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INSTITUTE FOR DEFENSE ANALYSES

An Analysis of Consolidated vs. Coordinated Operational Support Airlift Scheduling

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PREFACE

This paper was prepared by the Institute for Defense Analyses (IDA) for the United States Transportation Command (USTRANSCOM) under the task entitled "Migration Strategies for DoD Transportation Systems." This paper responds to an objective of the task, to "provide necessary information to USTRANSCOM that is required to make a decision about the scheduling and operation of the OSA fleet."

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EXECUTIVE SUMMARY

A fleet of Operational Support Airlift (OSA) aircraft is maintained by the Department of Defense (DoD) to provide wartime support for movement of passengers and cargo that have time- or mission-sensitive intratheater requirements. During peacetime, the fleet is used for pilot training and transporting official DoD passengers and cargo. The fleet is composed of low-capacity jets and turboprop aircraft (primarily C-21s and C-12s, respectively). Each Service schedules, operates, and maintains its OSA assets with minimal coordination with the other Services.

The United States Transportation Command (USTRANSCOM) was tasked by the Chairman, Joint Chiefs of Staff (CJCS), to provide recommendations concerning consolidating the scheduling of the OSA fleet. This consolidation would result in all Services' OSA flight requests being transmitted to a single activity for scheduling. A single, consolidated scheduling activity was viewed to be more efficient in performing the OSA mission, although the amount of efficiencies gained was unknown. Improved utilization of the OSA fleet became more important, given planned reductions in the size of the future OSA fleet. USTRANSCOM tasked the Institute for Defense Analyses to conduct a study to investigate the effectiveness of consolidated scheduling vs. the extant multi-Service coordinated OSA scheduling.

As part of this study, a Joint team of military aircraft schedulers from all Services was formed at Scott Air Force Base, Illinois. Over a two-month period, the team simulated a consolidated OSA scheduling activity. Actual OSA flight requests and Continental United States based aircraft status information from all Services were provided to the team on a daily basis. Consolidated OSA schedules were then built using manual processes.

A representative sample of consolidated and coordinated flight schedules was selected for analysis. The analysis revealed a consistent positive trend in the effectiveness of consolidated scheduling over coordinated scheduling. Consolidated scheduling satisfied 7.5 percent more requests and 7.7 percent more passengers while flying the same number of mission-hours. Consolidated scheduling also produced, on average, missions with a greater number of passengers on fewer aircraft. The analysis in this report contributed to the USTRANSCOM recom-

mendation to the CJCS to "Consolidate OSA scheduling under a single unified commander" (USTRANSCOM, Report of Recommendations for Operational Support Airlift (OSA), p. i, January 19, 1996).

CHAPTER 1. INTRODUCTION

1.1 PURPOSE

The Department of Defense (DoD) maintains a fleet of Operational Support Airlift (OSA) aircraft for military transportation needs. The fundamental purpose of the OSA fleet is to provide wartime movement of high-priority passengers and cargo with time- or mission-sensitive requirements. During peacetime the OSA fleet is used to provide training for operational personnel, to provide cost-effective seasoning of pilots, and for logistic needs in support of national defense policies. Each Service independently schedules, operates, and maintains a portion of the OSA fleet.

The United States Transportation Command (USTRANSCOM) was tasked by the Chairman, Joint Chiefs of Staff (CJCS), to provide recommendations concerning consolidating the scheduling of the OSA fleet. This consolidation would result in all Services' OSA flight requests being transmitted to a single activity for scheduling. A single, consolidated scheduling activity was viewed to be more efficient than multiple, coordinated scheduling activities in performing the OSA mission. USTRANSCOM tasked the Institute for Defense Analyses (IDA) to conduct a study to investigate the effectiveness of consolidated scheduling vs. the extant multi-Service coordinated OSA scheduling.

As part of this study, a team of military flight schedulers was used to simulate a consolidated OSA scheduling activity. The team was given OSA flight requests and Continental United States (CONUS)-based aircraft status information from all Services, from which a daily flight schedule was produced. The consolidated schedules developed by the team were then compared to the actual schedules created by the Services. This report provides analysis of the efficiency of consolidated scheduling of the OSA fleet, compared to the extant multi-Service coordinated scheduling. The analysis in this report contributed to the USTRANSCOM recommendation to the CJCS to "Consolidate OSA scheduling under a single unified commander" [USTRANSCOM 1996].

1.2 BACKGROUND

The requirements for an OSA fleet stem from the need during wartime to move high-priority passengers and cargo having time- or mission-sensitive constraints. Unfortunately, the wartime mission for OSA has not been adequately defined. The governing DoD Directive on OSA concentrates on peacetime OSA issues [DoDD 1985]. A recent Joint Staff report on wartime OSA requirements focused on the number of aircraft needed in the OSA fleet, not the missions of those aircraft [Joint Staff 1995]. However, an accompanying briefing to the Joint Staff report does provide insight into the wartime OSA mission [LaPlante 1995]:

Wartime movement of high priority passengers and cargo with time, place, or mission-sensitive requirements flown in support of DoD-directed wartime operations and other critical CINC-required worldwide wartime commitments which **MUST** be satisfied by organic OSA aircraft. OSA missions include all airlift transportation using DoD-owned or controlled aircraft, except as noted below:

- Strategic Airlift between CONUS and overseas theater
- Tactical employment missions in support of combat operations
- Presidential and congressional support missions provided by the 89th Airlift Wing and HMX-1
- Attache support missions
- Security Assistance Organization
- Pilot training and proficiency flights
- Unit movements

A recent report on the history and possible future of United States Air Force (USAF) OSA provides an excellent description of the OSA wartime mission [Dyche 1995, pp. 196-197]. The following missions are defined:

- a. Intratheater transportation of commanders and their staffs. OSA provides short-notice, rapid-response airlift to support the time-critical travel needs of the senior military commanders and staff personnel so they can visit their field commanders and troops and personally assess the course of battle.
- b. Intratheater transportation of other essential personnel including small teams. OSA provides efficient, reliable transportation of small numbers of key personnel when regular intratheater airlift cannot meet time constraints and/or the number of personnel is too small to make efficient use of larger aircraft.

- c. Intratheater patient airlift and medical support. OSA provides rapid response medical evacuation capability from forward areas to rear area medical facilities or between rear area facilities.
- d. Intratheater logistics transportation. OSA provides quick response airlift of critical spare parts and other mission essential logistics needs.
- e. Intratheater transportation of courier, intelligence, and other classified material. OSA provides rapid delivery of essential materials between command headquarters and field units. Such items as air tasking orders and other classified mission orders, video and still photographic imagery, general intelligence materials, and even key enemy prisoners of war can be moved on OSA aircraft.
- f. Intratheater search and rescue. OSA augments the normal search and rescue (SAR) assets by providing additional sets of eyes and ears during SAR operations.

Clearly, the focus of the wartime OSA mission is on intratheater transportation. This focus is supported by the recent Joint Staff report on OSA wartime requirements, which used a scenario involving two major regional contingencies in order to determine the number of aircraft needed in the OSA fleet [Joint Staff 1995].

The number of aircraft in the OSA fleet is declining. In late 1994, there were 551 OSA aircraft based in CONUS and Outside Continental United States (OCONUS) [CORM 1995]. The Joint Staff effort to base the OSA inventory on wartime requirements has led to a planned reduction of the OSA fleet to 391 aircraft by 1997 [Joint Staff 1995]. The majority of aircraft in the OSA fleet are low-passenger jets and turboprop aircraft (C-21s and C-12s, respectively). These aircraft typically seat seven passengers. During peacetime, many of these aircraft are based in CONUS. In wartime or during contingencies, needed aircraft would be flown to the theater(s) of interest.

The peacetime OSA mission is "to provide essential training for operational personnel, to provide cost-effective seasoning of pilots, and for logistic needs to ensure military effectiveness in support of national defense policies" [DoDD 1985]. Fundamentally, the peacetime OSA mission is to ensure that adequately trained pilots are available to fulfill the wartime OSA mission. As a by-product of funded and essential readiness training, OSA aircraft can be used to transport official DoD passengers and cargo.

Each Service currently operates a scheduling activity for its OSA aircraft. A generic scheduling process is shown in Figure 1. The process begins by building a schedule based on a Service's set of requests and available aircraft. Requests that are allocated to a mission are

deemed *satisfied*. The missions that constitute the schedule can be modified up to the time of flight. Up to 50 percent of the scheduling effort is devoted to this modification process. The lower portion of Figure 1 depicts what happens to requests that are not initially satisfied. These requests are either 1) satisfied on non-OSA aircraft (e.g., contract aircraft), 2) satisfied on another Service's aircraft in what is called a *passoff*, or 3) *regretted* with the requester needing to fly on a commercial airline.

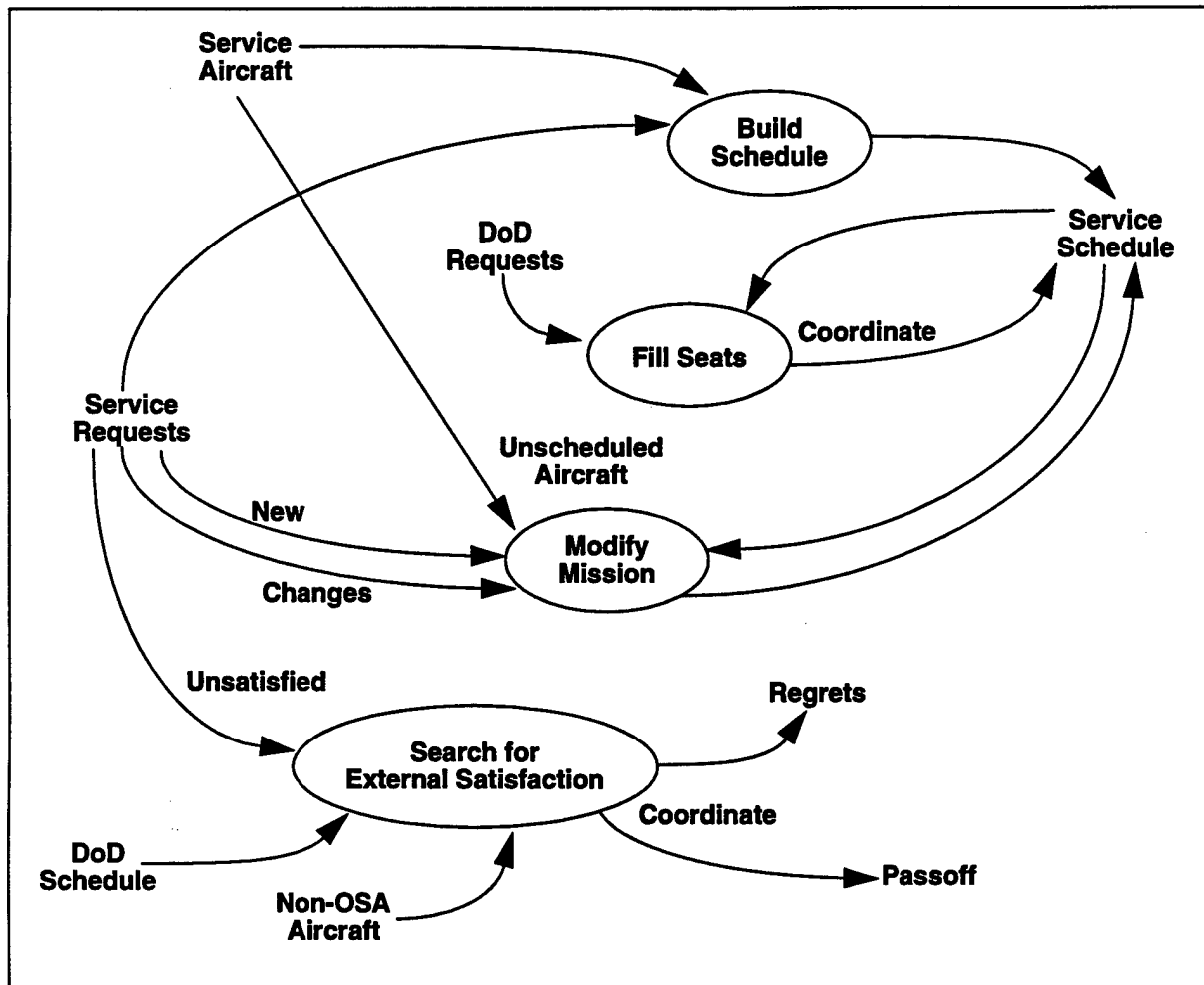


Figure 1. Generic OSA Scheduling Process

The “Fill Seats” process in Figure 1 involves a Service actively searching for requests from other Services in order to fill as many empty seats as possible on their own scheduled missions. This process is currently not performed, but automated tools currently in development will make this practical. The “Search for External Satisfaction” process involves

a Service attempting to satisfy a request on another Service's aircraft. This manual process is performed infrequently today, and automated support is anticipated in the future.

