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EMPLOYMENT OF THE C-17
IN SUPPORT OF NATIONAL OBJECTIVES

GRADUATE RESEARCH PAPER

M. Shane Hershman, Major, USAF

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M. Shane Hershman

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Abstract

How can the C-17 support the military objectives of rapid mobility? Should the aircraft be a strategic, or a tactical, airlifter, or can it fulfill a mixture of both strategic and tactical? This paper examines employment opportunities for rapid power projection from CONUS, and how the C-17 can be employed in a rapid and cost effective role in supporting the war fighting CINC. The direct delivery option can provide for rapid mobility in support of national objectives, but is direct delivery viable? Seams have developed in the transition from inter-theater to intra-theater movement of cargo, and what employment method of the C-17 can minimize this seam Using actual cargo hauled from Ramstein, Germany to Bosnia during December, 1995 and February 1996, a model was developed to optimize for the least cost of cargo movement with a fleet of C-17s and C-130s. The recommendation of this paper is the direct delivery sortie is efficient, and the C-17 can be utilized in a strategic and tactical role in a very cost effective method for rapid power projection.

EMPLOYMENT OF THE C-17

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I. Introduction

Background

The C-17 acquisition program was shrouded in controversy in the early 1990s. The critics claimed the aircraft could not meet specifications. The Readiness Maintainability and Availability Evaluation (RM&AE) occurred in September, 1995 and the aircraft outperformed all requirements of the contract between McDonnell Douglas and the Air Force. The doctrinal problem facing the Air Mobility Command (AMC) and the Air Force today is how to amalgamate the C-17 in a force projection or rapid mobility role in support of the National Military Objectives. Should the aircraft be a strategic, or a tactical, airlifter, or can it fulfill a mixture of both strategic and tactical? The primary role of the C-17 is power or force projection from the CONUS anywhere in the world. The C-17 was designed to haul outsize cargo, specifically the Army's M-1 tank, anywhere in the world, and land on austere dirt air fields.

The C-17 has capabilities to land on dirt runways, combat offload, and airdrop. Airland is the preferred method of deploying forces, but the airdrop of equipment and troops is an essential capability of Army doctrine. Army doctrine may require a formation of up to 100 aircraft to deliver a brigade, and the concept of strategic brigade insertion includes an airdrop and airland mix of equipment and personnel delivered over a great distance (AMMP, 1996:1-11). Current AMC doctrine states that airdrop crews and the airborne troop commanders need near real-time situational awareness of the battlefield to react to the dynamic character of combat operations (AMMP, 1996: 1-11). Airdrop is useful if a landing zone is not available, but airdrop has an inherent risk of damage to essential equipment or personnel. In addition, the airdrop could land off the Drop Zone (DZ) and be unrecoverable. A mechanical malfunction can prevent the doors from opening in flight. Furthermore, in a hostile environment 100 airplanes flying over the same location may not be tactically sound; the location may be compromised before the battlefield commander is prepared to take the fight to the enemy. Airdrop may deliver mass to the battlefield, but what happens when an aircraft is lost due to enemy action or equipment malfunction? Will the battlefield commander be prepared to fight? For forced entry an airdrop is appropriate, but if an aircraft could land near the battlefield the commander could drive to the fight without the dangers associated with an airdrop.

During OPERATION JOINT ENDEAVOR, the C-17 blurred the lines of a theater airlifter and a strategic airlifter. The major portion of the C-17 employment for Operation JOINT ENDEAVOR occurred during December 1995 and January 1996 with the C-17 flying out of Germany for Bosnia and from the US to Germany.

The direct delivery sortie is planned to depart from the CONUS and land at a forward operating base (FOB) and offload the cargo. The FOB could be an improved or unimproved airfield. After the operations tempo relaxed, all cargo bound for Bosnia was flown into Ramstein AB, Germany and transferred onto C-130s for theater airlift.

The C-17 is to be the core airlifter for the USAF into the middle of the next century. The C-17 presents a unique capability to TRANSCOM as the single manager for DOD transportation and the supported unified commander. Missions could be strategic missions, employ the direct delivery concept, in theater missions or a combination. All C-17 crews are trained in tactical and short field operations, and tactical operations does not require a special qualification as in other AMC aircraft. The C-17 can back and maneuver under its own power; this maneuverability would have permitted four C-17s on the ground in Mogadishu instead of two C-141s. Twice as many pallets can be loaded on C-17 logistic rails than the airdrop rails, and vehicles can be loaded side by side for an airland mission. The total throughput could be effectively doubled by airlanding cargo rather than airdropping the cargo.

Since 1945, the Department of Defense (DOD) has embarked on having rapid response by aircraft, and the C-17 is the newest airframe for a global projection force. With the reduction of troops overseas a time period is needed for a buildup of troops for all contingencies. The AMC doctrine states "airland is the preferred method of deploying forces" (AMMP, 1996:1-11), and given the problems associated with airdrop, the direct delivery concept may be the most logical approach for the Army component commander to take the fight to the enemy. The C-17 is capable of landing on a 3000-foot dirt strip and deliver a 136,000 LB M-1 tank. The M-1 can drive on and off the C-17 without any special equipment. Instead of a mass airdrop on the battlefield, personnel or equipment could be landed near the battlefield. When the ground commanders have their equipment and personnel on the ground and ready to go, they then can take the battle to the enemy.

AMC current doctrine of Global Reach utilizes the aerial refueling capability of aircraft, so when cargo or personnel are uploaded the aircraft does not land until the aircraft reaches its destination for rapid mobility or force projection. The direct delivery sortie is an extension of current policy. In past contingencies an improved airfield was required for strategic airlift, but the C-17 can deliver the cargo where the theater commander needs the cargo without trans-shipment. When the cargo arrived in theater the cargo was flown by theater airlift forces or driven to where it was needed. The C-17 can deliver mass where it is needed in theater from anywhere in the world, freeing theater airlift for much needed support. Seamless airlift is important, and a direct delivery from the US to anywhere in the world would be seamless. Aerial Port capacities can be exceeded. If a C-17 delivers 18 pallets, then three C-130s are required to haul that cargo in theater. The aerial port operator would have to download the C-17 and then upload the C-130s, taking additional time for delivery of needed goods. Additional storage space is also required. Pipeline visibility is increased; if you know it is on the aircraft, then you know when it will be delivered. Knowing what is on the aircraft removes variability and provides options to the unified commander, but there is a chance an aircraft could be lost to enemy action or a maintenance divert.

