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MACIMS AIRLIFT OPERATIONS BENEFITS ANALYSIS

T. A. Mackey
M. N. Sherman

JULY 1971

Prepared for

DEPUTY FOR COMMAND AND MANAGEMENT SYSTEMS
ELECTRONIC SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
L. G. Hanscom Field, Bedford, Massachusetts

Approved for public release;
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Project 5150
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FOREWORD

MACIMS is the future Management Information System of the Military Airlift Command, USAF. This report was prepared by The MITRE Corporation, Bedford, Mass. , under contract number F19(628)-71-C-0002, MITRE Project 5150. The ESD Program Monitors are Lt Col Henry F. Ebertshauser and Mr. William C. Morton, III.

The MACIMS Project Group is comprised of personnel from ESD, MITRE, and the MAC Command Automation Management Office (MACAM).

REVIEW AND APPROVAL

This Technical Report has been reviewed and is approved.

William W. Melanson

WILLIAM W. MELANSON, Acting Director
Directorate of Systems Management
Deputy for Command and Management Systems

ABSTRACT

The potential benefits in airlift operations that MAC can expect from MACIMS have been analyzed and are reported herein. MAC has the dual responsibility of: first, deploying combat forces with their immediate supplies and equipment into the combat zone; and, second, sustaining the combat forces as long as they remain in the combat zone. During the Pueblo Crisis and Tet Offensive of 1968, MACIMS would have aided MAC in reducing the closure time by reducing excess ground times at enroute stations and by increasing ACL utilization of military channel (resupply) missions. In the post-1974 era MACIMS will aid MAC in improving ACL utilization through the capability to plan the use of aircraft pallet spaces for each mission segment prior to mission launch. This document contains the rationale and techniques we used to arrive at these conclusions. Supplement I contains classified material supporting the conclusions.

ACKNOWLEDGMENT

We would like to express our gratitude and appreciation to the following for their aid in the preparation of this document:

Professor Frederick Thayer, Jr., currently on the Graduate School faculty of the University of Pittsburgh and formerly Assistant, DCS/Operations at Hq MAC, who provided functional guidance throughout our studies;

Captain David Nickerson, Jr., currently with the U. S. Forces in South Vietnam and formerly a transportation analyst with MACAD, who participated in the analyses of airlift resupply operations;

DCS/Operations staff officers at Hq MAC, who aided us in the evaluation of operational data, provided programming support for the airlift resupply operations analyses, and provided critiques of initial drafts of this document; and

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SECTION I

INTRODUCTION

SCOPE

The Military Airlift Command's mission is to provide strategic airlift of men and materiel anywhere in the world. MAC serves as the single manager operating agency of the U. S. Government strategic airlift resources, applying these resources both for the rapid deployment of U. S. Forces during emergencies and for their continued logistical support.

Rapid deployment during emergencies is the primary objective of strategic combat airlift operations under the overall direction of the J-3 (Operations) Directorate of the JCS. The U. S. forces to be deployed are carefully packaged integral combat organizations (e.g., Army brigades and divisions, Air Force tactical squadrons and wings, Marine brigades). The combat force carries with it only the bare minimum of supplies and equipment, relying on logistical support airlift to sustain it. Logistical support is the principal objective of strategic resupply airlift operations under the overall direction of the J-4 (Logistics) Directorate of the JCS. These operations comprise the major portion of the total airlift mission. For example, an Army division requires 1000-1600 tons per day for as long as it remains in the combat zone over and above what was delivered by the initial deployment.

Hence, MAC has the dual responsibility, first, to deliver combat forces with their immediate supplies and equipment under J-3/JCS direction and second, to sustain the combat forces with logistical resupply under J-4/JCS direction. While the packaged combat forces are deployed through use of contingency missions, the resupply efforts are handled as SAAMs and channel traffic. The importance of these resupply efforts is often minimized since high attention is given to the basic deployment. Historically, MAC and its users have associated channel traffic with peacetime operations primarily performed to maintain MAC airlift proficiency. However, an examination of the significant airlift events during the contingency period of early 1968 clearly shows the interdependence of contingency and resupply (channel) operations.

APPROACH

The approach we used in determining quantifiable benefits that MAC can expect from MACIMS was: first, to study MAC operations and their environment in order to identify problems which have arisen and their causes; second, to analyze operational data in order to measure the losses resulting from the problems; and, finally, to show how MACIMS can reduce the problems thereby providing substantially improved utilization of airlift resources.

To study contingency operations, we selected the period of early 1968 during which the Pueblo Crisis and the Tet Offensive occurred. We reconstructed a scenario of significant airlift events in order to achieve a perspective of the situation. Analytically, we examined offshore ground times, ACL utilization, and commercial procurement. The derived benefits are directly dependent on the contingency period of early 1968; hence, we did not project these benefits to the post-FY 1974 time frame.

To study resupply operations, we developed an analytical model, MPO,* which measures "unused-pallet-spaces" on MAC aircraft and converts them into equivalent flying hours. The model was used to analyze channel operations during FY 1969 and FY 1970. Hence, the results are based on a wide range of MAC resupply operations and are independent of transient occurrences. The recurring monthly benefits after FY 1974 have been estimated by extrapolating from FY 1969/1970 pallet capacity to FY 1975 capacity. As previously discussed, these channel operations are necessary for the logistical support of U. S. forces during both "high" emergencies such as the Pueblo Crisis and "continuing" emergencies as in South Vietnam.

Complementing the analyses reported herein is a DCS/Operations study, entitled C-141 Payload Productivity Study, performed by the Studies and Analyses Division within the Directorate of Current Operations. This payload study reports the results of a system analysis effort performed on a sample of C-141 CONUS outbound channel cargo missions. On-site data collection, observation, and measurement were performed at Dover, Travis, Kelly, McChord, and Norton. The investigation included: payload weights, allowable cabin load (weight and cube), stacking loss, pallet buildup procedures, and management criteria. A major conclusion of the study was that high density cargo was assigned to commercial aircraft at the expense

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*Thayer, F. C., Design for an Analytical Model for Measuring Lost Opportunities in the Management of MAC Airlift, MITRE WP-3195, February 1970.

of C-141 payload productivity. Further, the study concluded that high payload productivity of the C-141 is achievable only when requirements and capability are kept in tight balance. This, in turn, can only be achieved by evaluating daily the often conflicting operation parameters (e.g., low port levels, low ground times, high ACL utilization, adherence to flying hours program, etc.). Only with the improved use of communications and ADP techniques can the functional managers select a balance among the operation parameters commensurate with the daily changes in MAC capability and airlift requirements. Finally, this payload study provided the analytic basis for the quantitative MACTRAC benefits ($1.6 to $3.5 million annually).

Ironic as it might seem, the payload productivity study and the analyses reported herein would have been enhanced had MACIMS been available. Without MACIMS and its associated management tools, literally hundreds of man-hours were expended in developing the analyses. In addition, investigations were limited to daily airlift operations since time did not permit investigations into other functional areas where quantitative benefits also exist. Hence, with the implementation of MACIMS, MAC can expect far higher benefits than those reported in this document. Further, MACIMS will permit the functional managers themselves to perform similar analyses to aid them in managing MAC's resources.

SECTION II

BENEFITS DERIVED DURING STRATEGIC COMBAT AIRLIFT OPERATIONS

SCOPE

In order to estimate benefits that MAC can expect from MACIMS during combat airlift operations, it was necessary to study actual contingency operations. The last major contingency for U. S. forces occurred in early 1968; specifically 25 January with the Pueblo Crisis, followed closely by the Tet Offensive on 12 February. Though the MAC operations in support of countering the Tet Offensive ended on 25 February, heavy logistical resupply resulted in a high level of activity for MAC during March and April. Hence, we have analyzed MAC operations during the period 25 January through 30 April to determine how the better use of communication and ADP techniques could have aided the functional managers.

Our basic source data are the air movements reports (F-1 data) and material deposited in the MAC archives dealing with messages, plans, reports, and evaluations of operations during the contingency. Though the data in the archives is somewhat incomplete, a scenario can be reconstructed to permit us to correlate the F-1 data and other operational data with significant events that occurred during the contingency. In addition to the air movement messages, numerous MAC reports were available. These included: (1) Military Airlift-Hearings Before the Subcommittee on Military Airlift of the Committee on Armed Services, House of Representatives, January and February 1970; (2) Statistical Abstract-ASIF Data, January through June 1968; (3) Management Information Summary, FY 1968; (4) Materiel Management Information, FY 1968; and, (5) Airlift Data Summary, FY 1968. The classified portions of our source data that are required for a thorough understanding of the contingency period are contained in Supplement I of this report.

In reconstructing the airlift events of the Pueblo Crisis and the Tet Offensive, the relation between contingency deployment (combat airlift) under (J-3/JCS) direction and logistical support (resupply airlift) under (J-4/JCS) direction became evident. Shortly after the emergency was announced by JCS, the initial deployment of combat units was begun. Concurrently, the port levels began to rise as the supporting logistics for the units being deployed were delivered at the APOEs. In addition, units already overseas were requesting extra resupply to insure they had sufficient materiel to meet any ramifications of the immediate emergency. This close relation between channel traffic and contingency deployment must be recognized to understand MAC's role in times of emergencies. A synopsis of the significant airlift events as they occurred with relation to both combat and resupply operations is presented in this section while a detailed scenario is presented in Appendix I.

With the perspective provided by the scenario, we proceeded to identify quantitative benefits by analyzing: (1) C-141 excess ground times at enroute stations; (2) ACL utilization for military channel missions; and, (3) procurement of supplemental commercial augmentation.

Though the primary purpose of this report is to identify MACIMS quantitative benefits, one must not overlook qualitative benefits that are necessary to insure MAC's ability to plan contingency operations on short notice and to replan rapidly when operations vary from planned execution as they did during the Pueblo Crisis and the Tet Offensive. The performance factors which will be improved by MACIMS include: (1) improved coordination with airlift user; (2) improved inventory control; (3) improved aircrew and aircraft availability data; (4) improved allocation of commercial augmentation; and, (5) improved force monitoring.

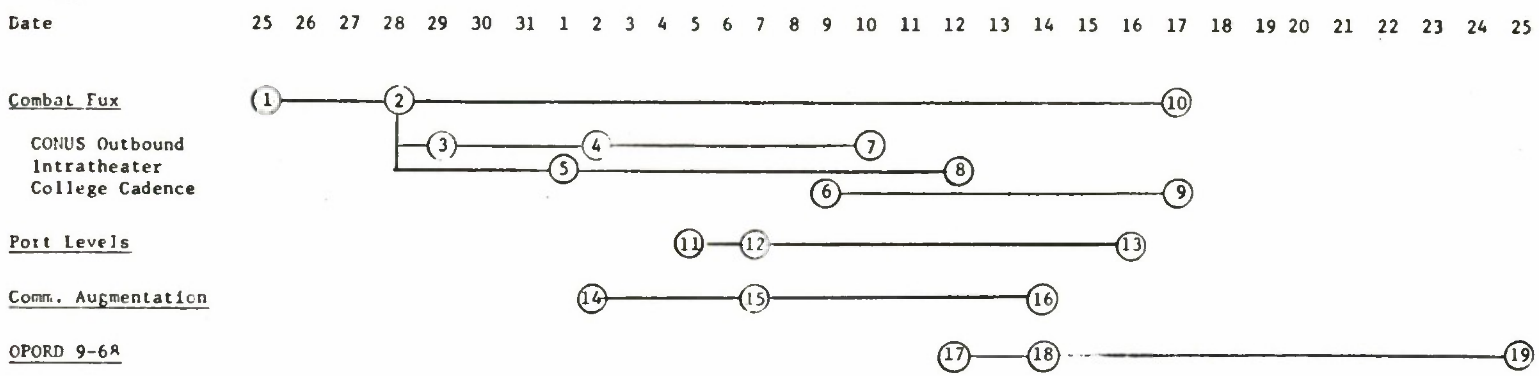
SCENARIO

Significant Events

On 25 January MAC was told by JCS to prepare for a major deployment of U. S. forces into South Korea. MAC was given less than three days to plan for this deployment, officially titled OPORD 7-68 and named Operation Combat Fox. To meet this emergency MAC initially withdrew 20 million-ton-miles (MTM) of airlift capability from scheduled channel operations (Reference Figure 1).

On 28 January Combat Fox was initiated and consisted of: (1) movement of USAF squadrons from CONUS to Korea (these USAF squadrons consisted of TAC fighter, TAC C-130, and ANG fighter units); and, (2) movement of CINCPAC forces intratheater to Korea. The CONUS outbound requirements were stated; however, the exact intratheater requirements were not known. These intratheater requirements eventually used 17 MTM of capability. Concurrent with the start of Combat Fox CONUS APOE port levels started to build up with cargo for units already overseas and those being deployed.

By 1 February the intratheater contingency requirements were stated by the user; however, MAC did not have sufficient capability to plan to meet these requirements. In fact, frequently during the intratheater portion of Combat Fox, MAC could not state how many



(1) MAC alerted by JCS for Pueblo Crisis.

(2) Combat Fox started.

(3) Reqts. increased 20%.

(4) Reqts. increased 17%.

(5) Reqts. stated by user.

(6) College Cadence started -- an extension of Combat Fox.

(7) Closed original CONUS outbound requirements of Combat Fox.

(8) Closed Intratheater reqts. of Combat Fox.

(9) Closed College Cadence.

(10) Closed Combat Fox.

(11) Tripled since 1/28.

(12) Maximum "tons-on-hand."

(13) Decreased to only 22% above capacity.

(14) Supplemental Commercial Augmentation for Combat Fox.

(15) More supplemental Commercial Augmentation for Combat Fox.

(16) Supplemental Commercial Augmentation for OPORD 9-68.

(17) MAC alerted for Tet Offensive.

(18) OPORD 9-68 started.

(19) OPORD 9-68 closed.

Figure 1. Significant Airlift Events (25 January through 25 February)

missions were scheduled in the next 24 hours. MAC was forced to schedule missions to meet intratheater requirements when aircraft became available rather than preplanning use of the aircraft and aircrews. Many aircraft were diverted from returning to CONUS by Area ACPs to meet intratheater needs. Consequently, CONUS outbound traffic was affected thereby necessitating a high use of SAAMs and commercial carriers to move the backlog at CONUS APOEs.

By 7 February the CONUS APOE port levels reached their maximum for the contingency period after tripling during the first seven days. Supplemental commercial missions were being procured to move the cargo.

On 9 February the CONUS outbound contingency requirements increased with the order for deployment of a fighter squadron from McChord to Okinawa; officially, this movement, called College Cadence, was part of OPORD 7-68.

