics device and methodology known at the time. Large concrete bunkers were towed in designated positions and bottomed to form a protective breakwater. Over 40 cargo ships were positioned between the bunkers and sunk in place to provide a unique logistics corridor and means of rapid supply. Assailed by one of the worst North Sea storms in over 50 years, the assembled bulwark survived long enough to get necessary supplies ashore. The effectiveness of this mammoth World War II LOTS effort was a military milestone and decidedly instrumental in the success of the Allied invasion.

But, then, it took over a year in planning and preparation and we knew the general location of the landing area. In today's regional strategy environment, we must expect that we will rarely have long preparation time and planning advantages. Even more challenging will be the capabilities to deal with adverse weather conditions on short notice. As recently as 1993, almost 50 years after the World War II LOTS success, and using the latest systems, equipment, ships, and methods for LOTS in a joint exercise, the exercise had to be suspended because of moderate sea state conditions. In his exercise summary message, the joint exercise commander noted that it is futile to continue joint LOTS exercises until we get a LOTS system that enables us to safely and quickly transfer supplies ashore above Sea State 3. We appear to be repeating history. But, wait, there is hope!



Very Large Crude Carrier (VLCC)

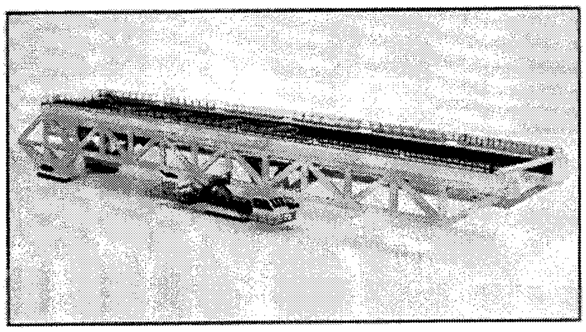
Taking advantage of extraordinary technological improvements, we now have systems and methods able to produce better LOTS results with less risk and greater efficiency for the joint exercise commander and for Army planners. It is called the Landing Ship Quay/Causeway (LSQ/C), developed by Brown and Root, Inc. The LSQ/C is a mobile, self-contained port causeway system using proven technology. It can serve as an alternate pier facility in an established port complex or, in the case of an unimproved beachhead, establish a stable pier head in the stream with an elevated causeway to and over the beach - beyond the dune line.



Causeway Section

- 150 feet long, 32 feet wide, 19 feet deep
- Deployable columns/footings
- Columns have adjustable length
- Quick connect pipeline and cables
- Accommodates all military equipment

The LSQ/C will be a modified Very Large Crude Carrier capable of 15 knot speed and designed to be ballasted to the seafloor on an open coastline to perform as a stable pierhead. The LSQ/C is self-sustaining. It can carry up to 10,000 feet of causeway and the necessary gantry crane, as well as the unique traveling bridge crane that deploys the causeway from the sea over the beach. Additionally, it comes equipped with sufficient mobile cranes to discharge cargo from vessels tied up alongside the LSQ/C. The LSQ/C is also equipped with a ramp capability to accommodate the various types of military RO-RO ships. Below deck is a water purification/desalinization plant, pipeline components and required equipment to pump water ashore once the causeway is in place. The modular causeway sections are 150 feet long and 30 feet wide. Each has a catwalk and conveyor belt system to move palletized cargo ashore.



Traveling Bridge Crane

- Installs/removes causeway sections
- Travels on rails
- Moves with construction
- Length of 300 feet
- Width of 40 feet
- Lift capacity 300 tons

As planning factors:

- The LSQ/C can effectively deploy 3,000 feet of causeway in 72 hours using 82 personnel.

- It can provide intermediate storage and pumping as a terminal for an offshore distribution system. With an appropriately sized piping system, the LSQ/C can handle a fuel flow rate or 1.2 million gallons per day that can be discharged, for example, from a tanker moored nearby at a single point mooring buoy to an onshore distribution system such as the Army's Inland Petroleum Distribution System.

- Off-loading time for material depends on the class of cargo ship and its cargo mix. Given a 20-hour work day, a T-AKR fully loaded with containers, flat racks, sea sheds, 1,087 vehicles, and 50 short tons of break bulk cargo can be offloaded in 28 hours.

- It can provide these off-load services with varying degrees of efficiency in conditions up to Sea State 6.

As we begin the 21st century we face a radically different strategic environment. We have lost the advantage of having a definitive battle line and must be prepared to rapidly focus our energies and resources of ever changing national commitments and successfully execute a wide range of Army missions. New ideas and concepts are critical. Organizations change, command, control, and communications continue to improve and doctrine adapts. The fundamental requirement, however, to position the ground forces with ample equipment and supplies for battle has not changed. The need for innovative logistics platforms supporting heavy forces anywhere in the world is mandatory and will be with us as we move our Army into the next century.

The Landing Ship Quay/Causeway (LSQ/C) is one concept that can bring enhanced transferring of cargo requirements into the Army's future. Technical risk is low because the LSQ/C relies heavily on proven technology. Some innovative aspects of the LSQ/C are:

- High mobility for a self-contained port/causeway system which can be deployed in a few days on an open coastline.

- Installation of a causeway can be accomplished without the aid of floating or land-based equipment.

- The causeway is installed from the bottomed vessel inward to the shore.

- Unassisted construction extends across the sandy beach to the hard surface beyond the dune line.

- Retractable columns are used to support modular causeway sections.

- The system enables increases in cargo discharge rates with significant decrease in manpower and equipment compared to present Logistics-Over-the-Shore (LOTS) methods.

- The system can be adapted to discharge fuel, potable water, and lubricants, and to provide electrical power to the shore facilities through flexible pipeline organic to each causeway section.

- The arrangement and berthing facilities enable cargo transfer operations in sea state conditions much higher than possible with existing portable discharge systems or with LOTS.

- The causeway can be recovered expeditiously and moved to another location for redeployment.

- The transport vessel becomes a quay when grounded by taking on ballast in water depths adequate for large cargo ships.

The time is 0500 hrs and the year is 1999. Negotiations have broken down with the hostile government of the Republic of Laranda. The decision has been made to deploy U.S. forces in a major operation. Airlift cannot provide the volume for a mechanized division and its required support train. The invasion site lends itself to the application of the LSQ/C. The site selected has the required sea floor and hydrographic conditions.

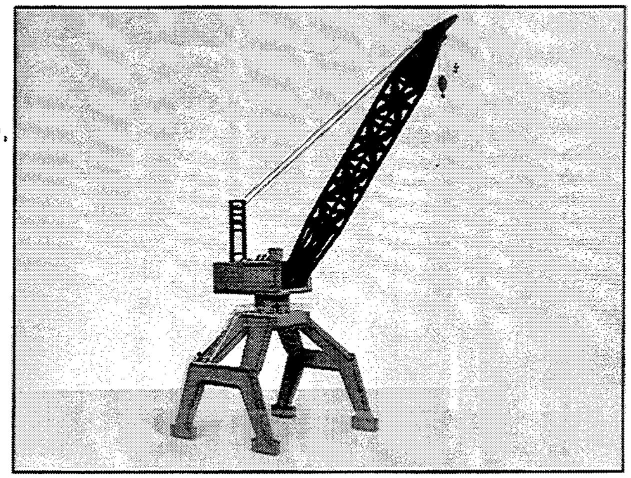
As the early morning sun begins to break the USS Wilson (a modified VLCC) slowly slips into the selected site. Seawater is then pumped into the ballast tanks which allows the Wilson to settle on the bottom at a 45 foot depth. There is much activity as the ship makes minor adjustments to ensure a reasonably level position. Off the bow we begin to see the shore almost 3,000 feet away. Suddenly we here the rumbling of the deck-mounted gantry crane as it positions the causeway sections. Other deck activities include the positioning of the Traveling Bridge Crane (TBC) and the movement of the Tractor Power Unit (TPU). The TBC extends steel arm beyond the ramp of the Wilson and with its legs locked to the rails it handles the loading.

Once the Tractor Power Unit (TPU) has positioned the first causeway section under the hooks of the TBC it returns to the ship. The TPU then begins to receive and position another causeway section. With remarkable smoothness the TBC lifts the causeway section and transports it forward within the TBC structure until the section extends far enough to permit lowering into a position level with the Wilson's ramp.

With only 72 hours to establish a serviceable port, activity on the Wilson's deck is very high. Communications are ongoing with nearby ships. Each will join with the Wilson and offload their cargo of fuel, water, containers, flat racks, sea sheds, vehicles, and break bulk as soon as the causeway is in position.

Gantry Crane

- Transfers causeway sections
- Usable for cargo handling
- Moves fore and aft on rails
- Revolving crane
- Reach of 160 feet
- 600 ton lift capacity at 80 foot radius



With the flurry of activity, the TBC moves forward 150 feet, secures itself to the just-installed causeway section rails and prepares to receive yet another section from the TPU. When the leveling and attachment of the causeway sections are verified, the TBC releases the locking blocks and the flexible pipelines at the lower level are available for connecting. This remarkable cycle continues until the causeway section have been deployed the 3,000 feet to the shore - beyond the sand dunes and on to the hard surface area. Meanwhile, preparations are underway to begin the stream of materials ashore.

