Commercial Application of Military Airlift Aircraft

(CAMAA)

FINAL REPORT

October 2000

Delivered to:

F. Whitten Peters
Secretary of the Air Force
Washington, D.C.

From the:

CAMAA Team

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Executive Summary (to be written)

The Executive Summary represents the final stage in report production.

1 Introduction

This study examines a unique opportunity to fulfill the nation's airlift requirements with highly capable commercial Outsize & Oversize (O&O) aircraft, while at the same time saving the United States Air Force (USAF) billions of dollars. The C-17 is the first military airlift aircraft truly capable of bridging the gap between military and commercial lift needs due to its original commercial design emphasis, O&O and austere field capability. This window of opportunity is narrow, however, because of the impending shutdown of the C-17 production line after 2005. A decision to procure additional military and possibly commercial C-17s must be made soon. Therefore, it is imperative that action be taken now to see if this radically new concept can provide a new and unique way to procure the airlift needed to meet the nation's deployment requirements.

The purpose of this study was to determine if a business case could be made to purchase and operate the C-17 in a commercial marketplace. In order to accomplish this task, the Commercial Application of Military Airlift Aircraft (CAMAA) study develops potential business options that have significant savings for the USAF and at the same time enhance the airlift fleet through investment in a public/private acquisition strategy.
2. Study Team Composition and Methodology

The CAMAA study team included active duty military from the Air Mobility Command (AMC), individual consultants considered experts in their fields, retired military and Boeing representatives. The team used consultant companies to study specific aspects of the market, to establish the value of the C-17 in the market, and to determine the value of the option the Government would be buying. These individual studies are included as attachments to the report. The team also used internal models and assessments to continually look at the validity of the work being done and its relevance to the purpose of the study.

The team members are:

- General Duane H. Cassidy, USAF Retired (former Commander-in-Chief United States Transportation Command/Military Airlift Command (CINC USTRANSCOM/MAC))
- Lieutenant General Gary H. Mears, USAF Retired (former Joint Staff J-4)
- Major General Charles L. Johnson II (Commander, Oklahoma City Air Logistics Center)
- Major General Arthur J. Lichte (Director of Plans and Programs, Headquarters Air Mobility Command)
- Major General Paul W. Essex (Director of Global Reach Programs)
- Colonel Gregory L. Lockhart (Deputy Director, Global Reach Programs)
- Colonel Matthew Martorano (Deputy Director of Plans and Programs, Headquarters Air Mobility Command)
- Colonel Robert Halbert (Chief, Civil Air Division, Directorate of Operations, Headquarters Air Mobility Command)
- William R. Boesch – Retired Chairman/President American Airlines Cargo
- John W. Beach – finance/economics consultant, DSD Laboratories, Inc.
- D. Christopher Raymond – Boeing representative
- Michael T. Noonan – Boeing representative
- Michael J. Cave – Boeing representative
- William T. Farrell – Project Coordinator, DSD Laboratories, Inc.

Third-party contributors to the CAMAA study included:

- KPMG
- Triangle
- Simat, Helliesen & Eichner, Inc. (SH&E)
- OBN Aviation, Inc.
- Morten Beyer & Agnew (MBA)

Individuals and organizations who directly participated in the study or who offered their expertise or opinions to study team members included:
The Team's approach was three fold:

- Get the right people and the support of their respective organizations
- Develop a phased plan to study the situation and to remain within the charter as stated in the purpose statement
- Analyze in sufficient depth so as to pass initial tests of financial and industry experts who will use these data to perform their own due diligence.

The team then determined the key factors that will determine if a case can be made for a commercial C-17:

- The requirements for military airlift
- The Air Force topline situation
- The Heavy Outsize Market (HOM) as it exists and can be developed, the Small Austere Market (SAM) and whether it exists
- Potential savings for the Air Force, considering procurement and life cycle costs of a similar fleet of C-17s.

To understand these four key drivers, the team launched a rigorous market review with the help of several experienced market forecasters who used a variety of analysis methodologies as checks and balances. Additionally, financial options were explored, and a commercial C-17 market-driven price was derived. Ultimately, aircraft valuation, financing, market potential, and benefits to all parties to the venture were analyzed and determined to construct a persuasive business case.

With these data and direction, the team developed several business cases and the foundation for actual business plans using two constants, a fleet of ten aircraft and a 15% Internal Rate of Return (IRR) for the operator. As the cases were studied in detail, it became evident that five of the cases made sense from a financing and marketing point of view. These are the cases that were presented to the Secretary of the Air Force for his review.