On 10 February the original CONUS outbound portion of Combat Fox was completed though intratheater and College Cadence operations continued. Within forty-eight hours MAC was alerted by JCS to prepare for another major deployment to counter the Tet Offensive.

On 14 February OPORD 9-68 was started and consisted of: (1) movement of a brigade of the 82nd Airborne Division from Ft. Bragg via Pope AFB to Chu Lai; and, (2) movement of a reinforced Marine Regiment from Camp Pendleton via El Toro AFB to Danang. Even though most of Combat Fox was finished, the College Cadence portion was still in progress. Concurrently, the commercial carriers committed more airlift capability to MAC though particular missions were still being negotiated. OPORD 9-68 was closed on 25 February, 24 hours prior to the original schedule.

Statistical Factors

The immediate effect of the contingency was a surge from normal operations. The degree of efficiency with which MAC responded in such a short time is to be commended. However, problems arose in the overall coordination of management activities. These problems were increased by the augmentation of MAC's organic resources by TAC augmentation and by mobilization of five Reserve Airlift Squadrons. Most of this augmentation was applied to channel traffic. In addition to the military augmentation, the commercial carriers voluntarily responded to MAC's request for maximum augmentation to keep the APOE port levels within acceptable limits.

It must be recognized that MAC had less than 72 hours to plan for the Pueblo Crisis and only 48 hours for the Tet Offensive. As reported to the Congressional Committee earlier this year, airlift requirements far exceeded original forecasts for February 1968, cargo requirements by 48% and passenger requirements by 13%. An increase of 18% in flying hours and use of commercial carriers in excess of $60 million were required to satisfy these requirements. The following is a brief statistical summary of operations (Reference Appendix I for details):

(a) C-141 Utilization - C-141s flew 58,246 hours at a utilization rate of 7.9 hours per day.* These are 26.3% and 22.3% increases, respectively, over the averages of the previous seven months.

(b) CONUS APOE Port Levels - At each APOE, the average ton-on-hand and port-holding time significantly exceeded the average of the previous months.

(c) Use of SAAMs - MAC used SAAMs to accomplish 318,054 MTM which is 133% above the previous seven month's average of 136,496 MTM (many SAAMs were used on channel routes).

(d) Aircrew Utilization - Pilots average flying time increased 13.0% over the previous seven month average.

(e) ACL Utilization Rates (Channel) - The ACL utilization for channel cargo missions decreased approximately 10% from the previous seven month average.

(f) Commercial Augmentation - Commercial capability was used for 115.0 MTM in February, an increase of 63.6% over January. Furthermore, the supplemental commercial augmentation that was procured during the height of the contingency buildup turned out to be more than MAC needed. Hence, there was high use of commercial carriers during the rest of the fiscal year when military capability was available to meet the requirements.

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*This 7.9 utilization is based on the total C-141s in the MAC force. Those C-141s which were available for use during the contingency operated at an 8.7 utilization rate.

(g) <u>C-141 Delays at Offshore Stations</u> - The number of delays for C-141s at offshore stations increased about 150% from December 1967.

Command and Control

Command operations, especially CONUS outbound contingency missions, proceeded smoothly for the most part; however, the intratheater movement of CINCPAC men and materiel into Korea encountered several problems.* Associated with this movement was the reestablishment of certain offload bases in Korea to full-scale operational capabilities, effectively a "bare-base" operation in the middle of winter. The need for housekeeping and ground support equipment to sustain operational airlift and fighter squadrons was paramount, but this support equipment was spread among various bases in the Pacific and lack of a detail coordinated plan prevented smooth movement into Korea. The Area ACPs at Yokota and Clark were directed to work directly with the 5th and 13th AFs, respectively but because there was no system for providing full-scale coordination between those ACPs, the cargo was not moved in the appropriate sequence. Therefore, fighter squadrons destined for Korea were delayed at Itazuke, Japan, pending arrival of necessary housekeeping and ground support equipment in Korea. Positive force control by the 22 AF, as coordinator of all MAC activities in the Pacific, was certainly needed during this contingency period. Though the quantitative benefits presented in the following sections do not address this confusion of command functions, the major qualitative benefit MAC should expect from MACIMS is improved force monitoring and improved coordination with the user of airlift services.

C-141 GROUND TIME

In our attempt to estimate quantitative benefits for strategic combat operations, we first analyzed C-141 mission ground times. C-141 delays were analyzed to determine excess ground times (at stations other than home base) that could have been converted to productive mission time through use of MACIMS. MAC attempts to minimize these ground times since maintenance and crew facilities are not comparable with those available at home station. The conversion of all excess ground times at enroute stations into productive mission hours is not feasible due to aircrew and aircraft

*The cargo requirements for the intratheater operations consisted of 73% of the total cargo requirements for Combat Fox; the remaining 23% were the CONUS Outbound cargo requirements.

limitations; however, the conversion of a certain percentage is necessary to insure MAC's ability to surge in times of emergencies.

During the contingency period more than 100 delay codes to explain excess ground time were used. Examination of excess ground time for five types of delays was done by analyzing the F-1 data for both the contingency period as an entity and the first six months of CY 1968. These situations are not the only ones that MACIMS will aid in avoiding, but are conducive to being avoided through integrated airlift planning and scheduling techniques.

<u>Analysis</u>

The five delay codes we selected for analysis were: (1) 000 - no incurred delay for the mission;* (2) 115 - weather at destination station; (3) 181 - user delays; (4) 232 - saturation of stage posture due to missions being out of scheduled sequence; and (5) 713 - NORS due to random demand of item which is not authorized for FSP or base stock.

For each of the selected delay codes the C-141 ground time in excess of two hours** was accumulated on a monthly basis for all C-141 missions. Then, a monthly average weighted by flying hours was obtained and compared with the contingency period as follows:

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* However, it records nothing about the aircraft; tail number continuity listings in some cases reveal 15 hour ground time. This usually occurred when the mission number was changed between arrival and departure of the aircraft.

** The fact that an onload at offshore stations was scheduled for three hours is considered in the final analysis of the percentage ground times MACIMS will convert to productive mission hours.

Delay Code	Monthly Weighted Average	Contingency Period	Δ	% (Δ/Average)
000	9,013	8,643	−370	−4.1
115	810	1,819	+1,009	+124.6*
181	245	467	+ 222	+ 90.6
232	984	1,972	+ 988	+100.4
713	1,071	1,437	+ 366	+ 34.2
TOTALS	12,123	14,338	+2,215	+ 18.3

(This increase in ground time closely correlates with the increase in C-141 flying hours.)

Next we examined excess ground time during the contingency period by type of mission as follows:

Type Mission	Flying Hours	000	115	181	232	713
Contingency	16,195	2,413	548	262	631	48
Channel	20,019	3,063	531	0	797	1,060
SAAM	16,763	1,634	663	103	511	267
Other	5,085	1,531	77	102	33	62
TOTALS	58,062	8,643	1,819	467	1,972	1,437

*Though this is a big increase, it must be recognized that most airlift activity occurred in the middle of winter. In fact, during the contingency Yokota received an 18" snowfall. This storm, in addition to closing Yokota, caused delays at Kadena and other stations.

MACIMS Support

A fraction of the excess ground time can be reduced through the use of MACIMS. Both in the planning stage of a contingency and during its execution, MACIMS will provide ADP support to the functional managers. Planning and contingency flow patterns of the deployment will be accomplished through use of the Combat Plans and Exercise (CPE) subsystem based on inputs from other MACIMS functional subsystems. Once the contingency is declared and MAC is responding to contingency requirements, the Airlift Planning and Scheduling (APS) subsystem will assign specific schedules for contingency, channel, and SAAM missions. Using the force status data (availability and constraints) of the Airlift Operations Management (AOM) subsystem, the MAC planners will be able to balance many alternatives among the diverse operation parameters and decide on the best approach for achieving the total mission.

Specifically, delays with no reason and those caused by stage posture saturation will be reduced by positive force control and scheduling techniques available within MACIMS. MAC AF planners and schedulers will have accurate, current knowledge of MAC capability and requirements through the use of APS, MACTRAC and AOM. Hence, they can plan the mission or missions for each aircraft round trip. Aircraft won't be on the ground because of lack of positive control nor because the user's cargo isn't available. The missions will not be scheduled until the cargo is available and, then, the ability to rapidly adjust and balance the schedule MAC-wide will ensure prompt pickup.

More accurate and current weather information via an external interface between Air Force Global Weather Center (AFGWC) and AOM will permit the MAC planner to reroute airlift missions before their initial home station departure, and during mission progress, via APS and AOM. Finally, delays due to NORS (item not authorized at FSP) will be reduced by use of (1) the Inventory Control subsystem; (2) an external interface with both Advanced Logistics System (ALS) and the proposed Materiel Intransit Control (MICS) system; and (3) knowledge of airlift schedules of operating, committed, and planned missions so as to take advantage of opportune airlift within MAC and other USAF commands, such as AFLC.

In each case, the ability of MAC to schedule missions as close to departure as possible through timely knowledge of stage status, weather data, cargo at enroute stations, and all pertinent data of the MAC system which could influence the departing mission will be provided by MACIMS. The many combinations in the complex system that MAC operates require both the communications and ADP capabilities of MACIMS for effective management.

Benefits

MACIMS will aid MAC in the conversion of a fraction of this excess ground time into productive mission time.* The delay code with the highest number of hours is 000 with 8,643 hours. Since the mission had no delay, the ACP monitors were not alerted to a delay. Nevertheless, an aircraft on the ground for fifteen hours represents lost capability which was certainly needed during the contingency. By positive force control and total mission scheduling, neither of which was available in 1968, MAC could use the excess ground times as productive mission hours.

The question arises over whether crews were available for more flying time. During the contingency period, MAC did not know the status of its aircrews due to the confusion in the Pacific. Once again, positive force control and total mission scheduling as provided by MACIMS will avoid this situation and permit better use of available MAC resources to include aircrews. Hence, we estimate that 80% of the total or 6,914.4 hours for delay code 000 could have been used as productive mission time. The other delay codes and associated estimated percentages are:

(a) 115 - 10%, or 181.9 hours;

(b) 181 - 20% of the total except those for SAAMs, or 72.8 hours;

(c) 232 - 85% for contingency missions (536.4) and 55% for other missions (737.6) or 1,274.0 hours; and

(d) 713 - 33%, or 479.0 hours.

The total number of productive mission hours that could have been saved was 8,922.0. Of this total we estimate 75%, or 6,692 hours, could have been converted to flying time, while 2,230 hours would have been the normal mission ground time. Translating these productive flying hours into quantitative benefits requires the following conversion factors. For performance improvements we used equivalent C-141 working days based on a 8.0 utilization rate

*Mission time consists of both flying hours and the necessary ground time at onload, offload, and enroute stations.

and equivalent million-ton-miles (MTM) based on 8000 TM/FH (20 tons x 400 knots) for the C-141. For monetary benefits, we used the commercial augmentation cost of 15.3 cents per ton-mile. Hence, the 6,692 productive flying hours would have produced either 833 equivalent C-141 working days and the associated capability of 53.3 MTM, or monetary savings of $8.2 million.

If MAC had recovered and applied the 53.3 MTM capability to channel traffic, the amount of supplemental commercial augmentation for cargo could have been reduced. Furthermore, the use of SAAMs to handle APOE backlog could have been avoided. More important is the fact that MAC struggled to reach a 7.9 utilization rate while the 6,692 hours would have permitted surging to almost 9.0.* Such a surge capability is essential for MAC to respond to future contingencies and provides JCS the ability to decrease closure times if the airlift users can react to benefit from MAC's increased capability.

ACL UTILIZATION

In addition to the C-141 mission ground time analysis, we also analyzed ACL utilization of channel cargo missions during February 1968. MAC military capability for these missions decreased from 49,915 flying hours in January to 35,944 in February. Commercial capability was used to service channel traffic to the extent of 115.0 MTM in February, an increase of 63.6% over the 70.3 MTM of January. Our assertion is that the use of MACIMS would have permitted MAC to obtain better ACL utilization on its military missions and, thereby, reduce the degree of required commercial augmentation. Furthermore, the commercial contracts negotiated during the height of contingency operations had to be honored. Many of these contracts were satisfied in the aftermath of the contingency; in particular, during March and April. However, military capability was also available to satisfy channel requirements in March and April. Hence,

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*To achieve the 7.9 hour utilization that MAC flew during February 1968, the daily mission utilization rate (ratio of flying time to total time away from home station) had to be approximately 12.0 since 35 percent of aircraft are usually at home station. Converting 6,692 ground hours to flying hours raises the mission UT rate from 12.0 to 13.39, which permits a 8.94 standard UT rate with the same available resources.

ACL utilization for military channel missions was lower in March and April since commercial capability was being applied.

Analysis

Our objectives in this analysis of military channel cargo missions were to determine the number of underutilized flying hours and the extent of their underutilization and to compute the equivalent unused flying hours (UFH). The measurement we used was the ton-mile per flying hour (TM/FH) rate. First, we obtained the FY 1968 average rate of 5306 TM/FH. Next, we made adjustments for the difference between outbound and inbound movement.* Using the F-1 flying hour data, we obtained an outbound/inbound flying hour ratio. Then, applying the flying hour ratio to the CONUS outbound TM/FH rate for each type of aircraft, we obtained an inbound TM/FH rate. The results are 5585 and 4926 TM/FH standards for outbound and inbound movement respectively during FY 1968. Next, the equivalent unused flying hours for February, March and April were obtained by comparing each month's TM/FH rate to the FY 1968 standard TM/FH rate (Reference page 65 for additional explanation).

The results we obtained were: (1) 4,448 unused flying hours in February; (2) 12,167 in March; (3) 5,813 in April; and (4) 22,428 for the three month period.

MACIMS Support

The procedures and subsystems of MACIMS which will support normal strategic resupply airlift are outlined in Section III. Once a contingency is declared, APS will use the CPE products (e.g., flow patterns, station workload forecasts) and attempt to balance the application of MAC capability over the whole system to maintain logistic resupply operations as well as handling contingency missions. In addition, APS will use the interface with the Commercial Procurement subsystem to request commercial capability when needed and to determine the extent needed during the emergency.

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*This adjustement was necessary to temper the abnormally high inbound flying hours since many outbound SAAMs became inbound channel missions on their return to CONUS.

Furthermore, MACIMS will support replanning by closely monitoring the disposition of the force and quickly forecasting and detecting out-of-tolerance performance when operations deviate from the plan. Through APS scheduling techniques, MAC will be able to rectify the deviations with minimal impact to the original plan. Specifically, MACIMS will permit MAC staff officers working interactively with computer aids to: (1) plan each segment of an airlift mission before its departure from home station; and, (2) replan the remainder of a mission when it deviates from its original schedule with minimal impact on other airlift missions in the MAC system.

