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"We need to change the logistics system. Logistics has always been central to the military. But it's also been a drag on what the military could do. And right now, it's a drag on transformation because so much money and so many people are absorbed in logistics processes, that we need to reach for new constructs."

Arthur Cebrowski, OFT Director, February 2004

Mobilus Initiative: Airships as a New Aerospace Industry Segment

LTC Michael Woodgerd

The United States requires greater mobility to meet burgeoning military and commercial demands. The US aerospace industry shows signs of faltering and losing its preeminent position in the world .The nation requires the emergence of a new transport capability within the aerospace industry that the US military can draw on in times of crisis Only a new type of airlift platform will need this emerging need.

Lighter-Than-Air (LTA) technology--derided, often wildly misunderstood and largely ignored for the last 50 years--offers the potential to provide tremendous increases in volume, speed and accessibility for air movement around the world. LTA technology offers new types of platforms, more complete use of national airspace, and supports a more fully networked concept of air transportation. The nation needs to move more, faster, from various points of origin to relevant locations worldwide. Only the atmosphere provides a navigable ocean that touches all of the Earth. Exploiting LTA technology allows payload totals more like ships than planes.[1] Only transport airships[2] will enable us to be Mobilus in Mobile[3] – Mobile Within The Mobile Element.

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[1] *See the first article in this series, Fantasy to Prophesy, The Need for a New Lighter-Than-Air Aerospace Capability, (Transformation Trends article dated 11 March 04) for substantial background data.*

[2] *The term "airship" includes various types. Ongoing research of past studies, work with the FAA and multiple LTA "greybeards" showed that earlier use of terms such as "hybrid air vehicle" by the author and other variants of "hybrid" by others were incorrect. Diagrams later in this article further clarify this.*

[3] *Latin: with the English translation shown in the text. Nothing more aptly describes a ship operating within the ocean of air.*

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Discussions on the value of transport airships are too often superficially dismissed. This stems from past failures of over-hyped government or civilian efforts that proceeded without precise objectives, cost estimates and timelines. The Mobilus Initiative intends to rapidly create a broad, diverse new capability in the commercial transport sector.

This development path will use previous efforts as a guide to yield useful lessons, but Mobilus is not tied to the past. Success depends on developing a sober, long-term view factoring in realistic cost and time estimates, realistic technical paths, considers training and existing airship experience, and includes key nodes across the private sector.

Technology alone is not enough, neither is a solely military or governmental effort. This article describes the Vision—enabling a worldwide LTA industry--towards which we must build a public/private partnership unlike any other yet constructed. Creating this new sustainable segment of the aerospace industry could take up to two decades. The Mobilus Vision presents a grand challenge for the 21st Century.

Mobilus airships do not yet exist, but are technically feasible. Historical data and significant conceptual engineering work over previous decades, reveals that airships capable of carrying payloads as much as 200 tons,[4] .are feasible in the near term. These ships could cruise 24-hours a day between 60-90 MPH (origin-to-destination) and operate independently of airports and seaports. Each airship of this size would be equivalent to nearly three C-5s or four-to-five C-17 transport aircraft in terms of capacity. These rough estimates of future capability do not require significant technical breakthroughs. The challenge lies more in closing the business case, in project management, in training crews, in operating airships and in organizing the required networks to finance, create and operate these craft. Technological advances are critical to achieve the more demanding sizes envisioned for the future, however.

This article briefly describes the key military/civilian/aerospace industry needs and opportunities to show how transport airships offer a common solution to multiple problem sets. The bulk of the paper then describes the Mobilus Initiative in greater detail.

Nexus of Challenges and Opportunities

The US aerospace industry is essential to the nation's mobility for commercial and military missions. A new LTA-centered aerospace sector is achievable and will make a significant improvement in our nation's mobility. It also supports several of the core strategies for transforming the Next Generation Air Transportation System.[5]

While each cargo-carrying airship will possess significant payload and range, it will require dozens or these airships in operations to have an impact. The US Department of Defense alone cannot develop, operate, crew and maintain a fleet of transport airships no matter how valuable. The DoD is at war, and cannot sacrifice current capabilities (force structure, funding for a full development, etc.) for potential

[4] *Payload depicted in tonnage can be deceptive. Airship design contains many critical trade-off decisions, but 200 tons is a defensible figure for current material/designs, reflects previous military deployment modeling, and is a also a viable amount of unit equipment for smooth staging and flow.*

[5] *References to the JPDO Futures Working Group/related efforts come from the author's ongoing work with the JPDO.*

futures. Development would also be too slow. A cursory inspection of traditional acquisition programs shows delays and cost increases of 40% are common.