The commercialization of the C-17 by the Air Force is being considered in four phases

- Phase I, Concept Development
- Phase II, Proof of Concept
- Phase III, Concept Integration and Implementation
- Phase IV, Aircraft Delivery and Operational entry
Phase I was completed and presented in early summer. Phase II ends with the delivery of this report, Phase III was begun with the approval of the Secretary following the team's presentation, and Phase IV is expected to run concurrently with Phase III beginning early in 2001.
Whether deploying combat forces or providing humanitarian assistance, airlift performs a critical role in securing the interests of the United States around the world. While just one leg of the Strategic Mobility Triad (airlift, sealift and prepositioning), airlift provides the speed, range and flexibility to respond quickly and decisively to the situation at hand. Our nation’s airlift forces have been called upon in the last decade for Operation Just Cause in Panama; Operation Desert Storm; Operation Allied Force in Kosovo; Operations Joint Endeavor and Provide Promise in Bosnia-Herzegovina; Operation Support Hope in Rwanda; Operation Maintain Hope in Haiti and Operation Restore Hope in Somalia. In each of these events, airlift provided the strategic agility to move the early entry forces and immediate re-supply to meet the theater Commander-in-Chief (CINC) deployment requirement.
Since the Gulf War in 1990, improvements have been made in the components of the Mobility Triad. Dramatic improvements have been made in our sealift and prepositioning capability. A comparison of the then and future state of the legs of the triad is shown in the figure below, which shows an increase in strategic sealift of 135% and an increase in prepositioned equipment and stocks of 53%. Only our airlift capability has remained at virtually the same levels since the Gulf War (48.9 Million Ton-Miles (MTM) in Fiscal Year (FY) 90 to 49.7 MTM projected in FY02). The procurement and delivery of the C-17 has provided some modernization of the airlift force. However, the total capability as measured by the outmoded Cold War metric of millions of ton-miles remains nearly static.

Rapid deployment by our nation's fighting forces requires immediate response and robust capacity in each leg of the triad. In each of the past operations, as well as any operation in the future, the deployment equation is

Requirements × Distance = Capability.

The figure below shows what has happened to the time requirement over the past ten years. During Desert Storm, Iraqi inaction allowed the United States 205 days to deploy the nearly 500,000 military personnel and their war fighting equipment. The current planning scenario for a Major Theater War (MTW) is based on having the fighting forces in place to counterattack by day 75. Future Army requirements are based on deploying three of the new lighter brigades in 96 hours, one division in 10 days and five divisions in 30 days. The
Expeditionary Aerospace Force (EAF) requirements are based on deploying one EAF in 48 hours and five EAFs in 15 days. This time compression has a dramatic effect on requirements for airlift, since no amount of sealift or prepositioning can affect the early deployment equation. Only airlift can be expected to meet these early closure requirements. Time requirements and forward-deployed force structure have shrunk dramatically over the last decade and our airlift force must be increased and modernized to meet these new national requirements.

Airlift Requirement

Determining our national airlift requirements has been an evolutionary process, from the Congressionally Mandated Mobility Study (CMMS) of 1981 to the most recent Mobility Requirements Study 2005 (MRS-05). CMMS focused only on the airlift requirement. More recent studies, including the MRS-05, established requirements for each leg of the Mobility Triad (airlift, sealift and prepositioning). Many of the past studies have produced results that were not true requirements, but rather established a result that either assumed significant risk or that was fiscally constrained. What decision-makers should recognize is that assuming risk in the deployment phase compounds the inherent risk to the combat forces once deployed.

The current airlift "requirement" was established in an update of the original Mobility Requirements Study (MRS) and was revalidated in the Mobility Requirements Study - Bottom-Up Review Update (MRS BURU), which established the current requirement of 49.7 MTM. The 49.7 MTM requirement
includes the Civil Reserve Air Fleet (CRAF), the current C-5 and C-141 fleets, a
contribution from the KC-10 fleet, and the procurement of 120 C-17s. The USAF
has also validated the requirement for 15 additional C-17s to support the Special
Operations Low-Level (SOLL) mission simultaneously with the two Major Theater
War requirements. This will bring the C-17 fleet to a total of 135 aircraft.