Statement of the Problem

Utilization of the C-17 is being debated at this time. Should the aircraft be used only in a strategic role, in a tactical role, or in a mixed role? AMC, as a component command of TRANSCOM, is responsible for strategic air transport. The C-17 in a direct delivery role can provide for efficient and rapid mobility to the theater CINC. The direct delivery for the definition of this paper includes both strategic and theater direct delivery. This paper examines, through a optimized linear program model, the use of the C-17 in a mixed strategic and tactical role of supporting the theater commander in the most cost effective method. The model examines cargo hauled from Ramstein AB, Germany into the Area of Responsibility for JOINT ENDEAVOR utilizing both the C-130 and C-17 for theater lift. Rapid force projection from the US is vital with CONUS basing. The primary question of this paper will be, what should be the method of employment for the C-17? To answer the primary question, the following subset of questions will be examined: 1. Should the C-17 be employed in a direct delivery role? 2. What should be the definition of a direct delivery sortie? 3. Should the C-17 be employed in an intra-theater role? 4. How does direct delivery impact intransit visibility and cargo backlogs? 5. When the initial surge occurs, can employing the C-17 result in cost savings and early closure for the supported CINC?

II. Literature Review

Introduction

One core competency identified for the USAF is Rapid Global Mobility. Rapid Global Mobility provides the nation global reach and identifies it as a global power. Rapid Global Mobility allows the nation to respond quickly and decisively to unexpected challenges. When an immediate response is needed, the operation must be carried out quickly. Rapid deployment is the most reliable combat force multiplier (Core Competency, 1997, 1). The direct delivery sortie capitalizes on rapid global mobility. Current business practices focus on competitive priorities. The direct delivery sortie could capitalize on the three competitive priorities of fast delivery time, customer service and customization.

Seams develop when there is a breakdown in the delivery of goods or personnel on the aircraft to the supported CINC. A seam in the airlift system can occur when there is a transition from the strategic delivery of cargo to the theater delivery of cargo. A seam could be the backlog of cargo at the destination airfield. Direct delivery includes the competitive strategies of dependable and rapid delivery. If the supported CINC can have rapid and dependable delivery, then inventory levels can be reduced. The supply system will not be saturated with duplicate orders, which in turn reduces the number of shipments and backlogs at the ports. The Theory of Constraints (TOC) could be applied to the seams in the current airlift system. Examing the airlift as a system constraints can be identified, and the constraints are the current seams in the airlift system. The seams occur at interfaces in the system. Combining the competitive priorities with elimination of constraints could increase global mobility. The TOC has five focusing steps and the first two may eliminate the constraint. 1. The first step is to identify the constraint. Fast rapid global mobility would require all seams to be identified. The first constraint for rapid delivery would be to reduce trans-shipments to decrease delivery time. Direct delivery would eliminate transshipments. 2. Exploit the constraint (Simons, 1996). If you need fast and rapid delivery, the airplane needs to be full and constantly moving.

Airlift Operations

Most airlift planners and policymakers understand the airlift system as a system of interconnected and interdependent parts, but the transportation policy process can obscure this knowledge and allow decision-makers to consider proposals that subotimize one section of the system. The policy and planning communities must refresh their understanding of the national military airlift system as a system. The core concepts, such as roles and organization, needed in an airlift system are easy to identify, but the secondary issues such as the determination of appropriate airlift technologies and the interplay of institutional self interests are more complex. The synergy of the system must be kept in mind in determining goals and requirements. The synergy includes the role of the Civil Reserve Air Fleet, acquisition of commercial aircraft and organizational centralization (Owen, 1995:1-2).

The role of the Air Mobility Command has grown from being able to transport an Army corps anywhere in the world in 72 hours in 1945 to the 1966 definition of moving 259,000 tons of personnel and material, seven divisions and 23 fighter wings from the US to Europe in 10 days. The fundamental requirement has remained the same, but the amount has changed. One minor change in a load requirement has hampered the true definition in the amount of airlift needed (Owen, 1995:9), such as adding 20,000 pounds of armor to the M-1 tank. The C-17 can still carry the M-1, but for the C-17 to land the M-1 with the added weight on a dirt strip, then 20,000 pounds less fuel can be carried. The reduction in fuel requires fuel at nearby field or a tanker nearby.

An efficient airlift fleet must be composed of several aircraft, due to the characteristics of individual loads, distances flown and closure requirements. The high costs of building and maintaining a large, multi-type airlift fleet present airlift planners with the added frustration of acquiring a large and diversified fleet for all requirements with maximum efficiency. The cost is greater than Congress's ability or willingness to purchase aircraft.

There are four tenets of Airlift Policy: 1. The commercial airline fleet is the heart of the national airlift fleet. 2. The military fleet should do what commercial aircraft or civilian aircrews cannot or will not do. 3. The military component should be equipped with aircraft designed for its role. 4. Airlift operations represent a continuum that should be under the operational and administrative direction of a single command (Owen, 1995:6-9).

The first tenet is that commercial airline fleet is the heart of the national airlift fleet. In 1980 MAC planners estimated that it was six to eight times less costly to maintain reserve airlift capacity in the CRAF than organic airlift. Until the late 1950s this was practical until Army long range requirements became a major airlift planning factor. The cargo could not fit into commercial carriers.

The C-17 meets the requirements of tenets two and three. The C-17 is capable of hauling outsize cargo into a improved or unimproved airfield and deliver what the unified commander needs.

Airlift operations represent a continuum that should be under the operational and administrative direction of a single command. Initially airlift organizations were placed under the direct operational control of the specific organizations and commands using their logistic services. These arrangements created duplication of effort, particularly in long range operations, and they undermined the overall flexibility and effectiveness of the national airlift effort. Experiences in Vietnam and the Israeli airlift of 1973 convinced many senior US military leaders that having theater and long-range airlift forces under separate commands was expensive. All Air Force transport aircraft were placed under MAC in 1974. The MAC commander was responsible to train, organize, and equip airlift forces. MAC was empowered to consolidate and service the requirements of all airlift users , and to develop plans for new aircraft and force structure. The Secretary of Defense directed that MAC would be a specified DOD command for airlift, and the MAC given commander combatant authority over all Air Force airlift forces and power to apportion available inter-theater airlift capacity among all users authorized by the Joint Chief Staff (JCS)(Owens, 1995:9).