Any mobility solution must address military and commercial needs and boost the US aerospace industry. This is a challenge, but it is also the key opportunity we will exploit. Mobilus will identify the most sensible development paths and build the networks across government and private industry to construct airships to meet varied commercial needs. Consortiums are a proven mechanism in harnessing the power of free markets and legal regimes exist to help small companies produce technology that they cannot do alone.

Mobilus Vision

The Mobilus Vision is of a future worldwide LTA industry, a robust and complementary component of the current aerospace industry made up of varied types of airships, both conventional and hybrids; performing varied commercial functions throughout the world. Integrated into a network of airships will be a similar network of facilities, both maintenance and construction, to crew and maintain the ships. This will include lifting gas production, distribution, storage and purification, more precise weather forecasting, and a training base for those who operate, maintain and manage airship operations.

The US military will be able to tap into the commercial airship fleet in a manner similar to how the DoD uses the Civil Reserve Air Fleet (CRAF) today. Airships will not be a permanent element within the military force structure, although opportunities for long- term contract support, as well as other options exist. This civilian capability must be broad, deep, and develop as rapidly as possible. Military considerations will be a key driver of airship development and a crucial first customer as well.

Realizing the Vision

The fundamental core of the Mobilus vision is a public-private partnership, or a technology-sharing consortium, although incorporating some unique aspects. This method reflects both reality and successful precedent.[6] Major industries have long pooled their innovation efforts to gain efficiencies and this form of partnership is most efficient and least risky. Under this approach innovators have a strong incentive to share knowledge, and technology-sharing consortia are quite stable.[7]

Arguably, previous airship development efforts were stymied in that developing such capability proved too onerous for any one company to pursue. Mobilus, by identifying all relevant participants up front, closely working with them to accurately identify the risk and reward for each participant (in a collaborative effort) and showing comprehensive cost and development paths, will significantly reduce overall collective risk.

Military Mobility Needs

[6] *Dr. Bruce Holmes of NASA Langley has pioneered several major efforts in the civil aviation arena using consortia. These efforts include the Small Aircraft Transportation System (SATS) and Advanced General Transportation Experiments (AGATE).*

[7] *A rationale for the use of consortia is found in William Baumol's The Free-Market Innovation Machine: Analyzing the Growth Miracle of Capitalism, 2002, Chapters 3, 4 and 7.*

Current military operations are always limited by the availability of lift. Future operations concepts issuing from the military services demonstrate a tremendous, perhaps even exponential, increase in potential movement demands, especially within a theater of operations. To provide an asymmetric advantage for US military forces, and counter multiple anti-access threats, the nation requires the capability to rapidly deliver large volumes/heavy payloads directly to desired destinations, independent of existing infrastructure.[8]

Multiple deployment analyses show the value of Ultra-Large Airlifters (ULAs)[9], the generic term for this capability. ULAs will improve overall force closure rates as well as offering entirely new ways to package and deploy specific capabilities such as hospitals, command and control nodes and bridge building materials. A point-to-point capability and high volume cargo bays translate into significantly faster employment of units such as helicopters (lightweight but large footprints) and also of heavier, denser units that can then make better use of vacated deck space on sealift ships. Airships blur the line between inter and intra theater deployment and propel the department toward the concept of operational maneuver from strategic distance.

Governmental Mobility Needs

Governments have concerns about national mobility separate from the military. Sovereignty and access to a nation's entire territory also factors into the equation. Seventy percent of Canada, for example, is not accessible by road. The cost of supplying remote settlements of the First Nations people is steep and existing aircraft are nearing the end of their useful lives, with replacement aircraft generating higher operating costs.[10]

Within the United States, population centers are not equally well connected by the nation's robust transportation network. The Futures Working Group of the Joint Planning and Development Office sessions identified a future need across many potential scenarios for a fully networked transportation system with much greater cargo carrying capacity across the US, this hemisphere, and in new patterns worldwide.