Mobility Requirements Study 2005 (MRS-05)

MRS-05 presents a deployment scenario that is more demanding than now
exists with the MRS BURU assumptions. The mobility requirement has
increased overall by at least one million ton-miles per day. Base case operations
assume the existence of an enemy threat that will use chemical weapons. The
early days of the conflict depend on a robust airlift force. Early warning, prompt
decision-making, and the proactive call-up of reserve forces and full-scale
exploitation of the commercial sector underlie the success of future wars. The
scenarios that were examined in MRS-05 begin from existing global postures of
engagement that pose risks to prompt responsiveness in a MTW effort. These
assumptions combine to suggest that current programmed air mobility force
structure is insufficient to meet the full spectrum of demands in MRS-05.
Besides the measured need for 48.3 Million Ton-Miles per Day (MTM/D) of
strategic lift capacity, the MRS-05 acknowledges a requirement for outsize
organic capacity in-theater during a conflict. Due to the nature of asymmetric
threats to national interests around the globe, there is also a need for
preparedness to conduct National Command Authority (NCA) directed Special
Operations concurrent with an MTW. For the first time in a study of this
magnitude, the MRS-05 also acknowledges the need for Joint Chiefs of Staff
(JCS) Priority 1 support of CINC requirements outside the primary theater of
operations during an MTW. All of these factors combine to establish a range of
strategic air mobility options that will set an airlift goal between 51.1 and 54.5
MTM/D. Wherever the requirement falls, airlift needs will increase. With this in
mind, the CAMAA team began a proactive process to address the increased
requirements for airlift.
Solutions for the Airlift Shortfall

Headquarters Air Mobility Command (AMC) conducted an Analysis of Alternatives (AoA) to examine solutions to correct the airlift shortfall and a deficiency in our nation’s Outsize and Oversize strategic airlift capability. The AoA recommendation considered beginning a program to fix poor C-5 reliability to include an Avionics Modernization Program (AMP) on C-5As and a Reliability Enhancement and Re-engining Program (RERP) on C-5Bs. Also included in the recommendation is that the USAF continue to procure additional C-17s.

The preferred AoA acquisition strategy that can implement the best value recommendation calls for Reliability, Maintainability, and Availability (RM&A) evaluation of an initial lot of six RERP-modified C-5B aircraft. Simultaneously with this RERP evaluation period, the strategy calls for procuring additional C-17s at a rate that optimizes both funding availability and aircraft unit cost. This strategy is necessary to ensure that the C-17 production line remains open during the interim RERP evaluation and decision period, because C-5 reliability improvements by themselves will not be able to completely satisfy the increased requirements.

C-17 Production

Without additional C-17 buys past the current multi-year contract, C-17 production would stop in 2004 with the 120th aircraft. However, fourteen additional aircraft have been programmed for procurement to satisfy Special Operations requirements (SOLL II), which will keep the production line open until
2006. The USAF has been looking at possible additional purchases of C-17s and the costs associated with different buy rates. Multi-Year Procurement (MYP) offers the USAF the ability to purchase additional C-17s at the lowest cost per aircraft. Initial savings goals for any follow-on purchases are required by Congress to be at least 25% below the current MYP rates. In 1999, Boeing submitted a new proposal that met the 25% cost reduction based on a smooth transition from the current MYP (aircraft 120) to a follow-on MYP for 60 additional aircraft at a production rate of 15 aircraft per year. Since the USAF had not determined the final lift requirement, no action was taken on the proposal. However, it is evident that only by capitalizing upon the savings to be realized by a new MYP will the USAF be able to continue to modernize the airlift fleet at an affordable price and meet other USAF/DoD acquisition goals well into the 21st century.

The procurement of an additional 15 aircraft (121-135) has extended the window of opportunity. An early decision for a follow-on MYP as described above is essential, because long lead procurement must take place early in calendar year 2001.

The USAF continues to examine options to meet the anticipated MRS-05 requirement, take advantage of C-17 MYP and increased production rates per year, and exploit innovative solutions to share the cost of meeting our future airlift needs.

Does the Commercial Application of a Military Airplane Make Sense?

Since planned DoD and USAF long-term funding levels continue to be insufficient to meet future acquisition requirements, the USAF faces difficult tradeoffs among its highest priority modernization programs each year. New fighter aircraft, space and intelligence programs, logistics and spare parts, and heavy lift aircraft all compete for the same limited dollars. If the USAF is to be able to balance all its critical modernization needs, then new and more innovative approaches to acquiring capability are required. For instance, traditional funding practices must be augmented with new sources of capital. One way to accomplish this is to work closer with the private sector to help meet the nation’s future heavy airlift requirements.

Given unlimited prospects for expanding world trade, there is likely to be considerable commercial interest in how goods can be transported at competitive world market rates, especially to the more remote locations characteristic of the developing nations. In this growing market that will serve customers operating in more remote locations, it is likely that an aircraft with the C-17’s capabilities...
would be in demand. However, it must also be determined whether the C-17 is uniquely capable of operating effectively and efficiently in the commercial market and if real economic and operational benefits will result for the USAF and the commercial cargo sector.