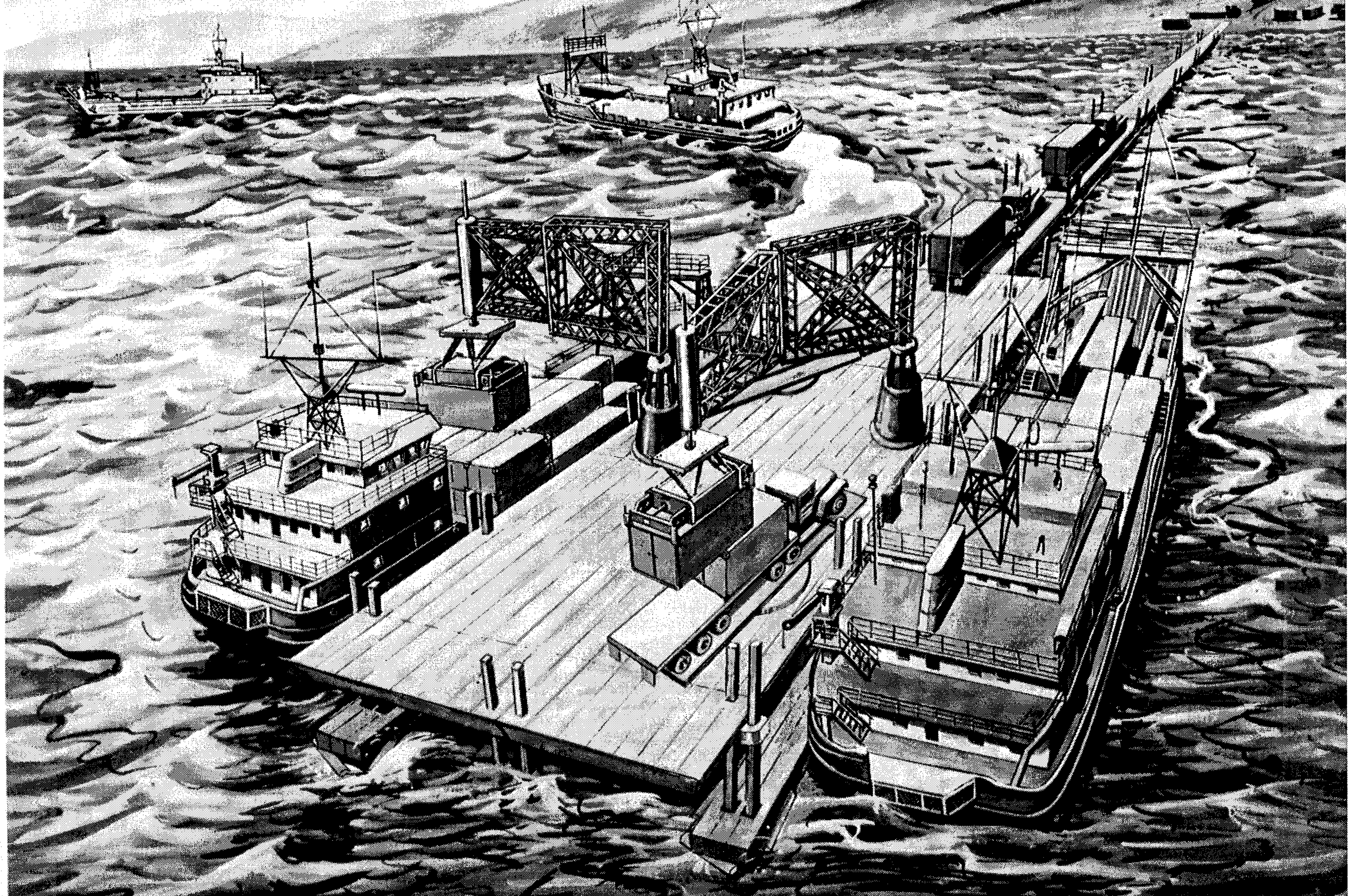
Given the current world situation and the possible military deployment scenarios, it is unlikely we will be faced with another Normandy. We are, however, faced with a standing requirement to position a formidable force on a yet-to-be identified beachhead and supply them with continuous logistical support. The LSQ/C can effectively provide this capability with current technology. Perhaps we have learned from history. Time will tell.

AUTOMATED ALL-WEATHER CARGO TRANSFER SYSTEM (AACTS)

Edmond J. Dougherty
President
August Design, Inc.
Merion, Pennsylvania

August Design, Inc. (AUGUST) is currently under contract with Naval Surface Warfare Center (NSWC) Carderock Division to develop an Intelligent Spreader Bar (ISB). The robotic ISB will have machine vision and the ability to move in six degrees of freedom. This will permit cranes to acquire or place containers, even if the containers are on vessels moving in high sea states. The ISB will be the first of the Automated All-Weather Cargo Transfer System (AACTS) components to be brought to full scale operation.

AUTOMATED ALL-WEATHER CARGO TRANSFER SYSTEM (AACTS)



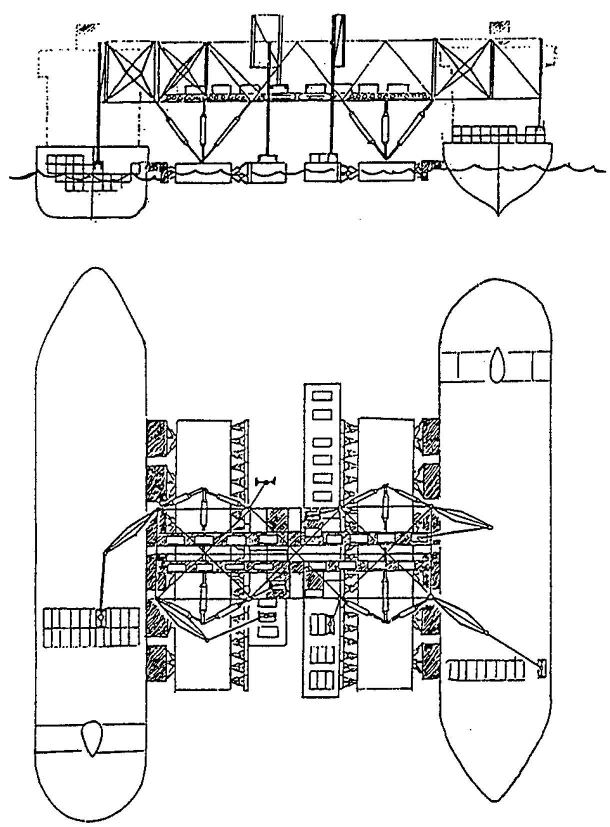
The AACTS is a concept for an off-shore container handling facility capable of simultaneously servicing two containerships and several lighters. Off-loading of containerized cargo from large ocean-going ships and lighters using conventional techniques is hazardous and inefficient during moderate seas, and impossible during periods of rough weather and high seas. Conventional cargo handling systems are not designed to cope with the motion of ships and lighters under such conditions. The AACTS employs advanced techniques that permit safe and efficient operation in high sea states.

The AACTS platform configuration is based on a twin hull catamaran. Barges are used as the twin hulls, and a large stabilized transverse platform is used as the cross member. In operation, the AACTS is stationed off-shore with containerships moored to its outboard sides. Lighters, which shuttle between the shore and the AACTS, berth in the protected area beneath the elevated AACTS platform to receive and discharge containers.

The platform itself is supported and stabilized by 12 electro-hydraulic actuators. The actuators automatically adjust to any motion of the support barges to nullify the motion of the barges in the ocean. This provides a relatively stable cargo transfer platform even during episodes of high sea states. Each set of stabilizing actuators forms an inverted tripod connecting the AACTS platform to the support barges. By using gyroscopic feedback, the actuators can be controlled so that the platform is stable while the support barges move with the forces of the seaway. It is estimated that the AACTS platform motion will be no more than plus or minus six inches in any direction under sea state three conditions.

Active berthing modules are used to provide an interface between the AACTS and the vessels. These berthing modules: suppress the relative motion between the vessels and the AACTS platform; provide a soft docking surface for the vessels; permit warping of the vessels along the AACTS; provide positional feedback to the control system for automatic operations of the AACTS cranes; and provide a means to rapidly and safely cast off vessels. The berthing modules are linear arrays of motion platforms located along the AACTS support barges. Each module is capable of movement in multiple degrees of freedom in response to commands provided by the AACTS control system.

The berthing modules incorporate six actuators attached to the AACTS barge on one end and the docking surface on the other. The actuators can move the docking surface up to 10 feet away from the AACTS barge. The berthing module can move with the berthed vessel in pitch, yaw, heave, surge, and sway. The berthing modules act as intelligent shock absorbers that damp the relative motion between the AACTS and the vessels, eliminating damage to the vessels and permitting it to safely berth in high sea states.