Benefits

We estimated that of the total UFH, MACIMS would have permitted MAC to recover approximately 66 percent. This estimate is conservative since the APOEs had more than enough cargo to load military missions during the three months as shown by the high level of commercial activity.

In translating the recoverable flying hours (RFH) into performance and monetary benefits, we used the following factors:

(a) Equivalent C-141 working days based on an 8.0 utilization rate.

(b) Equivalent MTM capability based on the particular month's TM/FH rate; i.e., 5,264 for February, 5,319 for March, and 5,309 for April.*

(c) Commercial augmentation rate of 15.3 cents per ton-mile.

*The C-141 TM/FH of 8,000 was not used since we analyzed all military channel missions which included C-124s, C-130s, C-133s, and C-141s.

The quantitative benefits derived from improved ACL utilization are:

	Feb.	March	April	Total
RFH	2,964	8,112	3,874	14,940
C-141 Working Days	370	1,013	484	1,867
MTM	13.9	34.8	18.4	67.1
$ (Millions)	2.1	5.3	2.8	10.2

COMMERCIAL PROCUREMENT

At the end of FY 1968, MAC had contracted for $2.4 million worth of commercial augmentation which it did not use. These contracts had to be honored in FY 1969. However, the tariff rates which commercial carriers charge MAC decreased by 22% in FY 1969. Hence, the $2.4 million was $530,000 in excess of equivalent commercial capability that could have been negotiated in FY 1969.

MACIMS will permit MAC to avoid contracting for supplemental commercial carriers in one fiscal year, and using them in the next. MACIMS will do this by permitting the functional managers to:

(a) Monitor the use of commercial carriers showing delivered services completed in the last 24 hours, delivered services being flown, and planned near-term use of undelivered services.

(b) Predict more accurately the surge of resupply activity which starts immediately after the contingency force is deployed and continues after the immediate contingency is closed; i.e., when military capability is again available for channel operations.

SUMMARY

This section has presented the quantitative benefits MAC can expect from MACIMS during contingencies. Operations during the last major contingency, caused by the Pueblo Crisis and Tet Offensive, were analyzed. A scenario of significant airlift events provided a perspective of MAC's operations during the contingency and showed the close relation between strategic combat and strategic resupply airlift. Analytic models which were used to measure C-141 excess ground time, ACL utilization, and commercial procurement have been outlined and the estimated benefits itemized. The scenario and analysis are further detailed in Appendix I of this document.

The major benefit that MAC could have expected from MACIMS is a reduction of approximately 35% in the closure time of the Combat Fox portion of the contingency (Reference, Supplement I).* The reduction in the closure time is a consequence of: (1) a reduction in excess ground time which would have converted 8,922 hours into productive mission time; and, (2) an increase in ACL utilization of military channel missions which would have recovered 2,964 flying hours. Recall that for ground time analysis we used the 8000 TM/FH for the C-141, since ground times for other type aircraft were not considered. For ACL utilization, we used the appropriate month's TM/FH standard since all types of military aircraft on channel missions were considered. The total benefits for the contingency period would have been:

	Ground Time	February ACL Utilization	TOTAL
C-141 Working Days	833	370	1203
MTM	53.3	13.9	67.2
$ (Million)	8.2	2.1	10.3

The previous set of benefits are only for the contingency period, itself. To obtain the total benefits MAC could have achieved from MACIMS, the aftermath of contingency must be included. The total benefits for the contingency period and the following months would have been:

*This reduction in closure time assumes a comparable user (CINCPAC) response to MAC's extra airlift capability.

C-141	Contingency Period	March & April ACL Utilization	Commercial Procurement	TOTAL
Working Days	1203	1497	-	2700
MTM	67.2	52.3	-	119.5
$ (Million)	10.3	8.2	0.5	19.0

These benefits are estimated conservatively. First, the estimates assume that only fractions of the unused capability could have been recovered. (For example, if the equivalent unused flying hours (22,423), as determined by the ACL utilization analysis, were claimed by MACIMS, we'd have a figure which converts to almost 100 MTM or $16 million.) Second, we selected for investigation only subsets of MAC operations. In the excess ground time analysis we considered only C-141s and only five types of delays. Furthermore, in the ACL utilization analysis we examined only military channel missions.

SECTION III

BENEFITS DERIVED DURING STRATEGIC RESUPPLY AIRLIFT OPERATIONS

SCOPE

In order to estimate the degree to which MACIMS can help MAC improve airlift utilization during strategic resupply operations, we analyzed military channel cargo mission utilization during FY 1969 and FY 1970. Using historical data, we applied the MPO Model which measures unused pallet positions on each leg and converts the unused space into equivalent unused C-141 flying hours. The MAC historical data were the J-2 (Daily Traffic Utilization) Reports for C-141 channel cargo missions. During the months we examined, no contingencies comparable to the Pueblo Crisis and Tet Offensive occurred. However, the techniques described in this section for analysis of C-141 cargo missions apply to strategic resupply operations during both contingencies and normal logistic support activities.

MAC load planners attempt to operate C-141 channel cargo outbound missions with all ten pallet positions used. Not all missions can carry ten pallets; e.g., those carrying outsize and floor-loaded cargo, and some mission legs, such as the Elmendorf-Yokota one, cannot always carry ten pallets due to the wind factor. Hence, before applying the MPO Model, the reasons why an aircraft did not carry ten pallets had to be carefully examined.

ANALYSIS

Reasons for Underutilization

Missions for which the following four reasons for underutilization were given were selected, since MACIMS will aid the functional manager in avoiding these problems:

(a) excessive scheduled capability (a mission was scheduled at the particular station even though cargo was not expected to generate);

(b) non-generation (expected cargo did not generate);

(c) negative-on-hand (generated cargo moved on a previous mission); and

(d) insufficient setup time (manifest preparation and/or pallet buildup could not be completed before mission was scheduled to depart).

Aircraft Payload vs. Pallet Weight

For missions which did not carry ten pallets for one of these four reasons, the aircraft payload and the total weight on the pallets were compared:

(a) if they were approximately equal (the entire payload was palletized), AND if the critical offered ACL permitted extra pallets to be carried, the aircraft was underutilized; and

(b) if they were unequal (some floor-loaded cargo were aboard), the aircraft was NOT considered underutilized since we could not ascertain from our source data whether or not more cargo could have been carried.

Unused Flying Hours

For missions which could have carried ten pallets, MPO accumulated unused pallet positions for each leg. Multiplying this accumulation by the leg flying time and dividing by ten yielded equivalent unused flying hours (UFH).

Recoverable Flying Hours

MACIMS will aid MAC in avoiding these equivalent UFH by supporting more effective planning and thereby allowing MAC to fly fewer missions for a given set of requirements. Actually, the saving in flying time that can be achieved is a multiple of the UFH. Two factors must be considered in determining the recoverable flying hours (RFH): first, a "return-home-base" factor of 1.7;* and, second, a "flying-hour-adjustment" factor of 1.3.** Multiplying the UFH by these two factors yields the RFH. We obtained five sets of UFH and RFH through interdependent applications of the MPO Model and by varying certain factors of the sample set (Reference Table I).

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*Since the C-141s generally return home more directly than they leave, they have greater outbound than inbound flying time. Examination of F-1 data revealed that the ratio of outbound to inbound is 1.0/0.7.

**Comparison of F-1 and J-2 data revealed the fact that J-2 data recorded only 75% of the legs reported in the F-1.

Table I

MPO Model

Sample Sets and Results

Constant Factors

Reasons For Underutilization
- Excessive Scheduled Capability
- Non-generation
- Negative-on-hand
- Insufficient Setup Time

Source: J-2 Reports

Type Aircraft: C-141

Type Mission: Channel Cargo

Variable Factors

Step	Time Frame	Geographic Area	Mission Destination	Departure Stations	Monthly Unused Flying Hours	Monthly Recoverable Flying Hours	Equivalent C-141 Working Days	$ (000)
I	Nov. 1969	Pacific	Outbound	All	803.05	1,855.81	231	803.6
II	Nov. 1969	Pacific	Westbound	High Frequency*	693.32	1,602.23	200	693.8
III	2ndQ FY70	MAC-wide	Outbound	All	677.79	1,566.35	195	678.3
IV	2ndQ FY70	Pacific	Westbound	High Frequency*	479.65	1,108.45	138	480.0
V	July 1968 - May 1970	MAC-wide	Outbound	All	698.88	1,615.08	201	699.3

*High frequency stations include all CONUS ports, ports in Vietnam and Thailand, Hickam, Wake, Guam, Clark, Yokota, Kadena, and Elmendorf.

MACIMS SUPPORT

MACIMS will support the functional managers in avoiding the UFH and, thereby, saving the RFH by providing improved use of communications and ADP techniques. Specifically, attainment of this goal rests on the integration* of: (1) MACTRAC which records airlift requirements; (2) aircrew, airframe, planning, and ASIF subsystems which record MAC capability data; and, (3) airlift planning and scheduling subsystem (APS), which matches MAC capability with MAC requirements.

Of the four reasons for low utilization which were included in the MPO analysis, three items (non-generation, negative-on-hand, and insufficient setup time) relate to a lack of timely coordination between mission schedulers and traffic managers at offshore stations. The MACIMS communications system and procedures will insure that offshore port level data is forwarded to the MACIMS computers for use by the mission scheduler. The fourth reason for low utilization (excessive scheduled capability) can be rectified by the mission scheduler when he examines the mission route choices presented to him by the computer for his final decision.

Using the integrated ADP support of MACIMS, the MAC functional managers will be able to plan the use of aircraft pallet spaces for each leg of a mission based on timely information regarding offshore port levels, weather, aircrew, airframe, and enroute station status data. In addition, MAC planners will use MACIMS to examine many more alternatives than they can now and evaluate each alternative against various operation parameters (such as port holding time, flying hours, etc.) to obtain an operational balance between capability and requirements. The MAC planners will then be able to decide at the latest possible time before a mission departure from home station exactly what cargo will be moved on each segment of the total mission. This decision will constitute an operational plan for the mission, which will lead to a mission directive to be followed in detail by MAC enroute stations for all but the most unusual circumstances. With MACIMS and its associated communications, computers, and software tools MAC staff officers will be able to handle the vast combinations of alternatives which can arise and must be considered to achieve economic and efficient use of MAC resources.

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*Mackey, T. A., and Sherman, M. N., A Concept For Integrated Application of Airlift Operations Subsystems Within MACIMS, MITRE TR-2042, January 1971.

BENEFITS

Though MACIMS will support MAC in avoiding UFH, not all missions will operate at full utilization even with the aid of MACIMS. This fact was basic in the development of our analysis and in the applications of the MPO Model. Recall that we did not include in our analysis many causes of underutilization of an aircraft; e.g., floor-loaded cargo, outsize and bulky cargo and mixed missions. However, with positive force control and the capability to examine alternative approaches for scheduling missions MAC with MACIMS support can reduce the amount of unused flying hours.

The quantitative benefits MAC can expect are presented in terms of minimum, maximum, and expected values. The minimum value is the result of the fourth application of the MPO Model, while the maximum value is the result of the first MPO application. The 23-month average is the result of the final MPO application and represents the expected value since it reflects a wide range of MAC resupply operations and alleviates the bias of transient occurrences.

The results of our analysis are in terms of RFH which can be considered as either improved performance benefits or monetary benefits. The following conversion factors were used for performance improvement:

(a) equivalent C-141 working days based on an 8.0 utilization rate; and

(b) equivalent million-ton-miles (MTM) based on 8000 TM/FH (20 tons x 400 mph) for the C-141.

For monetary benefits, we used $433 per flying hour which is the ASIF rate for total reimbursable direct cost for the C-141 as of 31 December 1969.*

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*Application of the RFH to a reduction in the ASIF tariff rate indicates a greater monetary benefit; but for purposes of this document the lower benefit has been used.

Applying these factors, we have the following monthly benefits:

	MIN	MAX	EXPECTED
RFH	1108	1856	1615
C-141 Working Days	138	231	201
MTM	8.86	14.85	12.92
$(000)	480.0	803.6	699.3

These figures represent conservative quantitative benefits since our analysis rests on: (1) consideration of only C-141 channel cargo missions (i.e., commercial missions and SAAMs are not included, nor are passenger and mixed missions); (2) adherence to the philosophy "when-in-doubt-drop" missions from inclusion in our model; and, (3) inclusion of data during periods when MAC was not flying at its full capacity. Commensurately, any projection to FY 1975 and thereafter remains in the conservative range.

The underlying basis of the MPO Model and its associated procedures were unused pallet positions. During the time frame of our analysis, MAC had a pallet capacity of 2340 (234 C-141s x 10) pallet spaces while in FY 1975 MAC will have 4860 (234 C-141s x 10 + 70 C-5s x 36) pallets. These figures yield a projection ratio of 2.077 which, when applied to the annual expected RFH (19,380), results in 40,252 RFH for aircraft with a ten pallet capacity. However, the additional (20,872) RFH are a direct consequence of C-5s which have a 36 pallet capacity. Hence, adjusting our projection to reflect this fact yields the following quantitative annual benefits:

	C-141	C-5*	Total
RFH	19,380	5,797	25,177
Equivalent Aircraft	6	2	8
MTM	155.0	185.5	340.5
$(Millions)	8.4	5.3	13.7

*C-5 conversion factors are conservatively based on the ASIF rate for total reimbursable direct cost per flying hour of $925 at an 8.0 hour utilization rate (much higher than is currently planned). The cost of $925 increases as the utilization rate decreases, though not proportionately.

In addition to avoiding the UFH, MACIMS through MACTRAC will provide MAC with the capability to load individual aircraft more efficiently with respect to the weight and volume capacities of the aircraft cabin. This improvement will be achieved by use of the cargo documentation subsystem and its pallet monitoring function. Through this improvement MAC will save between $1.6 and $3.5 million annually with the expected value of $2.5 million.

SUMMARY

This section has presented quantitative benefits which MAC can expect from its strategic resupply operations by use of MACIMS support in the management of channel missions. Channel missions constitute a major portion of the total airlift mission during both contingency and resupply operations. The techniques we used to analyze cargo channel missions are applicable to all cargo missions, both military and commercial.

To analyze the cargo channel missions, we used the MPO Model to measure the number of unused pallet positions on C-141 aircraft. These unused spaces were used to obtain equivalent C-141 unused flying hours, which were converted to recoverable flying hours. These RFH were then projected to post-FY 1974 using the relative pallet capacities of the MAC force in FY 1969/1970 and post-FY 1974 as the projection base.

Hence, MAC through positive force control and total mission scheduling, can expect the following annual benefits — an equivalent extra capability of 6 C-141s and 2 C-5s with the associated 340.5 MTM capability which has a monetary value of $13.7 million.