As indicated in the earlier discussion of the AoA, USAF planning and programming to date has focused on determining which of the various mixes of military aircraft (i.e., repair and modification of C-5As and Bs, versus the purchase of additional new C-17s) would produce the most cost-effective alternative to satisfy the DoD's Outsize and Oversize airlift requirements. All of the conventional alternatives examined in past and ongoing studies are very expensive, and the USAF struggles every year to keep them funded in the face of other critical priorities. The CAMAA team considered a larger perspective by introducing joint military and commercial use of C-17 aircraft as a potential complementary means of increasing airlift capacity. This allows the Government, by using commercial practices, to buy future airlift capacity at present airlift prices.

Joint Commercial Acquisition

There are three major parties in this venture: the United States Department of Defense with the USAF as the principal player, the Boeing Company (as the manufacturer of the C-17 aircraft) with its vendors, and prospective commercial carriers with their investors. All three will have to share in the respective investment and risks of this effort to achieve the benefits of a successful outcome.

The USAF and the DoD have the most to gain from successful implementation of the CAMAA concept. In essence, these two organizations will get more Outsize and Oversize airlift, when it is most critically needed, and for less money. For decades, USAF procurement of airlift to support the national military strategy has been fiscally constrained, and has therefore been insufficient to fulfill the need. With a CAMAA-like arrangement, the USAF would have guaranteed access to additional C-17 equivalent aircraft in time of war or contingencies without shouldering the full financial burden of the acquisition price and a lifetime of support costs. Prior to activating the CRAF, the United States Transportation Command (USTRANSCOM) could call on these extremely capable cargo haulers to fill the gap in the USAF O&O capacity. In addition, the USAF would obtain this added capability while saving procurement and life cycle costs.
These benefits are compelling reasons for the DoD to pursue this approach, but the benefits will not accrue without USAF investment and risk. To ensure commercial financing of such a venture and reduce operator risk, the USAF must be willing to fund a portion of the upfront aircraft purchase cost for the commercial operator (referred to as the "readiness option" in this report). This financing assistance is required to offset the difference between the actual aircraft price and an initial market-derived value for the aircraft. This readiness option investment also secures the USAF a right to use the aircraft in a time of need. The DoD must also provide a level of guaranteed business (along with the funding) each year that will support the aircraft's launch while the operator develops the commercial market.

The CAMAA approach poses two risks for the USAF. The principal risk is the possibility that the venture will not become commercially viable as quickly as expected or will unequivocally fail. If this risk were to materialize, the USAF would be required to buy back and modify the commercial aircraft or lose the capacity provided by these aircraft. A secondary risk is that considerable time and effort could be expended in trying to implement the CAMAA approach, but the operation might not get activated. Such a situation could arise due to an inability to find an interested and capable commercial operator. Additionally, the operation could be prevented from achieving success in the implementation phase due to failure to conquer the multitude of political, legal, and negotiation hurdles that currently exist. Unresolved hurdles could prevent timely resolution of a final deal to integrate the aircraft commercial buys with the next C-17 multi-year procurement. The CAMAA team believes that the first risk is very low by virtue of the market research that is presented later in the report. However, avoidance of the second risk will require full commitment from the USAF, possibly in conjunction with a buyback arrangement in the early stages of the program.

The CAMAA concept will enable the Boeing Company to sustain a higher production rate and sales volume than the USAF budget alone could support. Boeing will also realize a resulting larger business base (and potentially lower overhead rates), a stronger supplier base, and the ability to sustain its experienced workforce. In the longer term, there also exists the strong potential
4. The Business Case for the Commercial C-17

Business Case Parameters

The following parameters, conditions and assumptions were used in the business case analysis:

- The CAMAA team used the upper end of the MRS-05 anticipated requirement to determine the number of additional C-17s (120 plus 60, for a total of 180 C-17s). To help offset USAF procurement and sustainment costs and meet the anticipated CAMAA market forecast, the team chose a 50/10 USAF/CAMAA mix.

- A fleet of ten aircraft was selected, since the market will initially support this number and it is sufficiently significant to launch the program.

- Two financial cases (15-per-year and 10-per-year buy profiles, with various CAMAA aircraft prices) were examined to determine CAMAA business viability and benefits to the USAF, as illustrated in the following funding profiles.

- USAF C-17 prices were $210.5M for the 15-per-year buy and $245.9M for the 10-per-year buy (Average Procurement Unit Cost of the 50 organic aircraft). To compute Life Cycle Cost (LCC) comparisons, the analysis used $15.4M per aircraft per year (FY00) for 10 USAF C-17s. (All USAF costs are USAF programming estimates.)