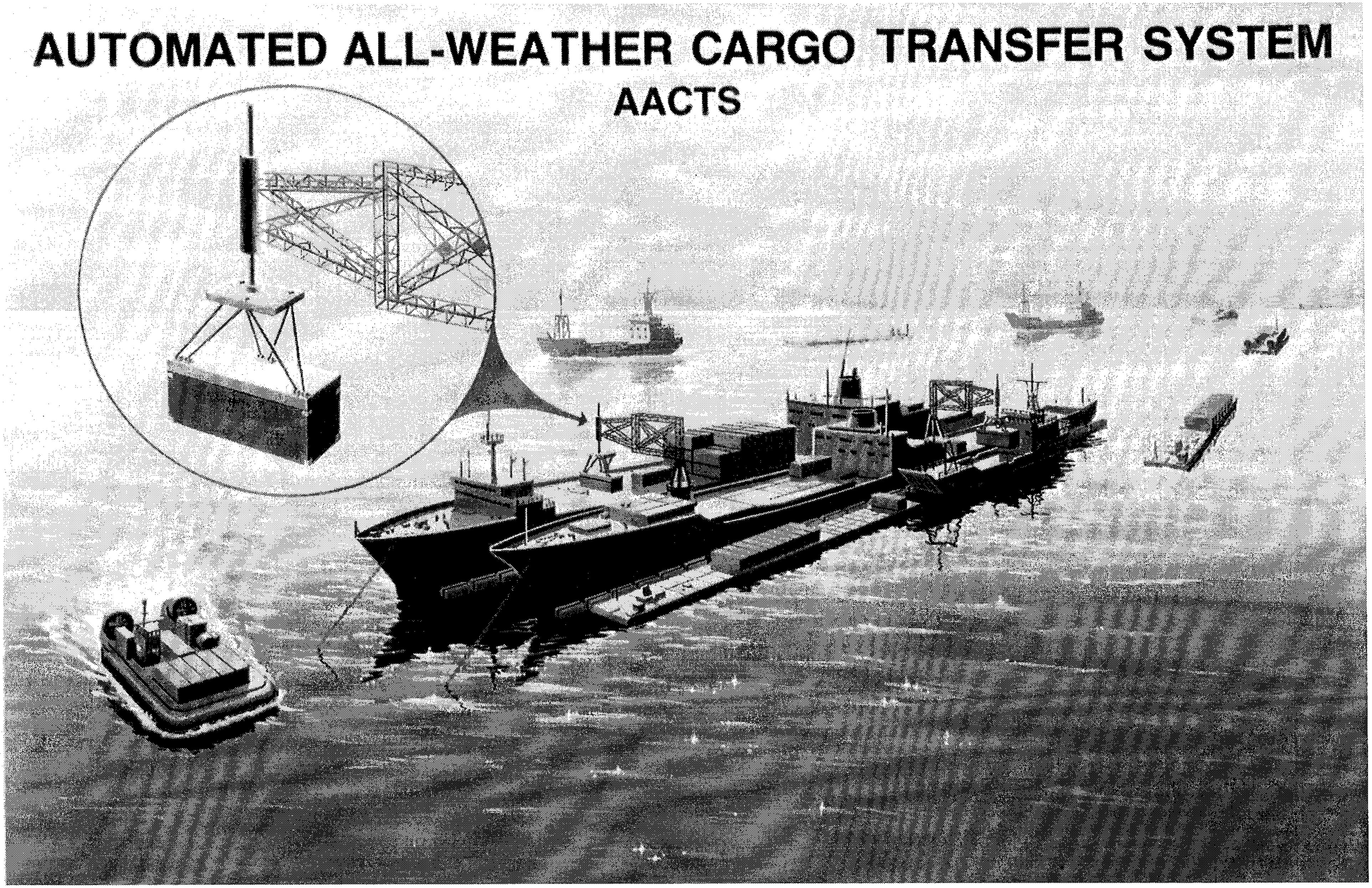
With the vessels safely alongside the AACTS, the system can load and unload containers. The stable AACTS platform holds eight container cranes. Four cranes work the containerships, and four cranes service the lighters. A horizontal conveyor system located on the elevated platform is employed to transfer containers from one crane station to another. Containers unloaded from the containership are automatically transferred over to a crane loading a lighter. The conveyor is also used as an accumulator to temporarily store containers; this allows the cranes to work independently of one another. Unlike conventional cranes that employ long cables that are subject to unwanted pendulation; the eight AACTS cranes are more like robotic manipulators with the position of each component tightly controlled. The AACTS cranes consist of three components: arm, rigid hoist, and ISB.

Each arm is articulated and consists of a forearm and an upper arm, forming a SCARA-like robot. Each arm is rigid in horizontal plane, but can rotate about two joints--a shoulder joint and an elbow joint. The shoulder joint of the upper arm can rotate 225 degrees, while the elbow joint can rotate 315 degrees. This allows the arm to efficiently and flexibly cover large areas of the vessel. The arms serving the containerships have a horizontal reach of approximately 140 feet and a coverage of approximately 15,000 square feet. The upper arm is designed as a tetrahedral to provide torsional stiffness. The forearm also has a tetrahedral design to withstand the moments produced by containers with offset centers of gravity.

The rigid hoist provides large vertical motions and eliminates the use of long cables. The hoist can accommodate a lift of over 120 feet and provides the needed rigidity in both torsion and bending. Having a rigid structure as the hoist eliminates pendulation and permits the spreader bar to be placed in a precise location in space. This eases the task of picking or placing containers. The hoist also has the ability to rotate about the vertical axis, permitting the spreader and container to be oriented as needed.

The ISB is connected to the rigid hoist and is able to move in any combination of six degrees of freedom (six DOF): roll, pitch, yaw, heave, surge, and sway, supplementing the motions provided by the arm and hoist. The ISB is based on the six actuator design of the Stewart platform. Stewart platforms can efficiently produce movements in six DOF and have been used for several years to provide motion for flight simulators. The length of each of the six actuators is set by the movement of winches located in the upper portion of the ISB. The ability of the ISB to move in six DOF in a controlled manner is important so that it can rapidly adjust to the movement of containers on vessels in high sea states. The AACTS platform, the arm, and the rigid hoist provide the macro movements--placing the ISB in the vicinity of the target location. It is the task of the ISB to provide the micro movements needed to track and acquire or place the container.

While the AACTS cranes can be controlled telerobotically, a key feature of the AACTS is its ability to automatically pick and place containers. To do this, a vision-based system of sensors is provided. Two classes of sensors are employed: macro and micro.


AUTOMATED ALL-WEATHER CARGO TRANSFER SYSTEM
AACTS

The macro sensor system is used to detect the relative position of the AACTS crane with respect to the vessel to be worked. A camera is placed on the AACTS in a known location relative to the crane. The camera is positioned in such a way that it has in its field of view certain known physical features of the vessel, such as a group of lights. An image processing system measures the attitude of the features on the vessel relative to the location of the AACTS crane. The features are used as index to the container locations on the vessel. The AACTS locates the features on the vessel and can then calculate the relative position of the container location. Given this information, the AACTS control system can generate the commands to move the AACTS arm and the rigid hoist in the vicinity of the vessel container location.

Once the control system has placed the arm and the hoist in the vicinity of the container location, the micro sensors on the ISB take over. The micro sensors are also vision-based sensors, but they are located directly on the spreader bar. In this way the attitude of the container location with respect to the spreader can be accurately measured. Because the ISB can move in six DOF, the feedback from the sensor system can be used to track and dock with the container location.

The sensor system for picking containers consists of two video cameras and three laser line projectors mounted on the ISB in a known geometric relationship. The laser line projectors produce three light stripes which "paint" lines of light on the top of a container located below the ISB.

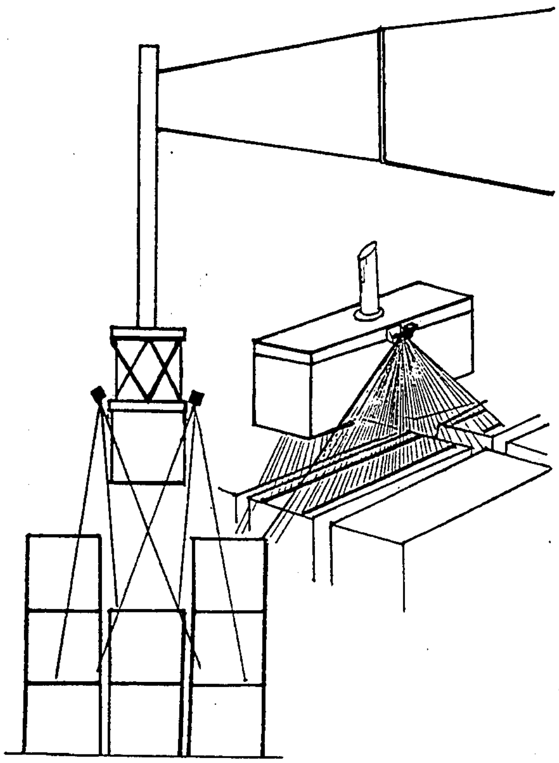
The cameras in the spreader bar are aimed so their fields of view include the laser light strips on the surface of the container below the spreader. A camera is located in each end of the spreader. The real-time video from the camera is sent to the AACTS computer which performs image processing.

The geometric configuration of the lasers and cameras are such that the video from the cameras can be used to determine the position of the container with respect to the spreader bar in six DOF. The system was designed to be most sensitive to heave, roll, and pitch because these are typically the primary motions of a moored vessel. The design allows heave, roll, and pitch to be determined directly be measuring the position and angle of the laser stripes in the video frame. These measurements are computed quickly and simply by the AACTS computer.

While optimized for heave, roll, and pitch, the sensor system also determines the yaw, surge, and sway positions in real-time by measuring the length of the various light stripes. In the video, the laser stripes crossing a container edge are shortened; by measuring the length of the stripes, edges of the container can be located. In this way, the surge and sway positions of the container relative to the spreader can be determined. By measuring the locations where the left and right light stripes fall off the edge of the container, the computer can determine the relative position of the edge of the container with respect to the spreader. By determining the location of the edge of the front and rear laser stripes, the computer can determine the yaw of the container relative to the spreader.