Our defense planning focuses on preparedness for two major regional contingencies (MRCs). Operations short of war have created rising demands for using the US military to solve problems of ethnic conflict, humanitarian and disaster assistance, and civil unrest. Somalia, Rwanda, Los Angeles riots, Bosnia and Kuwait are a few examples of operations short of war or other than war. The Air Force is at the cutting edge for airlift both global and theater for the delivery of relief supplies and for the deployment and support of forces. "Air Power must be able to feed, supply, rescue, police, and punish from the air, without resort to air bases within the afflicted area" (Builder,1995:4). "Now, after the Cold War, the challenge for air power could very well be to offer the nation's leadership military alternatives to crises and lesser conflicts that the nation wants neither to ignore nor to be held hostage by" (Builder,1995:5).

A General Accounting Office (GAO) report states that the Army will not use the C-17 in a direct delivery role, and the Army must change its doctrine to employ the C-17 in a direct delivery mode. The Army plans call for mass and maneuver with forward movements planned from major bases in the theater of operations (C-17 Aircraft: Cost and Performance Issues, 1995).

MAC has used a two-step airlift concept for delivering forces to airfields nearest to the forces' wartime destination. Inter-theater airlift operates from the CONUS to a main operating base, and intra-theater airlift performs the theater redistribution from the main operating base in country to the final destination airfield. It is the theater commander's responsibility to move the cargo in country. The two-step process is inefficient. The trans-shipment of cargo is costly in terms of time it takes to deliver forces, and it underutilizes available airlift capability due to the time-consuming offload and onload procedure. The process consumes extra resources from aircraft needed to deliver the forces to holding areas for cargo awaiting transportation, extra MHE equipment (Soligan, 1985:3-4).

Direct delivery's greatest benefit is "the reduction in the required time to deliver combat units to the battle." Time savings arise from no trans-shipment of cargo and ground handling time, and airfield saturation is also reduced by not having trans-shipment you don't have two aircraft on the ground to download and upload. In an integrated airlift concept, without trans-shipment, MAC would deliver wartime forces to their combat locations (Soligan, 1985:28-30).

Force Projection

The shift from forward deployed troops to a force projection is changing the logistics planning process. Although most future US military responses will involve a joint task force, each service is responsible to get its personnel and equipment where they're needed. Seamless logistics is needed to know where the goods are at all times. The goal is total asset visibility (Roos, 1994:29).

Power projection is a new paradigm for future military operations and has been tested recently in Somalia, Rwanda, Bosnia, and Haiti. Strategic mobility had been considered a weak link in US military force structure due to the concept of force projection versus forward basing. The 1992 Mobility Requirements Study calls for improvements in Mobility Forces. The pentagon should be able to deploy within days or weeks of any crisis one heavy Army division, seven to eight AF fighter wings and one to two Marine Corps brigades in either the Persian Gulf or Korea. Airlift is taxed daily; in 1995 alone, the Air Mobility Command averaged 140 missions daily in support of troops to 40 different countries. Military Airlift is critical today. With a US-based force, you have to rely on airlift to project power quickly (Kitfield,1995:30).

Joint Vision states that to project power we need capable forces at the right place and time. Logistics must be responsive, flexible and precise. Focused logistics will be the fusion of information, logistics and transportation technologies to provide rapid crisis response and deliver tailored logistics packages and sustainment directly at the strategic, operational and tactical level of operations. It must be fully adaptive to the needs of dispersed and mobile forces, providing support in hours or days versus weeks. Focused logistics will enable joint forces of the future to be more mobile, versatile and projectable from anywhere in the world. The deployed force will be smaller and more capable. The force will have a smaller logistics footprint (*Joint Vision*: 24).

The reliability of the C-17 also reduces the logistics footprint needed for sustainment of the aircraft. During RM&AE the reliability rate was 99.4%, and during Joint Endeavor the reliability rate was 98%. The C-17 can provide for rapid response anywhere in the world without a large maintenance package to support the aircraft. Not requiring a large maintenance package effectively frees up cargo capacity by not having to haul maintenance personnel. Only 2% of returning aircraft needed more than routine maintenance, compared with 40% for C-141 and C-5 during Joint Endeavor. The C-17 carried more than 19,800 tons of cargo and 6,100 troops more than the C-141s and C-5s combined (*C-17 Airlift Workhorse*, 1996: S1-S5).

The US needs a capability-based, not a threat-based, military force. The Pentagon's Quadrennial Defense Review (QDR) is underway, and is to provide a comprehensive examination of defense strategy, force structure and infrastructure readiness. The US must decide the capabilities needed to execute the full spectrum of requirements dictated by our national security strategy. The military force structure has decreased by 40 percent, but the use of military force has increased by 300 percent (Dubik, 1997:42-44).

In 1995 RAND began a study to support the C-17 Tactical Utility Analysis. The study was conducted by the Office of the Secretary of Defense (OSD), and it found a need for up to a squadron of C-17s operating in-theater during major regional contingencies. The study used a large-scale linear program optimization model, called CONOP, which attempted to determine the appropriate mixes of theater airlifters under a variety of circumstances.

RAND was tasked with two objectives in the utility analysis. The first task was to provide estimates of the capacity of airfields to support air mobility operations. The second task was to evaluate concepts of operations for intra-theater C-17 operations. The CONOP model incorporates routes, bases, aerial refueling points, cargo types and delivery timeliness of actual military deployment operations. A mix of C-130s and C-17s was selected by CONOP to deliver the intra-theater cargo with greatest efficiency. The program modeled both strategic cargo and intra-theater cargo in a single optimization. Since the C-17 has capabilities in both strategic and intra-theater, and any use of it in the intra-theater role can only come at a cost to the movement of strategic cargo, the CONOP model optimized both strategic and intra-theater cargo movement. The model simulated two nearly simultaneous major regional contingencies. The first contingency was a Korean scenario and the second contingency follows the first on the Arabian Peninsula in 60 days. Massive cargo is transported from CONUS, European and Pacific aerial ports to each theater. The model deployed C-130s and C-17s to fly shuttles from aerial port of deembarkation's (APOD) to FOBs. The number of C-17s varied from 40 to 120 with a baseline of 86. Ten C-17s were deployed to the east MRC and 13 to the west MRC as a baseline for intra-theater airlift. The model found that whenever the direct delivery opportunity existed from a CONUS APOE to an FOB, the direct delivery was preferred. Direct delivery avoided the necessity to deploy airlifters to the theater and transshipment of cargo. RAND concluded that few requirements would be identified early enough for a direct delivery. The number of C-17s is sensitive to the need to move outsize cargo in theater. Without a requirement for outsize cargo the model still deployed nine C-17s for the west MRC and seven for the east MRC.