Commercial Mobility Needs

The inability to move large volume and/or large heavy cargo to remote locations at reasonable costs and speed, means that certain types of business cannot be done today. This includes such business activities as foregoing the mining of certain mineral deposits while other business is done less efficiently. The identification of commercial value is twofold. First, there are areas of business where we can estimate the savings a new transportation technique offers. Second, new ways to move cargo suggest savings in other parts of the business chain and perhaps in several supply chains. Airships can bring efficiencies in

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[8] *This destination will vary by mission and situation. The chosen destination's landing zone would not be in direct enemy contact, but would be as close as possible to the actual area of employment of the capability.*

[9] *This term, coined by BG Charlie Fletcher in 2000, refers to a capability that will be manifested in airships of various types (conventional or hybrid types) that use lifting gas for most of the buoyancy (lift), have a payload far greater than conventional aircraft, range in the thousands of miles, speed significantly greater than surface ships, and do not require significant infrastructure for operations.*

[10] *Dr. Barry Prentice, University of Manitoba at Winnipeg. Dr. Prentice has graciously supplied the author with information and coordinated overall efforts since 2002.*

reduced engineering costs, reduced manufacturing costs, reduced labor costs, more efficient and timely use of capital, and other savings.

Normal air cargo demand is expected to triple by 2025, and desired passenger flow through existing terminals will be two to four times greater.[11] The existing air transportation network does not utilize all airspace or airports, is predominately a hub and spoke construct and …"does not appear scaleable to meet the future".[12]

One example of commercial usage is pipeline construction. Airships offer the only viable new method of moving the volume and weight of cargo in the remote regions of the world, particularly wooded and hilly areas. Currently material is barged and trucked into place and requires building roads and clearing base camps. Bases include modular housing, fuel, and supplies. Sample equipment ranges from 200 ton pieces to 63 ton pieces up to 20 or 30 in number. Factor in the building of roads, moving camps several times and the removal of the roads/restoration of the land, and one gains an appreciation for the sheer mass of material to be moved and the time required to move it. "You will note that we are not flat and do contend with tree cover. The less environmental damage by way of tree clearing or road building the better."[13]

US Aerospace Industry Situation

The US aerospace industry is a critical component of our national power. It is a key productivity engine of our economy, and the national mobility it provides is key to other businesses, many jobs, and is essential to our military mobility. It is also a system in peril. The Commission on the Future of the United States Aerospace Industry chose as its "urgent purpose" to show that the "…critical underpinnings of this nation's aerospace industry are showing signs of faltering." As part of its findings, the Commission has set challenging goals, such as tripling overall air transportation capacity by 2025, and to reduce point to point travel time anywhere on earth by 50%.[14]

Visualizing the Impact of Airships and a Transformed Air Transportation Network

Picture a map of the Internet. This represents the flow of ideas and information and also the physical movements of good and services, business and leisure travelers, military units, humanitarian relief supplies, and so much more. One key point is the robustness of a network. A terrorist attack or a storm front can now throw an entire transportation network into chaos, but a robust network that can synchronize itself and alter the flows of physical movement can absorb significant damage and still get the information and goods to destination.

Airships are a physical component of changing our existing transportation networks into more robust ones. Not all airspace is used right now, for instance, and airships operate best at the lowest altitudes so

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[11] *Remarks by John Kern, Director of Joint Program Development Office (JPDO, 6 May 2004.*

[12] *Holmes, Dr. Bruce J, "21st Century Networking", Aviation Week and Space Technology, Dec. 15th, 2003.*

[13] *The information and figures shown are courtesy of Mr. John Skalski of Enbridge Pipelines, Inc.*

[14] *All references of findings of the Commission come from the Final Report Of The Commission On The Future Of The United States Aerospace Industry, November 2002, pp. v-19.*

they would not conflict with other commercial traffic. Their ability to operate free from significant infrastructure makes them much more flexible and environmentally friendly and cheaper in many ways.

