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REPORT

Commercial Intratheater Airlift

Cost-Effectiveness Analysis of Use in U.S. Central Command

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Summary

Intratheater airlift (ITA) is used to deliver critical and time-sensitive supplies, such as blood products for transfusions or repair parts for vehicles, to deployed forces. ITA within a combat theater of operation has traditionally been assumed to be provided by military aircraft. However, in recent years, a number of commercial providers have been providing a significant amount of ITA within U.S. Central Command (USCENTCOM). A number of motivations for the use of commercial intratheater airlift (CITA) within USCENTCOM have been identified, such as[1]

- concerns about structural fatigue to C-130 aircraft due to the heavy use of these aircraft in USCENTCOM
- lack of access to C-130 aircrews, particularly those in the Air Reserve Component, for deployments
- a desire to reduce the use of convoys over high-threat roadways.

The analysis detailed in this report aims to answer the following question: Were these expenditures on CITA cost-effective, relative to the cost of performing these same movements on organic U.S. Air Force (USAF) aircraft? That is, did the Department of Defense (DoD) get a "good value" on these purchases?

When multiple airlift options exist for any specific movement, it is first necessary to identify the cost to provide each movement via each airlift option. Identifying such a cost is complicated by two primary factors: for commercial carriers, the extent of *price elasticities of demand* (to what extent do changes in the demand for CITA movements impact the price charged by commercial carriers for these movements?); for USAF-organic aircraft, the set of *which fixed and marginal costs to include* (is the procurement or retirement of aircraft under consideration, or is one only considering variations to the number of flying hours performed by aircraft that are already in the USAF inventory, and whose inventory levels are justified according to some requirement exogenous to their use in this specific scenario?).

Moreover, identifying the cost for each individual movement does not capture the potential for reducing costs by *aggregating multiple movements across aircraft sorties and missions*. Given a large collection of movement requirements and a set of airlift alternatives, it is nec-

[1] Another potential motivation that has been suggested, beyond the three listed here, is a desire to foster the development of more-robust commercial logistic options in the region to support reconstruction and other local, nonmilitary development activities. Given that the carriers providing CITA were not indigenous Iraqi or Afghan firms and that, by the nature of the cargo airlift industry, these aircraft will move around the globe in response to the demands for their services, we find this motivation to be somewhat lacking in validity.

essary to solve a routing problem and an assignment problem: which movements to assign to which missions. We developed an optimization model to identify the most cost-effective movement-to-mission assignments for any set of movement requirements and available airlift alternatives.

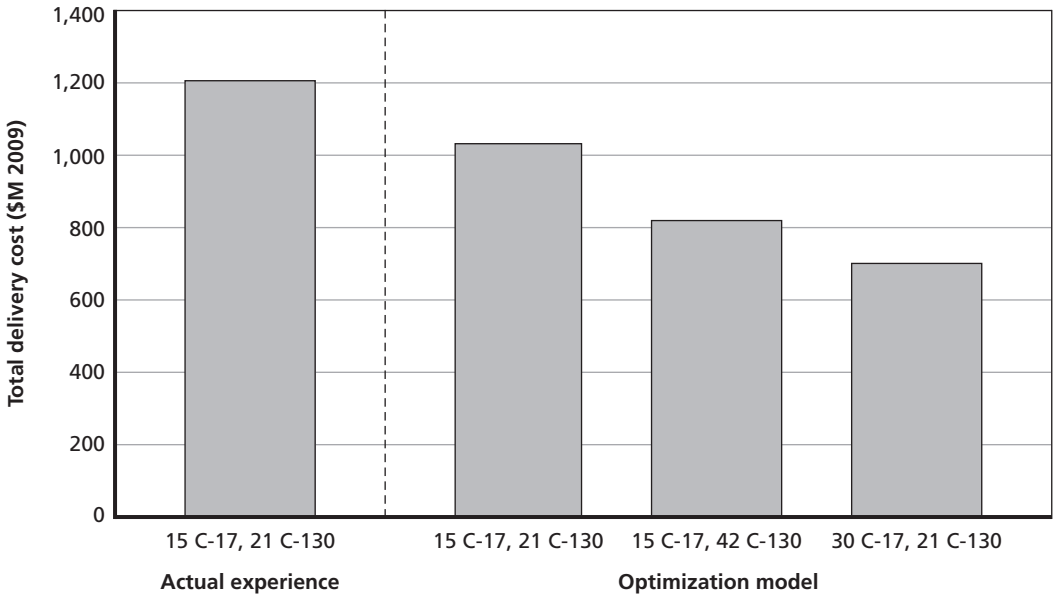
Conclusions

Based on the demands for ITA and the costs paid to CITA providers in USCENTCOM in 2009, we find:

C-17 and C-130 are both generally more cost-effective than CITA, but CITA options should be retained to supplement USAF aircraft. Across all our optimization model runs, the model demonstrated a clear preference for the increased use of USAF aircraft and the decreased use of CITA, although, for a relatively small fraction of the USCENTCOM ITA demands, the IL-76 charters and Theater Express Program (TEP) tenders were the most cost-effective options.