The C-17 is effective when the beddown base capacity is limiting. The mix of deployed C-17s and C-130s favors the C-17, as beddown capacity becomes constrained. The C-17 makes the best use of limited parking space per ton of cargo delivered.RAND also considered an alternative which RAND called the stratashuttle. The C-17 would fly strategic cargo into APODs and then fly a day of intra-theater shuttles prior to returning to the strategic flow (Killingsworth, 1995:1-35). The 1997 AMC Air Mobility Master Plan (AMMP) states, " Delivering and maturing the C-17 remains the number one priority in AMC. This impressively capable aircraft combines the advantages of a strategic airlifter--range, speed, aerial refueling and heavy, outsized payload with those of a tactical airlifter" (AMMP, 1997:IV). The C-17 is planned to haul .1314 Million Ton Miles per Day (MTM/D). The C-5 planning factor is .1404 MTM/D.

Vision 2025 states that power projection is dependent on mobility forces. The air mobility system should be capable of supporting the national objectives of humanitarian and nonhostile operations through armed conflict. The airlift system needs to be independent of theater basing. Most US military forces will be based in the US (*Vision 2025*,1997, Vol 2, Ch 4: vi). General Fogleman told AF 2025 participants, "The single biggest deficiency in the Department of Defense is lift" (*Vision 2025*, 1997,Vol 2 , Ch 4: 1). Basically it does not matter how good the armed forces are, if they cannot be in the right place at the right time to get the results the US needs. Challenges facing the US are the pending retirement of C-5, C-141, C-130, the aging of air mobility assets, and austere economic conditions. These challenges will require an analysis of customer needs and the attributes required of the air mobility system. The airlift system supports the national objectives through all levels of conflict. The airlift system supports the US military and civilian agencies, allies, foreign governments, multinational organizations, nongovernmental organizations and other entities necessary to support national objectives (*Vision 2025*, 1997, Vol 2, Ch 4:3).

Moving personnel and material from the strategic transport mediums to the tactical mediums has been a slow and labor intensive process (*Vision 2025*,Vol 2, Ch 4:6). On the battlefield of the future, there will be an increase in the efficiency, speed, and lethality of the battle. The war fighter needs rapid support. The warfighting challenges are compounded by the need to respond to operations other than war, such as natural and man-made disasters and nation assistance (humanitarian). Time is of the essence and our nation's air mobility system needs to be flexible and responsive to enhance the abilities of the user (*Vision 2025*, 1997, Vol 2, Ch 4:6). "If the war fighter is to succeed, the airlift system must address the customers' needs and not expect the customers to sacrifice their capabilities for the sake of eliminating air mobility constraints" (*Vision 2025*, 1997, Vol 2, Ch 4: 7).

The lack of established bases for transshipment and vulnerability of forward bases will require the capability for airlift systems that can provide direct delivery from CONUS to the point of use, and without the availability of an established support infrastructure. Current airdrop systems are still inaccurate. The ability to change the place of delivery while the personnel or material are en route will increase responsiveness (*Vision 2025*, 1997,Vol 2, Ch 4:13-14). The US needs to field an airlift system that considers cost factors in determining the airlift platform and systems (*Vision 2025*, 1997,Vol 2, Ch 4:15).

The ability to arrive at a particular place and time with particular capabilities is part of the policy solution. Doing it from a distance in a timely fashion is a mission of the USAF. One of the missions of Global Reach is establishing presence. Global reach is the USAF's ability to deploy nearly anywhere in the world, on short notice, in hours and not days or weeks (*Vision 2025*, 1997, Vol 2, Ch 1: 37).

III. Model Development

Introduction

The problem facing this study was how to quantify a cost for and the utility of the C-17 in supporting national objectives. The airplane has blurred the lines of a true strategic or tactical airlifter, and since the lines were blurred, could it be used in a dual role? To date AMC and ACC have delineated the lines between strategic and tactical airlift, but perhaps an airlifter, such as the C-17, could fill both roles, and provide fast and dependable transportation. With this thought I developed a linear program to compare the costs of using the C-17 cargo capability to that of the traditional theater airlifter, the C-130.

Model Development

This study could not develop a linear program that had 33,906 rows, 104,943 columns, 696,451 non-zero elements that required a Sparc 10 workstation and a run time of 2 hours, as the RAND study had. A simple linear program (utilizing Excel and Solver) was developed to look at minimizing total cost for movement of cargo from Ramstein, AB, Germany to Tuzla, BH. The model was developed to examine the total amount of cargo that was transported from Ramstein AB, Germany during the months of December, 1995 and February 1996 to Bosnia. It is a basic model which tries to determine the number of C-17 and C-130 sorties to deliver the actual amount of cargo moved at the least cost. Ramstein was used to stress the importance of the C-17 in the strategic or tactical role of delivering the goods from the CONUS to theater and distributing the cargo within theater to a FOB. Only the cost of transporting the cargo within theater was examined. The cost of delivery from CONUS had to be borne whether it was organic or civilian delivery to Ramstein. December 1995 and February 1996 data were used, since December was the surge period and to show how the C-17 could provide rapid transportation. February was the sustainment phase and loads were different. Picking December and February illustrates data for rapid deployment and sustainment. Depending on the airfield any organic aircraft could deliver the cargo. The operating costs for the aircraft are the FY 96 operating costs obtained from the Tanker Airlift Control Center, Special Assignment Airlift Branch.

Assumptions

The total cargo amount carried by C-130s, C-17s and C-141s during this time period was used. Also assumed was all cargo was palletized, and each pallet weighed 5,000 pounds. The round trip flying time for the C-17 is two hours and for the C-130 three hours. The program used 90,000 pounds of cargo for the C-17, 18 pallets at 5,000 pounds. The C-130 would carry 25,000 POUNDS or 5 pallets. The landing weight for the C-17 was 430,000 POUNDS (60,000 POUNDS of fuel) within the weight limits established for Tuzla. There was not a weight restriction for the C-130 at Tuzla.

The linear program was solved to minimize the total cost of operating the aircraft and calculate the number of sorties per aircraft type to move the cargo for the month. Equations used in Solver and Excel are provided in Appendix A for review.

IV. Data Description and Analysis

Results Analysis

The eyes of the world were watching the resolve of the US in December when US troops were sent to Bosnia. Flooding rivers, unpassable roads, a European rail strike, and foul weather hampered the movement of US troops into Bosnia. During December there were a total of 295 missions flown hauling 7,360,754 pounds of cargo. The total operating cost was $3,159,760 or $0.42 per pound (Table 1). This will form the baseline for comparing the results from the linear programs examining varying constraints.