Figure 4: The Mobilus Domains

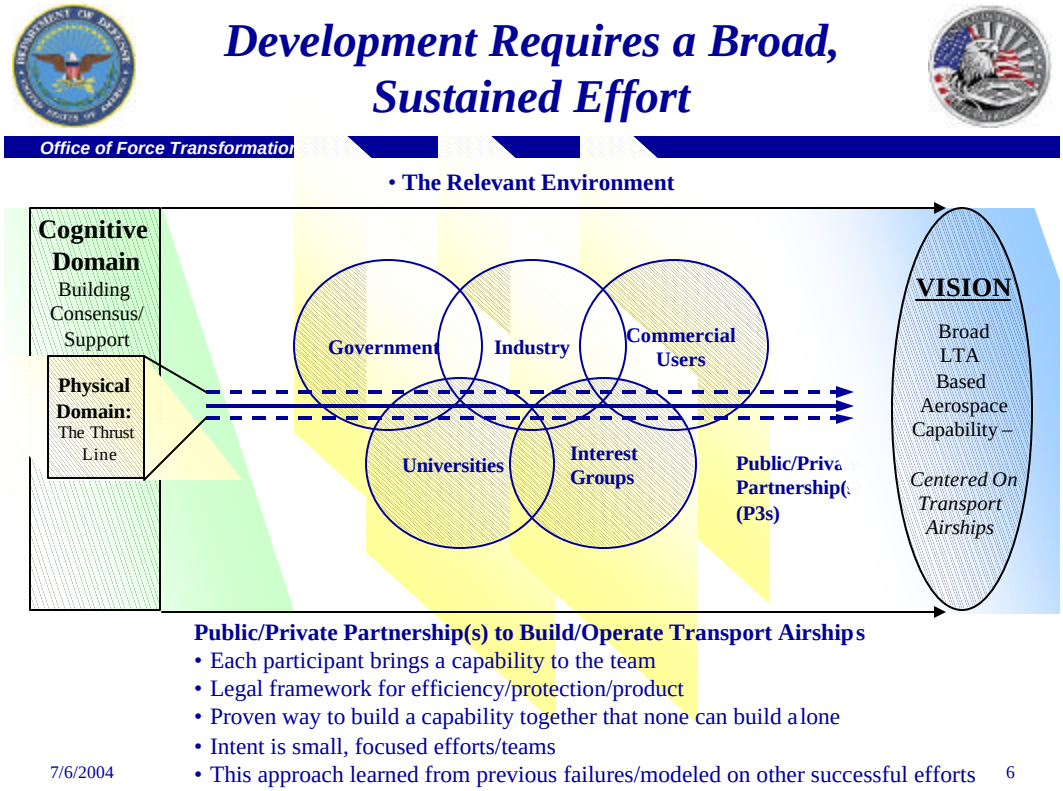


Figure 4 shows the overall environment within which airship development will occur and identifies the sectors from which key stakeholders will emerge. The linked rings also emphasize the interrelationship of all parts of any network, particularly a transportation network. Each circle in the figure represents many organizations and individuals, public and private, who will be either direct stakeholders in a public-private partnerships (P3), or who must either support or not oppose this development. Much of this will be "self discovery" as early entrants work together during the study phases to learn where their value lies. This will also promote commitment and consistency by both government and commercial participants throughout a long-term effort. These must be "win/win" situations.

Notice that there may be multiple P3s focused on varied airship designs/commercial applications. Some development would be common to all, but each path would proceed independently. The overall intent is to build a broad capabilities base, with new companies and participants. This will produce more innovation and provide a wider choice of suppliers to military, government and commercial users.

One key distinction is important. Previous alliances either included major players in established industries, or very small companies teamed with a major government organization such as NASA. In the latter, participants chose what to produce, but then faced the challenge of how to market this unique capability for profit. There would also be an inevitable "platform focus". Mobilus is different in including the actual end users in the process to guarantee immediate use of the airships produced. This is

crucial. The airships will be designed to meet clearly defined missions/markets, not designed as a ship seeking solutions.

By including future operators, financiers and others in the process from inception we ensure a more robust capability and allow for concurrent development across the board. Obviously, this unique approach is not for everyone because participants in a P3 must get along and cooperate, so only those willing and able to do so will join.

Government: Government participants have needs, such as military mobility, and also capabilities and responsibilities. The US government does not seek to own airships; it wants the capability to exist. The military can define useful capabilities – a smart push – in concert with commercial end users – a smart pull.

US government agencies have organic and unique capabilities – facilities, airspace, personnel, legal capabilities/ functions, modeling and analysis, and others to contribute "in kind". Certification for example, should be proactive instead of reactive, shortening the existing timeline for introducing an aircraft into commercial service. In return for investment and effort, and to provide support to the fledgling "industry", the military or other government agencies would have access to airships in a manner similar to our CRAF program or the government might opt to lease prototypes.

Industry: There is no significant LTA industry in existence. Pieces exist, but all the designers, manufacturers, operators, leasing agents, and others do not exist in mass. Underutilized aviation capability does exist, such as various small component suppliers and other members of the General Aviation Manufacturers Association (GAMA). Some companies already operate heavy lift helicopters, lease aircraft, train pilots, and perform all the functions necessary. Thus, some participants will be from outside of LTA, but from within aviation.