- Commercial C-17 prices are assumed at $170M and $200M respectively, based on total aircraft production rates of 15 and 10 per year. The commercial cost is based on the only cleared Boeing price and is based on the MD-17 configuration.

- The commercial C-17 is FAA certified and has been removed from the United States Munitions List (USML). A discussion of certification issues.

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16 USAF costs for 15-per-year and 10-per-year C-17 buys and life cycle costs were developed for the Air Force Strategic Lift Options Tiger Team.
Business Case Financial Assumptions

The following major financial assumptions were established for the case studies:
(For a complete list of assumptions categorized by type, please see Appendix Q.)

Period of analysis, 2001 through 2033

Discounted cash flow back to 2001 (time of funding commitment)

Aircraft are purchased and 80% financed

Financing terms:
- Interest rate = 8%
- Term = 20 years
- Payments per year = 2
- Type of payments = level principal

Bank fees: 1% of the financed amount has been added to the total financed

Progress payments of 35% of aircraft net price are paid by aircraft operator

All cases were built to provide a 15% Internal Rate of Return (IRR)

Cost and revenue escalation is 3% per year, beginning with base year 1999 dollars

Depreciation is accelerated depreciation over 7 years (using a Modified Accelerated Cost Recovery System)

Start-up costs of approximately $20M incurred from 2003 through 2006

Income tax rate is 40%

Deliveries of 10 aircraft:
Case 1 delivers ten aircraft to a commercial operator using a 15-aircraft-per-year MYP production run. This case gives the commercial operator two aircraft in 2004 and four aircraft in both 2005 and 2006. Case 1 looked at four different CAMAA aircraft prices, and Case 2 used five. The following are the aircraft prices for Case 1:

- $128M per aircraft for commercial operator with $42M in Government readiness options
- $140M per aircraft for commercial operator with $30M in Government readiness options
- $155M per aircraft for commercial operator with $15M in Government readiness options
- $170M per aircraft for commercial operator with $0 in Government readiness options

Case 2 delivers ten aircraft to a commercial operator using a 10-aircraft-per-year MYP production run. This case gives the commercial operator two aircraft in 2004, 2005, 2006, 2007, and 2008. The following are the buy profiles for Case 2:

- $129M per aircraft for commercial operator with $71M in Government readiness options
- $140M per aircraft for commercial operator with $60M in Government readiness options
- $155M per aircraft for commercial operator with $45M in Government readiness options
- $170M per aircraft for commercial operator with $30M in Government readiness options
- $200M per aircraft for commercial operator with $0M in Government readiness options

**Measures of Merit**

As cases were analyzed, measures of effectiveness were also developed. The following are those measures of merit that were used to determine the viability of solutions. Options were analyzed and "graded" using these measures.

1. Is there a viable commercial market for this airplane?
2. Does it solve military airlift shortfall and does it do it sooner/better than traditional methods?
3. Is the benefit worth the investment?
4. How would a solution fit within the multi-year procurements and the USAF topline?
5. Are there sufficient long-term positive implications for the three parties?
6. Is the solution innovative enough to be worth the trouble and investment?
7. What range of readiness option investment incentivizes market development and also provides value for the USAF?

8. What is an appropriate level of carrier liability protection with a specifically developed and negotiated buyback clause (or insurance options)?

9. What are the significant drivers (e.g., Government business, business case that can be financed)?

Internal Review Process

The CAMAA team also implemented a continual internal review process, based on standard approaches toward verifiable financial and analytical review processes. Its intent was to review analytical processes, creation of financial models, and derivation of conclusions. The output of the internal review process was an analytical model and a set of real options. A discussion of the resulting models and their applications is presented in Appendix R.

Airline Business Case Analysis

Background

McDonnell Douglas and the Boeing Company have been evaluating the potential for a commercial derivative of the C-17 since 1995. Their work with the Federal Aviation Administration (FAA) and the Department of State, through the Commodity Jurisdiction process, resulted in an aircraft configuration originally designated the MD-17. Boeing's efforts to market the aircraft drew mixed reaction. Although many potential customers were intrigued with the MD-17 concept, they had concerns related to the uncertainty of this new market segment combined with a high aircraft price relative to conventional widebody freighters.

Continuing discussions with potential customers, end users such as freight forwarders, and financial institutions, have resulted in the following conclusions:

(1) Customers will require a lower price than Boeing is currently offering.
(2) The risk associated with entering the embryonic HOM market must be mitigated.
(3) A residual value guarantee will be required by the financing entity.