Table 1. Actual Missions, December

December Outbound			
aircraft	sorties	cargo	Average cargo/sortie
C-130	239	4010858	16781.83264
C-141	23	621303	27013.17391
C-17	33	2728593	82684.63636
totals	295	7360754	
	missions	cost/mission	cargo/mission
C-130	239	10722	16781.83
C-141	23	9626	27013.17
C-17	33	11388	82684.64
		$3,159,760.00	7360754.00

The first constraint examined was maximum cargo on the aircraft, and what mix of C-17 and C-130 aircraft would provide the lowest cost. The maximum cargo for the C-17 was 90,000 pounds due to landing weight restrictions at Tuzla, and the C-130 unrestricted at 30,000 pounds. Solving the optimized model only 82 C-17 sorties were required at a total cost of $931,381 or $0.13 per pound (Table 2). It may be unrealistic to consider that every sortie would have the maximum cargo available. This would only occur in a ideal situation where the load would weigh exactly the maximum permissible. The interesting point is the linear program did not use any C-130 sorties to complete the mission, because the program solved for the combination of sorties that would produce the least cost. The least cost is by using all C-17s due to the operating cost per mission and the total amount of cargo moved for the month.

Table 2. Full Max Airplane, December

December Outbound			
aircraft	sorties	cargo	cargo/sortie
C-130	239	4010858	16781.83264
C-141	23	621303	27013.17391
C-17	33	2728593	82684.63636
totals	295	7360754	
	missions	cost/mission	max cargo/mission
C-130	0	10722	30000
C-17	82	11388	90000
		$931,381	7360754

The next problem was how to quantify what cargo should be carried by each sortie. The maximum cargo was not realistic due to not having an exact load available for the maximum load for each sortie. The next constraint added was for the average weight carried by each type of aircraft for the month of December. This constraint was added to account for not all of the material being immediately available for shipment, and more accurately reflects movement for the month(Table 3). In this case the linear program solved that 89 C-17 sorties would be required to haul the cargo for the month at a cost of $1,013,782 or a savings of $2,145,978 from the baseline method. Seven additional sorties were required for movement, since the average cargo per mission was 82,684.64 pounds versus 90,000 pounds in Table 2. The program solved the most cost efficient method is employing all C-17 sorties.

Table 3. Average Weight, December

December Outbound			
aircraft	sorties	cargo	cargo/sortie
C-130	239	4010858	16781.83264
C-141	23	621303	27013.17391
C-17	33	2728593	82684.63636
totals	295	7360754	
	missions	cost/mission	cargo/mission
C-130	0	10722	16781.83
C-17	89	11388	82684.64
		$1,013,782.85	7360754.00

A requirement to fly into Bosnia was that the aircraft had to have a defensive system and armor installed. During the initial deployment only four C-17 aircraft had defensive systems and armor installed. To account for only four aircraft being equipped with defensive systems a constraint was added of four C-17s flying twice a day. Again only 89 sorties were required by the C-17 at a total cost of $1,013,783 or $0.137 per pound (Table 4). Utilizing 89 C-17 sorties to move the cargo for the month would have resulted in a savings of $2,145,978. Four aircraft were selected to examine the possibility of an intra-theater shuttle for the future if a limited number of aircraft were deployed to the theater for support. This is realistic with current humanitarian operations. Only a few number of aircraft may be assigned for the movement in theater and the rest would be tasked with strategic missions

One area that was hard to justify was what should be the amount of cargo carried by the C-130, should it be the average weight or 30,000 pounds. The assumption was made to allow the C-130 carry up to 30,000, since if 30,000 pounds or less of cargo was to be carried, the C-130 would be the most economical for the times involved in this model.

Table 4. 4 C-17s, 2 per day, December

December Outbound			
aircraft	sorties	cargo	cargo/sortie
C-130	239	4010858	16781.83264
C-17	33	2728593	82684.63636
C-141	23	621303	27013.17391
totals	295	7360754	
	missions	cost/mission	cargo/mission
C-130	0	10722	30000
C-17	89	11388	82685
totals	89	$1,013,783	7360754

February began a period of sustainment. In February there were 44 C-17 missions, 40 C-141 missions and 278 C-130 missions hauling 8,031,340 lb. of cargo from Ramstein to Bosnia. The total cost for aircraft operating hours was $3,866,828 (Table 5).

Table 5. Actual Missions, February

February Outbound			
aircraft	sorties	cargo	cargo/sortie
C-130	278	4092804	14722.32
C-141	40	1442048	36051.2
C-17	44	2496488	56738.36
totals	362	8031340	
	missions	cost/mission	cargo/mission
C-130	278	10722	14722.31655
C-141	40	9626	36051.2
C-17	44	11388	56738.36364
		$3,866,828.00	8031340

Utilizing the maximum weight of 90,000 pounds for the C-17 and 30,000 for the C-130 the optimized model solved that 89 C-17 missions would have been the least expensive method of employment at a total cost of 1,016,232, a total savings of $2,850,596 (Table 6). The cost per pound was $0.13 per pound versus $0.48.

Table 6. Full Max Airplane, February

February Outbound			
aircraft	sorties	cargo	cargo/sortie
C-130	278	4092804	14722.32
C-17	44	2496488	56738.36
C-141	40	1442048	36051.2
totals	362	8031340	
	missions	cost/mission	max cargo/mission
C-17	89	11388	90000
C-130	0	10722	30000
		$1,016,232	8031340

The average weight carried by the C-17 for the month of February was 56,738 pounds and the C-130 was 14,722 pounds. Using the constraint for average weights 142

C-17 sorties would be required at a cost of $1,611,976 a savings of $2,254,852 from the current method (Table 7).

Table 7. Average Weights, February

February Outbound			
aircraft	sorties	cargo	cargo/sortie
C-130	278	4092804	14722.32
C-17	44	2496488	56738.36
C-141	40	1442048	36051.2
totals	362	8031340	
	missions	cost/mission	cargo/mission
C-17	142	11388	56738.36364
C-130	0	10722	14722.31655
		$1,611,976	8031340

Constraining the C-17 to the actual average weight for February and only four aircraft flying twice per day 142 sorties were required at a cost of $1,617,096 or $.20 per pound (Table 8).