Based on the measurement of the position of the ISB with respect to the container, the AACTS computer generates position commands for the rigid hoist and the six DOF Spreader Bar. The execution of the commands places the Spreader Bar's four corners directly over, and in close proximity to, the container's four corner posts. At this point the AACTS computer lowers the Spreader Bar onto the container and engages the picking mechanism (standard twist locks). After the picking mechanism has been engaged, the computer issues instructions to raise the container off the vessel.

Although the laser light striping concept works well in picking up containers, it cannot be used in placing containers. When a container is held by the spreader bar, it blocks the view of the location where the container is to be placed. Because of this, a different technique is used to place containers, although it still employs machine vision.



A camera located on the spreader is used to capture three known points on the vessel. From its vantage point above the deck, the camera in the spreader can view the three known points even though the spreader is holding a container. The video of the points is sent to the AACTS image processing computer which calculates the relative attitude of the spreader and the deck of the vessel. The system is able to determine the location of the deck relative to the spreader in all six DOF. The commands generated by the computer are fed to the spreader which then aligns with the deck and places the container.

While the AACTS concept provides an all encompassing solution to the offloading of containerships in offshore military operations, the components of the AACTS can be employed in a number of related applications for both the military and commercial worlds.

With the growing expense of developing and maintaining deep water ports, commercial offshore cargo handling, known as in-stream operations, are becoming popular around the world. AACTS and its components are perfectly suited for such operations. In these cases, containerships are offloaded onto lighters which are more easily able to navigate the local rivers and ports.

Because the AACTS cranes can deal with changes in the position of vessels, the cranes can eliminate the large expense of developing means to protect ports from the action of the seas. This is currently a problem in the port of Long Beach, CA, where surges are causing great difficulty in commercial container operations using conventional ship to shore gantry cranes. An AACTS-style crane has the ability to deal with such problems.

AACTS cranes and spreader bars are also of commercial interest because of their ability to rapidly and automatically handle containers. Such an ability increases productivity of container ports and lower costs.

In the military application, AACTS cranes can be placed on crane ships to permit safe and efficient offshore operations. The cranes would pick containers from the containership and place them on lighters. An AACTS crane can also be used on the end of a causeway to handle containers on lighters. Wave tank tests were recently conducted demonstrating the ability of an AACTS crane mounted on an Elevated Causeway (Modular) (ELCAS(M)) pier to successfully load and unload an LCU2000 lighter in sea states up to and including sea state four.

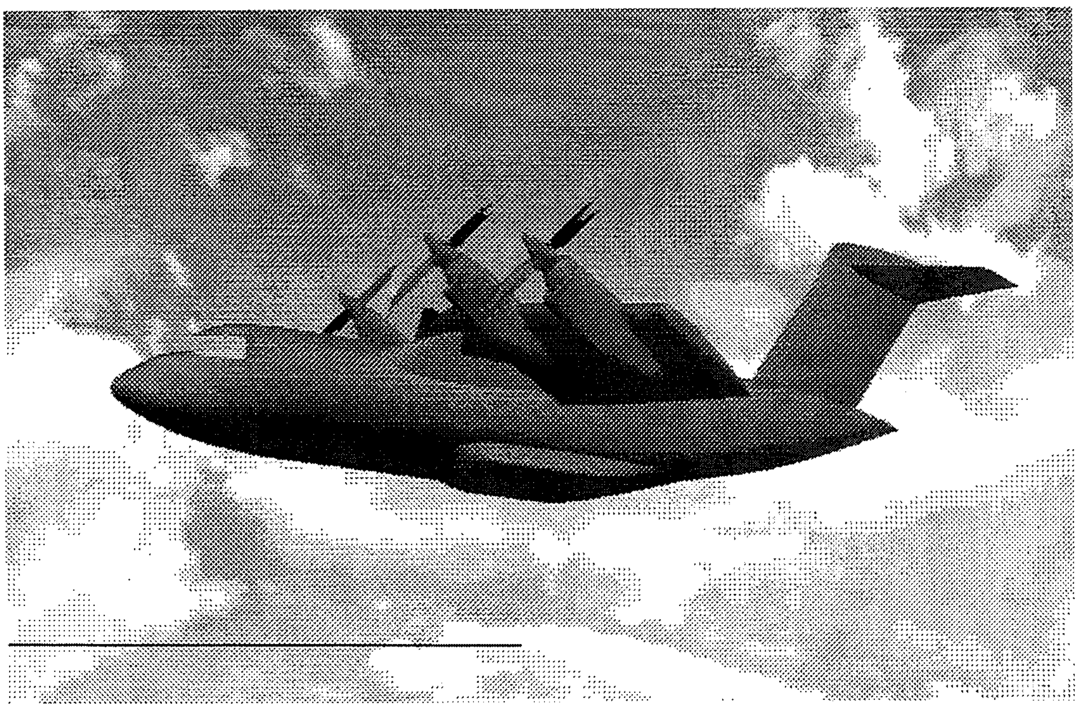
The ISB can be used with cranes other than the AACTS crane. AUGUST Design is currently studying the use of the ISB with conventional ship to shore gantry cranes, as well as boom cranes such as those used on the T-Auxiliary Cream Ship (T-ACS).

AN ADVANCED THEATER TRANSPORT (ATT)

Mike Rohrlick
Blaine K. Rawdon

Question: What do you get when you cross a bush plane with a forklift?

Answer: The Tiltwing Super STOL Advanced Theater Transport.



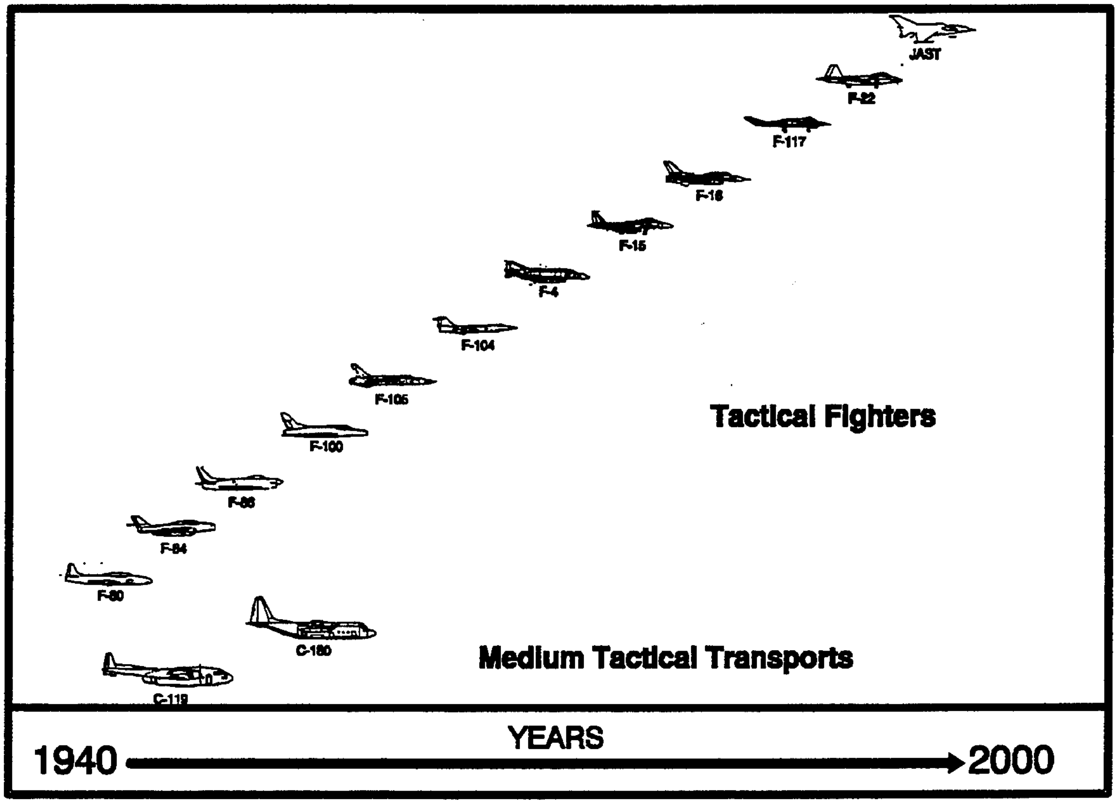
- About the same outside dimensions as the C-130--but with a much larger cargo compartment.
- Combat offload ten times faster.
- Combat offload three times more payload.
- Land and takeoff in 750 feet over a 50-foot obstacle at 45 knots.

The Advanced Theater Transport (ATT) now under independent development by McDonnell Douglas combines the short field performance of the bush plane with the material handling talents of the forklift to provide unprecedented support of forward area operations.

Powerful turboprops and a tiltwing give the ATT the ability to fly very fast, very slow, and land/takeoff much shorter than conventional STOL transports. New, fully integrated cargo handling systems permit rapid forward area operations without any material handling equipment (MHE). And, like the C-17, the ATT can carry larger and heavier loads, with a smaller crew, than the predecessors in its class. This permits the ATT to support troops in forward battle areas much more directly and efficiently than current airlift aircraft which require conventional sized airstrips and landing zones. The ATT's rapid offloading capability combined with the potential to frequently change landing location greatly enhances survivability.

Some History

Before looking at this new aircraft, let's review some airlift history beginning in the early 1960's when the Air Force began seriously thinking of replacing the decade-old C-130.



What's Wrong With This Picture?

In the early 1960's the CX6, a Vertical/Short Takeoff and Landing (VSTOL) aircraft about the size of the C-130, was studied.