As previously discussed, the price issue was addressed by developing the "readiness option" concept, by which the DoD will "buy down" the price of the aircraft to an affordable level for the commercial customer in exchange for the option of use by the DoD. This shared "investment" is expected to empower the commercial operator to procure the aircraft at a near market-driven price, therefore enabling the operator to compete in the marketplace while adding a heavy outsized capability to the CRAF.
Since a sufficiently large readiness option investment to make a viable operator business case may not fit within DoD funding profiles, additional DoD participation in the form of "guaranteed business" was evaluated. A complete discussion of CAMAA Government business is found in Appendix S. The commercial operator will be viewed more favorably by the financing institution if a portion of the revenue is guaranteed by the DoD for some duration. Additionally, given the level of risk associated with entering a new, unproven market and the potential lack of liquidation for the aircraft if the initial operator is unsuccessful, the financial institution will require assurances before investing in the project. The "buyback" scenario could result in the DoD owning the aircraft in the event of a bankruptcy. Another alternative is the purchase "residual value" insurance. The resolution of the "buyback" issue has not been assumed to affect the operator business case and is not addressed in the following paragraphs.

Market Expectations

To understand the expectations of a commercial customer for a unique product like the commercial C-17 envisioned by the CAMAA team, an analysis was conducted to determine the price an operator might be willing to pay, based on operating profit and aircraft utilization. Recognizing that the aircraft would be primarily servicing the heavy outsise air cargo market segment that characteristically yields premium rates, but would also service the military/other Government agencies and commodity freight segments, an average rate of $15,280 per block hour was assumed. Price as a function of operating profit/flight and utilization is shown below.

As the figure shows, to achieve an acceptable profit, the aircraft price in 1999 dollars ranges from $112M to $139M as utilization increases from 2500 to 3000 hours per year. The CAMAA team weighed utilization and profit margin necessary to drive sufficient cash return, and selected $125M as the target market-driven price for the initial business case analysis. Since the Boeing price to design, build, test and certify the aircraft was above the market expectations, the readiness option concept was applied to drive convergence of market expectations and the manufacturer's offering price.
Market Assumptions

To develop notional business cases, an operational concept was created that addressed the market segments that the aircraft would serve, including positioning flights necessary to move the aircraft to the location of the cargo. The CAMAA team developed the notional business case assumptions using inputs from consultants and recognized commercial financial experts. A financial model was developed that accounted for the introduction of aircraft to the commercial operator's fleet in a manner consistent with Boeing's ability to deliver aircraft. Recommendations from the commercial financial experts addressing debt to equity ratio, interest rate, term of financing and depreciation were incorporated into the model. An Internal Rate of Return (IRR) of 15% was specified as the target for return on investment. Additionally, the business provided by the DoD would be guaranteed for a period of 12 years for each aircraft. The resultant analysis would then represent viable alternatives from the operator's perspective. The DoD would then have to decide which combinations of up-front readiness option investment plus guaranteed business over 12 years represented the most affordable CAMAA solution.

Developing the Cases

The initial analysis had assumed a combined C-17 / commercial C-17 production rate of 15 aircraft per year (Case 1). A maximum annual build of 4 commercial aircraft was assumed. Since USAF funding still remains an unknown, a second build rate of 10 aircraft per year was selected (8 USAF C-17s plus 2 commercial airplanes – Case 2). For both cases, a MYP of 60 total units (50 USAF plus 10 commercial) was assumed.

Both the C-17 and commercial C-17 prices are a function of the production rate. For Case 1, Boeing’s required price for the commercial C-17 was assumed to be $170M in 1999 dollars. For Case 2, Boeing’s price was $200M in 1999 dollars and assumed the recovery of the non-recurring costs over the fleet of 10 aircraft. The original market-driven price of $125M was increased slightly ($128M for Case 1 and $129M for Case 2) when the analysis was run with the revised assumptions and the 15% IRR target. Additional price variations were assumed between these limits and analysis was generated to show the trade-off between the readiness option investment and the required level of guaranteed Government business. The following table lists the variations that were examined:
Allocating Aircraft to Market Segment

The overriding factor in assigning aircraft block hours to the various market segments was the desire to quickly capture as much of the growing HOM/SAM market segment as possible, as the aircraft are entered into the commercial operator’s fleet. At the same time, the DoD commitment would be reduced until a steady state value was achieved that approximated the level of CRAF business that the CAMAA operator could win as a result of the mobility points associated with operating the commercial C-17. The figure shows how the market allocation varies over time for Case 1, reaching the steady state condition in 2009.