Until recently, each Service had its own information system to assist in building flight schedules. In fiscal year 1996, the Services began transitioning to the use of a single system, the Joint Air Logistics Information System (JALIS). This system provides automated support for validating flight requests, determining aircraft status, building aircraft missions, and limited support for optimizing flight schedules.

Two DoD reports have made recommendations concerning the scheduling of OSA aircraft. The 1993 Roles, Missions and Functions of the Armed Forces of the United States report recommended that "TRANSCOM will develop the capability to coordinate and schedule intratheater airlift" [CJCS 1993]. To that end, JALIS was selected as the DoD standard migration system for OSA scheduling and USTRANSCOM provided funding to implement a coordinated scheduling capability. The 1995 Commission on Roles and Missions of the Armed Forces report recommended that the whole OSA fleet be assigned to USAF and that "USTRANSCOM should manage and schedule the resulting OSA fleet in support of all Services and CINCs and coordinate the scheduling of Navy C-9s to ensure optimum use of the entire OSA fleet" [CORM 1995].

1.3 APPROACH

A set of OSA effectiveness measures was developed to allow comparison between the coordinated and consolidated scheduling methods. A Joint scheduling team was then formed at Scott Air Force Base, Illinois, and operated from October 15, 1995, through December 15, 1995. The team consisted of six experienced schedulers: two representatives from both United States Army (USA) and United States Navy (USN), and one representative each from United States Marine Corps (USMC) and United States Air Force (USAF). Using actual OSA flight requests and CONUS-based aircraft status information from each Service, the team produced a set of consolidated OSA flight schedules. A contiguous 13-day subset of these schedules was selected for analysis. These schedules were then entered into JALIS which performed several validation checks to detect erroneous missions (e.g., missions that exceeded allowable pilot crew day). The consolidated schedules were then compared to the actual coordinated schedules produced by the Services. This comparison was done by IDA using the aforementioned set of OSA effectiveness measures.

1.4 SCOPE AND LIMITATIONS

The analysis in this report is drawn from an experiment involving replicated scheduling of OSA aircraft. The baseline aircraft schedules were those independently developed and flown by each of the Services. A second set of schedules, based on all of the Services' airlift requests and available aircraft, was generated by a Joint team of military schedulers. Care was taken to reasonably simulate a consolidated scheduling activity. However, there were a number of factors that differentiated the methods in which the consolidated and baseline schedules were developed:

- a. The scheduling modification process was not fully simulated. This process involves incrementally modifying missions based on changes in requests or aircraft status. Often these modifications involve time-consuming phone calls to airlift requesters to ensure the changes are acceptable. Changes to missions were simulated by the consolidated scheduling team, albeit without actual phone calls. The team used reasonable judgement in evaluating whether or not a requester would accept flights outside of their scheduling window
- b. The consolidated scheduling team developed schedules manually without the aid of an automated information system. The use of such a system was planned but encountered implementation difficulties. Without an automated system, optimizations could not be performed on the consolidated schedules. Although most of the missions were ultimately entered into an automated system, these optimizations were not performed.
- c. The analysis is drawn from a small sample of scheduling days, due to the limited duration in which the scheduling team was constituted. However, a concerted effort was made to ensure that the selected sample was representative of annual flight patterns.

1.5 ORGANIZATION

Chapter 2 of this report provides more detail on the methodology used in developing and analyzing the OSA consolidated flight schedules. Chapter 3 presents the analysis of the consolidated flight schedules, with respect to the actual coordinated schedules created and flown by the Services. Chapter 4 presents conclusions based on the analysis from Chapter 3. Appendix A is a brief examination of the potential effect that a reduction in OSA flying hours would have on the Services' capability to satisfy lower priority requests. Appendix B is a sum-

mary of the raw data that forms the basis for the analysis in Chapter 3. The report concludes with a list of references, a glossary, and a list of acronyms.

CHAPTER 2. METHODOLOGY

This chapter describes the methods used in conducting this study. Presented first are the effectiveness measures established for comparing the data resulting from the two scheduling methods studied in this report. The specific data items collected in support of the analysis of these measures are then given. The scheduling method currently used by the Services is referred to as *coordinated scheduling*. The Joint scheduling method is referred to as *consolidated scheduling*. Next, the consolidated scheduling process is described. A brief discussion is then presented of how the manually developed consolidated schedules were transformed to allow automated analysis. Finally, the aircraft inventory available to the consolidated scheduling team is identified.

2.1 EFFECTIVENESS MEASURES

At the beginning of the study, three areas were selected for analyzing the coordinated and consolidated schedules. Within each of the three areas, measures of effectiveness were developed. The areas and measures are presented in the following list and are analyzed in Chapter 3.

- a. What is the volume of passengers and cargo accommodated by the OSA fleet?
 1. How many passengers were transported (by grade and priority)?
 2. How many pounds of cargo were transported?
 3. What percent of requests are being satisfied (by grade and priority)?
 4. How many missions and mission-hours were scheduled?
 5. How many passenger-hours and empty-seat hours were scheduled?
- b. What is the cost effectiveness of OSA missions?
 1. How does the cost of flying the OSA missions compare with the cost of commercial transportation (by grade and priority)?

2. How many of the OSA missions were less expensive to the government than flying on commercial aircraft?
- c. What is the level of inter-Service resource sharing?
 1. How many passengers from other Services were flown (by priority and grade)?
 2. How many missions were composed of single Service passengers and/or cargo?
 3. How many missions were composed of multiple Service passengers and/or cargo?
 4. How many missions were flown by one Service exclusively for another Service?

2.2 DATA ITEMS COLLECTED

The following data items were collected and analyzed from the sample set of scheduling days included in this study.

- a. For each OSA aircraft-mission flown:
 1. Aircraft type flown.
 2. Number of legs (by hours per leg).
 3. Passenger information (by grade, priority, request, and leg).
 4. Cargo information, in pounds (by priority, request, and leg).
- b. For each OSA aircraft-mission flown:
 1. Cost to fly the aircraft.
 2. Cost to fly each passenger on commercial aircraft (by priority and grade).
- c. Miscellaneous data items:
 1. Number of requests (total received, satisfied, regretted, passed off, and cancelled).
 2. Number of requests denied because they could not be cost justified.
 3. Cost to fly regretted passengers on commercial aircraft (by priority and grade).

2.3 CONSOLIDATED SCHEDULING PROCESS

The first two weeks of the study were used to develop and become proficient in the processes to be used in consolidated scheduling and to allow team members to gain an understand-

ing of the other Services' OSA environments. Example activities performed during this two-week learning period included the following:

- a. Becoming familiar with all Services' aircraft inventories, configurations, and capabilities.
- b. Developing common methods for graphically representing requests to facilitate the process of building missions.
- c. Developing guidelines for satisfying and regretting Priority 2 airlift requests of one or two passengers. All airlift requests have a priority associated with them. Priorities range from 1 to 3, with 1 being the highest priority and 3 being the lowest.
- d. Obtaining daily data (e.g., requests, aircraft status) from each Service's scheduling activity in order to provide the input to the consolidated scheduling process.

A number of trial schedules were developed during this initial training period. The data from this period were not used for analysis because they reflected the team's scheduling learning curve. The team gained experience as time passed, however, and the data from the 13-day period of October 29, 1995, to November 10, 1995, were selected for analysis.

The actual consolidated scheduling process consisted of the following steps.

- a. Request and aircraft status information was obtained from each Service's scheduling activity. Only requests that would be normally satisfied by CONUS-based aircraft were considered.
- b. The requests were written onto large whiteboards with a superimposed CONUS map. Request information displayed on the whiteboards included the requester's origin and destination, number of passengers and cargo, request priority, and the scheduling window for the request. Due to space limitations, Priority 3 requests of one, two, and three passengers were not placed on the whiteboards. Had an automated scheduling system been available to the team, these requests would have been automatically evaluated to determine if they could be satisfied on existing missions. As such, these requests were manually examined, as part of a later schedule modification process, to determine if they could be satisfied.
- c. A list was created of all aircraft that had remained overnight at a location and needed to fly back to their base or installation. These aircraft were made available to satisfy requests.

- d. Missions were then created based on the requests displayed on the whiteboards and the list of available aircraft. As available aircraft were assigned to a mission, an aircraft summary status sheet was updated.
- e. Requests that could not be satisfied were regretted. Requests were regretted because a cost-effective mission could not be built, or there were no aircraft available to support the request.
- f. All information related to the scheduling day was recorded on paper for later analysis.

2.4 DATA PREPARATION

The JALIS scheduling system became partially operational after the scheduling team disbanded. To facilitate data analysis, IDA entered approximately 80 percent of the consolidated missions into JALIS. Minor adjustments were made to correct some of these missions, such as missions that exceeded the crew day, used unavailable aircraft, or where insufficient seats were available on the aircraft. Pertinent data from the remaining 20 percent of the missions that were not entered into JALIS were extracted manually for inclusion in the study analysis.

2.5 AIRCRAFT INVENTORY

Table 1 describes the inventory of 360 CONUS-based aircraft that were included in this study. Actual aircraft status information was provided to the scheduling team on a daily basis.

Table 1. Aircraft Inventory

Service	Aircraft Type	Number in Inventory	Maximum Passengers
USAF	C-21	51	7
	C-22	3	77 or 89
USA	C-12	110	7 or 8
	C-20	4	26
	C-21	3	6, 7
	C-23	18	19
	C-26	9	18
	U-21	56	4 or 5

Table 1. Aircraft Inventory (Continued)

Service	Aircraft Type	Number in Inventory	Maximum Passengers
USMC	C-9	2	90
	C-12	14	7
	C-20	1	26
	T-39	2	7
USN	C-9	27	90
	C-12	43	7
	C-20	4	26
	C-130	8	76
	T-39	5	6 or 7

Two of the USAF C-22s were configured for 77 passengers, one for 89 passengers. Not included in Table 1 were Special Assignment Airlift Mission (SAAM) contract aircraft that flew OSA requests. There were approximately a dozen SAAM missions on KC-135s, KC-10s, C-141s, and C-130s.

A number of the USA aircraft were not considered OSA aircraft but were included in the study and made available to the team for occasional OSA missions. These non-OSA aircraft were from Army Table of Organization and Equipment (TO&E) units (18 C-12s and 8 U-21s), Army Reserve units (8 C-12s and 18 U-21s), and Army Materiel Command units (6 C-23s). During the study period, the Army was gradually replacing U-21s with C-12s.