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*Reference page 2 for a synopsis of the <u>C-141 Payload Productivity Study</u>, which provides the analytic basis for this benefit.

SECTION IV

SUMMARY

This report has presented the quantitative benefits MAC can expect from MACIMS during contingencies such as the Pueblo Crisis and Tet Offensive and during logistical resupply operations. It has been shown that contingency deployments (air movement of U. S. forces into combat zones) and logistical resupply operations (airlift support of the deployed U. S. forces) are interdependent and constitute the totality of the overall airlift mission in times of emergencies.

COMBAT AIRLIFT

We analyzed MAC operations during the contingency period of early 1968 by: (1) developing a scenario of significant airlift events; (2) identifying problems that MACIMS could have aided MAC in avoiding; and, (3) measuring the degree of improvement which MACIMS could have supported. In particular, MACIMS could have helped MAC in reducing offshore ground time for C-141s, increasing ACL utilization for channel missions, and reducing amount of supplemental commercial augmentation by use of positive force control, total mission scheduling and near-term forecasting techniques. A fraction of offshore ground time could have been used as productive flying hours. These flying hours plus increased ACL utilization could have been used to reduce APOE port levels and thereby reduce the amount of supplemental commercial augmentation that MAC procured in February. These commercial contracts had to be honored in the aftermath of the contingency when military capability could have been applied. The quantitative benefits are presented for both the contingency period, and its aftermath with the effect of decisions that were made during the contingency.

	Contingency	Aftermath	Total
C-141 Working Months	40	49	89
MTM	67.2	52.3	119.5
$(Millions)	10.3	8.7	19.0

These benefits are representative of only the contingency period we studied. We have not projected them to the post-1974 era because occurrence and magnitude of contingencies cannot be predicted. But the analysis shows by several measures that MACIMS will be effective in contingency operations and can, in effect, increase the airlift force by the equivalent of 40 C-141s. This extra capability could have been used to reduce the closure times of the contingencies by an appreciable amount in the range of 30% to 40%. Supplement I contains the details of the closure time aspect.

RESUPPLY AIRLIFT

We analyzed MAC's resupply operations during FY 1969 and FY 1970 by measuring the unused pallet positions of underutilized aircraft and converting them into equivalent flying hours. An aircraft which departed with less pallets than its capacity was considered underutilized by us only if MACIMS could have supported MAC's attempt to fully use the aircraft pallet positions. Specifically, we examined C-141 channel missions which operated with less than 10 pallets and available information indicated it could have carried 10 pallets. Our analysis resulted in the monthly average of increased pallet space utilization MAC can expect.

MACIMS will support MAC in improving pallet space use through integrated ADP and communications support which will permit planning the use of aircraft pallet spaces for each leg of a mission based on timely information regarding offshore port levels, weather, aircrew, airframe, and enroute station status. Furthermore, when missions deviate from the plan, MAC will be able to replan the use of pallet spaces for the rest of the mission with minimal impact on other airlift missions in the MAC system.

Since the measurable factor in our model was pallets, we used the relative pallet capacities of the MAC force in FY 1969/1970 and FY 1975 as the basis of our projection to the post-1974 era. MAC can expect the following annual benefits: an equivalent extra capability of 6 C-141s and 2 C-5s with the associated 340.5 MTM capability which has a monetary value of $13.7 million.

CONCLUSION

In no way do these benefits represent the totality of quantitative benefits that MAC can expect with MACIMS support. First, the estimated benefits have been adjusted to reflect a percentage of the potential benefits derived by our analyses. If all the loss opportunities measured in our analysis of combat operations were recovered, we'd have about $40 million.

Second, we limited the scope of our analyses to particular aircraft or missions. For example, in analyzing resupply airlift we did not consider SAAMs, passenger, and commercial missions. Furthermore, in analyzing combat airlift we emphasized only military operations; however, increasing commercial ACL utilization is certainly feasible.

Third, we believe other MAC functions with MACIMS support will yield quantitative benefits. These areas include: inventory control, procurement and monitoring of commercial augmentation, use of war-gaming techniques to evaluate operational plans and policies, and replanning of MAC operations when they deviate from the original plan during both combat and resupply airlift operations.

Finally, indirect benefits must not be overlooked. For example, utilization of SAAMs will be improved. In particular, a major benefit of MACIMS (improved channel operations) should reduce the user's desire for SAAM service since he will be assured that his cargo will be delivered in a timely and consistent manner. Reducing the number of SAAMs, in turn, reduces the associated aircraft and aircrews removed from MAC's immediate resources, all of which are needed for MAC to surge to its full potential in times of emergency.

The attainment of the benefits, described herein, is dependent upon two major factors: first, MAC managers must have accurate, timely, and relevant data regarding MAC capability and requirements; second, MAC managers must be able to use computer aids which manipulate the data and present alternate solutions to the decision-maker for his evaluation in matching airlift capability with airlift requirements. With the improved use of communications and ADP techniques available in MACIMS MAC could realize the complete potential of its resources.

APPENDIX I

ANALYSIS OF STRATEGIC COMBAT BENEFITS

This Appendix contains supporting material for Section II, Benefits Derived During Strategic Combat Airlift Operations, and includes a scenario of significant airlift events with a statistical summary and the analyses performed on both C-141 mission ground time and ACL utilization of military channel missions.

SCENARIO

The contingency period we have selected for analysis extends from the latter part of January with the start of the Pueblo Crisis through the latter part of February with the end of the Tet Offensive. A listing of the significant airlift events from 25 January through 25 February is presented for the purpose of correlating isolated factors within the complexity of MAC operations during a contingency period. With such a correlation the effect of the contingency on various management areas can be better understood. Since the contingency period occurred mostly in February, analysis of February reports were also used when available (Reference Figure 2).

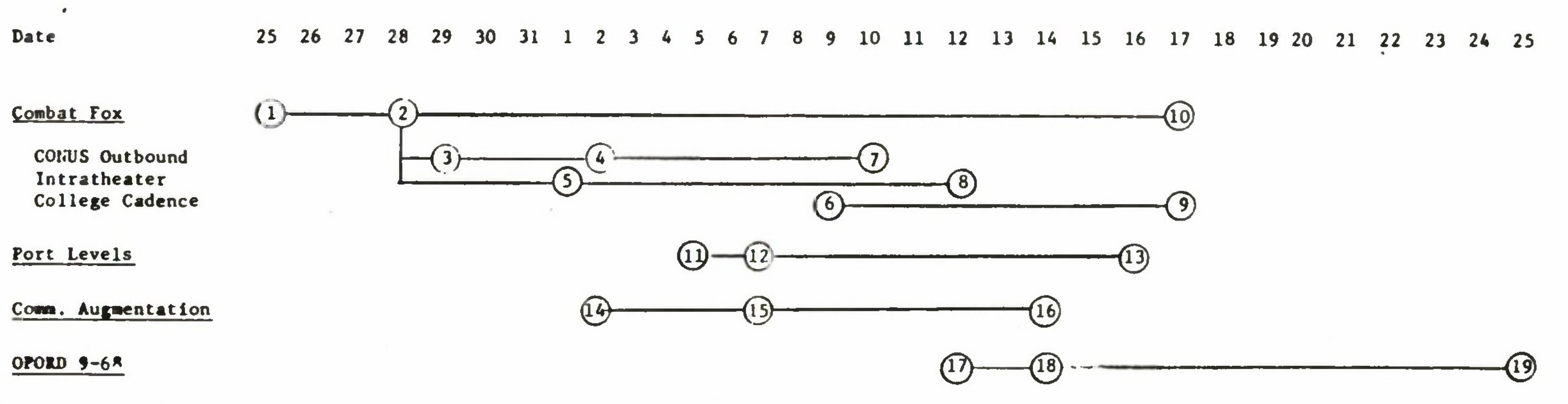
Daily Events (25 January Through 25 February)

25 January - MAC received word from JCS to prepare for a major deployment of U. S. forces into South Korea. MAC was given less than three days to plan for this deployment, officially titled OPORD 7-68 and named Operation Combat Fox.

28 January - Combat Fox was initiated and consisted of: (1) movement of USAF squadrons from CONUS to Korea (these USAF squadrons consisted of TAC fighter, TAC C-130, and ANG fighter units); and, (2) movement of CINCPAC forces intratheater to Korea. The CONUS outbound requirements were stated; however, the exact intratheater requirements were not known. In addition, CONUS APOE port levels started to build up to provide logistical support to units already overseas and those being deployed.

29 January - CONUS outbound requirements increased 20%; however, MAC still had not received the intratheater requirements. Meanwhile, CONUS APOE port levels continued to rise.

30 January - With CONUS outbound contingency requirements remaining steady, MAC received intratheater requirements which were far in excess of MAC capability and required refinement on the part of the user (CINCPAC).



1. MAC alerted by JCS for Pueblo Crisis.
2. Combat Fox started.
3. Reqts. increased 20%.
4. Reqts. increased 17%.
5. Reqts. stated by user.
6. College Cadence started -- an extension of Combat Fox.
7. Closed original CONUS outbound requirements of Combat Fox.
8. Closed Intratheater reqts. of Combat Fox.
9. Closed College Cadence.
10. Closed Combat Fox.
11. Tripled since 1/28.
12. Maximum "tons-on-hand."
13. Decreased to only 22% above capacity.
14. Supplemental Commercial Augmentation for Combat Fox.
15. More supplemental Commercial Augmentation for Combat Fox.
16. Supplemental Commercial Augmentation for OPORD 9-68.
17. MAC alerted for Tet Offensive.
18. OPORD 9-68 started.
19. OPORD 9-68 closed.

Figure 2. Significant Airlift Events (25 January through 25 February)

31 January - CONUS outbound contingency requirements remained stable while the intratheater contingency requirements were still being refined.

1 February - Intratheater contingency requirements stabilized; however, MAC did not have sufficient capability to commit aircraft to the requirements. In fact, frequently for the intratheater portion of Combat Fox, MAC could not state how many missions were scheduled in the next 24 hours; MAC was forced to schedule missions to meet intratheater requirements when aircraft became available rather than preplanning the use of aircraft. This situation resulted in many aircraft being diverted by area ACPs to meet intratheater needs and not returning to CONUS to serve normal CONUS outbound traffic. Hence, the aircraft could not service the backlog at CONUS APOEs, and caused the high use of SAAMs and commercial carriers.

2 February - CONUS outbound contingency requirements increased 17% with the planned movement of another fighter squadron overseas. Intratheater contingency requirements remained stable; however, MAC could not schedule aircraft for next day's operation due to lack of knowledge when aircraft would be available. In addition, supplemental commercial missions were being negotiated to aid in moving cargo from the APOEs.

4 February - CONUS APOE port levels had tripled since the start of Combat Fox on 28 January.

7 February - CONUS APOE port levels reached their maximum for the contingency period. In addition, more supplemental commercial missions had been procured.

9 February - CONUS outbound contingency requirements increased by 14% with the deployment of a fighter squadron from McChord to Okinawa; officially, this movement was part of OPORD 7-68, though nicknamed by MAC as College Cadence.

10 February - The original CONUS outbound portion of Combat Fox was completed though intratheater and College Cadence operations continued.

12 February - MAC was alerted by JCS to prepare for another major deployment to counter the Tet Offensive. The intratheater requirements of Combat Fox were concluded.

14 February - OPORD 9-68 was started and consisted of: (1) movement of an Army Brigade of the 82nd Airborne Division from Ft. Bragg via Pope AFB to Chu Lai; and, (2) movement of a reinforced Marine Regiment from Camp Pendleton via El Toro AFB to Danang. Even though most of Combat Fox was finished, the College Cadence portion was still in progress. In addition, the commercial carriers committed aircraft to support MAC though the particular missions they would fly remained to be negotiated.

16 February - CONUS APOE port levels had decreased from their maximum, though still 22% above normal capacity.

25 February - The OPORD 9-68 operations were concluded a day ahead of original schedule.

Summary Highlights

The effect of the contingency period is statistically summarized in the following paragraphs. The fact that MAC had to "surge" from normal to emergency operations is obvious though the exact amount is surprising. The degree of efficiency with which MAC responded in such a short time is to be commended. Any shortcomings in the operations rest in the area of overall coordination of management activities which were increased by augmentation of MAC's organic resources. TAC augmentation was assigned in addition to mobilized Air Force Reserve and Air National Guard Airlift Squadrons (Reference Table II).

It must be recognized that MAC had less than 72 hours to plan for the Pueblo Crisis and only 48 hours for the Tet offensive. As reported to the Congressional Committee earlier this year, MAC requirements and planned activities far exceeded original plans for February 1968. Total cargo requirements increased 48% over forecasts, while passengers requirements increased by 13%. An increase of 18% in flying hours and supplemental commercial procurement in excess of $60 million was required to satisfy MAC requirements. The following paragraphs contain specific information which complements MAC's report to the Congressional Committee.

C-141 Utilization

During February, C-141s flew 58,246 hours at a utilization rate of 7.9. These figures represent a 26.3% and 22.3% increase, respectively, over the averages of the previous seven months (Reference Table III).

Table II

Total Transport Capability

February 1968

Productive Flying Hours

	C-141	C-133	C-130	C-124	Other*
MAC	53,816	6,625	7,527	20,426	-
Air Force Reserve	-	-	-	5,880	274
Air National Guard	-	-	-	2,581	6,269
Tactical Air Command	-	-	7,307	-	-
TOTAL	53,816	6,625	14,834	28,887	6,543

*Includes C-97s, C-119s, and C-121s.

Table III

C-141 Hours Flown and Utilization (FY 68)

	7	8	9	10	11	12	1	2	3	4	5	6
Rate	6.4	6.4	6.3	6.4	6.5	6.5	6.7	7.9	6.9	6.9	7.2	6.8
Hours	41575	43000	42327	46548	47368	50233	51743	58246	54382	51388	55430	52510

	(FY 68 Without Feb.) Aver.	Feb.	Δ	(Δ/Aver.) %
Rate	6.64	7.9	+1.26	19.0%
Hours	48,773.1	58,246	9,472.9	19.4%

	(7/67 to 1/68) Aver.	Feb.	Δ	(Δ/Aver.) %
Rate	6.46	7.9	+1.44	22.3%
Hours	46,113.4	58,246	+12,132.6	26.3%

CONUS APOE Port Levels

Throughout the month of February, activity at the CONUS APOEs remained above normal capacity. At each APOE, the "average-tons-on-hand" exceeded the average of the previous months. Some (Dover, Charleston, and McChord) more than doubled the seven month average. For instance, Dover increased 131%. In addition, the port holding time for February increased 31.0% over the previous seven month's average (Reference Tables IV and V).