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### Aircraft Price

<table>
<thead>
<tr>
<th>Price</th>
<th>$1999 Million</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>$200M, $200M, $300M, $400M</td>
</tr>
<tr>
<td>Case 2</td>
<td>$200M, $200M, $300M, $400M</td>
</tr>
</tbody>
</table>

### Readiness Option

<table>
<thead>
<tr>
<th>Option</th>
<th>(Per Aircraft $1999)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>$0, $15, $30, $42</td>
</tr>
<tr>
<td>Case 2</td>
<td>$0, $15, $30, $42</td>
</tr>
</tbody>
</table>

### Deliveries


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DoD Revenue declines as the HOM/SAM business is developed
Revenue Assumptions

The success of the operator business case is highly dependent on the ability to generate revenue and is dominated by the revenue produced in the HOM/SAM segment. The figure below shows block hour rate as a function of flight length for actual operations conducted by the An-124. Although there is significant scatter in the data (rates vary from $10,000 to $35,000 per block hour), the CAMAA team selected $16,000 per block hour to be representative of the revenue potential of this market segment. Inputs from consultants validated the use of this value.

The DoD / Government rate was assumed to be $14,000 per block hour. This value was selected because it was felt that the DoD should get a preferential rate due to its investment in the project. In addition, the team assumed that the operator would be encouraged to develop the HOM/SAM segment faster and reduce dependence on DoD business if the revenue potential were less due to the lower rate. The final market segment, which is commodity freight, generates the lowest returns and is traditionally expressed as cents per ton-mile rather than as dollars per block hour. Converting the typical cents per ton-mile rate, the CAMAA team agreed to a commodity rate of $10,000 per block hour.
Analysis Results

Using the above inputs and the assumptions in Appendix Q, financial modeling was used to build the business plan. The figure below shows the DoD revenue flow over a 12-year period for Case 1. The area under each curve represents the “guaranteed revenue” that the DoD must provide to the commercial operator under a “take-or-pay” arrangement, along with the readiness option associated with the specific curve to assure a 15% IRR for the operator. The area under each curve above the line labeled “AMC estimated CRAF” represents a commitment that requires new funding, in addition to that available through the CRAF.

The characteristic shape of the curves reflects the introduction of the aircraft into the fleet in the early years and the completion of the 12-year commitment for each aircraft in the later years. The business case analysis assumes that the revenue from the AMC/Government market segment continues at the AMC-estimated CRAF levels (approximately 13.7% of the revenue stream), but is no longer guaranteed to the operator. Rather, it is what the operator can be expected to earn in a modified CRAF program that would place value on the commercial C-17 operating attributes (e.g., short/austere field and heavy outsize cargo capabilities).

The Total Commitment figure on the next page illustrates the overall big picture of total Government investment over a 12-year period for both Case 1 and Case 2. It is important to understand that this is a cumulative bar graph. This depicts the total revenue (escalated) over the 12-year period that is necessary to drive a 15% IRR. The average 10 aircraft escalated readiness option has been added to each case to demonstrate the total required commitment (readiness option plus guaranteed business). Using the $30M bar in Case 1 as an example, note that there is $1.58B in guaranteed DoD business and $.36B in readiness options over 12 years, equating to a total outlay of $1.94B. Income statements for each case are included in Appendix T.
The CAMAA team did not rank order or make a specific selection of a preferred option. This will occur as the USAF and Boeing begin to work with potential operators and financing entities. It is this process that will ultimately determine the mix of readiness option and Government revenue that is needed to attract an operator and finance the venture.

Government Benefits

As shown before, the CAMAA team used several buy profiles with various readiness option investments. The figures below show the different options used during this exercise. The first row (USAF 10 C-17s) in each figure is the USAF price for ten C-17s for both Future Years Defense Program (FYDP) and Life Cycle Cost (LCC). Case 1 uses a 15-aircraft-per-year production rate with a commercial price of $170M per aircraft. Case 2, on the other hand, uses a 10-aircraft-per-year production rate with a commercial price of $200M per aircraft. The second and subsequent rows in each figure show the different commercial price strategies and the cost to the USAF during the FYDP and LCC for ten C-17 aircraft at that price. The highlighted columns in these rows show the topline benefits or savings to the USAF. All figures are presented in then year dollars.

As an example, in Case 1, the USAF 10 C-17s line shows it would cost the USAF $2.428B in the FYDP and $8.998B over the life cycle to buy and operate ten aircraft. Now, using the CAMAA 140 line as an example, a commercial investor would pay $140M per aircraft, and the USAF would contribute $30M in readiness options and $158M in guaranteed DoD business to help offset the price. The cost to the USAF over the FYDP and LCC, for these ten commercial C-17
aircraft, would be $.848 and $1.938, respectively. Subtracting these numbers from the USAF 10 C-17 FYDP and LCC lines yields the topline benefits of $1.588 for the FYDP and $7.068 during the life cycle, which represent significant benefits to the USAF.