The USN C-9s and C-130s are Navy Unique Fleet Essential Airlift (NUFEA) aircraft. Two of the USN T-39s and two of the USN C-20s were from the USN Washington Detachment.

The Air National Guard (ANG) operates approximately 29 OSA aircraft in support of unit, state, and federal requirements. However, these aircraft were not included in this study because they were being independently scheduled by the units that operated the aircraft. During this study, the ANG was beginning the transition to a centralized ANG scheduling activity using the JALIS scheduling system.

CHAPTER 3. ANALYSIS

This chapter provides analysis of the data obtained from the coordinated and consolidated scheduling processes. Effectiveness measures defined in Chapter 2 are presented via figures that compare the two scheduling methods. The following areas were examined:

- a. Satisfied requests.
- b. Satisfied passengers.
- c. Missions scheduled.
- d. Mission-hours scheduled.
- e. Passenger-hours scheduled.
- f. Empty seat-hours.
- g. Joint missions.
- h. Mission cost effectiveness.

Most of the figures are organized on the horizontal axis by four aircraft categories:

- a. Total: The total from the Large, USA TO&E, and Small OSA aircraft, as defined in the next three categories.
- b. Large: The large aircraft, with a capacity of greater than 20 passengers, included the following:
 - 1. USN NUFEA C-9s and C-130s.
 - 2. USAF Team Travel C-22s.
 - 3. USAF SAAM aircraft contracted from the Air Mobility Command (AMC) SAAM for an OSA mission.
 - 4. USMC C-9s.
- c. USA TO&E: C-12s, U-21s, C-23s, and C-26s.

- d. **Small OSA:** Aircraft dedicated to OSA missions with a capacity of 20 or fewer passengers.

The vertical axis on all figures in this chapter represent a yearly projection of the results from the 13-day study period. A coefficient of 36 was used to project the consolidated scheduling data to the level of request satisfaction of Fiscal Year 95. This coefficient was derived by dividing the total number of fiscal year 1995 OSA requests (68,985) by the total number of requests during the 13-day study period (1,918).

Each bar on the figures is broken down either by request priority level or by Very Important Person (VIP) category. The priority levels are as follows:¹

- **Priority 1:** Emergency airlift in direct support of operational forces or for life-saving purposes.
- **Priority 2:** Airlift with scheduling constraints that cannot be satisfied by any other mode of transportation.
- **Priority 3:** Official airlift which can be shown to be cost effective when supported by military airlift.

The VIP categories for missions are broken down into the following military ranks:

- **Required Use:** O-10 (and equivalent) and above.
- **VIP:** O-6 to O-9 and equivalent.
- **Non-VIP:** All other passengers.

¹ DoD Directive 4500.43 specifies five priorities. However, a three-priority system has been subsequently adopted by all Services and is expected to be used in the future revision to DoDD 4500.43.

3.1 REQUESTS SATISFIED

Figure 2 shows the number of OSA requests scheduled by aircraft category and priority using the coordinated and consolidated methods. Satisfied requests are an indicator of the number of transactions a scheduling activity might accommodate. Since requests range in size from a single passenger to a large unit movement, the count of satisfied requests must always be examined with the number of satisfied passengers as a measure of volume of work accomplished.

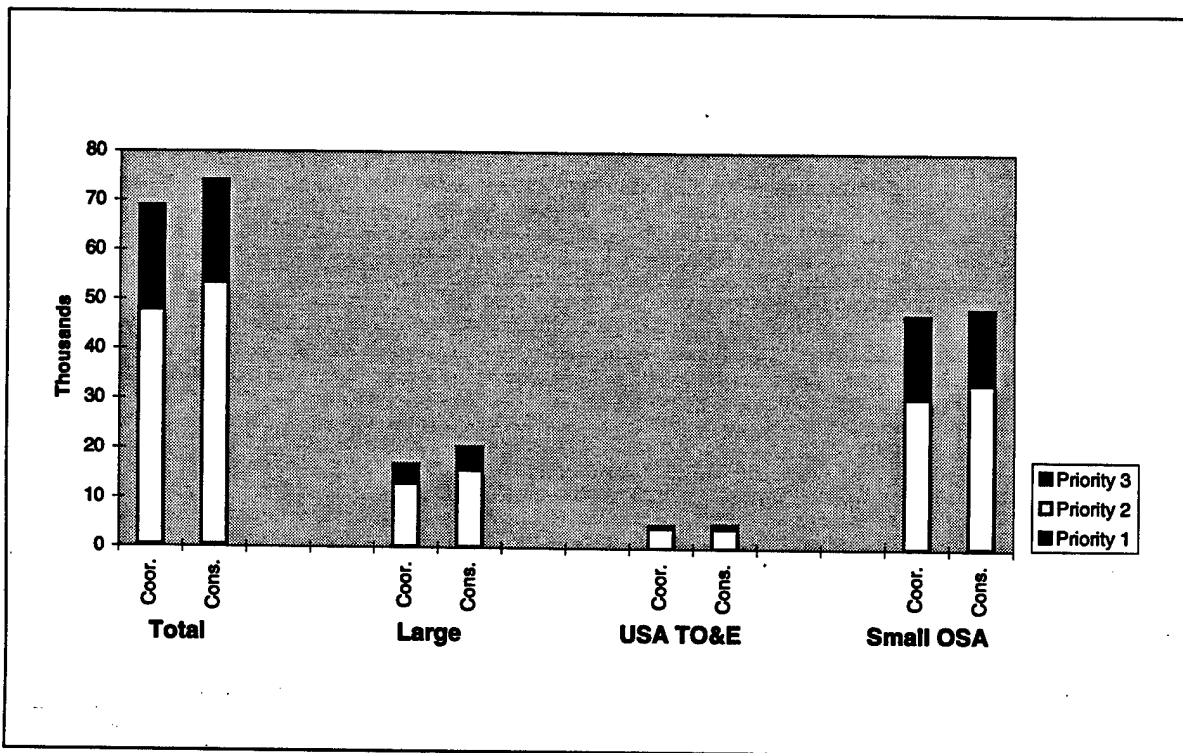


Figure 2. Requests Satisfied

As shown in Figure 2, the total number of satisfied requests increased by 7.5 percent. This increase is primarily due to a 21.5 percent increase in satisfied requests on large aircraft. The number of satisfied Priority 2 requests increased by 11.5 percent. This increase was brought about by equal contributions from large and small OSA aircraft.

Figure 3 gives a breakdown of the number of satisfied requests by large aircraft. There are two reasons why NUFEA satisfied the majority of large requests. First, there are many more NUFEA aircraft than other large aircraft. Second, the individual personality of the consolidated scheduling team tended to consider these aircraft first when satisfying requests. The key point of Figure 3 is that large requests were combined on these aircraft (along with smaller requests)

in order to more effectively fill seats. Figure 4 illustrates the number of satisfied requests by VIP category. While the total Required Use and Non-VIP requests increased, the VIP category decreased by 9.9 percent. This decrease was probably due to the scheduling team giving more consideration to request priority and cost effectiveness, rather than VIP category, in selecting requests to be satisfied.

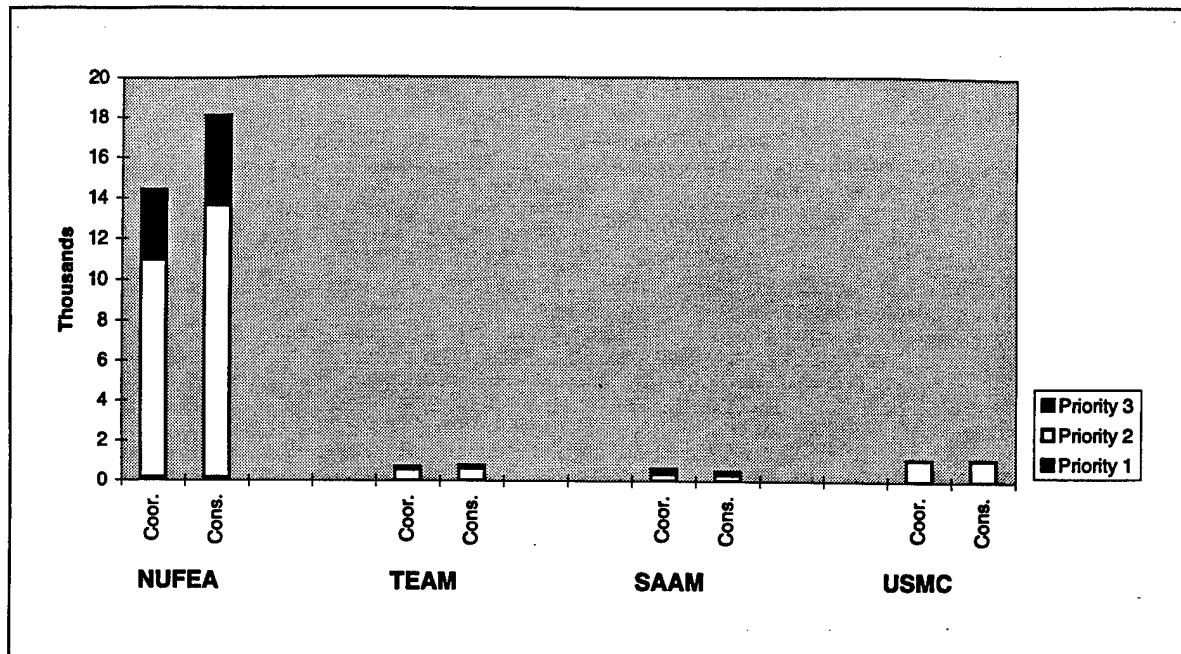


Figure 3. Requests Satisfied on Large Aircraft

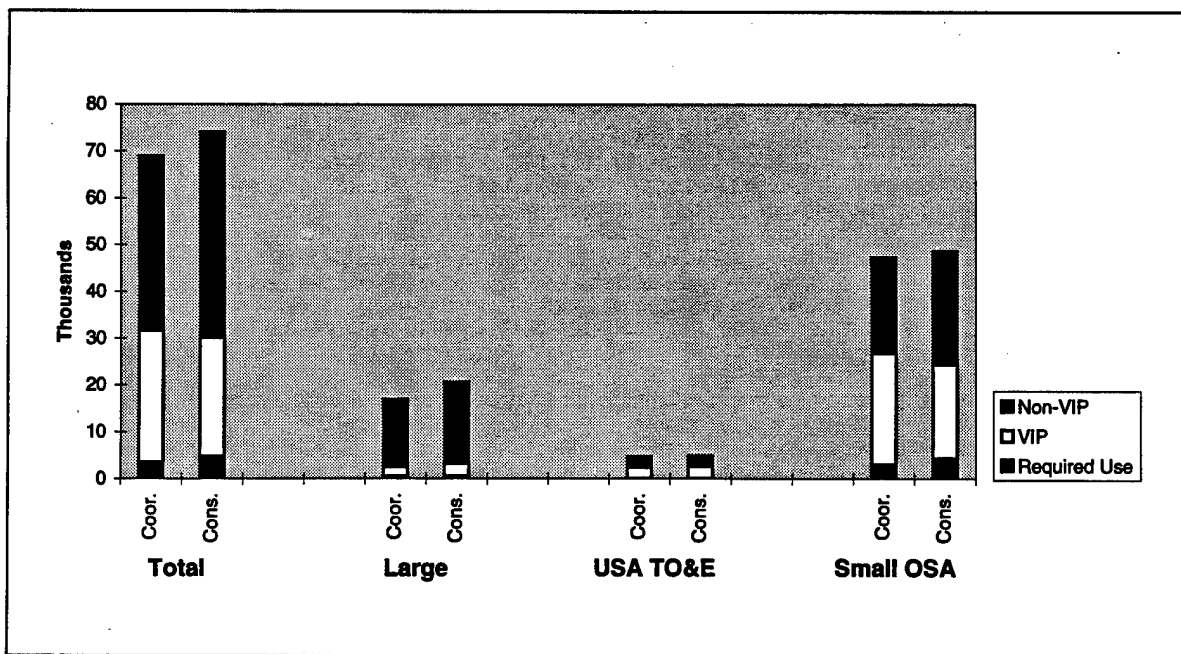


Figure 4. Requests Satisfied by VIP Category

3.2 PASSENGERS SATISFIED

Figure 5 shows the number of passengers from OSA requests by aircraft category and priority that were scheduled using the coordinated and consolidated methods. It is an indicator of the volume of work accomplished and should always be considered along with the number of satisfied requests. The priority of the passenger is determined by the priority of the request.