In the mid-1960's, five XC-142's were built and flown. These were small experimental aircraft capable of lifting about 8,000 lbs of cargo in the vertical mode. Unfortunately, its extreme short field or super short takeoff and landing (SSTOL) capability was not well advertised and received little notoriety at the time. When used in the Super STOL mode the XC-142 could lift twice as much from fields shorter than 500 feet. The process to bring this experimental program into production and operational use was begun but died during the formal source selection process. Some think because the aircraft was too complicated, too small, or way ahead of its time.

Around 1969 the Light Intra-theater Transport (LIT) made it to Air Staff as a potential "Tactical Airlifter." Although somewhat smaller than the C-130, it was also to be a VTOL aircraft. The LIT effort went pretty far until the commander of Tactical Air Command dropped his support in the early 1970's.

Following the demise of the LIT another effort to replace the C-130 began. A number of concepts were considered and in some cases actually prototyped. Known as the Advanced Medium STOL Transport (AMST), Boeing and McDonnell Douglas built two prototypes each which were somewhat larger than the C-130.

The USAF designated these as the YC-14 (Boeing) and YC-15 (McDonnell Douglas).

In the mid-1970's a number of related events occurred which had a profound impact on "Tactical Airlift." The C-130 force was transferred from Tactical Air Command (TAC) to Military Airlift Command (MAC). The AMST program, in the midst of a formal source selection effort, was stopped. Although the MAC staff tried to keep the AMST alive, in 1980 the AMST effort was replaced by the much larger and heavier CX which in time became the C-17 now in production.

Concern in the military for tactical airlift capability gave rise to a series of studies. In 1988, the SECDEF-directed "Worldwide Intratheater Mobility Study" (WIMS), identified long-term intratheater mobility programming goals which significantly exceeded existing tactical airlift capabilities.

At the same time, the joint (USAF and USA) Airlift Concepts and Requirements Agency (ACRA) completed the "Qualitative Intratheater Airlift Requirements Study" (QITARS) which thoroughly reviewed service doctrine and unified command requirements that identify tactical airlift tasks and capabilities required to support the combat commanders' needs.

Beginning in 1986, Air Force Systems Command's (AFSC) Aeronautical Systems Division (ASD) sponsored the Advanced Transport Technology Mission Analysis (ATTMA), Advanced Theater Transport (ATT), and Future Theater Airlift Studies (FTAS) which further defined mission requirements, explored a range of new conceptual designs, confirmed the need for new and unique future airlift capabilities, and developed both programmatic and technology development data. This work was done primarily by Boeing, Lockheed, and McDonnell Douglas. In the end, both Boeing and McDonnell Douglas determined that a non-vertical, Super STOL tiltwing had the best potential to accomplish the theater airlift mission.

In 1989, the Military Airlift Command (MAC) developed a Draft Statement of Operational Need (SON) for an Advanced Theater Transport (ATT). The Draft SON identified how present and future doctrinal requirements of U.S. ground forces necessitated an ATT. The Draft SON identified the following:

- Defeating the enemy by securing and retaining the battle initiative, and exploiting it aggressively, was the Army's operational doctrine. This was emphasized in the "AirLand Battle" concept, and the Army's emerging future operational concepts.

- To satisfy future tactical airlift requirements, the ATT must be capable of delivering essential cargo directly to the user without traditional airfield/cargo handling constraints.

- The C-130 design did not envision "today's" emphasis on increased short field or "farmer's field" delivery requirements, increased weight and size of modern combat vehicles and armaments, counterinsurgency and counterterrorism support operations, or the forward area and deep attack support required by evolving Army doctrine.

- The present and future threat environment is far more lethal than that envisioned by designers of the defenseless tactical airlifter.

- Theater airlift's present and future commitments and threats demand superior capabilities not available with current transport aircraft. Technological advancements focusing on rapid cargo on/offload and aerial delivery improvements are of particular importance.

- The ATT must eliminate reliance on established airfields, current on/offload methods, material handling equipment (MHE), traditional transshipment LOC's.

Back then MAC concluded that the ATT design must:

- Secure, retain, and exploit the battle initiative.
- Provide direct delivery of cargo and troops.
- Meet modern requirements for field length, payload, and missions.
- Respond to a lethal threat environment.
- Provide new capabilities in cargo handling and aerial delivery.
- Eliminate reliance on established airfields and MHE.

When we examine the military need for an Advanced Threat Transport in the 21st Century, the synergistic relationship between aircraft performance, loads delivered, and available landing sites is evident. Established airfields are likely to be prime targets for an increasingly well-armed enemy, so landing zones of the future are likely to be very temporary to reduce their targetability. An aircraft that can deliver and offload key payloads to extremely short fields without preparation and MHE will permit very rapid and flexible response close to the battle front and significantly reduce aircraft and Army personnel exposure to enemy fire.

The Aircraft

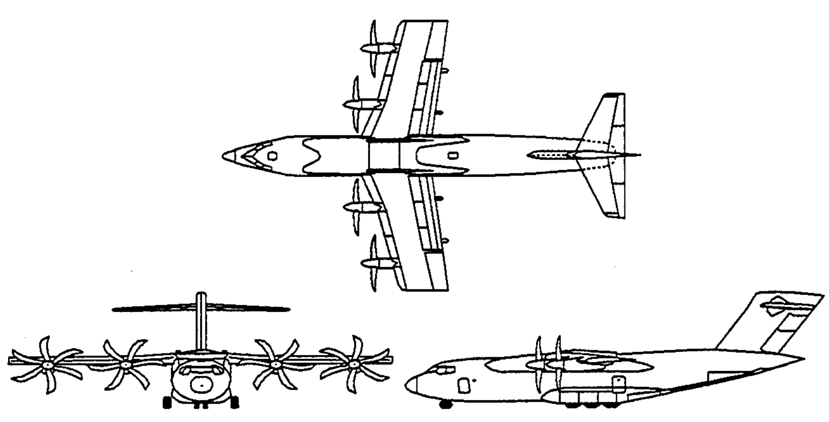
Introduction

In response to these emerging needs, McDonnell Douglas has studied the ATT mission and aircraft in extensive variations: Payloads between 33,000 lb and 63,000 lb; Field lengths from 3,500 feet down to VTOL; Prop, propfan, and turbofan propulsion systems; Stealthy and conventional configurations; Conventional, tilt rotor, tiltwing, lift fan, and lift engine configurations.

Of all the aircraft studied, the Tiltwing Super STOL (SSTOL) aircraft has the best characteristics for the ATT mission.

McDonnell Douglas is developing a Tiltwing SSTOL to meet the ATT mission. The aircraft is currently in the conceptual design phase. In this phase, both the design and the mission are responsive to new requirements and user comments.

The Tiltwing SSTOL is conventional in appearance when the wing is stowed. It resembles a scaled-up C-130 or a scaled down C-17. It has four powerful turboprop engines mounted on a high wing that tilts upward at low speed and is stowed for higher speeds. The aircraft also incorporates innovative cargo handling systems.



This design offers a significant leap in airlift aircraft performance and capability. Takeoff field lengths between 300 and 1,000 feet will allow operations into much smaller forward areas than are now feasible with conventional airlift aircraft such as the C-130.

The Tiltwing SSTOL carries modern Army weaponry such as a loaded Multiple Launch Rocket System (MLRS), the Bradley Infantry Fighting Vehicle, and the HEMMT truck. It can also carry eight 463L pallets. Maximum assault payload is 33,000 lb. Maximum 2.5 g payload is 55,700 lb. The wide cargo floor permits 463L pallets to be carried width-wise with room for seated troops on either side.

Innovative cargo handling systems permit rapid, direct transfer of palletized loads between the aircraft and bare Army trucks. This is achieved with a single loadmaster and a single truck driver. The loadmaster may operate from his console in the aircraft cockpit or from the cargo bay. The aircraft is also equipped to autonomously handle two Palletized Loading System (PLS) flatrack pallets, or two 20 foot ISO containers.

The Wing

The key feature of the wing is that it is pivoted about a lateral axis located near the rear wing spar. This permits the wing to be tilted up to a large angle of incidence without rotating the entire aircraft. This angle, ranging from about 15 degrees at takeoff to near 45 degrees during landing, is used only for takeoff, landing, low-speed airdrop (dump truck), and low-speed terrain following. During cruise the wing is stowed to the standard faired position.

Precise, rigid wing tilt actuation is provided by two substantial jack screw actuators similar in concept to those used to control tail incidence in the MD-11 and DC-10 airliners. These actuators are housed within the wing fillet fairing and do not penetrate the fuselage pressure shell.

Aerodynamic flow remains attached over the entire range of wing tilt, aided by standard wing high lift systems as well as flow turning due to the powerful prop-rotors. This means that lift is always provided by the wing, and that at low speeds this lift is augmented by propeller thrust.

Propulsion System

Propulsion advancements of the last two decades permit a practical Tiltwing SSTOL. These advancements include much more powerful engines, lightweight and reliable gearboxes and driveshaft systems, and efficient propellers.

The Tiltwing SSTOL uses four engines to drive four large propellers. These are all linked together with gearboxes, clutches, and driveshafts to keep all four propellers spinning in the event of an engine failure. An automatic emergency power boost to the remaining three engines maintains the total power so that engine failures require no immediate pilot action. This permits the ultimate in training. The Air Force could safely train in peacetime the same way they would fly in combat. In other words, no assault/combat rules required.

The engines and propellers are sized to give a thrust-to-weight ratio substantially higher than for conventional STOL aircraft to provide extreme short field capability. The engines are higher-power derivatives of the engine used in the V-22 Tilt Rotor aircraft.