In the figure below, total Government annual investment can be tracked through the life of the 12-year contract. Again, one should focus attention on the $30M readiness option line, which includes readiness and Government business. The initial spike is the one-time $30M per aircraft readiness option payment. One can see that in 2003 the initial payment of $66.8M is due, a year before the commercial carrier receives the initial two aircraft. In 2004, the Government will pay readiness for the next four aircraft and the guaranteed DoD business for the delivered aircraft. This will repeat itself again for the last time in 2005, at which time the Government will only pay for guaranteed business thereafter. In the beginning of this commercial venture, the commercial company will need to rely more heavily on the Government as it develops and penetrates the commercial market. Once the company establishes itself and captures its share of the HOM market, reliance on the Government will decrease. In 2005, the company will begin its initial progress toward interception with the black line, which is the guaranteed DoD business line. Any dollar amount above this black line is a premium.

These commercial options in Case 1 give the USAF the ability to anticipate the MRS-05 increase in MTM/D requirements. The USAF will get more C-17s with CAMAA quicker than it could afford to buy them on its own. Additionally, it allows the production of 15 aircraft per year instead of the current buy profile of eight or ten aircraft per year. Higher production rates equate to more C-17s in the
system sooner, a lower price per aircraft, a production line that remains open, and future year options for the DoD.

The USAF with 50/10 vs. 60/0 C-17s will realize anywhere from $1.5B to $1.9B topline benefits in the FYDP alone. Life cycle costs are even better, with a range of $6.8B to $7.3B, depending on the strategy used. The CRAF will gain outsize capability and guaranteed pre-CRAF capacity. Most importantly, the nation will rapidly obtain required mobility capability at the least cost.

As with any new business venture, there is always risk. Buyback alternatives and guarantees will have to be resolved between the commercial carrier and the DoD. These costs are not included in the Government benefits calculations of FYDP and life cycle savings. However, these costs are addressed in Appendix R.
5. Conclusions

Measures of merit, which would be essential to "make the CAMAA case", were outlined earlier in this report. In this conclusion section, the measures are used to evaluate the findings of the report and to provide the conclusions of the CAMAA team.

The major conclusions tested against the measures of merit are:

1. Significant evidence has been gathered which validates that a strong market for the commercial C-17 exists. Commodities, industries and potential clients for the commercial C-17 operator have been identified.
2. Using the operator internal rate of return as the primary measure, the team has found several mixes of readiness options and DoD revenue that form a solid business case for a commercial C-17 venture.
3. Demonstrable benefits accrue to the USAF from commercial C-17s being available in the air cargo marketplace. Among the most compelling benefit is the cost avoidance of procuring and operating organic C-17s in the AMC fleet versus the availability of the commercial C-17 in the private sector. Additionally, this concept modernizes the CRAF, assists in keeping the C-17 production line open and continues air mobility re-capitalization with reduced USAF investment.
4. The CAMAA concept will be attractive to a commercial entity because the USAF can assist in mitigating the risk of a new venture, while still avoiding most of the cost of USAF ownership of the C-17. Also, because of the continued development of the heavy outsize air cargo market, this is an ideal time to enter the commercial C-17 in the HOM/SAM market.
5. USAF leadership will be required to bring Boeing, the USAF and an operator together. The USAF has the most to gain from the introduction of commercial C-17s and therefore should be willing to take the lead to bring the other parties (Boeing and a commercial C-17 operator) together.
6. Recommendations

1. The CAMAA team recommends that the USAF and the Department of Defense move forward on the commercial C-17 concept developed in this report. The benefits to the USAF and DoD are significant. Implementing the CAMAA concept will be a challenge, but well worth the investment in time and resources to accomplish a successful implementation.

2. Implementation will require an aggressive parallel effort within the pertinent organizations (the USAF, Boeing and the airline operating entity) to close the CAMAA case and introduce the commercial C-17. Among the parallel efforts will be:
   a. The execution of a follow-on multi-year production program for organic and commercial C-17s, and other necessary agreements that would allow the program to begin in 2001.
   b. Finalizing the FAA certification and commodity jurisdiction baseline for the commercial version of the C-17.
   c. Designing a process to identify potential operators for the commercial C-17 and the selection of the operator(s) to work with on the initial ten aircraft.
   d. Satisfying the financial market and commercial aircraft financing entities that the business case for the commercial C-17 is viable, through close work among the USAF, Boeing and the potential operator(s).