Use of SAAMs

During February, MAC used SAAMs to accomplish 318,054 MTM which is 133% above the previous seven month's average of 136,496 MTM. Even though ACL utilization of the SAAMs was exceptionally high, many SAAMs flew channel flow patterns. Each SAAM decreases MAC resources since the aircrews and aircraft are committed to serving the user who contracted for the SAAM. Hence, MAC's alternatives for meeting unplanned events (replanning) are limited.

Aircrew Utilization

Examination of pilots average flying time, only, indicates that 21 AF pilots increased 13.0% over the previous seven month average, while 22 AF pilots increased 14.2% (Reference Table VI).

ACL Utilization Rates (Channel)

Though high for contingency operations, the ACL utilization for channel cargo missions decreased.

Procurement of Commercial Carriers

The supplemental commercial augmentation that was procured during the height of the contingency buildup turned out to be more than MAC needed. This resulted in high use of commercial carriers during the rest of the fiscal year, when military capability was available to meet the requirements. In addition, about $2.5 million had to be carried over to FY 1969 when the tariff rates decreased.

Table IV

CONUS Port Levels Average-Tons-On-Hand (FY 68)

	(FY 68 Without Feb.) Aver.	Feb.	Δ	(Δ/Aver.) %
Dover	464	896	+432	+93
McGuire	104	93	-11	-11
Charleston	98	215	+117	+119
Norfolk	39	38	-1	-3
Travis	755	1,093	+338	+45
McChord	127	306	+179	+141
Norton	128	202	+74	+58
Kelly	265	386	+121	+46

	(July 67 - to Jan. 68) Aver.	Feb.	Δ	(Δ/Aver.) %
Dover	389	896	+507	+130.8
McGuire	79	93	+14	+17.7
Charleston	101	215	+114	+110.0
Norfolk	37	38	+1	+2.7
Travis	751	1,093	+342	+45.4
McChord	104	306	+202	+193.3
Norton	111	202	+91	+82.5
Kelly	283	386	+103	+35.7

Table V

CONUS Port Levels and Holding Time (FY 68)

Monthly Averages

MONTH (FY 68)	TOTAL MAC CONUS PORT LEVEL (TONS)	PORT HOLDING TIME IN DAYS (WEIGHTED BY PORT LEVEL) Average Tons on Hand
July	2310	2.66
Aug	1677	2.56
Sept	1284	1.93
Oct	1580	2.03
Nov	1620	2.25
Dec	3279	3.70
Jan	1231	2.00
Feb	3229	3.21
Mar	2369	2.56
Apr	2535	2.76
May	2115	2.26
June Data Not Available		
Average (July 67 to Jan 68)	1854	2.45
Feb Increase Over Average	76.8%	31.0%

Table VI

Aircrew Utilization - Pilots' Average Flying Time (FY 68)

Month	7	8	9	10	11	12	1	2	3	4	5	6
21	76	73	73	72	74	73	72	83	82	69	79	76
22	77	78	74	79	78	79	80	88	81	79	86	82

	(FY 68 Without Feb.) Aver.	Feb.	Δ	(Δ/Aver.) %
21 AF	74.5	83	+8.5	+11.3
22 AF	79.4	88	+8.6	+10.8

	(July 67 - Jan. 68) Aver.	Feb.	Δ	(Δ/Aver.) %
21 AF	73.3	83	+9.6	+13.0
22 AF	77.9	88	+11.1	+14.2

C-141 Delays at Offshore Stations

The number of delays for C-141s at offshore stations increased about 150% from December 1967; however, by April 1968 the delays were decreased to below December 1967 level even though MAC was flying more hours (Reference Table VII).

Command and Control

Command functions for the most part proceeded acceptably. For example, CONUS outbound contingency missions proceeded smoothly; however, the intratheater movement of men and materiel led to some confusion. The intratheater requirements were to move CINCPAC materiel into Korea. Associated with this requirement was the reestablishment of certain offload bases in Korea to full-scale operational capabilities, effectively a "bare-base" operation in the middle of winter. Hence, the need for housekeeping and ground support equipment to sustain operational airlift and fighter squadrons was paramount. However, this support equipment was spread among various bases in the Pacific. Lack of a detailed coordinated plan prevented smooth movement into Korea. Therefore, the Area ACPs at Yokota and Clark were directed to work directly with the 5th and 13th AFs, respectively. Because there was no system for providing full-scale coordination between the Area ACPs, the cargo was not moved in the appropriate sequence. This resulted in fighter squadrons destined for Korea being delayed at Itazuke, Japan, pending arrival of necessary housekeeping and ground support equipment in Korea. Positive force control by the 22 AF, as coordinator of all activities in the Pacific, was certainly needed during this contingency period. Though the quantitative benefits presented in the following sections do not address this confusion of command functions, it is the major benefit MAC should expect from MACIMS through improved force monitoring and improved coordination with the user of airlift services.

C-141 GROUND TIME ANALYSIS

In view of the events of February 1968 described in the previous scenario, several hypothesis were formulated concerning C-141 mission ground time and military channel ACL utilization rates. This section explores and analyzes the data relevant to aircraft ground time for the period January - June 1968.

Table VII

C-141 Delays

Time Increment (Hours) / Delay Categories	December 67					February 68					April 68				
	0-4	4-12	12-24	24-48	Over 48	0-4	4-12	12-24	24-48	Over 48	0-4	4-12	12-24	24-48	Over 48
Operations	133	98	33	9	3	221	146	37	6	3	78	56	25	5	2
Traffic	56	3	6	2	1	113	10	3	2	-	31	3	1	1	1
Base Support	21	1	-	-	2	49	30	20	4	-	11	2	1	-	-
Supply	11	11	17	22	8	15	10	26	15	22	13	6	11	15	10
Material General	10	3	1	1	-	28	6	3	2	-	4	2	1	-	-
Mechanical	246	84	49	17	8	244	102	85	23	5	176	47	52	17	9

The study was motivated by three basic premises:

(a) Although an OPORD is carefully and extensively planned in advance, the rescheduling necessary to perform the transformation from routine operations to contingency operations cannot be planned in advance, since the location of MAC aircraft and crews throughout the world just prior to OPORD initiation cannot be predicted. The manual accomplishment of the rescheduling task, possibly completed in a 6 to 12 hour period immediately prior to the contingency, is likely to result in many idle aircraft awaiting rerouting decisions. Excessive ground time can similarly be expected at major turning points in modes of operation during the contingency operation and immediately thereafter.

(b) Excessive ground time for aircraft during a contingency, both that results from the disruption of normal operations and that usually is associated with regular monthly operations, reduces the surge capability of MAC in terms of its aircraft utilization rate. Such a lost opportunity, although not of great consequence in peacetime, is of paramount importance during a contingency.

(c) A portion of the excessive ground time which is due to uncontrollable factors such as weather at the destination station would be recoverable if the planner had timely data and could quickly respond with an appropriate mission change. While such replanning is considered too disruptive during peacetime operations, it is again necessary when a contingency plan is being executed.

The ensuing analysis provides data on a long-term basis for the 6 months, January - June 1968, and the contingency period, January 28 - February 26. A short-term study examines day-to-day occurrences during the contingency.

Delay Code Analysis

The Air Movement data for January - June 1968 was analyzed for all legs where ground time was in excess of 2 hours for C-141 aircraft. In addition, flying hour data was also recorded for C-141 aircraft and commercial cargo channel traffic for use in both ground time and ACL utilization analyses. The data was further subdivided by mission identifier prefix and delay code. The mission identifier prefix yielded information concerning the type of mission. The code for this prefix is presented in Table VIII. The excess ground time was then considered in light of the delay code and whether MACIMS would directly aid in recovery of this excessive ground time. The applicable delay codes are listed below:

Table VIII

Mission Identifiers
Conversion Factors (Prior to FY 69)

1st Character - Carrier

A	21 AF Line Aircraft
P	22 AF Line Aircraft

2nd Character - Type Mission

A	SAAM - Directed by Hq MAC
K	Scheduled Military Channel
M	Contingency - Onload to Offload Stations Listed in Flow Schedule
P	Non-Scheduled - Positioning for a Contingency
T	Non-Scheduled - Depositioning for a Contingency
R	Non-Scheduled - Recycling for a Contingency

3rd Character - Mission Purpose

(Not used in ground time analysis)

Very controllable by MACIMS:

000 No explanation.

232 Crew rest required due to missions being out of scheduled sequence resulting in saturation of stage posture (no legal crew).

233 Crew unable to make scheduled departure due to stage crew release policy.

234 Crew Hold - To preclude crew member(s) exceeding 125 hours for 30-day period.

235 Crew Hold - To preclude crew member(s) exceeding 330 hours for 90-day period.

241 Delay due ACP support (late alert, faulty mission setup, etc.).

242 Crew rest required or delay due scheduling error.

243 Nonreceipt of diplomatic clearance.

244 Improper operator scheduling (airdrome operating hours or daylight only operating restriction not considered when schedule was prepared, etc.).

245 Improper operator planning for flight (aircraft not properly equipped or configured for mission requirements, etc.).

246 Improper operator planning for ground support (required ground support equipment not positioned to support the mission; e.g., power units, local handling equipment, etc.).

Partially controllable by MACIMS:

115 Weather at destination station.

322 Loading (allocated loading time exceeded).

323 Offloading (allocated offloading time exceeded).

324 Load configuration, condition or documentation.

325 Load handling equipment (shortage, malfunction, inadequate).

326 Cargo transshipment aircraft held for connecting flight).

327 Pallet or net availability (requiring floor loading).

329 Saturation of cargo handling facilities/equipment.

713 NORS - Random demand; item not authorized for FSP or base stock.

181 User.

182 SAAM load not ready - user responsibility.

183 SAAM load improperly configured, prepared or documented - user responsibility.

184 Unable to support MAC operation during planned ground time.

Five major codes were responsible for most of the excessive ground time amenable to MACIMS. The average monthly ground time for each of these as well as the codes is presented below:

CODE	AVERAGE EXCESS GROUND TIME (Hours)
000	9,013
115	810
181	245
232	994
713	1,071
TOTAL	12,133

Monthly Ground Time Analysis

Excessive ground time for 6 months and the contingency period by major delay code and mission type is exhibited in Tables IX - XVI, and Figures 3 and 4. Total excess ground time for these five codes as a percentage of flying hours can be considered an approximate measure of planning effectiveness with respect to aircraft utilization. Although relative ground time for all mission types dips in February, it peaks for channel operations. Controllable code 232 (crew stage sequence) ground time increases considerably in February, mostly because of contingency depositioning.

Table IX

Ground Time* Analysis by Delay Code and Mission Prefix-Contingency Period (Days 28 - 57)

Mission				Ground Time By Code				
Mission Prefix (1st 2 Letters)	Total Ground Time as a % of Flying Hours	Flying Hours	Total Ground Time of 5 Selected Delay Codes	000	115	181	232	713
AK	35.7	9,869	3,521	2,010	395	0	436	680
PK	19.0	10,150	1,930	1,053	136	0	361	380
AM	22.4	5,813	1,300	736	356	127	61	20
PM	25.0	4,352	1,090	933	19	97	33	8
AA	23.4	7,305	1,706	819	414	64	210	199
PA	15.6	9,458	1,472	815	249	39	301	68
AT	27.6	3,171	876	486	84	28	278	0
PT	20.0	2,338	468	173	16	0	259	20
PP	32.6	521	170	87	73	10	0	0

*Ground time in excess of 2 hours.

Table X

Ground Time* Analysis by Delay Code and Mission Type-Contingency Period (Days 28 - 57)

	Total Ground Time as a % of Flying Hours	Flying Hours	Total Ground Time of 5 Selected Delay Codes	Ground Time By Code				
				000	115	181	232	713
Channel	27.2	20,019	5,451	3,063	531	0	797	1,060
Contingency Legs	23.5	10,165	2,390	1,669	375	224	94	28
Contingency Deposition	24.4	5,519	1,344	659	100	28	537	20
Contingency Position	32.6	521	170	87	73	10	0	0
All Contingency Legs	24.1	16,195	3,904	2,413	548	262	631	48
SAAM	19.0	16,763	3,178	1,634	663	103	511	267
Other	35.5	5,085	1,805	1,531	77	102	33	62
Total	24.7	58,062	14,338	8,643	1,819	467	1,972	1,437

*Ground time in excess of 2 hours.

Table XI

Delay Code Analysis By Mission Type (January)

TYPE MISSION	FLYING HOURS	TOT. GRD. TIME AS % OF FLYING HOURS	TOT. GRD. TIME OF SELECTED 5 CODES	000 TIME % OF FH	Ground Time By Delay Code				
					000	115	181	232	713
CONTING. (Exercises)	4263	55.9	2384	47.4	2023	145	199	15	2
CHANNEL	29343	18.0	5293	10.8	3183	810	4	781	515
SAAM	6413	30.2	1936	17.2	1101	360	276	89	110
OTHER	5985	82.6	4943	68.4	4092	607	4	71	169
TOTAL	46004	31.6	14556	22.6	10399	1922	483	956	796

NOTE: All referenced ground times are those <u>in excess</u> of scheduled enroute ground times of 2 hours.

Table XII

Delay Code Analysis By Mission Type (February)

TYPE MISSION	FLYING HOURS	TOT. GRD. TIME AS % OF FLYING HOURS	TOT. GRD. TIME OF 5 SELECTED CODES	000 TIME % OF FH	Ground Time By Delay Code				
					000	115	181	232	713
CONTING. (Exercises)	12433	14.6	1816	10.9	1359	303	26	102	26
CHANNEL	20930	26.7	5589	14.5	3026	585	0	739	1239
SAAM	15784	16.9	2674	8.5	1344	542	74	447	267
OTHER	11430	18.0	2056	11.9	1362	92	232	348	22
TOTAL	53924	22.5	12135	13.1	7091	1522	332	1636	1554

NOTE: All referenced ground times are those <u>in excess</u> of scheduled enroute ground times of 2 hours.

Table XIII

Delay Code Analysis By Mission Type (March)

TYPE MISSION	FLYING HOURS	TOT. GRD. TIME AS % OF FLYING HOURS	TOT. GRD. TIME OF 5 SELECTED CODES	000 TIME % OF FH	Ground Time By Delay Code				
					000	115	181	232	713
CONTING. (Exercises)	245	88.2	216	31.6	200	16	0	0	0
CHANNEL	29394	17.9	5266	11.6	3413	237	1	903	712
SAAM	12271	36.4	4472	28.0	3438	377	334	167	156
OTHER	6554	59.4	3897	56.4	3694	163	19	3	18
TOTAL	48463	28.6	13851	22.2	10745	793	354	1073	886

NOTE: All referenced ground times are those in excess of scheduled enroute ground times of 2 hours.