The propellers have full cyclic pitch capability to aid low speed control. Simpler, alternative means to provide this control are currently being studied.

Other Systems

Aside from the cargo handling systems described below, other systems on the Tiltwing SSTOL are approximately conventional in order to take advantage of well proven systems. Therefore the Tiltwing SSTOL is feasible without extensive development of numerous systems.

Technical Advancements

Many technical advancements have occurred in the state of the art since the inception of the C-130. These serve to increase performance and decrease price.

Key structural advancements include improved analytical methods, inexpensive, and rugged composite structure, and integrally machined metallic structure which substantially reduces parts count and assembly time.

Design and manufacturing are now completely computer-based, yielding a precise, efficient and inexpensive manufacturing method.

Although earlier tiltwing aircraft used bellcranks, cams and levers to provide control surface mixing, flight control systems are now also completely computer-based. This permits a straightforward execution of the complex flight control laws required to provide the Tiltwing SSTOL with excellent flight characteristics throughout its flight envelope.

Technical Risk

While studies show that SSTOL Tiltwing has enormous potential, they have also identified several areas of risk. The most significant of these are low speed handling qualities and the propulsion system design. Due to the aircraft's very slow speed flight capability (about 50 knots), the design of the control system must be robust enough to provide acceptable handling qualities at these speeds. Low speed pitch control by cyclic pitch or by a vertical-axis tail rotor appears to solve control problem, but at the expense of increase complexity. Therefore, other means of low speed pitch control are now being investigated. Lateral control, on the other hand, is straightforward by comparison.

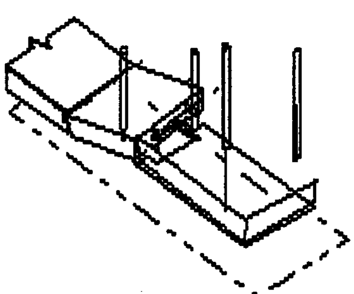
Cargo Handling Systems

While the unusual tiltwing configuration provides exceptional field performance, it is its combination with advanced cargo handling systems that creates an extraordinary aircraft with exceptional capability.

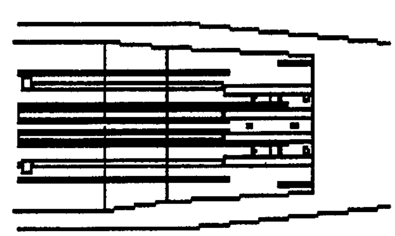
IMACH (Improved Methods of Automated Cargo Handling) is an integrated group of technologies which streamline airlift cargo handling operations by reducing turnaround time, manpower requirements, and material handling support equipment needs. As seen below, IMACH is made up of a number of subsystems.

IMACH Technology Areas

Aircraft Ramp and Floor Systems

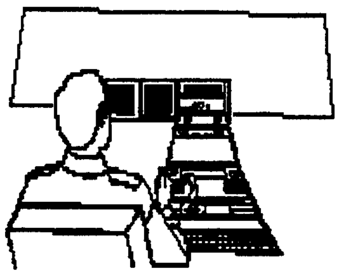


Articulated Aircraft Ramp

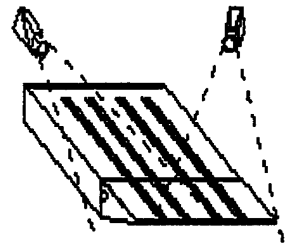


Retractable Rollers, Rails, Powered Belts

Control System



Computer Aided Loadmaster Console



Stereo Video

Current military doctrine stresses the need for rapid initial response to conflict, including rapid delivery of materiel close to the action. A new combat delivery aircraft needs to be designed so as to support this strategy. It should require little site preparation and no MHE (Material Handling Equipment) resources. Its ability to efficiently carry PLS flatracks and containerized cargo will also enable the Army to respond more effectively. Modern doctrine also stresses high mobility during a war. A new tactical transport will deliver closer to a moving front, enabling fewer Army resources to supply fighting troops. For the airlifter of the future, significant design changes in cargo handling equipment and the aft fuselage need to be accomplished.

Today, sustained, efficient operations require landing sites several thousand feet long, equipped with material handling equipment (MHE) such as forklifts and K-loaders. MHE, its insertion and retrograde can create logistic problems. MHE weighs a lot. Most people not familiar with MHE think of a forklift as a small item. They are used to seeing forklifts at Home Depot. They don't realize that 10K forklifts weight in excess of 12 tons. One forklift generally equals one C-130 sortie in--and--one out. The increased number of sorties to move MHE is just the tip of the iceberg. It often means flying in support teams, control teams, and loading/offloading teams. The time it takes to insert these teams and equipment inhibits rapid response and limits flexibility. Taking MHE away from the major Aerial Port to support forward landing site operations significantly reduces the port's capacity to build up and move loads. In addition, for sustained operations, MHE needs maintenance support. All these limitations cry out for an airlift aircraft to be equipped with an advanced cargo handling system that, when necessary, can efficiently operate without MHE support.

IMACH technologies support the concept of autonomous cargo handling operations by focusing on automation of airlift cargo handling functions such as reconfiguration for different loads, the offload and onload of Army vehicles without the need for MHE, and combat offload for the large and more complex loads such as triple married pallets, PLS flatracks, and ISO containers. The IMACH automation features will also enhance standard cargo loading and airdrop operations.

IMACH provides the following:

- Rapid reconfiguration of the cargo floor and ramp in whole or in segments. This includes raising/lowering rails, rollers, locks, and drive systems.
- Rapid 463L pallet transfers with bare Army trucks of all heights without the need for MHE.
- Transferring loads from the side of Army vehicles lined up across the rear of the aircraft (backing into position is not required).

- Controlled combat offload at low or fast taxi speeds.

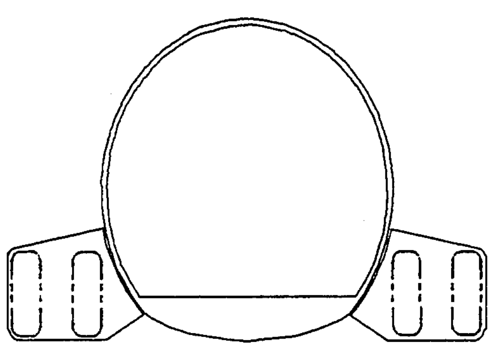
- Efficient accommodation of PLS flatracks, ISO containers, and triple married pallets.

In its simplest application, IMACH would reduce the number of aerial port load pushers because it would automate the movement of palletized loads. Reducing the need for MHE support would significantly reduce the great number of airlift sorties required to preposition MHE during forward area operations. In future applications, IMACH combined with a Super Short Takeoff and Landing (SSTOL) would ideally support direct delivery to rapid maneuvering forces.

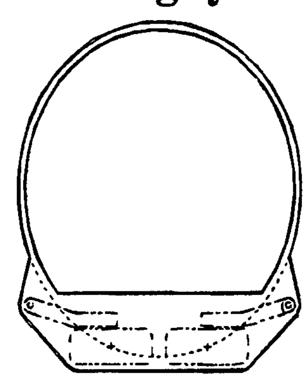
One question we often hear is how come IMACH influenced the design of the Tiltwing SSTOL. In actuality aircraft designers look at many performance characteristics when designing an airlift aircraft. The most significant performance factors are generally incorporated in the "design mission." The "design mission" specifies an airspeed, payload range, and load size/weight. These specifications are always fundamental to the configuration design of any airlift aircraft. All configuration designers and performance engineers rely heavily on them.

Unfortunately, it appears that not since development of the rear opening aircraft have designers paid much attention to the cargo handling system itself; especially during the initial configuration design phase. Some believe that cargo handling is just a bunch of bric-a-brac, i.e. rollers, rails, and tiedown rings, that happen to reside inside the cargo compartment. The Tiltwing SSTOL basic configuration design integrates the cargo handling system (specifically designed to meet all mission needs). When the advanced cargo handling system was incorporated into the basic design configuration, the aircraft underwent remarkable change. As an example, because the aircraft is not designed with a specific floor height (due to an adjustable height ramp), the fuselage remains essentially round. As seen in the figure below the fuselage on the right provides sufficient room to store the landing gear under the floor, thus reducing landing gear pod drag by about 60 percent.