Table 8. 4 C-17s, 2 per day, February

February Outbound			
aircraft	sorties	cargo	cargo/sortie
C-130	278	4092804	14722.32
C-17	44	2496488	56738.36
C-141	40	1442048	36051.2
totals	362	8031340	
	missions	cost/mission	cargo/mission
C-17	142.00	11388	56738
C-130	0	10722	30000
totals	142	$1,617,096	8056847.636

Summary of Results

Table 9 illustrates the savings in C-17 employment for December and February. Employing four aircraft flying twice a day a savings of $2,145,978 for December and $2,254,852 for February could have been realized. The cost per pound for cargo in December was $0.429 and utilizing the C-17 it would have been $0.1377. In February the cost per pound was $0.481 and utilizing the C-17 the cost would have been $0.20. Currently cost per pound is not a factor in determining shipping charges to the user and only hourly rates are considered. The cost per pound aids in quantifying the charges for the user. The number of increased sorties in February is due to the decrease in weight of the average loads for the month. During December heavy equipment was being moved. The average load weight for December for the C-17 was 82,684 pounds and in February the average weight was 56,738 pounds. The average load weight for C-130s in December was 16,781 pounds and in February 14,722 pounds. Utilizing cost per flying hour is easily quantifiable, and is the basis for the cost per pound shown. By looking at only operating cost per hour the C-130 is cheaper at $3,574 per hour versus the C-17 at $5,694 per hour. Two other factors in the equation are speed and load weight capability. The speed advantage of accomplishing the mission gave the C-17 an advantage during longer missions in terms of charging per flying hour. When ever there is greater than a 1.593 mission time advantage the C-17 will enjoy a cost advantage in terms of dollars per flying hour. In this scenario of 2 hours for sortie time for the C-17 and 3 hours for the C-130 the C-130 enjoys a cost advantage for loads less than 30,000 pounds.

This information is provided for the user to make a informed decision regarding employment plans and the cost of employment. Flying time and load weights will determine what is the mix of aircraft required for mission accomplishment.

Table 9. Comparison of Methods

December	Total Sorties	Cost	Cargo	Cost/Pound	Savings over baseline
Baseline	239	$3,159,760	7360754	0.42927124	$0
Full Max Aircraft	82	$931,381	7360754	0.12653337	$2,228,379
Average Weight	89	$1,013,782	7360754	0.13772801	$2,145,978
4 C-17 2 sorties/day	89	$1,013,782	7360754	0.13772801	$2,145,978
February					
Baseline	362	$3,866,828	8031340	0.48146735	$0
Full Max Aircraft	89	$1,016,232	8031340	0.12653331	$2,850,596
Average Weight	142	$1,611,976	8031340	0.20071072	$2,254,852
4 C-17 2 sorties/day	142	$1,611,976	8031340	0.20071072	$2,254,852

V. Findings and Conclusion

Discussion of Model Results

The issue of this paper is, what should be the method of employment for the C-17? Can C-17 use result in cost savings and early closure for the supported CINC? The model supports that the C-17 can provide a cost advantage and provide for early closure. The model indicated a cost savings of $2,145,978 for the month of December. Instead of 295 missions only 89 missions would have been required. Assuming eight missions per day, the whole months' cargo could have been carried in 12 days. During the month of February using average cargo weights, 142 sorties would have been required at a cost savings of $2,254,852. The average weight carried per sortie was less during February resulting in more sorties.

One must remember that budgets are shrinking. Just looking at December and February there could have been total savings of $4,400,830. That is quite a savings for the theater commander, contingency budget and the taxpayer. There are additional costs of downloading and uploading aircraft for delivering all of the goods to a POD versus delivery to the FOB. Transshipment costs and savings were not determined and that could be examined in a follow on study. Just looking at December and February for OPERATION JOINT ENDEAVOR, the use of the C-17 in a direct delivery role has a cost benefit.

Issue Discussion

The issue for this paper and model development is how has the C-17 opened up new avenues for power projection for the US. The C-17 was developed to fulfill both Strategic and Tactical airlift requirements and has proven itself in JOINT ENDEAVOR, but its potential for employment is not fully understood or developed. By FY 2006 the Air Force is programmed to have 120 C-17s and no C-141s. In FY 1996 we have 23 C-17s and 223 C-141s. With the C-17 assuming the role as the core airlifter and the US dependent on power projection from the CONUS, the role of the C-17 in power projection needs to be developed and understood by all of the users today for doctrine development. There will be a loss of aircraft numbers from today, and the doctrine for C-17 employment must be developed to use the aircraft in an efficient manner.

The C-17 can carry 3.4 times the maximum payload of a C-130 but still land in the same runway length as a C-130. This capability has opened a new area of development for power projection. The projection of power could be from the CONUS or an intra-theater role. My model and the RAND study show the utility of the aircraft for the theater role or delivering cargo strategically to a FOB. This is a fort to fox hole plan. The combat commander can deliver troops with cargo where it is to pursue the fight. Currently the troops and cargo are delivered to an APOD and then driven or flown by tactical assets to a FOB to prepare for the battle. The brigade airdrop was planned to take the fight to the enemy by airdrop, along with all of the inherent dangers of airdrop. The direct delivery sortie can land all of the troops at an FOB to accomplish the same objective.

Lean logistics depends on rapid and dependable transportation. The C-17 can provide rapid transportation reducing wait times with large cargo capabilities. The C-17 can deliver forces quickly from the home station to the point of employment without any change in transportation mode, which translates into no intermodal delays or synchronization of transport required. The C-17 permits rapid throughput into small austere airfields to maintain the momentum of operations, allowing the commander to outpace the enemy's ability to react.

The C-17 can make the transportation based sustainment system more flexible and capable and can deliver both replacement equipment and supply items to support the force. Resupply of fragile depot items would reduce the handling times of the equipment. Support could be provided from outside of theater and could possibly eliminate a level of support from the depot and the user.

This is not say the C-17 has eliminated the need for C-130s. Using the C-17 in an intra-theater role would free up theater C-130s for a quick response, small loads, or for FOBs the C-17 can not operate into. The C-130 is better suited to deliver certain small loads, as in this model, loads weighing less than 30,000 pounds. To land a C-17 on an unimproved or dirt surface requires a minimum California Bearing Ratio (CBR) of 19. The CBR is compaction of the ground. The C-130 does not have that limitation and the C-130 could be used to deliver troops and material into those fields. The C-130 could be used in quick and rapid retrograde of troops or medevac within intra-theater, since they are based there.