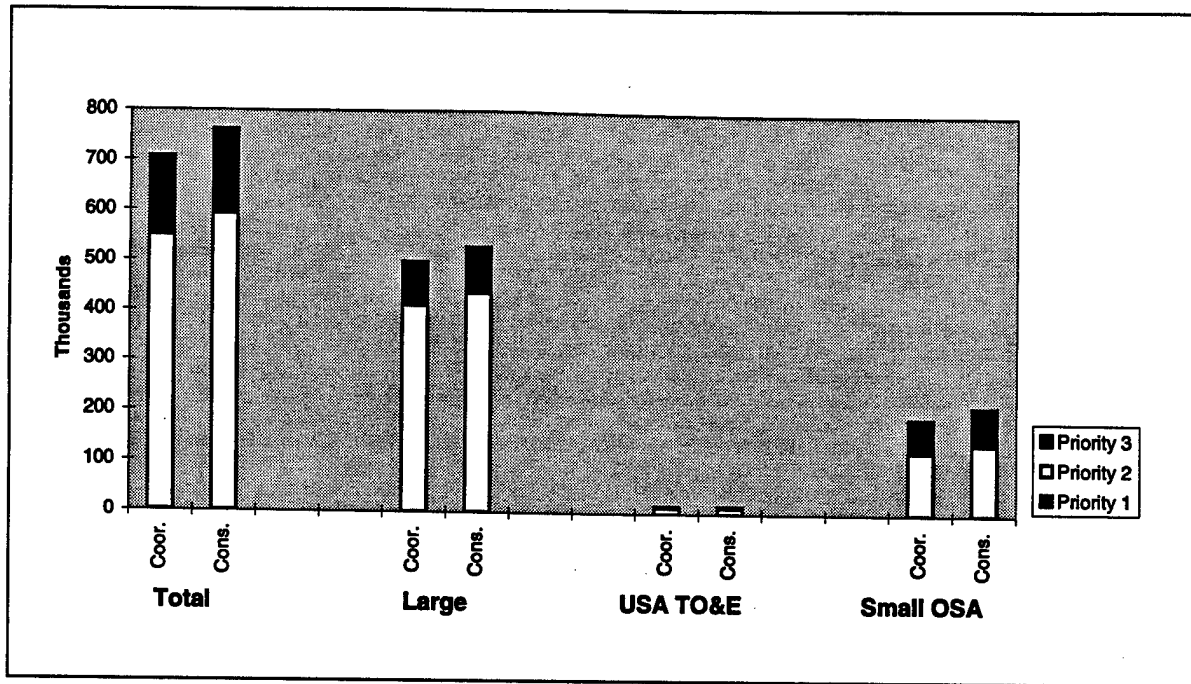


Figure 5. Passengers Satisfied

As shown in Figure 5, the total number of satisfied passengers increased by 7.7 percent. This increase is roughly the same as the increase in total satisfied requests (Figure 2). There was a 6.1 percent increase in passenger satisfaction on large aircraft, and a 12.4 percent increase in passenger satisfaction on small OSA aircraft.

Figure 6 illustrates the number of satisfied passengers by large aircraft. Figure 7 illustrates the number of satisfied passengers by VIP category. The VIP category of each passenger is determined by the grade or VIP code of the senior passenger. Therefore, six passengers traveling with an O-10 are all counted with the Required Use numbers. Additionally, there was a 3.5 percent increase in the pounds of cargo carried on OSA missions.

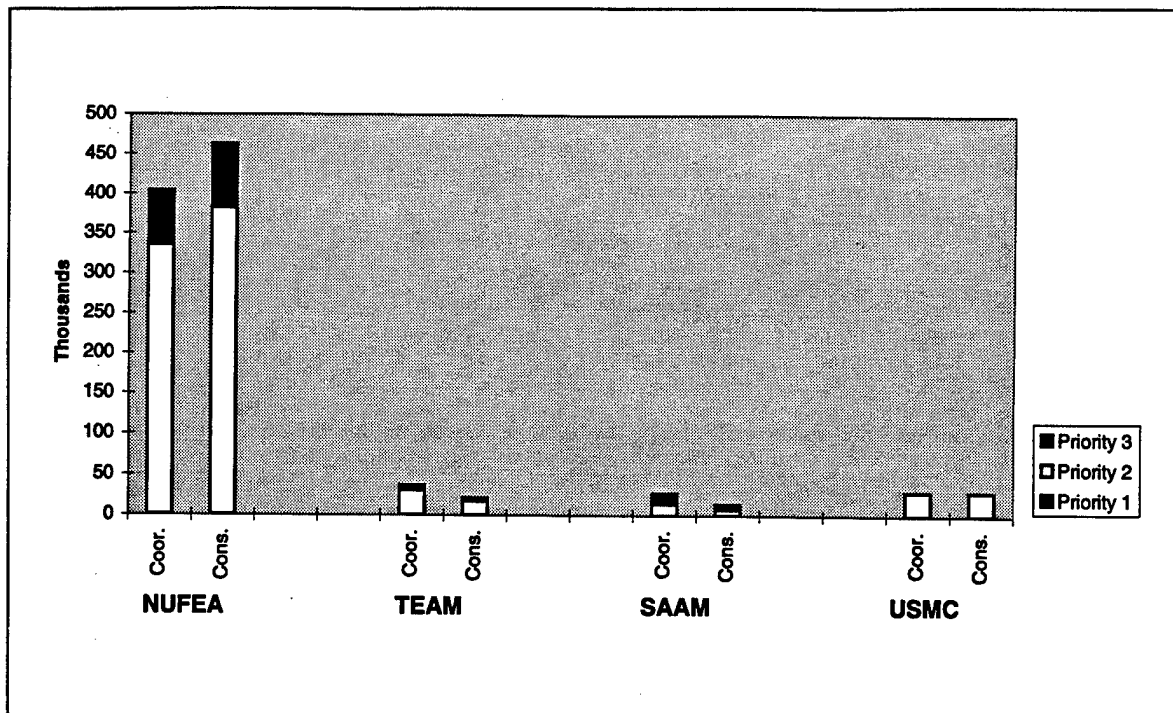


Figure 6. Passengers Satisfied on Large Aircraft

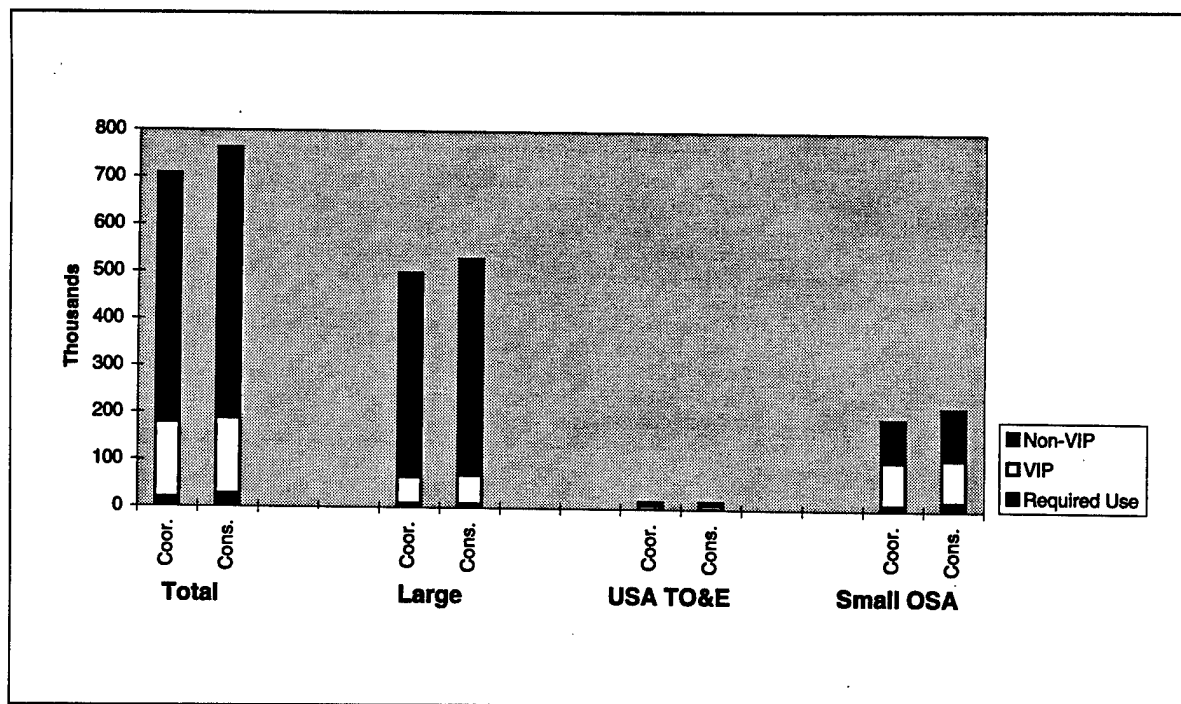


Figure 7. Passengers Satisfied by VIP Category

3.3 MISSIONS SCHEDULED

Figure 8 shows the number of missions scheduled by aircraft category and priority using the coordinated and consolidated methods. Missions scheduled is an indicator of the amount of resources expended to accomplish the work. Since missions vary greatly in duration, this should always be considered with the number of mission hours.