Standard Cargo Handling System

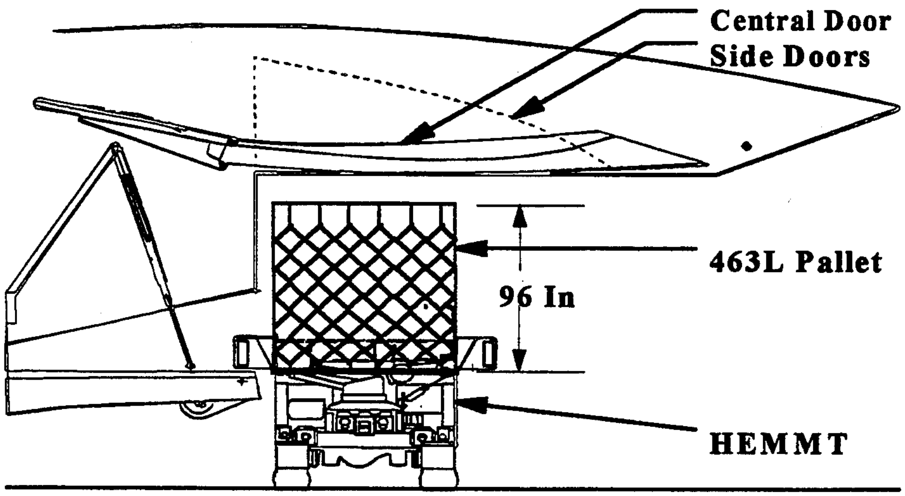


Advanced Cargo Handling System



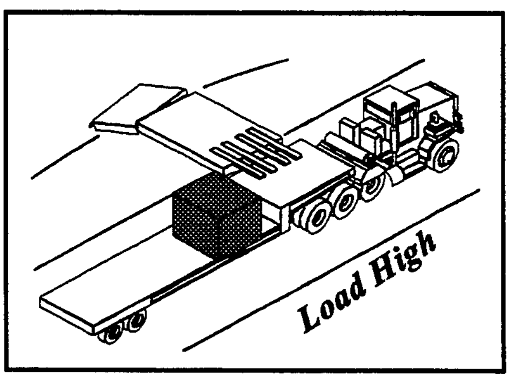
Another example is the aft fuselage design. The McDonnell Douglas IMACH design includes an articulated ramp which changes the way combat delivery can do business. Some Army trucks cannot be loaded when they are backed up to the aircraft ramp. For instance, the Army's HEMMT has a large cargo crane folded in the rear blocking it from being loaded from the rear. However, the HEMMT can be loaded if it pulls alongside the cargo ramp.

Side Loading HEMMT Truck



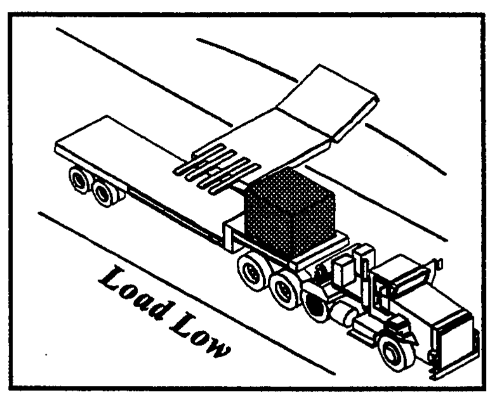
Actually, not only can a HEMMT be side loaded, but any truck, including flatbeds can also be side loaded.

Ramp Adjusts To All Truckbed Heights



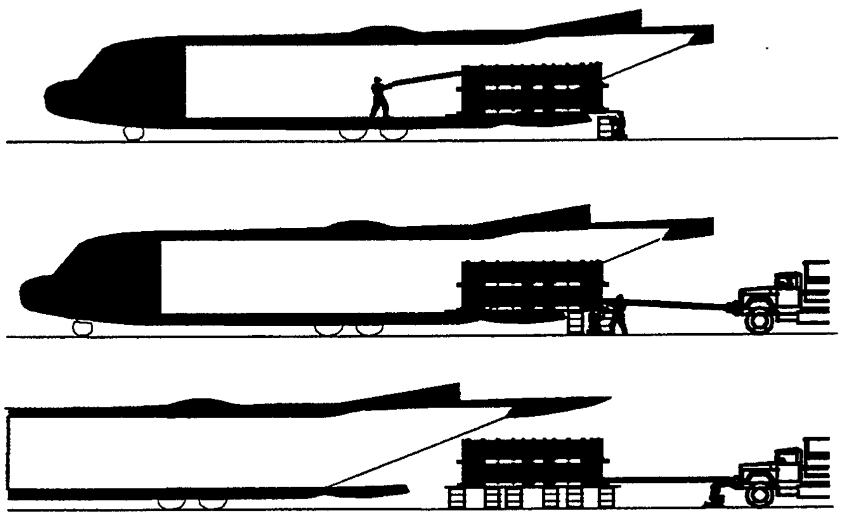
Load To Bare Floor Trucks And Trailers No Need For Rollers

Offload In Minutes To Any Army Transport Vehicle



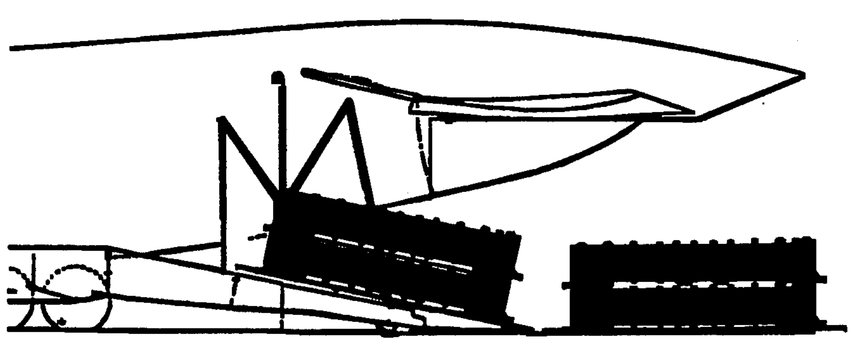
Military loads have been changing and in some cases gradually increasing in size and weight since the inception of the C-130. Firepower, such as the Multiple Launch Rocket System (MLRS) and the Bradley Fighting Vehicle push the C-130 beyond its capability. There appears to be an emerging trend towards 8 ft x 8 ft x 20 ft ISO containers. The latest is the 33,000 lb capacity PLS Flatrack pallet which is being purchased in large numbers by the Army, primarily for delivery of ammo. These are not efficiently handled by current airlifters because they have to be restrained on triple married pallets. At the destination the triple married pallet must be offloaded onto a K-Loader or combat offloaded onto the ground. Combat offloading triple married pallets from the C-130 borders on madness. The figure below depicts combat offloading triple married pallets. Notice how the loadmaster must place 12 55-gallon drums under the load (limited to 15,000 lbs maximum weight) while the aircraft taxies out from under it.

C-130 Triple Married Pallet Combat Offload
Approximately 30 Minutes



As shown in the next figure, combat offload is significantly improved when accomplished by the IMACH equipped ATT. Loads weighing up to 55,700 lbs can be combat offloaded.

ATT Triple Married Pallet & Flatrack Combat Offload
Approximately 3 Minutes



What do you get when you cross a bush plane with a forklift? We look forward to our armed forces finding out--they need such an aircraft in the battlefield of the future.

ARMY PRE-POSITIONED AFLOAT

MAJ Steven B. Edwards
HQDA (DAMO-ODR)

"In my mind, as far as I see, the single most important enhancement the Nation needs to meet our two MRC contingency strategy is strategic lift."

General Shalikashvili
8 Feb 95

Force projection usually begins as a contingency operation - a rapid response to a crisis. Recent contingency operations reflect our reliance on strategic lift and pre-positioned equipment for CONUS-based Army units to meet CINC contingency requirements. The Mobility Requirements Study (MRS) recommended that the Army pre-position two million square feet of equipment, to include a combat brigade and port opening equipment, in an afloat package by FY 97. Since the establishment of the interim afloat package in FY 94, its commitment to support Operations VIGILANT WARRIOR and SUPPORT HOPE have validated the MRS recommendations.

Today, Army Pre-positioned Afloat (APA) offers a robust capability across the range of military operations. The 14-ship interim APA package includes: seven Roll-On/Roll-Off (RO/RO) ships with unit sets of equipment, a Heavy Lift Pre-position Ship (HLPS) for port opening capabilities, a T-Class Auxiliary Crane Ship (T-ACS) for offload assistance, three Lighterage Aboard Ships (LASH), and two container ships with ammunition and sustainment stocks. The interim APA provides the warfighter with an armored brigade (2x1 or 1x2) with doctrinal combat support and combat service support (CS/CSS) equipment sets augmented with equipment to sustain independent operations. APA also provides Corps/Echelon Above Corps (EAC) theater opening CS/CSS equipment sets, sustainment stocks for the Contingency Corps and a port opening capability.

APA force projection operations permit rapid deployment and employment of the heavy brigade into secured ports in an area of operation. The APA enhances the regional CINC's ability to occupy or augment an advanced lodgment or reinforce an ally with a credible force prior to hostilities. APA proved its value as a deterrent force during Operation VIGILANT WARRIOR. The 24th Infantry Division's rapid generation of combat power using APA and Kuwaiti pre-positioned equipment was decisive in removing Iraq's threat to the region. The 24th Infantry Division significantly enhanced APA's value to the warfighter by reconfiguring ship load plans from pure battalions to balanced task forces, each with CS/CSS slices.

APA also provides a rapid peacetime response in support of Operations Other Than War (OOTW). The Army demonstrated this capability during Operation SUPPORT HOPE in Rwanda when three APA ships arrived in Mombassa, Kenya within nine days of the National Command Authority (NCA) execute order. APA was prepared to provide responsive disaster relief to the Japanese government after the Kobe earthquake.

The interim APA package still has some limitations. At present, the size of the interim RO/ROs limit the ability to fully configure equipment to unit sets while afloat which in turn causes delay in the port staging area. The interim APA has limited in-stream Logistics Over the Shore (LOTS) and Offload Preparation party capability. However, Operation VIGILANT WARRIOR resulted in significant improvements to asset visibility of secondary loads for the brigade and configured these loads to their tactical vehicles.

Operation VIGILANT WARRIOR identified the need for the Army to develop a training program to improve APA operations. Pending final FY 97-01 Program Objective Memorandum (POM) decisions, the DCSOPS has approved annual APA exercises with the goal of validating APA doctrine and identifying/correcting training deficiencies. The first APA exercise supports CENTCOM Exercise BRIGHT STAR 95. A FORSCOM initiative is integrating APA training tasks into National Training Center rotations. TRADOC is developing APA tasks, conditions, and standards and will field an APA Mobile Training Team (MTT) in FY 96.