Vision 2025 had the premise that to project power we need capable forces at the right place and time. The ability to project forward from the US anywhere in the world is a requirement for the next century, and the C-17 can perform that mission now. The CINCs need to understand this capability and incorporate it into force deployment plans, and understand the ability to deliver anywhere is a force multiplier. The deployed force is smaller and more capable, and the mode of transportation must be more capable to provide the flexibility for the deployed forces. To project forces in a time sensitive manner to the battle area, requires a direct delivery.

Answers to Problem

The primary question of this paper was, what should be the method of employment for the C-17? There were five subquestions to support how the C-17 should be employed. 1. Should the C-17 be employed in a direct delivery role? 2. What should be the definition of a direct delivery sortie? 3. Should the C-17 be employed in an intra-theater role? 4. How does direct delivery impact intransit visibility and cargo backlogs? 5. When the initial surge occurs, can employing the C-17 result in cost savings and early closure for the supported CINC?

Should the C-17 be employed in a direct delivery role? The basis of force projection from the CONUS depends on rapid delivery. The C-17 is designed to be able to deliver strategically anywhere in the world including a dirt runway, and deliver what the forces needs. The answer to this question is a definite yes. The ability to deliver anywhere is paramount in the theory of force projection.

What should be the definition of a direct delivery sortie? The direct delivery sortie is thought of being a long range mission, but why does it have to include only strategic missions? The model showed that the C-17 can deliver cargo rapidly from within theater. The definition should be that the delivery occurs where the force commander requires the delivery, and that could be from CONUS or from a few hours away. Rapid and efficient delivery is needed and it can occur from anywhere. The force commander needs rapid movement of cargo or personnel.

Should the C-17 be employed in an intra-theater role? Providing flexible transportation within theater is an asset of the C-17. The theater commander can have rapid delivery of outsize cargo anywhere needed. The dedicated theater lift (C-130) can still support the theater with sustainment loads or smaller loads that they are more suited for. It could be a synergetic effect of the aircraft working together.

How does direct delivery impact intransit visibility and cargo backlogs? If you can avoid trans-shipment of cargo, then whatever was on the aircraft at the POE will be delivered. Avoiding transshipment would also prevent cargo backlogs and reduce double orders being placed by the supply system. Inventory levels could be reduced with rapid and dependable transportation.

When the initial surge occurs, can employing the C-17 result in cost savings and early closure for the supported CINC? The initial surge is the most important process of rapid global mobility. The model showed there is a cost savings. All of February's cargo could be delivered in 12 days. The resolve for action and the ability to deliver anywhere in the world to an international airport or a dirt strip may be enough to stop aggression and show the resolve of the US.

Opposition of Direct Delivery

A few questions need to be addressed for opponents of direct delivery. Direct delivery has drawbacks. Critics would claim that a crew departs 14 hours or more prior to landing in a combat zone, and if they do not have current intelligence data, the aircraft and aircrew would be danger. It is inappropriate to ask the crew to fly the most dangerous portion of the mission during the period of fatigue, especially with only two pilots. One recommendation to avoid this problem is to have the C-17 operate in both a strategic and tactical role. If the threat was high a staging base could be used, within a few hours of the objective area. At the stage base, a rested and briefed crew could assume the leg into theater, and the strategic crew could join the stage flow out of the base. This solution adds a extra degree of safety and is basically what was done during OPERATION JOINT ENDEAVOR. Although most of the cargo and passengers came from Europe, the direct delivery sortie does not have to be from the CONUS, but could originate within a few hours of the objective area or airfield. Without trans-shipment of cargo time, money and energy are saved. A few hours would be lost on the ground while the aircraft was refueled, but this would be enhanced by safety. Without transshipment of cargo the logistic footprint is reduced. If you do not have to download a C-17 to upload it on a C-130 fewer port personnel are required, less ground handling equipment is needed and storage space is reduced. Intransit visibility is increased if the material is on board the aircraft from the CONUS, and the material does not have to be tracked at intermediate locations. Savings are realized in time and money. The logistics footprint is reduced at the intermediate base with the reduction of personnel and MHE. Tanker support could be lowered; if the stage base was within two hours of the objective location, fuel could be uploaded during the turn to reduce airspace congestion and freeing tankers for fighters.

One argument against intermediate stops is that aircraft develop maintenance problems when they are on the ground. Aircraft also develop problems enroute and with the two-person cockpit a system malfunction, such as the loss of a HUD or mission computer, could cancel or severely degrade the mission or cause a maintenance divert. If a aircraft diverts, then it could be out of the AMC system. A stage base with maintenance personnel could return an aircraft to service and increase mission success rates.

Another argument against a stage base is the lack of landing locations. The reduction of military budgets around the world almost assures that any action will be a multinational effort, and a staging location should be available. If a staging location is not available, then airspace overflight is probably not available.

Summary

In summary, the C-17 adds a new flexibility for power projection. The commanders can move tactical forces directly to the combat area. The C-17 provides a new intra-theater airlift capability, provides sustainment from CONUS depots directly to brigade support areas, and reduces the logistic footprint in theater. The need for trans-shipments is reduced. The aircraft has opened new avenues for power projection into the 21st century, and all commanders must plan for implementation of C-17 employment in their plans.

Appendix A

Tabular Presentation of Formula in Solver

Table 10. Full Max Airplane, December (Formula)

December Outbound			
aircraft	sorties	cargo	cargo/sortie
C-130	239	4010858	=C3/B3
C-17	33	2728593	=C4/B4
C-141	23	621303	=C5/B5
totals	=SUM(B3:B5)	=SUM(C3:C5)	
minimize total cost from Ramstein to Tuzla			
X1=C-17			
X2=C-130			
	missions	cost/mission	max cargo/mission C-17
C-17	81.7861555555556	11388	90000
C-130	0	10722	30000
		=SUMPRODUCT($B$12:$B$13,C12:C13)	=SUMPRODUCT($B$12:$B$13,D12:D13)
	min		=C6
	max		
	equal		

Table 11. Actual Missions, December (Formula)

December Outbound				
aircraft	sorties	cargo	tons	cargo/sortie
C-130	239	4010858	2046.4	=C3/B3
C-17	33	2728593		=C4/B4
C-141	23	621303	721.02	=C5/B5
totals	=SUM(B3:B5)	=SUM(C3:C5)	=SUM(D3:D5)	
minimize cost per sortie from Ramstein to Tuzla				
X1=C-17				
X2=C-130				
	missions	cost/mission	cargo/mission	flying time/mission
C-141	23	9626	=E5	2
C-17	33	11388	=E4	2
C-130	239	10722	=E3	3
		=SUMPRODUCT($B$12:$B$14,C12:C14)	=SUMPRODUCT($B$12:$B$14,D12:D14)	
	min			
	max			
	equal		=C6	