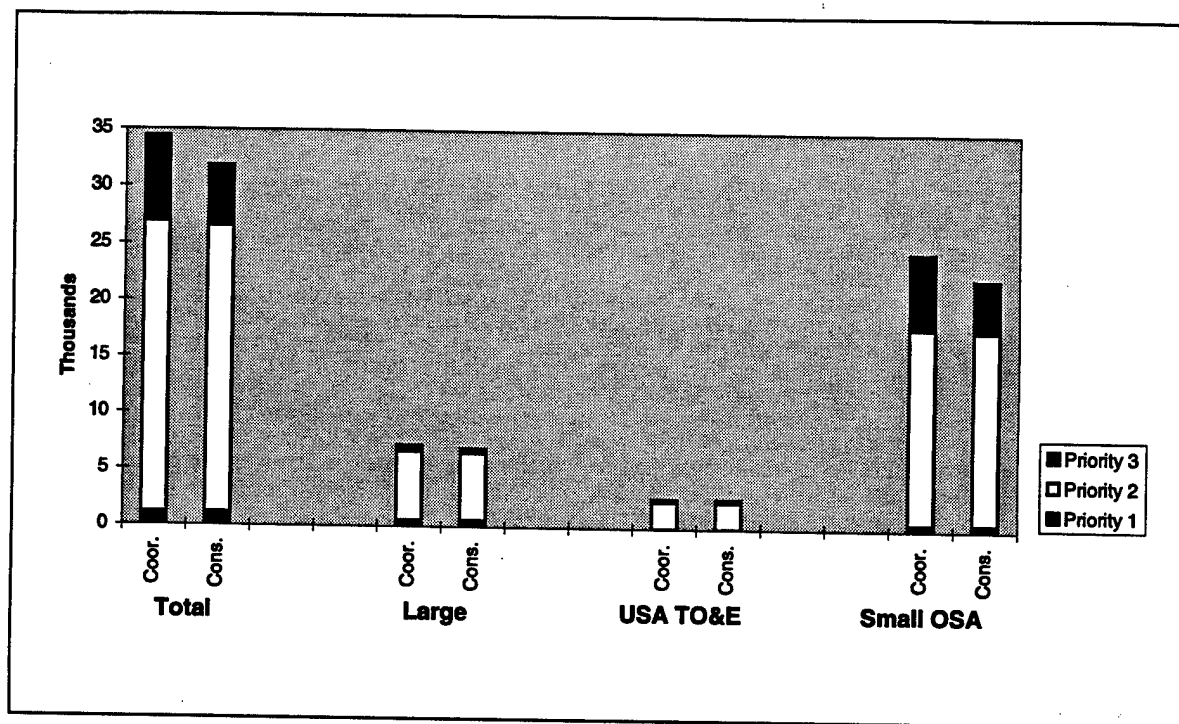


Figure 8. Missions Scheduled

There is a relatively small percentage of multi-day missions but normally a mission is assigned to one aircraft for one day. A mission will satisfy one or more requests. Missions with no passengers or cargo were removed from the study. Large requests are often split between multiple missions. The priority of a mission is determined by the highest priority of all of the requests scheduled on the mission.

As shown in Figure 8, the total number of missions scheduled decreased by 8.1 percent. This decrease is primarily attributed to a 10.3 percent decrease in small OSA missions. There was a 31 percent decrease in small OSA missions with a highest priority request of 3.

Figure 9 illustrates the number of missions scheduled on large aircraft. The same circumstances that led to a large increase in request satisfaction (Figure 2) also led to an increase in the number of missions for NUFEA even though fewer large aircraft were used.

Figure 10 depicts the number of missions scheduled by satisfied VIP request category.

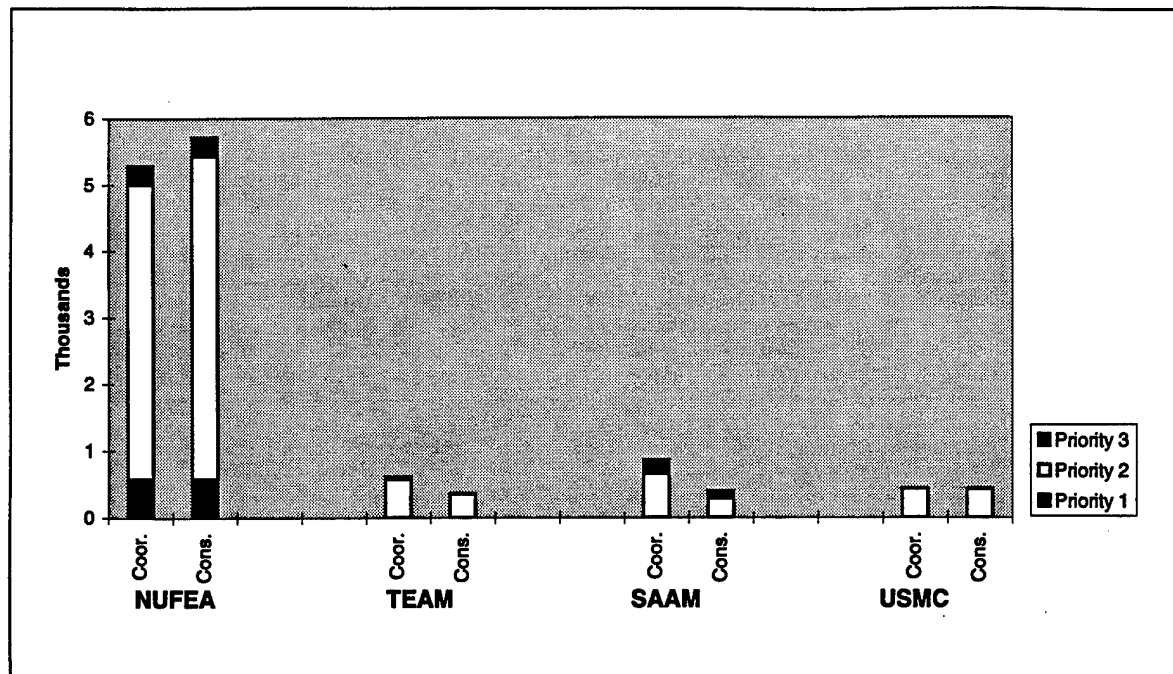


Figure 9. Missions Scheduled for Large Aircraft

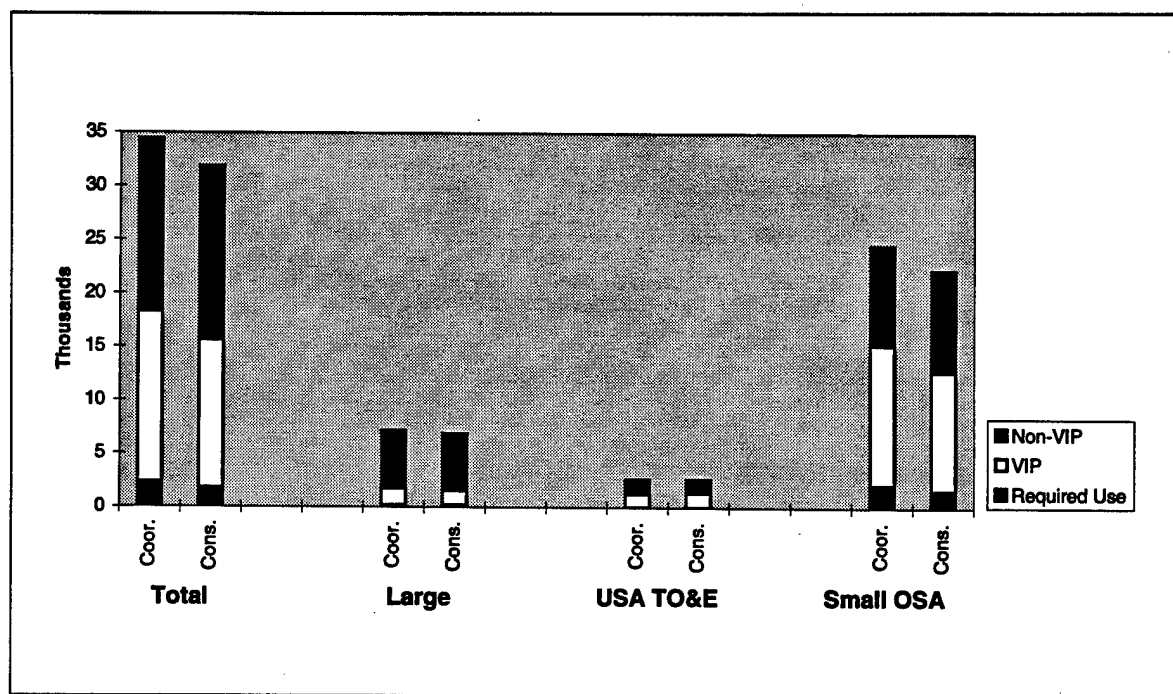


Figure 10. Missions Scheduled by VIP Category

3.4 MISSION-HOURS SCHEDULED

Figure 11 shows the number of hours scheduled (by aircraft category and priority) on OSA missions for the coordinated and consolidated methods. The number of mission-hours scheduled is another indicator of the amount of resources expended to accomplish the work. Since missions vary greatly in duration, this should be considered with the number of missions.

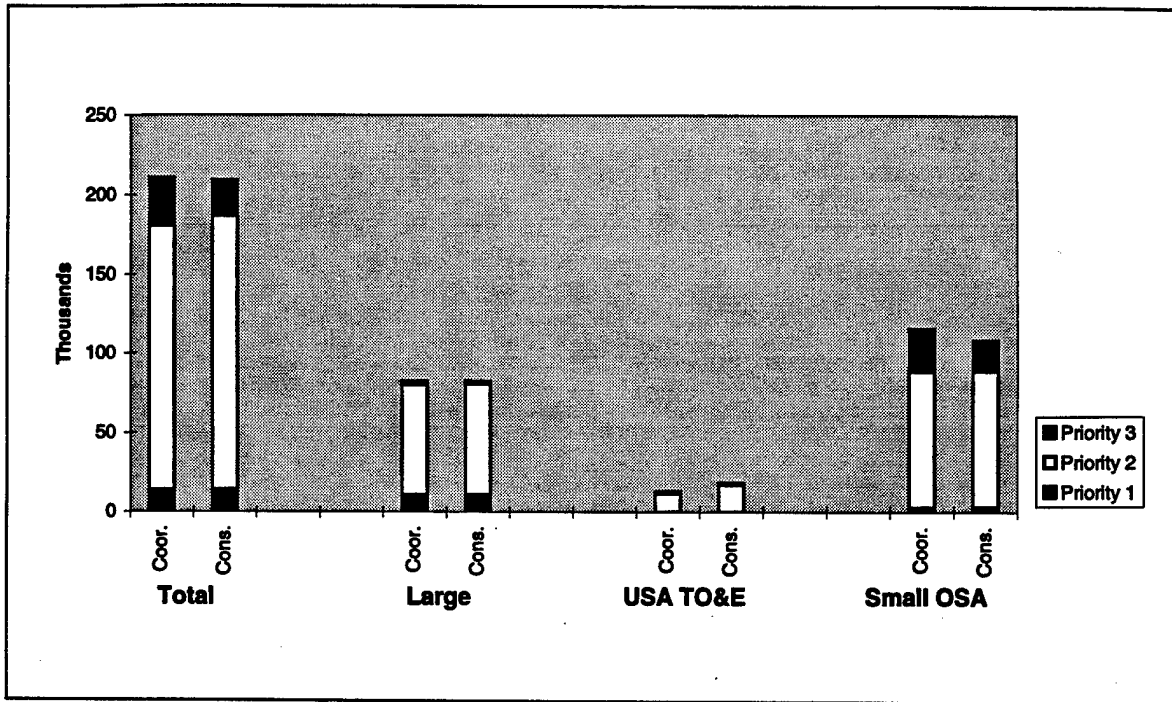


Figure 11. Mission-Hours Scheduled

The number of mission-hours scheduled between the two scheduling methods was roughly equivalent while the number of missions decreased. This suggests that the individual missions were somewhat longer. This increased mission length is most likely due to more complex missions that have a higher ratio of requests and legs per mission.

Figures 12 and 13 present the number of missions-hours scheduled by large aircraft and VIP category, respectively.