Table XIV

Delay Code Analysis By Mission Type (April)

TYPE MISSION	FLYING HOURS	TOT. GRD. TIME AS % OF FLYING HOURS	TOT. GRD. TIME OF 5 SELECTED CODES	000 TIME % OF FH	Ground Time By Delay Code				
					000	115	181	232	713
CONTING. (Exercises)	2146	293.8	6305	293.8	6305	0	0	0	0
CHANNEL	30278	16.8	5072	12.2	3708	56	5	564	739
SAAM	7909	25.4	2010	21.1	1673	96	78	50	113
OTHER	5266	58.5	3078	54.3	2858	98	49	19	54
TOTAL	45599	36.1	16465	31.9	14544	250	132	633	906

NOTE: All referenced ground times are those in excess of scheduled enroute ground times of 2 hours.

Table XV

Delay Code Analysis By Mission Type (May)

TYPE MISSION	FLYING HOURS	TOT. GRD. TIME AS % OF FLYING HOURS	TOT. GRD. TIME OF 5 SELECTED CODES	000 TIME % OF FH	Ground Time By Delay Code				
					000	115	181	232	713
CONTING. (Exercises)	229	490.3	1123	490.3	1123	0	0	0	0
CHANNEL	33614	18.3	6167	12.9	4345	73	0	713	1036
SAAM	8931	31.2	2785	26.9	2406	54	77	72	176
OTHER	6756	50.6	3421	47.1	3187	86	39	12	97
TOTAL	49530	27.2	13496	22.3	11061	213	116	797	1309

NOTE: All referenced ground times are those <u>in excess</u> of scheduled enroute ground times of 2 hours.

Table XVI

Delay Code Analysis By Mission Type (June)

TYPE MISSION	FLYING HOURS	TOT. GRD. TIME AS % OF FLYING HOURS	TOT. GRD. TIME OF 5 SELECTED CODES	000 TIME % OF FH	Ground Time By Delay Code				
					000	115	181	232	713
CONTING. (Exercises)	1157	110.7	1281	108.5	1256	21	0	4	0
CHANNEL	28855	20.0	5795	14.3	4124	51	0	713	907
SAAM	9439	37.2	3513	35.5	3352	33	39	41	48
OTHER	6421	32.9	2110	29.6	1907	54	16	113	20
TOTAL	45872	27.7	12699	23.2	10639	159	55	871	975

NOTE: All referenced ground times are those in excess of scheduled enroute ground times of 2 hours.

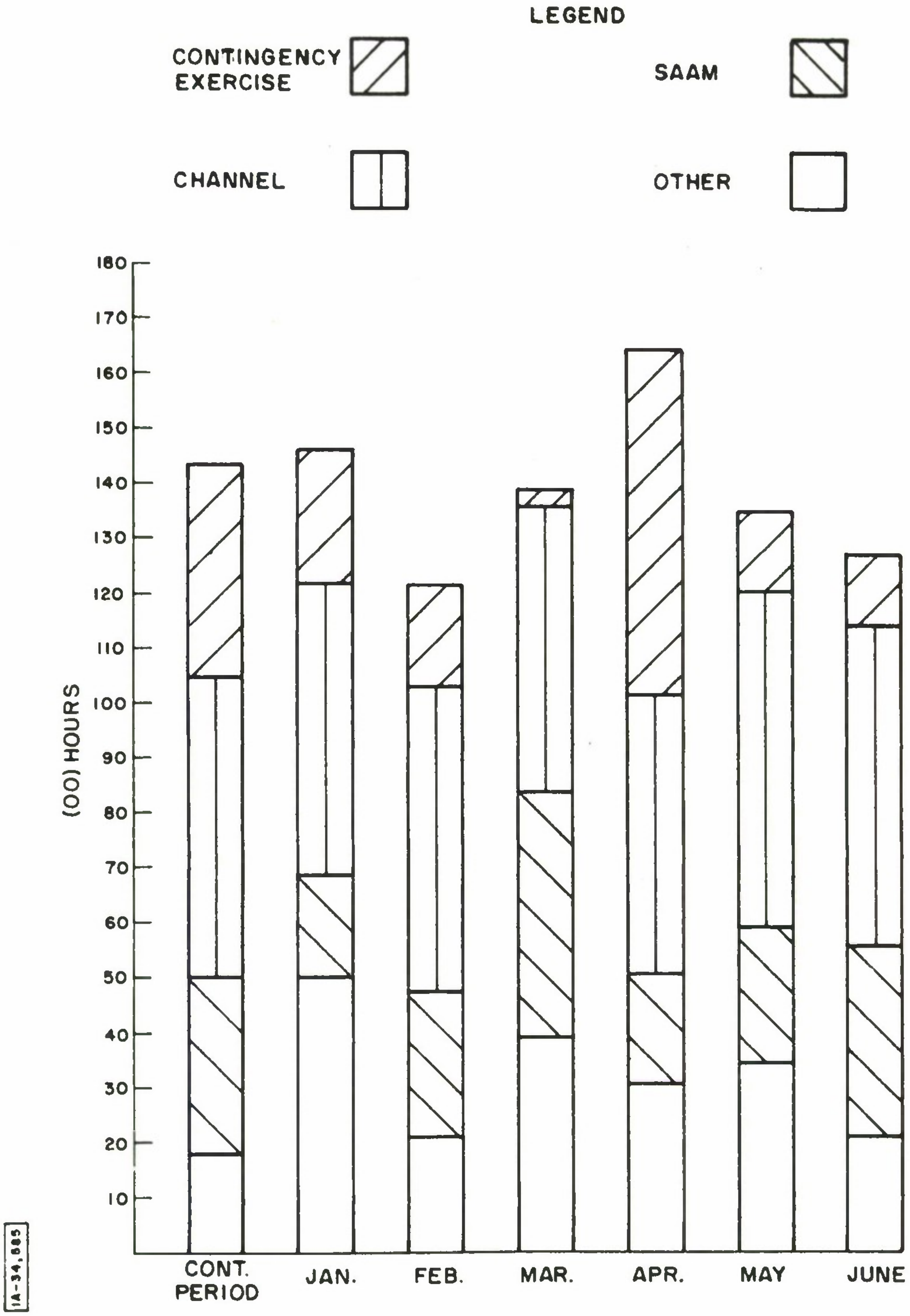


Figure 3. EXCESS GROUND TIME BY TYPE MISSION

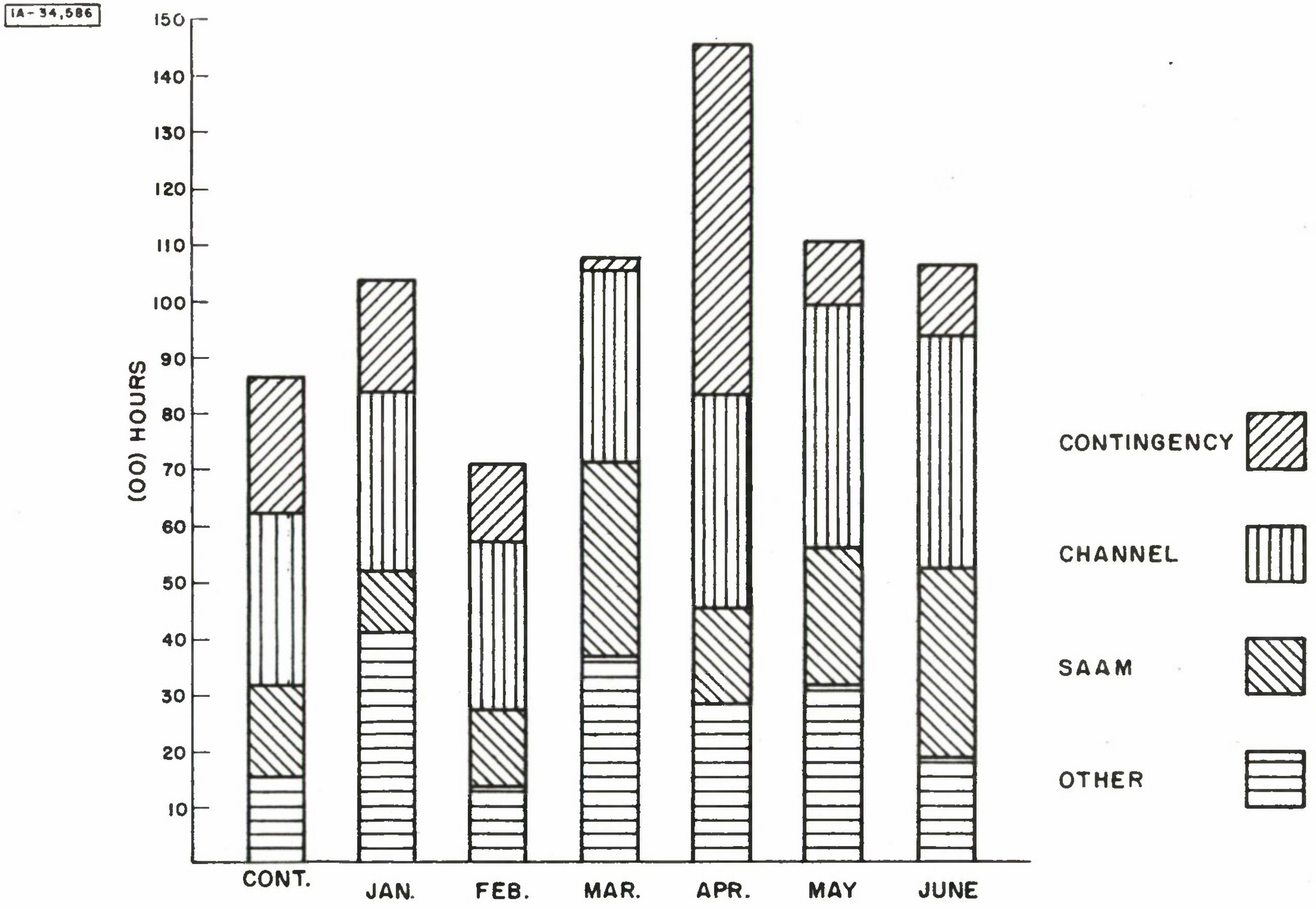


Figure 4. EXCESS OOO GROUND TIME BY TYPE MISSION

Contingency Period Analysis

All applicable codes were considered in a daily breakout of ground time and flying hour data for January 1 to February 28, 1968. The excess ground time for each applicable code is presented in Table XVII for the period January 28 - February 26. For the entire contingency period, the excess ground time was 15,109 hours or 1,888 C-141 working days. The excess ground time and flying hours per day for SAAM, channel, contingency and the total of these is graphically displayed in Figures 5 - 9. The contingency starts on January 27, prior to the OPORD, due to positioning and administrative flights. Every sudden increase in either contingency, SAAM, or channel traffic results in a marked daily increase in excess ground time associated with the respective mission category. The excess ground time then recedes with returning continuity in the MAC environment. This phenomenon is less pronounced in the case of OPORD 9-68, which did not involve major intratheater redeployment. Following the Figures 5 - 9, the path of events described earlier can be traced. Channel operations were reduced considerably during the first days of OPORD 7-68, while SAAMs increasingly supported the contingency. Channel traffic resumed toward the end of OPORD 7-68 as port backlogs mounted and airlift became available. Less clear, but similar events accompanied the execution of OPORD 9-68. Meanwhile, supplemental commercial augmentation increased throughout February, as shown in Figure 10, with a spurt 1 - 3 days after each authorization to purchase additional supplemental commercial airlift. (Reference Supplement I for a discussion on applying extra capability to contingency closure time.)

Table XVII

Contingency Period
(Days 28-57)
January 28 - February 26
Delay Code Data

DELAY CODE	REASON	GROUND TIME IN EXCESS OF 2 HR	C-141 WORKING DAYS
000		8643	1080
115	Weather	1819	227
181	User	467	58
182	User	76	10
183	User	28	3
232	Stage Saturation	1972	247
241	ACP Support	82	10
242	Scheduling Error	39	5
322	Cargo	95	12
323	Cargo	42	5
324	Cargo	144	18
325	Cargo	55	7
327	Cargo	10	1
329	Cargo	200	25
713	NORS	1437	180
TOTAL		15109	1888