As shown in Figure S.1, for a level of USAF resources equal to that used in USCENTCOM (15 C-17s and 21 C-130s available each day for ITA movements), the optimized allocation of cargo and passengers to airlift options reduced costs by $175 million from the historical performance. The model achieved these savings by replacing the TEP tenders with C-17s for long movements and by replacing TEP with IL-76 charters for short movements. The optimization model made these changes primarily because of the ability of the C-17 and IL-76 to aggregate cargo across multisortie missions, supporting a mix of high-demand and low-demand origin-destination pairs on a single mission. Using TEP to provide the same sets

Figure S.1
Total Delivery Cost for Optimization Model Results and Experience



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of movements would require a separate tender for each origin-destination pair, with the low-demand origin-destination pairs driving a comparatively high cost per amount moved.[2]

If the level of C-130s supporting USCENTCOM ITA could be doubled, the optimized allocation could reduce costs by slightly more than $210 million over the optimization result for 21 C-130s (for a total savings of approximately $390 million). These $210 million savings accrue because the increased number of C-130s allows significantly more passengers movements to occur on C-130s, with a corresponding decrease in C-17 passenger movements, thereby freeing C-17s to replace IL-76s for long cargo movements (some of the additional C-130s are also used to replace IL-76s for short cargo movements). Doubling the level of C-17s supporting USCENTCOM ITA while holding C-130s at the historical level could allow the optimized allocation to reduce costs by slightly more than $330 million over the optimization result for 15 C-17s (for a total savings of approximately $510 million). These $330 million savings are accrued by significantly increasing both the passenger and cargo movements occurring on C-17s, with a corresponding decrease in C-130 passenger movements and cargo movements using TEP and IL-76 charters. In both cases, the increased usage of C-17s for cargo movements is due to the C-17's relative cost advantage: On a cost-per-mile basis, the IL-76 costs three times as much as the C-17, for a comparable aircraft block speed and payload. These cost reductions do not account for the increased costs to the USAF associated with deploying additional aircraft to USCENTCOM, but our preliminary analysis suggests that these deployment costs would be much smaller than the potential savings.

The minimum cost that was achieved with 30 C-17s was essentially equal to the global minimum cost achievable if we allowed the model access to an unlimited pool of C-130s and C-17s. Because the model's solution with 30 C-17s utilized TEP and IL-76s to transport 4 and 6 percent, respectively, of the total cargo tonnage, CITA appears to be the most cost-effective delivery option for these cargoes, suggesting that, even though USAF aircraft appear to be more cost-effective for most of the USCENTCOM ITA movements, CITA options should be retained for some small fraction of movements.[3]

We also performed sensitivity analyses, running the optimization model with lower per-movement costs for TEP and higher costs for C-130s, C-17s, and IL-76s. In these sensitivity analyses, the amount of cargo transported via C-17 and C-130 did not significantly change, suggesting that our finding that USAF aircraft are more cost-effective than commercial alternatives for most ITA movements within USCENTCOM is fairly robust. However, as IL-76 costs increased and TEP costs decreased, the amount of cargo transported via TEP increased, with most of this increase coming at the expense of cargo previously transported via IL-76. This suggests that, while IL-76s may be slightly more cost-effective than TEP for most of the ITA movements within USCENTCOM best suited for CITA, this preference is not robust to moderately sized changes to the relative IL-76 and TEP cost structures.

Decision-support tools are needed to assist the Combined Air and Space Operations Center (CAOC) Air Mobility Division (AMD) and USCENTCOM Deployment and Distribution Operations Center with daily airlift cargo allocation decisions. Within

[2] Note that, in other applications, such as contract trucking movements in the United States, the use of *combinatorial auctions* allows competitors to submit bids on any desired combination of individual movement requirements; optimization routines can be used to select the set of bids that spans the requirements at minimum cost. Our analysis did not examine the potential benefits of such an application to the TEP; rather, we examined the TEP as it existed in 2009.

[3] This assumes that CITA providers would still elect to participate at the reduced volumes.

USCENTCOM, each day the CAOC AMD, based on guidance from the USCENTCOM Deployment and Distribution Operations Center, must assign movement requirements to airlift options. Given a large collection of movement requirements and a set of airlift alternatives, this entails solving a routing problem and an assignment problem: which movements to assign to which missions. At the time of this analysis, the CAOC AMD did not have access to sophisticated decision-support tools to assist in its daily determination of cargo-aircraft allocation decisions. The extremely large number of potential assignments prohibits any individual from considering all feasible options and selecting the most effective solution without the aid of a computer model. We developed an optimization model to perform such movement-to-mission assignments and found that the model was able to identify significant improvements to the historical performance. As noted in Figure S.1, in contrast to USCENTCOM historical performance of approximately $1,210 million in total ITA delivery cost, the model found a solution that could have reduced this cost by up to $175 million, without increasing the number of employed C-17 and C-130 flying each day in theater. This suggests that an investment in the development of such tools for AMD use could achieve large savings.