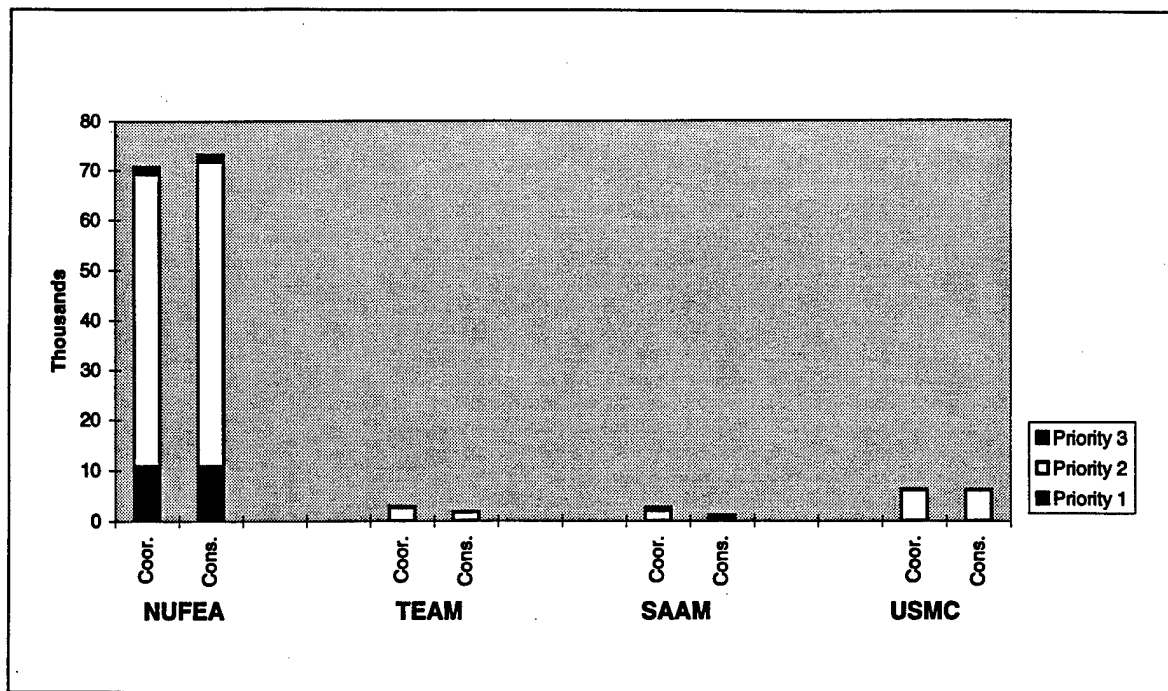


Figure 12. Mission-Hours Scheduled for Large Aircraft

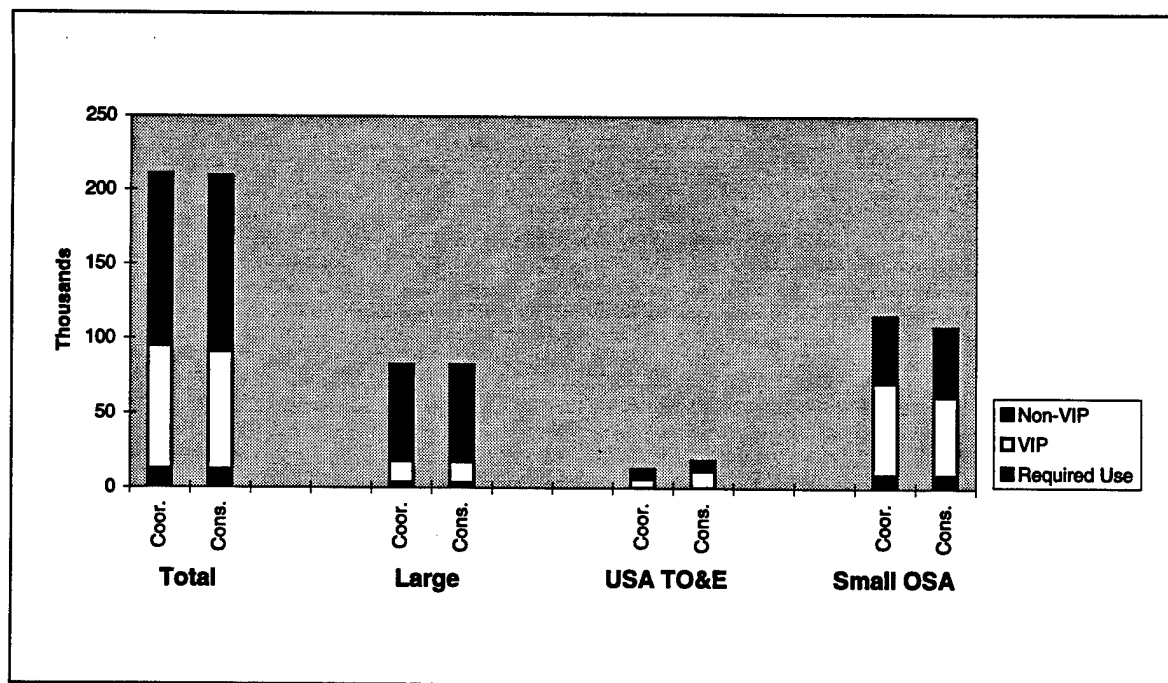


Figure 13. Mission-Hours Scheduled by VIP Category

3.5 PASSENGER-HOURS SCHEDULED

Figure 14 shows the sum of hours that each passenger was in the air. The increase in total passenger-hours is 14 percent. Figure 14 supports the previous figures in that a greater volume of passengers are being scheduled on fewer missions.

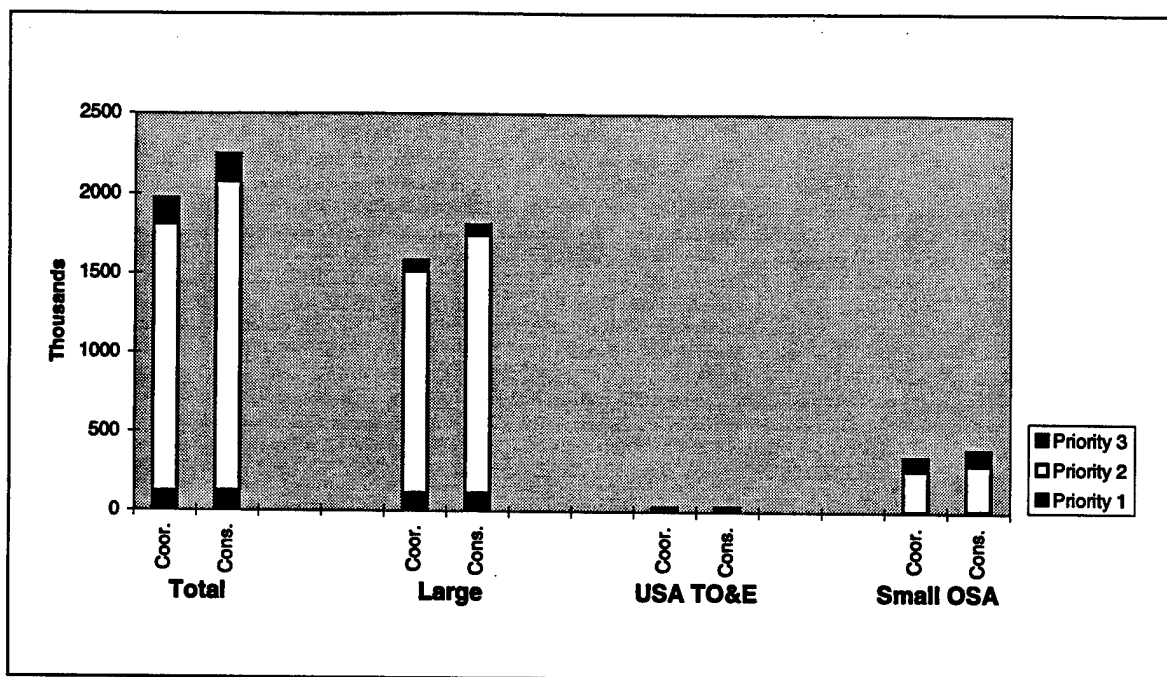


Figure 14. Passenger-Hours Scheduled

Again, as shown by Figure 15, the largest number of passengers are being scheduled on large aircraft. Figure 16 shows a 21.8 percent increase in passenger-hours scheduled by non-VIP category passengers for consolidated scheduling.