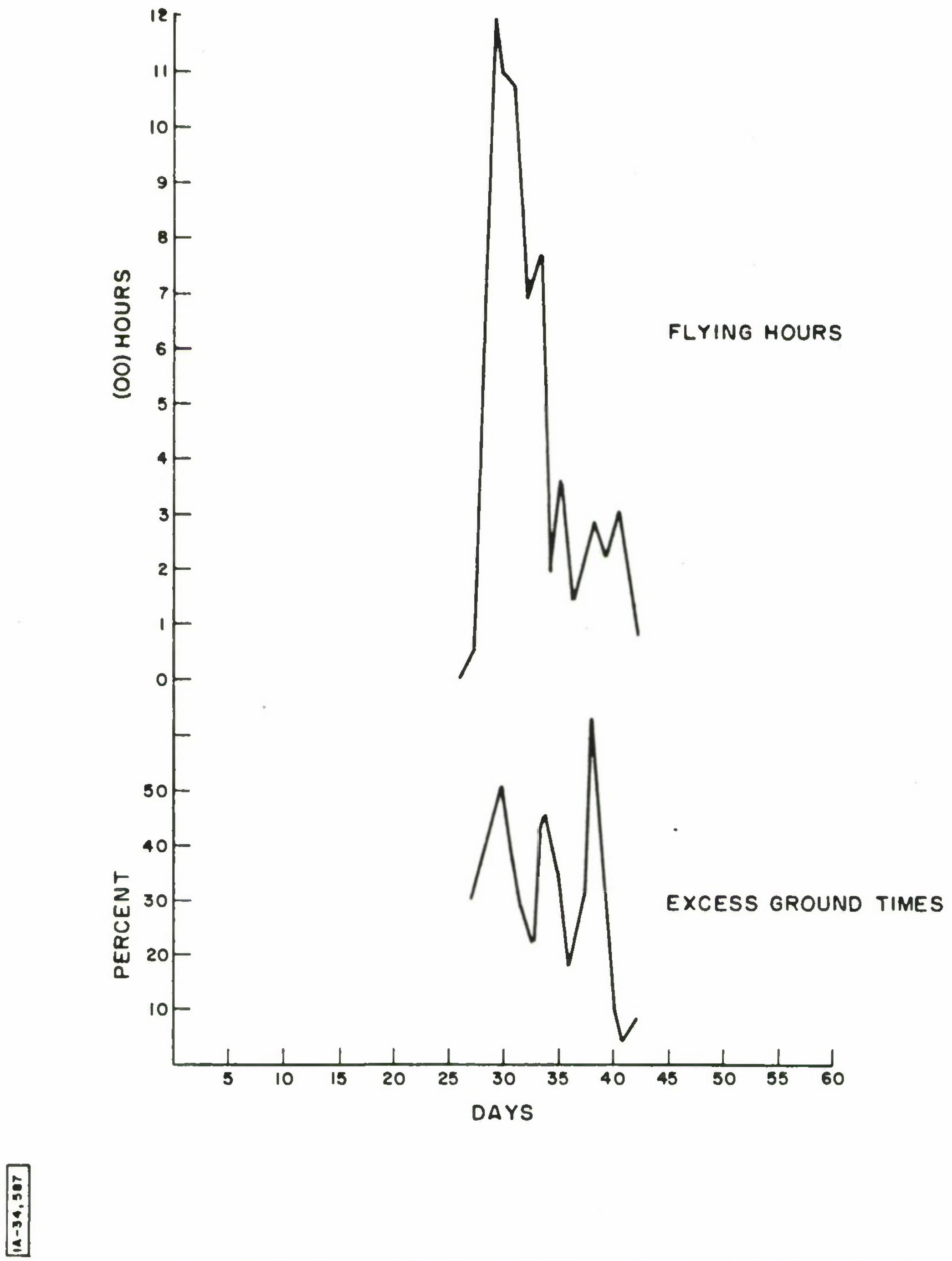


Figure 5. CONTINGENCY EXCESS GROUND TIME AS A PERCENTAGE OF FLYING HOURS – COMBAT FOX

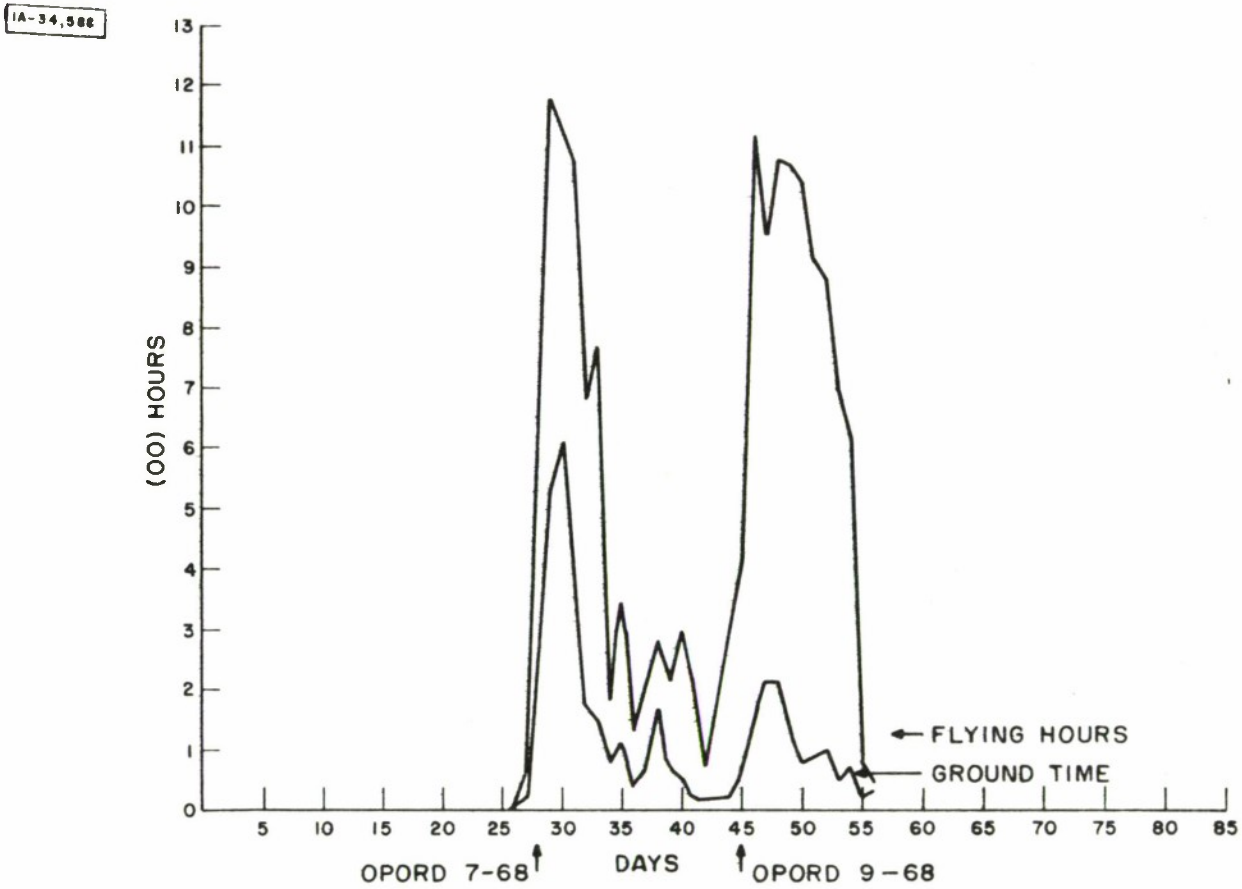


Figure 6. CONTINGENCY EXCESS GROUND TIME AND FLYING HOURS

IA-34,589

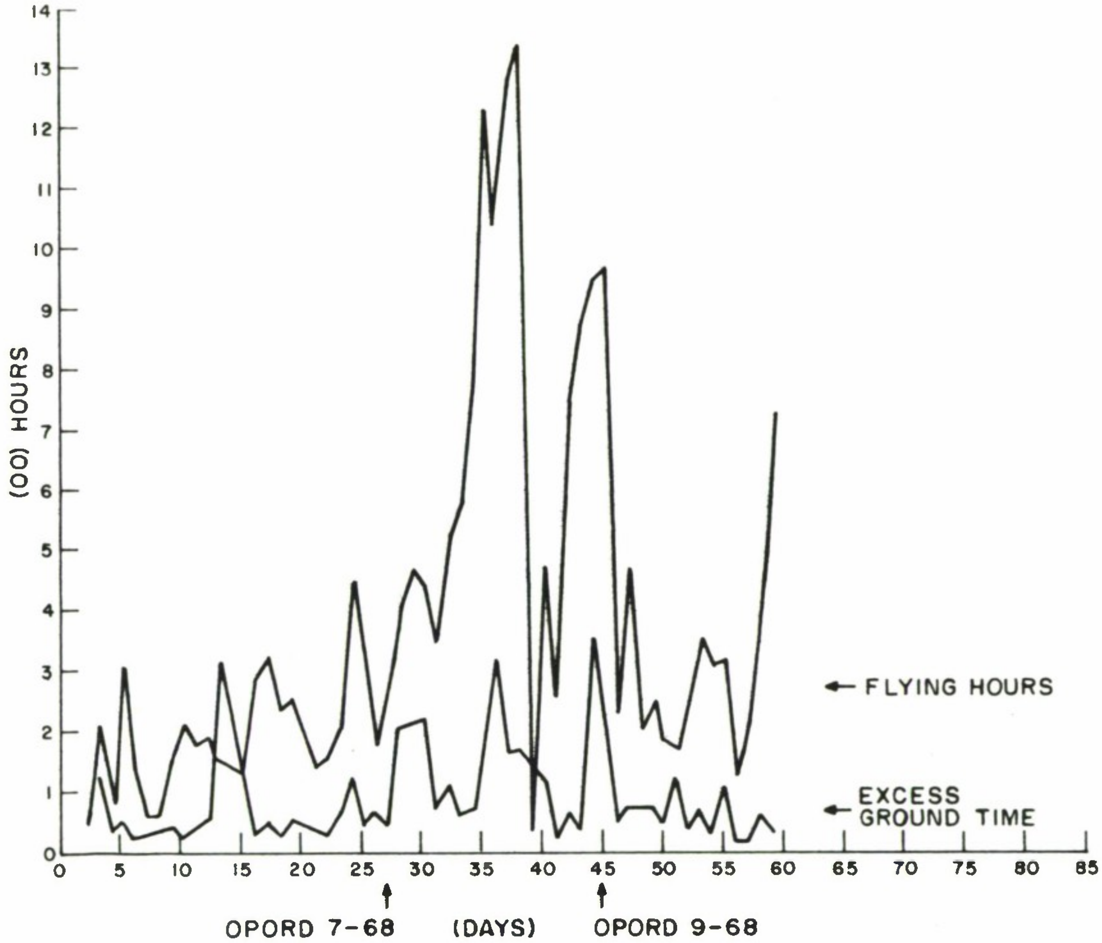


Figure 7. SAAM EXCESS GROUND TIME AND TOTAL FLYING HOURS

1A-34,590

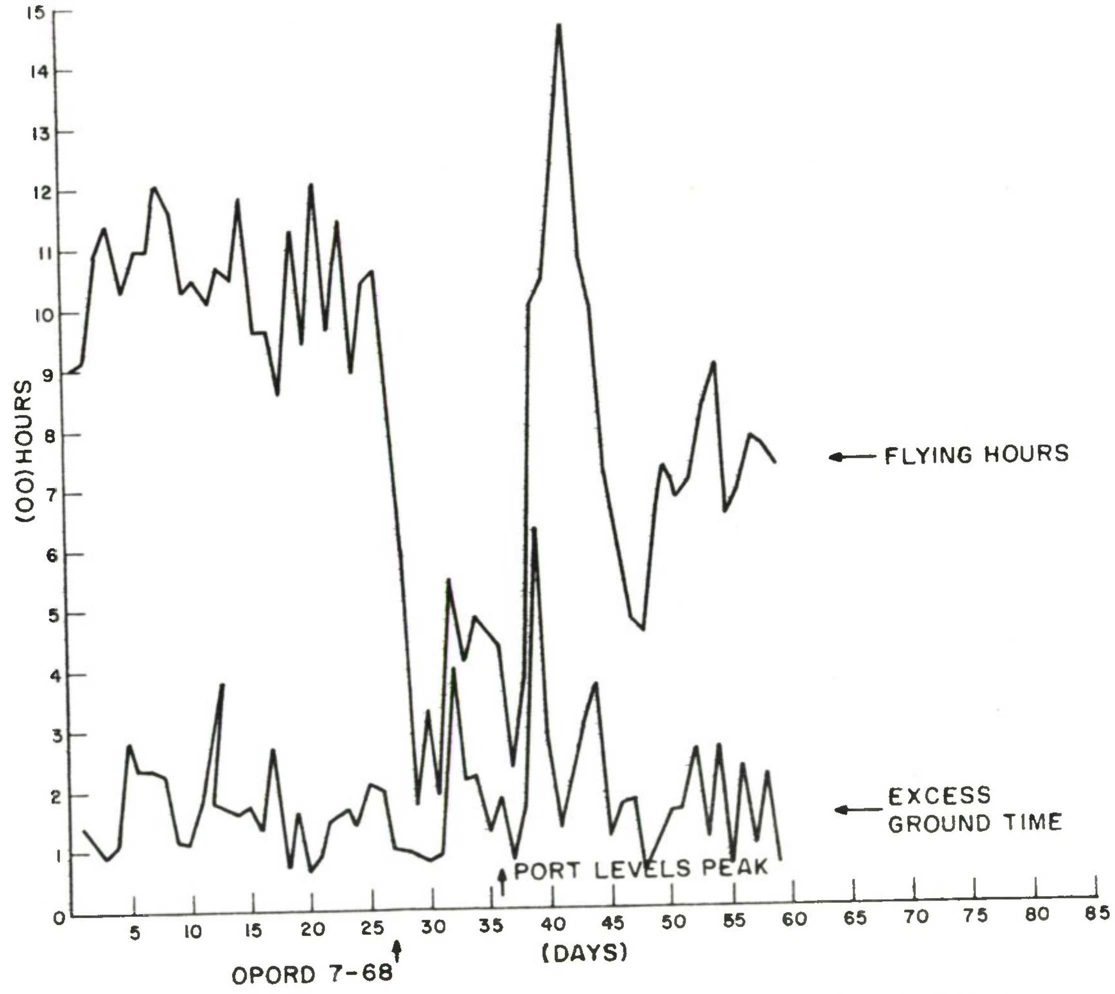


Figure 8. CHANNEL EXCESS GROUND TIME AND FLYING HOURS

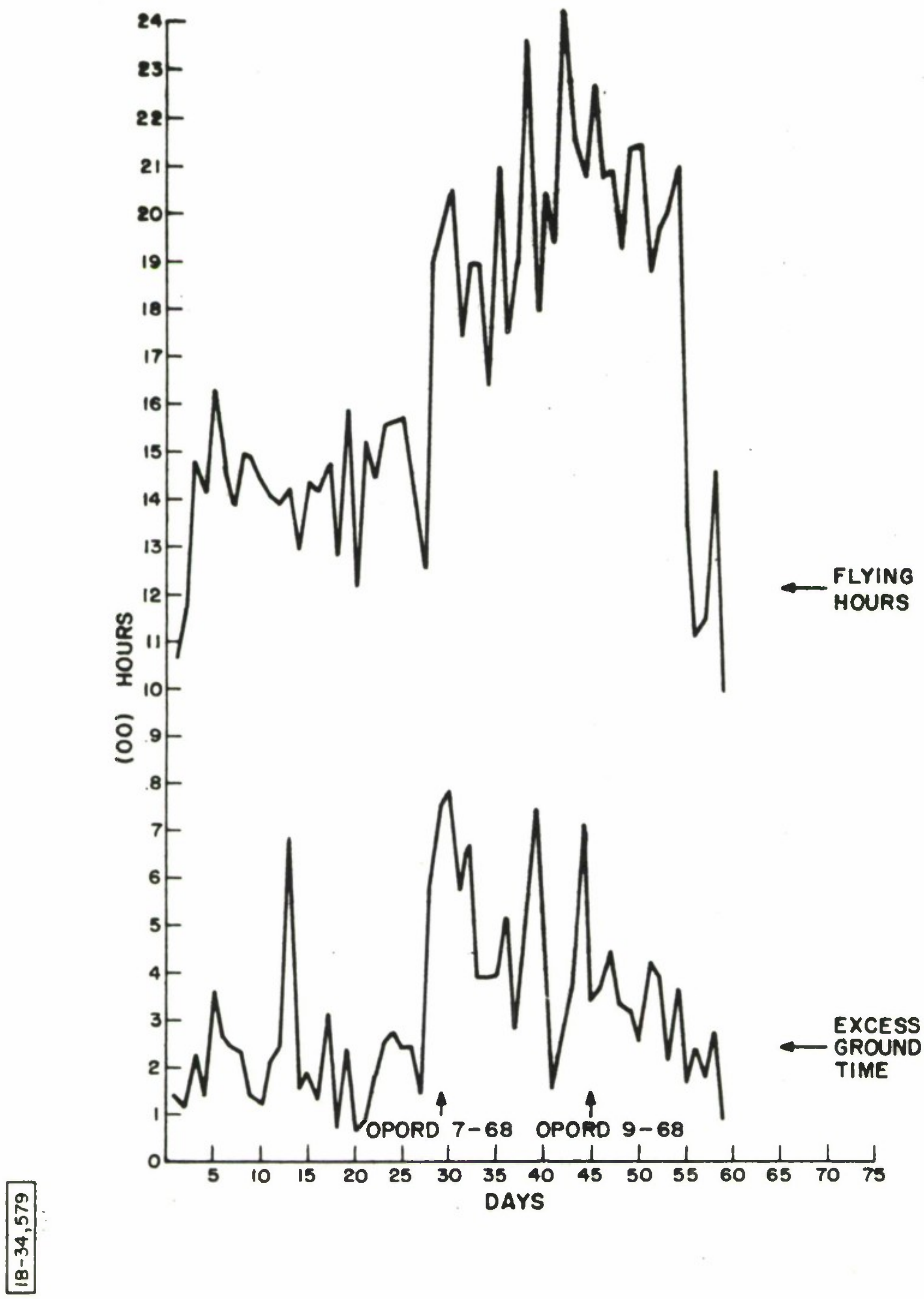


Figure 9. TOTAL SAAM CHANNEL CONTINGENCY ACTIVITY

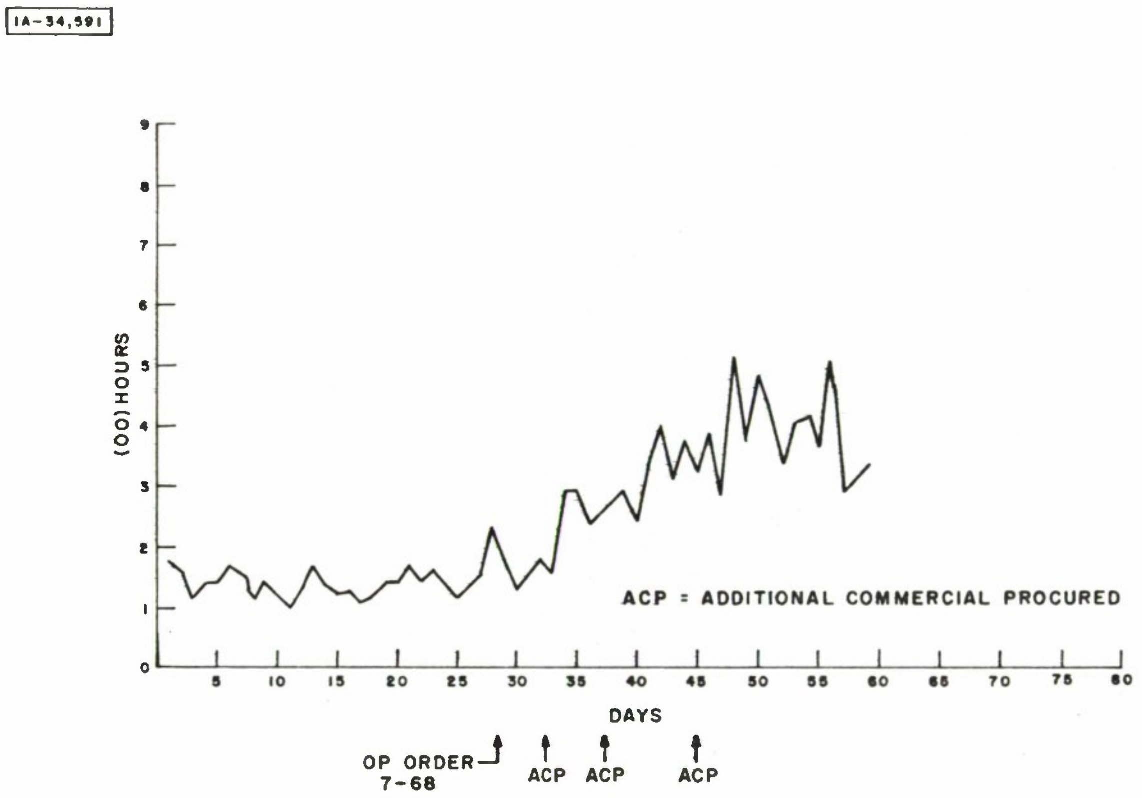


Figure 10. COMMERCIAL CHANNEL FLYING TIMES (ALL CARGO + MIXED)

CONTINGENCY PERIOD ACL UTILIZATION

ACL utilization of military aircraft was examined for channel missions. Basically, the average ACL utilization rate for each mission category for FY 1968 without February and March (March constitutes a heavy resupply month) was considered a very conservative goal or standard for MAC to have attained during the contingency related months of February, March, and in some cases, April. In the case of channel traffic the goal was adjusted for the ratio of inbound to outbound missions. That is, even with MACIMS, one would expect lower ACL utilization in February, a month of abnormally high inbound traffic (due to outbound SAAMs becoming inbound channel missions). The savings expected if the goal was met were then computed.

The following steps for military channel cargo missions were used:

a) Compute the average ton-mile/flying-hour rate for FY 1968 without February and March as shown in Table XVIII. From this standard, we can, knowing the average flying hour ratio of inbound to outbound for C-141 channel traffic and assuming this ratio for other aircraft, compute the average inbound TM/FH rate.

b) Compute the outbound and inbound average ton-miles/flying-hour rate for FY 1968 as shown in Table XIX.

c) Adjust the standards for February, March, and April to account for the abnormal inbound/outbound ratios as shown in Table XX. Use these standards to compute unused ton-mile capability and equate to flying hours, C-141 working days and months, and possible savings in commercial augmentation. The results indicate a total potential saving in February, March, and April 1968 of $15.41 million on channel traffic.

Although our final analysis only considered military channel cargo missions, preliminary investigation indicates potential benefits from improving ACL utilization for both commercial cargo missions and SAAMs. If, during the contingency and its aftermath, the commercial airlift was used as well as it was in the first six months of CY 1968, a savings of 1895 flying hours or $4.5 million could have been realized by MAC. Similarly, SAAMs during February and March contained lost opportunities of approximately 70 MTM. Although utilization of SAAMs is not directly under the control of MAC, improved channel service would have lessened the need for SAAMs, thereby recovering a portion of the aforementioned SAAM lost ton-miles.

Table XVIII

Military Cargo Channel TM/FH Rate (FY 68)

MONTH	MISSIONS	FLYING HOURS	MILLION TON MILES	UTILIZATION TON/MILE F.H.
July	537	38181	187.9	4921
Aug	626	35409	185.0	5224
Sept	582	37421	218.9	5849
Oct	728	42139	196.1	4653
Nov	668	43734	209.3	4785
Dec	633	40377	259.3	6421
Jan	740	49915	240.5	4818
Feb	441	35944	168.5	4687
Mar	806	50973	218.9	4294
Apr	809	50301	239.4	4759
May	919	54833	291.9	5323
June	761	48123	308.7	6414
Average Without Feb & Mar (Weighted by F. H.)	700	44043	233.9	$\boxed{5306}$
% Feb Over/ Under Average	-37.0	-18.39	-27.96	-11.67%
% Mar Over/ Under Average	+15.1	+15.73	- 6.41	-19.08%

Table XIX

Military Cargo

Channel Outbound/Inbound TM/FH Rate (FY 68)

Step 1 Computation of Outbound TM/FH Rate FY 68

	C-124	C-130	C-133	C-141	Total
Speed (Knots)	190	290	240	400	N/A
Average Payload FY '68	8.433	9.650	20.258	18.850	N/A
Flying Hours (000) FY '68	127.5	60.6	20.1	351.6	559.8
Percent Flying Hours of Total Flying Hours	22.8	10.8	3.6	62.8	100.0
Weighted Contributions to TM/FH Average	365	302	175	4743	5585

Step 2 Computation of Inbound TM/FH Rate FY 68

$$\frac{5585\ (1.0) + .734\ (x)}{1.734} = 5306$$

$$x = \frac{(5306)\ (1.734) - 5585}{.734} = \boxed{4926 \text{ TM/FH}}$$

NOTE: The outbound/inbound ratio of 1.0/.734 is based on samples of C-141 channel cargo missions during FY 68 through FY 70; the selection of C-141 as the standard is based on: (1) most (63%) missions during FY 68 were C-141, and (2) examination of C-124 ratio differed less than 5%.

Table XX

Military Cargo Channel Missions (Feb., Mar., and April 1968)

MONTH	ADJUSTING TM/FH STANDARD	UNUSED FH	EQUIVALENT MTM	COMML. COST	C-141 EQUIV. WORKING DAYS	C-141 EQUIV. WORKING MONTHS
February	Outbound/Inbound Ratio: 1.0/.928 Feb. Standard: $\frac{5585 + .928(4926)}{1.928} = 5267$	$(\frac{5267}{4687} - 1.0) \times 35944$ = 4448 FH	4687 x 4448 = 20.85 MTM	20.85 x \$.153 = 3.19 M	$\frac{4448}{8.0} =$ 556	$\frac{4448}{232.0} =$ 19
March	Outbound/Inbound Ratio: 1.0/.677 Mar. Standard: $\frac{5585 + .677(4926)}{1.677} = 5319$	$(\frac{5319}{4294} - 1.0) \times 50973$ = 12167 FH	4294 x 12167 = 52.25 MTM	52.25 x \$.153 = \$7.99 M	$\frac{12167}{8.0} =$ 1521	$\frac{12167}{248.0} =$ 49
April	Outbound/Inbound Ratio: 1.0/.720 Apr. Standard: $\frac{5585 + 720(4926)}{1.720} = 5309$	$(\frac{5309}{4759} - 1.0) \times 50301$ =5813	4759 x 5813 = 27.66 MTM	27.66 x \$.153 = \$4.23 M	$\frac{5813}{8.0} =$ 727	$\frac{5813}{240.0} =$ 24
Totals	N/A	22428 FH	100.76 MTM	\$15.41 M	2804	92

APPENDIX II

ANALYSIS OF STRATEGIC RESUPPLY BENEFITS

BACKGROUND