Commercial End Users: This is the most unique aspect of the Mobilus approach. Commercial customers who understand how a cargo airship can add value to their operations will provide two important things: precise identification of performance measures that matter, and contributions to the P3 such as funding or manpower to work on initial studies.

A precise definition of key performance, probably size of payload bay, range, allowable "footprints" or sizes of landing zones, speed and method of loading and unloading will determine selection of airship type and then the sizing required. This allows examination of military utility. Military and commercial push and pull will focus and prompt progress.

Few if any commercial users will want to own or operate the airships. As they do now, they will rent, lease or otherwise contract for the service, not own the asset outright. In this way they are exactly like the military. We want the capability to exist and we want to use it, but we do not want to own it. In return for their risk and investment, commercial participants would perhaps get sole right to charter the airships for some period of time.

Academia: Universities play a key role in the research and developmentof new ideas and technology. They also conduct commercial and transportation research that can guide the development of airships. The most defined markets/military uses will greatly influence design choices and the formation of networks.

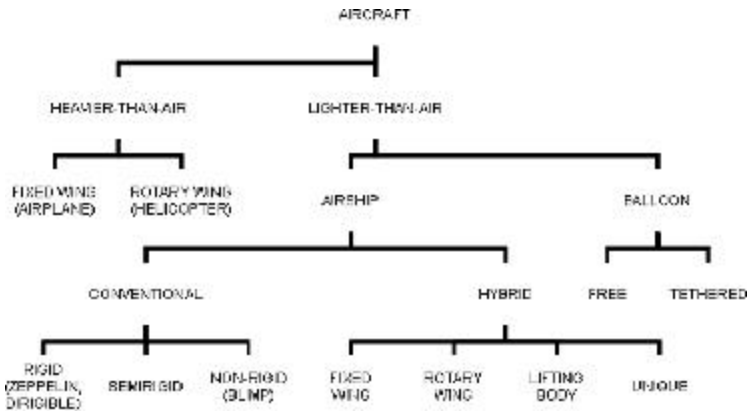
Interest Groups: There are many aviation related professional organizations and other sources of support for overall development of airships. These interest groups are both public and private. Some interest groups will be state and local governments combining with other organizations to support key participants in one of the P3s. Entities in the Interest Group "circle" may operate in the cognitive domain, the physical domain or both and will have varied degrees of influence on the overall process.

Analytical Foundation

A foundation must be built upon solid engineering, and the Center for Army Analysis funded by the Deputy Secretary of the Army for Operations Research and supported by a team of engineers and others are examining all existing studies and reports and exploring all other hard evidence relating to airships. The team is comprised of veteran and new LTA talent. The next article in this series will cover the ongoing engineering and market analysis. Only hard analysis will identify logical starting points, developmental paths, and future trade space to guide development. This is proceeding in parallel with government and private partners.

Figures 5 and 6 below provide two ways to understand the spectrum of potential airship types that may exist. They demonstrate the varied types of aircraft and airships and how each relates to another. We are gathering data on many of the types shown.

Figure 5: Aircraft/Airship Terminology[15]



[15] *Figure by Mark Ardema, "Missions and Vehicle Concepts for Modern, Propelled, Lighter-Than-Air Vehicles", AGARD Report No.724, Feb 85. Agrees with multiple other LTA and aviation authors and reviewers.*