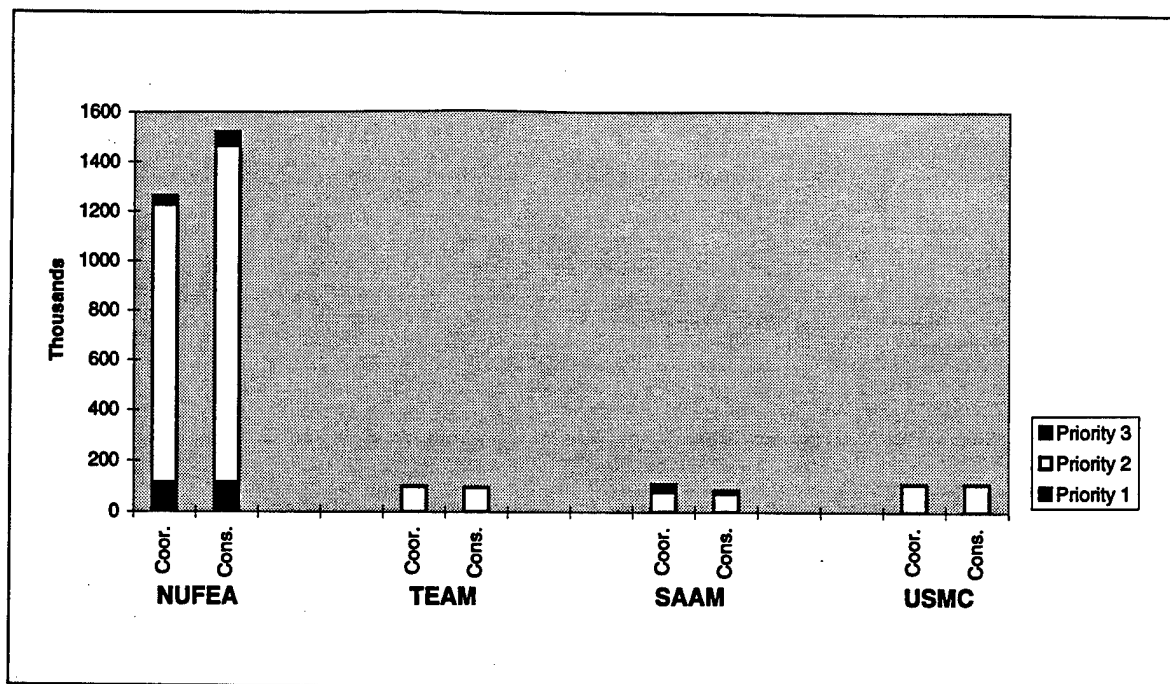


Figure 15. Passenger-Hours Scheduled for Large Aircraft

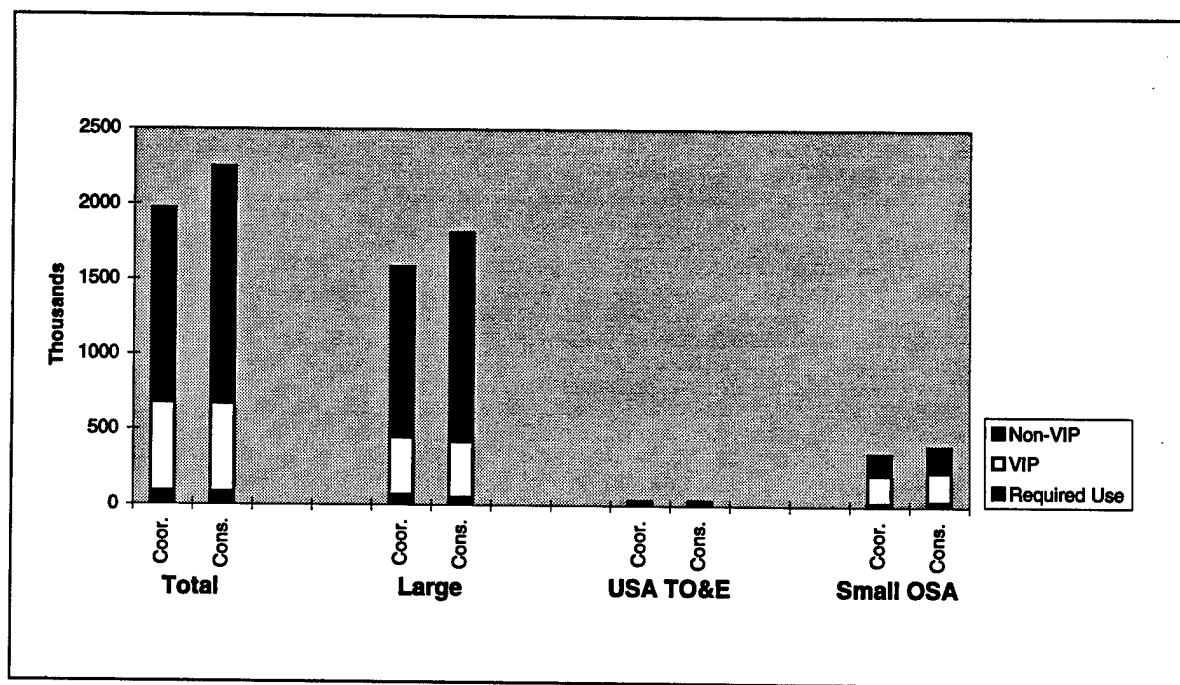


Figure 16. Passenger-Hours Scheduled by VIP Category

3.6 EMPTY SEAT-HOURS SCHEDULED

Figure 17 shows an overall 7.3 percent decrease in total empty seat-hours scheduled. Nearly all of the trends are favorable to consolidated scheduling. The 19.9 percent increase in small OSA empty seat-hours scheduled is partially attributable to a 12.4 percent increase in passengers and a high rate of empty repositioning legs.

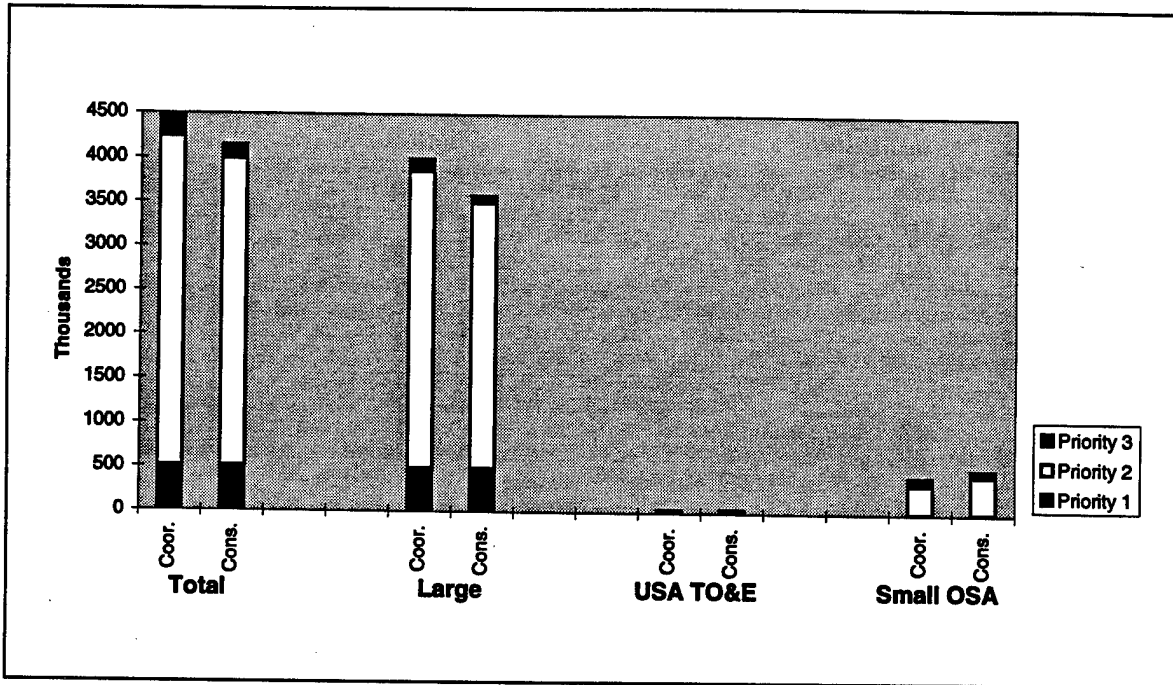


Figure 17. Empty Seat-Hours Scheduled

Figures 18 and 19 present the empty seat-hours by large aircraft and VIP category, respectively.

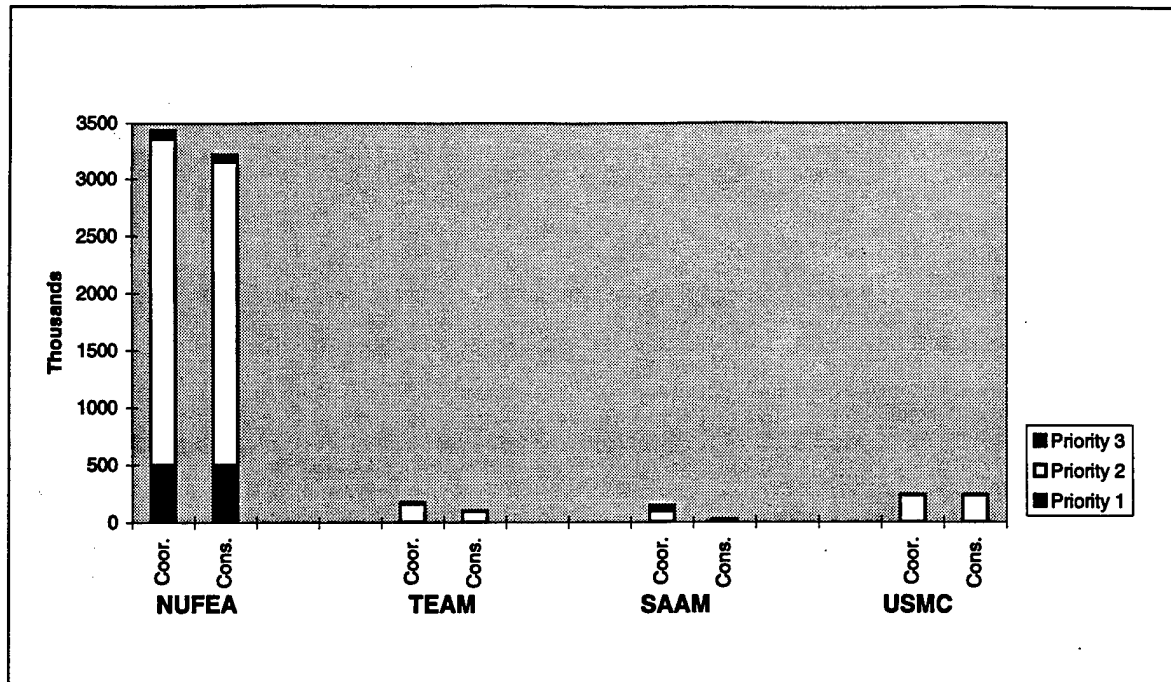


Figure 18. Empty Seat-Hours Scheduled for Large Aircraft

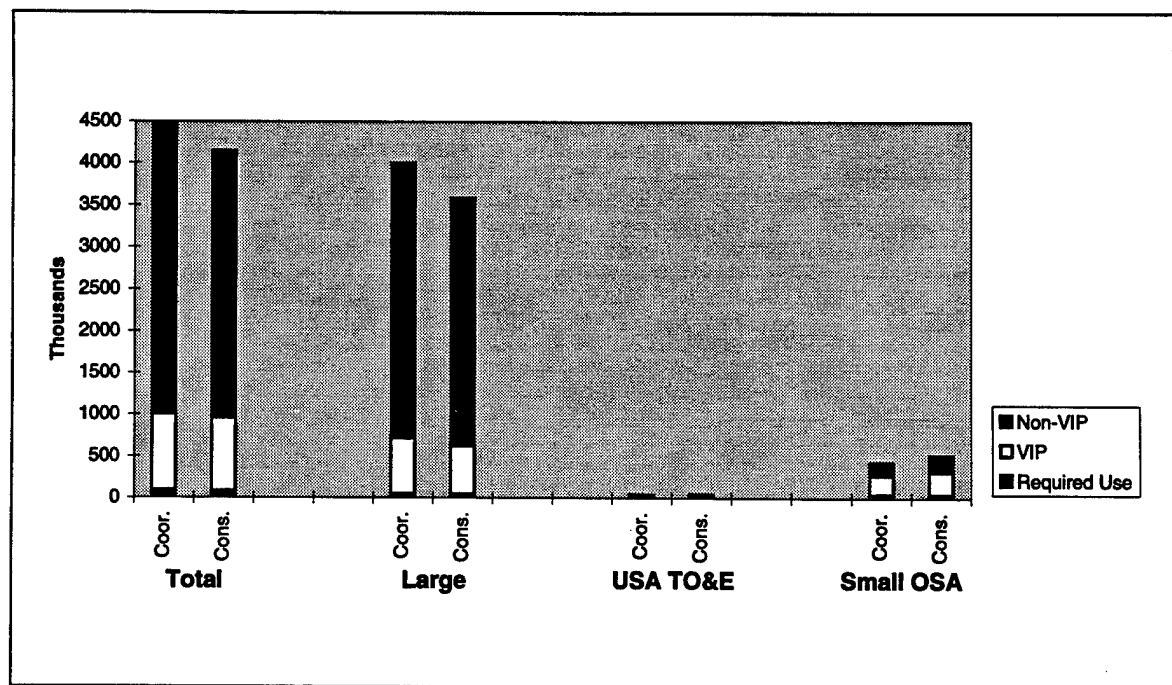


Figure 19. Empty Seat-Hours Scheduled by VIP Category

3.7 JOINT MISSIONS SCHEDULED

Figure 20 shows the relationship between the passengers on each mission and the Service that is operating the aircraft. Single Service missions are those where all passengers on a mission are of the same Service as the pilots of the aircraft. Joint missions are those that have passengers from more than one Service. Sole Use missions are those where all of the passengers are from the same Service, but not of the Service of the pilots of the aircraft (e.g., a USAF C-21 mission with all USA passengers).