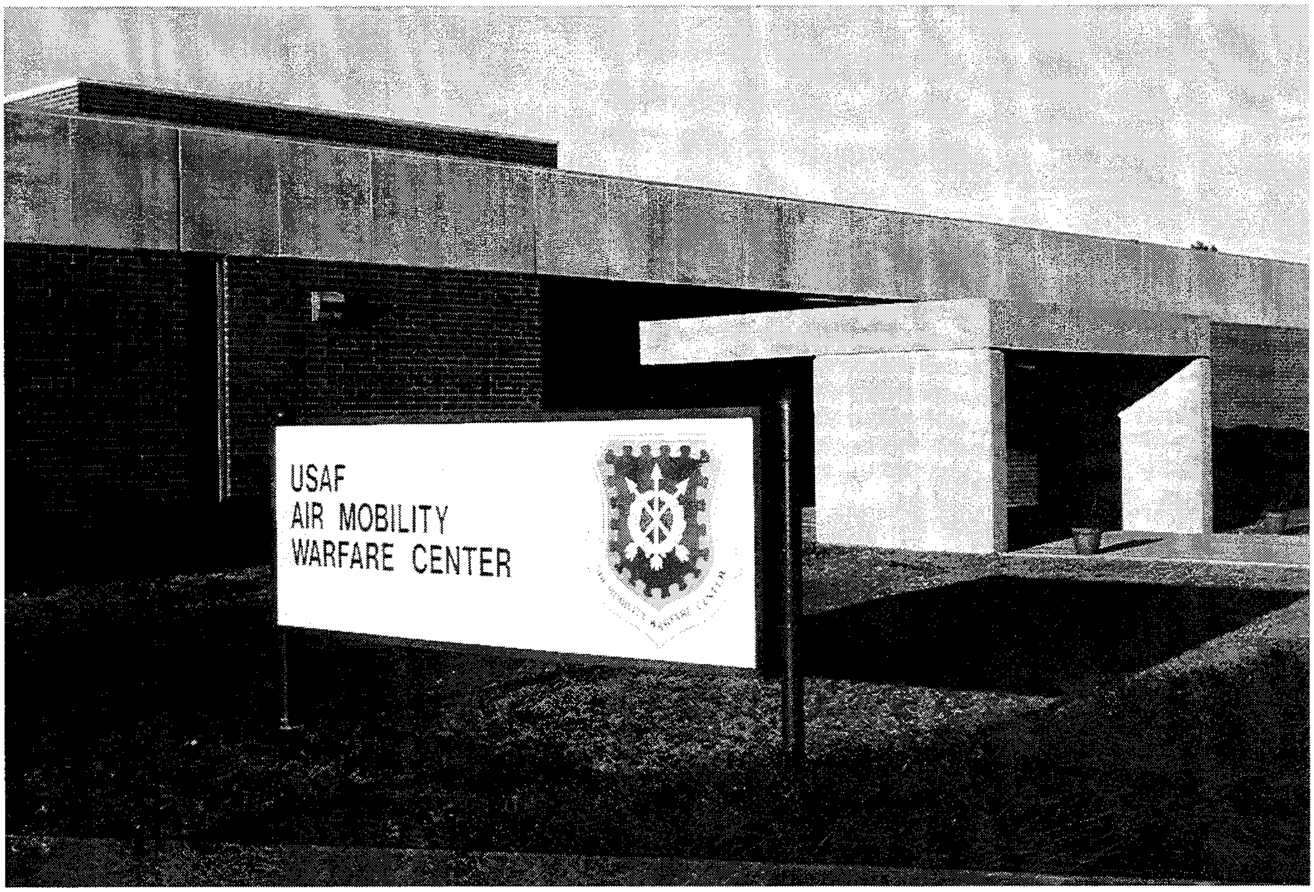
The endstate APA will redress the limitations of the interim package and provide a more robust capability for the warfighting CINCs. Beginning in FY 97, five Large, Medium Speed, RO/ROs (LMSRs) will replace the current RO/ROs for the brigade afloat. These new ships will provide space for a significantly enhanced Corps/Theater-base and additional space/facilities for onboard maintenance operations. By FY 98 APA will have nine LMSRs, two container ships, three LASH ships, two HLPSs, and a T-ACS.

With APA the Army has met the challenge to significantly improve its ability to rapidly deploy a heavy brigade into a designated theater of operations. APA has proven it can provide an Army-unique ability to establish a significant armored heavy force inland capable of operating great distances from the theater port. By continuing aggressive support of strategic lift acquisition together with fort to port infrastructure improvements, and additional pre-positioned sets, the CONUS-based Army continues to enhance its ability to serve as a power projection force for the warfighting CINCs.

THE AIR MOBILITY WARFARE CENTER–ENHANCING GLOBAL REACH

Capt Ken Backes
AMWC Executive Officer

The Air Mobility Warfare Center (AMWC) is Air Mobility Command's (AMC's) center of excellence for education, training, and operational test and evaluation. The AMWC is located on Fort Dix, New Jersey and has been operational for just over a year. The Center consolidated air mobility training and testing previously located at seven geographically separated units. It is responsible to the AMC Commander for operational and logistical training for air mobility managers and senior leaders. It formulates doctrine, develops tactics, and conducts operational tests and evaluation of new procedures and systems for airlift and tanker fleets in support of Presidential and SECDEF direction for use of mobility assets during war, crisis, and JCS exercises in support of unified CINCs.



The AMWC is organized into three divisions and two squadrons.

The Operations Division provides a broad range of customers with a dynamic series of courses and products. The division's diverse activities are accomplished by five branches: Operations, Tactics, Transportation, Intelligence, and Advanced Studies of Air Mobility.

The Operations Branch has AMWC's most diverse academic venue, hosting its highest ranking student base. Fifteen courses cover enlisted training requirements and breadth developing officer programs. The branch presents the Air Mobility Operations Course (AMOC, formerly the Air Mobility School; formerly the Airlift Operations School), Director of Mobility Forces (DIRMOBFOR) Seminar, and State Manager Course.

The Tactics Branch develops and exercises tactics within the Training and Tactics Development sections.

The Air Transportation Branch provides distributed computer-based training and Community College of the Air Force accredited classroom instruction. Courses focus on aerial port management and contingency operations.

The Intelligence Branch provides intelligence instruction for Air Mobility Operations, Tactics, and 421st Training Squadron courses. It also provides intelligence advocacy to the AMWC at large.

The Advanced Studies in Air Mobility (ASAM) is the first-ever Air Force Institute of Technology (AFIT) accredited master's degree program specializing in air mobility. It is educating future squadron, group and wing commanders. The student body includes rated and support officers, as well as Air Force

Reserve and Air National Guard officers. Students earn an AFIT accredited graduate degree.

The Logistics Division, provides aircraft maintenance in-residence courses and exportable training products in support of the Air Mobility mission. The division teaches senior and junior maintenance officer, production superintendent, and instructor qualification courses. It also produces Command Aircraft Systems Training (CAST) manuals and Maintenance Training Guides.

The Education Support Division is responsible for establishing academic and training standards, Quality programs, and audio visual support center-wide. the division developed and teaches the only initial formal training course for combat camera and visual information officers in the Air Force.

The 421st Training Squadron conducts operational training of air mobility leaders and managers. It provides AMC and other commands with base support contingency training in areas concerning command and control, civil engineering, and security. Training courses include a full range of deployed site, including: command and control, global transportation system threat analysis, bed-down issues, combat and survival skills, security, routines in defense, integration in overall ground security system, military operations other than war (MOOTW), military operations in urban terrain, convoy, dismounted operations, rules of engagement, law of armed conflict, leadership issues, and other pertinent areas of concern at deployed sites.

The 33rd Flight Test Squadron is AMC's only operational test and evaluation agency for field tests. It conducts logistics systems, mobility, and operations support tests to include tactics evaluations and development. It is currently testing several tanker formation procedures and combat tactics and has been tasked to validate the C-5's equipment airdrop capability. The squadron has a detachment at Charleston Air Force Base to conduct Follow-on Test and Evaluation of the C-17.

The philosophy of the Center--innovation, synergy, immediate response to command requirements--has already paid substantial dividends to the Air Mobility Command. The Center quickly spun-up to an annual throughput of approximately 6,000 students participating in over forty different courses of instruction and is executing over thirty-five aircraft and equipment tests. Recently, they shifted to around-the-clock operations to produce and deliver critical pre-deployment training to AMC forces supporting Operation Joint Endeavor in the Bosnia-Herzegovina region. A true success story for the Air Mobility Command.

The Commander of the Air Mobility Warfare Center, Brigadier General Buck Marr, said "We have experts from every mobility discipline under one roof. This permits us to think creatively about how to improve our Global Reach before we actually need it. The Warfare Center is helping to make mobility forces into a proactive force rather than a reactive one. This is good for America."

List of addresses who receives our news bulletin:

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U.S. Army Aviation Center and Fort Rucker
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U.S. Army John F. Kennedy Special Warfare Center and School
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10th Mountain Division
U.S. Army Combined Arms Center and Fort Leavenworth
U.S. Army Depot Systems Command
11th Transportation Battalion
Naval Doctrine Command
U.S. Marine Corps Forces, Atlantic Liaison Element

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