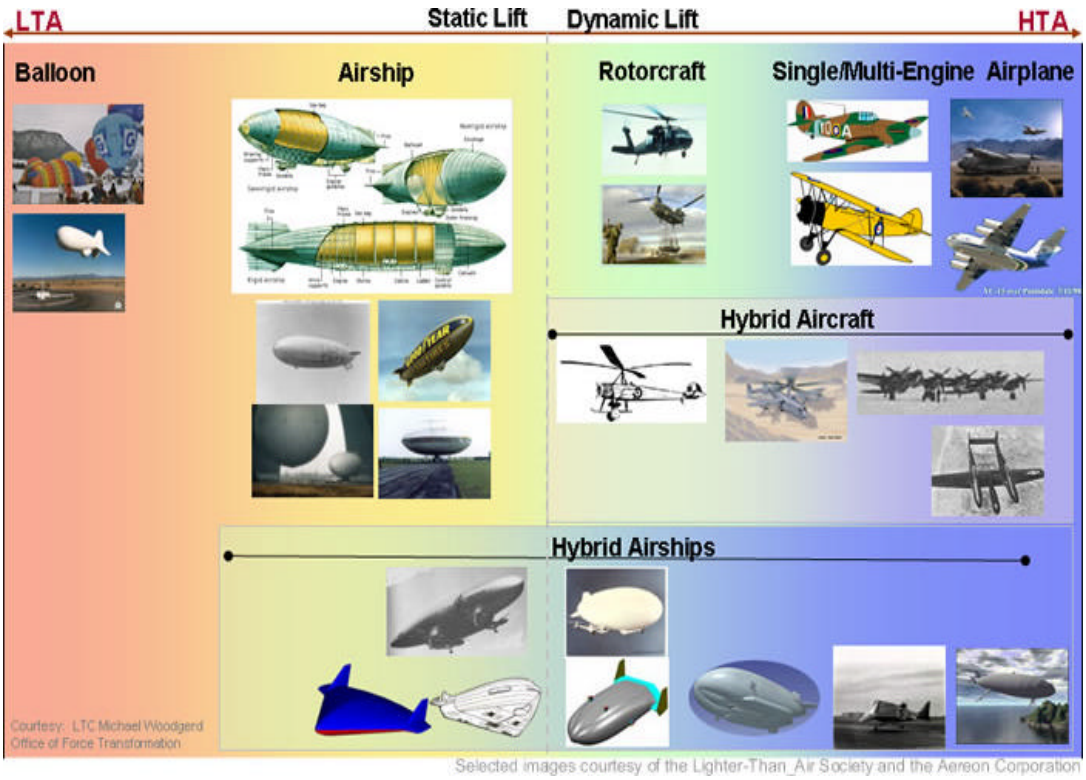


Figure 6: Aircraft Spectrum

Conclusion

Mobilus is fundamentally a vision on which interested individuals and entities can focus their effort. Mobilus is also a method to build a major new sector of the US, and then the world, aerospace industry. By building a broad, firm industrial base of airships and related LTA applications (stratospheric airships, for example) and building it in a new and commercially driven manner, the nation gains mobility and economic power; perhaps even a dominant place in world aviation. It is also a challenge for entrepreneurs, engineers, and other pioneers who seek a challenge and seek the rewards of being first explorers in a disruptive technology. Mobilus offers opportunity to build systems, businesses, and other things that do not now exist, but can exist, and should exist.

The modern world exists as it does to a great degree because of transportation. Creating transportation links such as the Transcontinental Railroad and the Panama Canal were challenges not only of technical skill but also of organizational, governmental and financial imagination and audacity. In the 19th Century, the Transcontinental Railroad linked the nation and formed a backbone on which to build economic power.[16] The unique financing of the construction set an example. In the 20th Century, the Panama Canal changed international trade and economics forever. Mobilus may be the great transportation challenge of the 21st Century. Innovation will create airships beyond any seen before. New trade routes will spread north and south in the Americas and reach into land-locked, impoverished, countries throughout the world. Innovation will create new markets, improve processes across business categories, and do other things not yet imagined.

[16] *A similar effort did the same for Canada as well.*

Mobilus provides a coherent, logical development plan to encourage/focus/accelerate development of a civilian aerospace capability centered upon LTA capabilities. The analysis of multiple platforms' developmental paths, the high-payoff commercial applications, the methodology of how multiple public-private partnerships would create this broad capability will be the first of its kind. It will support the collaborative approach that will drive development across a broad array of technical types, varied geographic areas, and accelerate the broad capability much faster than the traditional approach of contracts focused on one type of platform.

Without a vision for Mobilus we will get nowhere. Without a method we will also get nowhere. "Transformation needs new government processes and policies, more attention to free market incentives, and development and deployment of new technologies."[17]
Two quotes should guide us. The first is a Korean proverb; "We plant the trees so that others may enjoy the shade." The second is of more recent vintage; "Sometimes you gotta create what you want to be a part of."[18]

LTC Michael Woodgerd is an Army Transportation Corps officer working this joint initiative between the OSD Office of Force Transformation and the U.S. Army. He has a background in strategic deployments, such as Cobra Gold 97 as the JTF Trans Officer, and in analyzing proposed new airlift/sealift platforms for military and civilian use. A member of several LTA and aviation professional organizations, he has conducted or taken part in all significant government analyses of ULA deployment value such as work within Center for Army Analysis (CAA) and the Advanced Mobility Concepts Study.

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This is an abridged version of the full article. For more information on the Mobilus Initiative, including complete copies of this and the previous article in the series, visit the Mobilus Website at www.oft.osd.mil/initiatives/mobilus

[17] *Dr. Bruce J. Holmes*

[18] *Geri Weitzman*