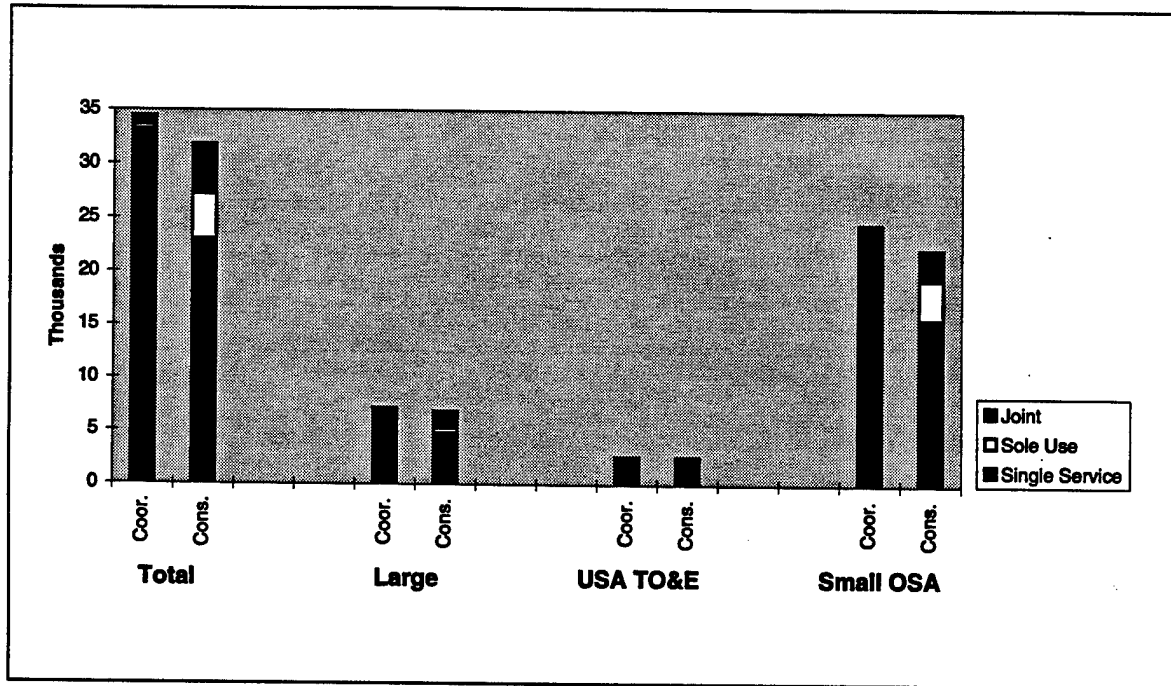


Figure 20. Joint Missions Scheduled

The most significant change in the mix of missions came from the small OSA missions. The number of Joint missions scheduled using the consolidated method increased by 810 percent. The number of Sole Use missions scheduled in the consolidated method increased by 3,300 percent. These extremely large percentage increases are due to a very small number of Joint and Sole Use missions scheduled using the coordinated method. The percentage of Single Service missions scheduled using the consolidated method decreased by 35 percent.

It is evident from Figure 20 that the consolidated scheduling team gave little consideration to matching requests to aircraft from their respective Service. This is an indicator that requests were being matched to the most suitable aircraft available. A Joint mission is not

inherently better than a single Service mission, but the option to schedule aircraft from any Service was a metric of interest.

3.8 MISSION COST EFFECTIVENESS

An analysis was conducted of the number of cost-effective missions created by the consolidated method based on comparison of military operating cost per aircraft and the cost of commercial passenger tickets. This information was only available for 53 percent of the missions because General Services Administration (GSA) city pair cost data was not available for all mission routes. Of these missions, 23.4 percent were cost effective. Broken down by priority, 20.1 percent of the Priority 2 missions were cost effective and 37.5 percent of the Priority 3 missions were cost effective. Because of insufficient information on commercial GSA ticket prices, this specific metric does not allow any independent conclusive evidence that one method of scheduling is better than another.

CHAPTER 4. CONCLUSIONS

The analysis revealed a consistent positive trend in the effectiveness of consolidated scheduling over coordinated scheduling. Consolidated scheduling produced, on average, missions with a greater number of passengers on fewer aircraft in every category. Consolidated scheduling satisfied 7.5 percent more requests and 7.7 percent more passengers while flying the same number of mission-hours.

The consolidated schedules were more effective than coordinated schedules even though the former were exclusively developed using a manual process. Most Priority 3 requests of less than four passengers could not be considered by the consolidated scheduling team because of JALIS fielding difficulties. An automated system would have likely been able to match many low passenger, Priority 3 requests with already scheduled missions. Accordingly, based on experience with automated scheduling systems, it is estimated that a consolidated scheduling activity using a fully operational automated system could produce an additional 10 percent increase in passenger satisfaction rates.

There are several reasons why the consolidated scheduling team was able to satisfy more passengers and requests while flying fewer missions. First, the team was able to build missions from the total set of requests and aircraft available each day. Such improved visibility facilitated the ability to combine several requests on a single mission. Today, Services develop their missions at different times, infrequently seeking to fill their aircraft with other Services' requests, and have an interest in ensuring their flying hour program is fully utilized. Second, the consolidated scheduling team developed a set of business rules to promote consistent scheduling decisions. For example, missions were not routinely written exclusively for one- and two-passenger Priority 2 requests. The scheduling team gave full consideration to cost effectiveness of the mission, the availability of commercial flights, and whether or not the passenger was required-use. This process reduced the number of highly cost-inefficient missions. Third, the consolidated scheduling team was able to better match an aircraft to a set of requests. For example, five-passenger USA U-21s were sometimes used in lieu of seven-passenger USN C-21s. The USN C-21 was then available to satisfy a larger request.

Based on our observations while working with the consolidated team for two months, there appears to be a definite advantage in having Joint representation on a consolidated scheduling team. The ability to make effective decisions about which requests will or will not be satisfied requires a basic understanding of each Service's community, culture, and requirements. For example, the scheduling window for a group traveling for simulator training is usually more flexible than a general officer attending a two-hour meeting. However, the scheduling window specified on the flight request often does not reflect the true range in passenger flexibility. A Joint consolidated scheduling team is often able to use knowledge of the purpose of a requester's trip to help determine the true flexibility of the scheduling window.

APPENDIX A. EFFECT OF REDUCED OSA FLYING HOURS

USTRANSCOM asked IDA to examine the potential effect that a reduction in OSA flying hours would have on the ability to satisfy Priority 2 and 3 requests. Based on data provided by the Services for the planned 391 OSA aircraft fleet identified by the Joint Staff [1995], USTRANSCOM estimated that 218,400 flying hours per year would be needed to maintain pilot proficiency. Of these hours, 20 percent (43,680 hours) would not be available for passenger movement due to functional flight checks, training that prohibits carrying passengers, etc. Thus, USTRANSCOM estimated that 174,720 flying hours would be available for passenger scheduling while maintaining pilot proficiency.

The projected annual flying hours for consolidated scheduling, based on the scheduled described in this report, is 209,365. The difference between the USTRANSCOM flying-hour estimate of hours available for passenger scheduling (174,720) and the projected annual consolidated flying hours (209,365) is 34,645 hours.

Data from the consolidated scheduling study projected a total of 22,947 annual flying hours for missions exclusively satisfying Priority 3 requests. These were missions where all passengers on all legs were Priority 3. Similarly, an additional 172,247 annual flying hours were projected for missions that included a Priority 2 request as the highest request on the mission. If a multi-leg mission had even one Priority 2 passenger on board, all mission hours were counted as Priority 2 flying hours.

If the projected consolidated flying hours were reduced based strictly on mission priority, a reduction of 34,645 hours would result in the elimination of all missions that were exclusively for Priority 3 requests. In addition, there would be a 6.8 percent reduction in the number of flying hours where the highest priority passenger on the mission was Priority 2.

APPENDIX B. SUMMARY OF RAW DATA

This Appendix provides a summary of the raw scheduling data used as the basis for the analysis presented in Chapter 3. The tables reflect data obtained during the contiguous 13 days selected for analysis.

Table B-1. Count of Requests and Passengers

Request Status	Count of Requests		Count of Passengers	
	Coordinated	Consolidated	Coordinated	Consolidated
Satisfied	1,918	2,062	19,675	21,193
Regretted	937	793	6,185	4,667
Total	2,855	2,855	25,860	25,860

Table B-2. Count of Requests and Passengers Satisfied

Priority	Count of Requests Satisfied		Count of Passengers Satisfied	
	Coordinated	Consolidated	Coordinated	Consolidated
1	10	12	27	29
2	1,319	1,471	15,232	16,417
3	589	579	4,416	4,747
Total	1,918	2,062	19,675	21,193

Table B-3. Count of Missions and Mission Hours

Priority	Count of Missions		Count of Mission Hours	
	Coordinated	Consolidated	Coordinated	Consolidated
1	31	32	385	394
2	717	705	4,630	4,789
3	209	148	852	638
Total	957	885	5,867	5,821

Table B-4. Count of Passenger Hours and Empty Seat Hours

Priority	Count of Passenger Hours		Count of Empty Seat Hours	
	Coordinated	Consolidated	Coordinated	Consolidated
1	3,355	3,506	14,200	93,378
2	46,971	54,208	103,510	96,511
3	4,488	4,788	6,703	4,457
Total	54,814	62,502	124,413	194,346

Table B-5. Count of Joint Missions

Mission Type	Coordinated	Consolidated
Single Service	923	640
Sole Use	10	116
Joint	24	129
Total	957	885

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- [CJCS 1993] Chairman of the Joint Chiefs of Staff. February 1993. *Report on the Roles, Missions, and Functions of the Armed Forces of the United States.*
- [CORM 1995] Commission on Roles and Missions of the Armed Forces. 1995. *Directions for Defense.*
- [DoDD 1985] Department of Defense Directive 4500.43. October 30, 1985. *Operational Support Airlift (OSA).*
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- [Joint Staff 1995] Joint Staff. October 1995. *Wartime Requirements for Operational Support Airlift (OSA).*
- [LaPlante 1995] Briefing by VADM Bat LaPlante. November 14, 1995. *Operational Support Airlift Methodology and Results.*
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GLOSSARY

Consolidated scheduling. The scheduling of all OSA missions by a single organization. Each Service forwards requests for OSA support to this organization.

Coordinated scheduling. The scheduling of OSA missions whereby each Service maintains a scheduling activity. If an activity is unable to satisfy an OSA flight request, it coordinates with another Service's scheduling activity to attempt to satisfy the request.

JALIS. An automated system that supports validating flight requests, determining aircraft status, building aircraft missions, and limited support for optimizing flight schedules.

Joint mission. A mission that has passengers from more than one Service. See **Single Service mission** and **Sole Use mission**.

Legs. That portion of a mission from take-off (origin) to landing (destination). See **Mission**.

Mission. The collection of legs during an OSA flight. A mission may span multiple days and typically terminates at its point of departure. See **Legs**.

Non-VIP. See **VIP categories**.

Priority 1 request. Emergency airlift in direct support of operational forces or for life-saving purposes.

Priority 2 request. Airlift with scheduling constraints that cannot be satisfied by any other mode of transportation.

Priority 3 request. Official airlift which can be shown to be cost effective when supported by military airlift.

Requests. Requests that are allocated to a mission are deemed *satisfied*. When requests are not initially satisfied, they are either 1) satisfied on non-OSA aircraft (e.g., contract aircraft), 2) satisfied on another Service's aircraft in what is called a *passoff*, or 3) *regretted* with the requester needing to fly on a commercial airline

Required use. See **VIP categories**.

Single Service mission. A mission where all passengers on a mission are of the same Service as the pilots of the aircraft. See **Joint mission** and **Sole Use mission**.

Sole Use mission. A mission where all of the passengers are from the same Service but not of the Service of the pilots of the aircraft (e.g., a USAF C-21 mission with all USA passengers). See **Single Service mission** and **Joint mission**.

VIP. See VIP categories.

VIP categories. *Required use:* Four-star general and flag officers and above. *VIP:* O-6 to O-9 and equivalent. *Non-VIP:* All other passengers.

LIST OF ACRONYMS

AMC	Air Mobility Command
ANG	Air National Guard
CINC	Commander In Chief
CJCS	Chairman, Joint Chiefs of Staff
CONUS	Continental United States
DoD	Department of Defense
GSA	General Services Administration
IDA	Institute for Defense Analyses
JALIS	Joint Air Logistics Information System
NUFEA	Navy Unique Fleet Essential Airlift
OCONUS	Outside Continental United States
OSA	Operational Support Airlift
SAAM	Special Assignment Airlift Mission
SAR	Search and Rescue
TO&E	Table of Organization and Equipment
USA	United States Army
USAF	United States Air Force
USMC	United States Marine Corps
USN	United States Navy
USTRANSCOM	United States Transportation Command
VIP	Very Important Person

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