Table 12. 4 C-17, 2 per day, December (Formula)

December Outbound					
aircraft	sorties	cargo	cargo/sortie		
C-130	239	4010858	=C3/B3		
C-17	33	2728593	=C4/B4		
C-141	23	621303	=C5/B5		
totals	=SUM(B3:B5)	=SUM(C3:C5)			
minimize cost per sortie from Ramstein to Tuzla					
X1=C-17					
X2=C-130					
	missions	cost/mission	cargo/mission	C-17 sorties per month	C-130 sorties per month
C-17	89.0220278363244	11388	=D4	1	0
C-130	0	10722	30000	0	1
totals	=SUM(B12:B13)	=SUMPRODUCT($B$12:$B$13,C12:C13)	=SUMPRODUCT($B$12:$B$13,D12:D13)	=SUMPRODUCT($B$12:$B$13,E12:E13)	=SUMPRODUCT($B$12:$B$13,F12:F13)
	min		=C6		0
	max			=8*25	

Table 13. Average Weight, December (Formula)

December Outbound				
aircraft	sorties	cargo	tons	cargo/sortie
C-130	239	4010858	2046.4	=C3/B3
C-17	33	2728593		=C4/B4
C-141	23	621303	721.02	=C5/B5
totals	=SUM(B3:B5)	=SUM(C3:C5)	=SUM(D3:D5)	
minimize cost per sortie from Ramstein to Tuzla				
X1=C-17				
X2=C-130				
	missions	cost/mission	cargo/mission	flying time/mission
C-17	89.0220278361464	11388	=E4	2
C-130	0	10722	=E3	3
		=SUMPRODUCT($B$12:$B$13,C12:C13)	=SUMPRODUCT($B$12:$B$13,D12:D13)	
	min			
	max			
	equal		=C6	

Table 14. Full Max Airplane, February (Formula)

February Outbound					
aircraft	sorties	Pax	cargo	tons	cargo/sortie
C-130	278	1034	4092804	2046.4	=D3/B3
C-17	44		2496488		=D4/B4
C-141	40	161	1442048	721.02	=D5/B5
totals	=SUM(B3:B5)	=SUM(C3:C5)	=SUM(D3:D5)	=SUM(E3:E5)	
minimize total cost from Ramstein to Tuzla					
X1=C-17					
X2=C-130					
	missions	cost/mission	max cargo/mission C-17		
C-17	89.2371111111111	11388	90000		
C-130	0	10722	30000		
		=SUMPRODUCT($B$12:$B$13,C12:C13)	=SUMPRODUCT($B$12:$B$13,D12:D13)	0	
	min		=D6		
	max				
	equal				

Table 15. Average Weights, February (Formula)

February Outbound					
aircraft	sorties	Pax	cargo	tons	cargo/sortie
C-130	278	1034	4092804	2046.4	=D3/B3
C-17	44		2496488		=D4/B4
C-141	40	161	1442048	721.02	=D5/B5
totals	=SUM(B3:B5)	=SUM(C3:C5)	=SUM(D3:D5)	=SUM(E3:E5)	
minimize cost per sortie from Ramstein to Tuzla					
X1=C-17					
X2=C-130					
	missions	cost/mission	cargo/mission	flying time/mission	
C-17	141.550434049753	11388	=F4	2	
C-130	0	10722	=F3	3	
		=SUMPRODUCT($B$12:$B$13,C12:C13)	=SUMPRODUCT($B$12:$B$13,D12:D13)		
	min		=D6		
	max				
	equal				cost per pound

Table 16. Actual Missions, February (Formula)

February Outbound	actual missions February				
aircraft	sorties	Pax	cargo	tons	cargo/sortie
C-130	278	1034	4092804	2046.4	=D3/B3
C-17	44		2496488		=D4/B4
C-141	40	161	1442048	721.02	=D5/B5
totals	=SUM(B3:B5)	=SUM(C3:C5)	=SUM(D3:D5)	=SUM(E3:E5)	

minimize cost per sortie from Ramstein to Tuzla

X1=C-17					
X2=C-130					
	missions	cost/mission	cargo/mission	flying time/mission	
C-141	40	9626	=F5	2	
C-17	44	11388	=F4	2	
C-130	278	10722	=F3	3	
		=SUMPRODUCT($B$12:$B$14,C12:C14)	=SUMPRODUCT($B$12:$B$14,D12:D14)		
	min				
	max				
	equal		=D6		cost/pound

Table 17. 4 C-17, 2 per day, February (Formula)

February Outbound					
aircraft	sorties	Pax	cargo	cargo/sortie	
C-130	278	1034	4092804	=D3/B3	
C-17	44		2496488	=D4/B4	
C-141	40	161	1442048	=D5/B5	
totals	=SUM(B3:B5)	=SUM(C3:C5)	=SUM(D3:D5)		
minimize cost per sortie from Ramstein to Tuzla					
X1=C-17					
X2=C-130					
	missions	cost/mission	cargo/mission	C-17 sorties per month	C-130 sorties per month
C-17	142	11388	=E4	1	0
C-130	0	10722	30000	0	1
totals	=SUM(B12:B13)	=SUMPRODUCT($B$12:$B$13,C12:C13)	=SUMPRODUCT($B$12:$B$13,D12:D13)	=SUMPRODUCT($B$12:$B$13,E12:E13)	=SUMPRODUCT($B$12:$B$13,F12:F13)
	min		=D6		0
	max			=8*28	
	equal			cost per pound	

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Vita

Major Mark Shane Hershman [redacted] He graduated from Belvidere High School in 1976. He graduated from Moravian College with a BS in Biology in 1980. He attended graduate school at Penn State University majoring in Physiology in 1981. He received his commission from Officer Training School on 9 September 1983.

He attended Undergraduate Helicopter Training at Ft Rucker, Alabama and received his wings in July 1994. His first assignment was at Malmstrom AFB, and he accumulated over 2,000 hours in UH-1H/F/N helicopters. He attended Fixed Wing Qualification at Vance AFB in 1987. Major Hershman qualified in the C-141 and was assigned to McChord AFB, Washington. He was selected as part of the C-17 initial cadre and the 12th pilot qualified in the C-17. He earned a Master of Aviation Science degree from Embry Riddle Aeronautical University in 1995, and then was selected to attend the Advanced Studies of Air Mobility in 1996. Major Hershman is a senior pilot with over 5,000 hours. He has been assigned to NATO in Stavanger, Norway.

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