In order to estimate MACIMS benefits that will accrue from strategic resupply operations, an analytical model* was developed to measure potential opportunities in the management of MAC airlift. Basically, the model, called MPO, accumulates unused pallet positions of an aircraft on a leg-by-leg basis and converts them into equivalent aircraft flying hours. In particular, the model addresses MAC management of C-141 channel cargo missions.

Rationale

For channel cargo missions, the load planners attempt to operate outbound missions with the maximum number of pallet positions utilized. Missions which operate with less than maximum pallets do so under directives from high authorities or airlift cargo which requires special handling; e.g., outsize cargo. Hence, the MPO Model examines missions which could have, but did not, operate with maximum use of pallet positions. The basic measurement for C-141 aircraft was unused pallet-spaces on those leg segments where available data indicate that the C-141 channel mission could have carried ten pallets, the C-141 pallet capacity. There are many reasons why a mission departs with less than ten pallets, foremost being that the offered ACL did not permit the loading of any more cargo. Another reason is the movement of floor-loaded cargo which may require one or more pallet spaces. It is clear that such missions are well utilized. However, other causes of low utilization can be avoided and better use of communications and ADP techniques should reduce the number of C-141 legs carrying less than ten pallets.

Reasons for Underutilization

The following four reasons for underutilization of an aircraft were selected for inclusion in our model since MACIMS will aid the functional manager in avoiding them: (1) excessive scheduled capability (a mission was scheduled at the particular station even though cargo was not expected to generate); (2) non-generation

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*Thayer, Frederick, C., Design of an Analytical Model for Measuring Lost Opportunities in the Management of MAC Airlift, MITRE WP-3195.

(expected cargo did not generate); (3) negative-on-hand (generated cargo moved on a previous mission); and (4) insufficient setup time (manifest preparation and/or pallet buildup could not be completed before mission was scheduled to depart).

Aircraft Payload Versus Pallet Weight

To determine whether an aircraft with less than ten pallets was fully utilized, the aircraft payload and the total weight on the pallets were numerically compared:

(a) if they were approximately equal (the entire payload was palletized) AND if the critical offered ACL permitted extra pallets to be carried, the aircraft was underutilized; and

(b) if they were unequal (some floor-loaded cargo was aboard), the aircraft was NOT considered underutilized since we could not ascertain from our source data whether or not more cargo could have been carried.

Source Data

The source data for the MPO Model were J-2 (Daily Traffic Utilization Reports) submitted by MAC Transportation managers at each departure station for each MAC mission. A J-2 record contains mission, station, and for cargo missions, payload data including number of pallets carried, weight of palletized cargo, and critical offered ACL.

Process

Applying the rationale of the MPO Model against the source data yielded the unused pallet positions for each leg of a mission. The following steps were performed to obtain total equivalent C-141 flying hours for our sample set:

(a) the total of unused pallet positions for each leg was divided by 10 to obtain the aircraft equivalent;

(b) the result was multiplied by the flying time for each leg;

(c) the resultant leg flying hours were accumulated for each departure (leg-originating) station; and

(d) the flying hours for each departure station were accumulated for all stations in the sample set. (Reference Page 82 for the mathematical formulation of the MPO process.)

Additional Factors

The primary results of the MPO Model are in terms of unused flying hours (UFH). To obtain the flying hours that can be considered recoverable when MACIMS is implemented, two additional factors must be included.

First, the MPO Model deals only with outbound missions. However, the aircraft must eventually return to home station. Examination of F-1 data yields a 1.0/0.7 outbound/inbound flying hour ratio.

Second, further analysis of the F-1 data revealed that not all mission legs had a J-2 record filed for each leg. This situation arises when there is no onload or offload at an enroute station. The numerical factor of 1.33 was arrived at by examination of the F-1 data for C-141s during 2nd Quarter FY 1970. Specifically, J-2 records reported only 74.6% of all C-141 channel cargo missions contained in the F-1 data base at Hq MAC. Hence, the recoverable flying hours (RFH) consist of the product of unused flying hours, the F-1/J-2 factor, and the "return-home-base" factor.

APPLICATIONS OF THE MPO MODEL

Five interdependent applications of the MPO Model were performed. Each varied certain elements in our sample set while leaving others constant. The constant factors were: (1) source data were J-2 Reports; (2) type A/C was C-141; and (3) type mission was channel cargo. The variable factors were time frame, mission destination, geographic area, and departure stations. For each application the RFHs are converted to: (1) C-141 working days using an 8.0 hour utilization rate, and (2) monetary value using $433 per flying hour which is the ASIF rate for total reimbursable direct cost for the C-141 as of 31 December 1969 (Reference Table XXI).

Application I

The first application of the MPO Model yielded 803 UFH (Reference Table XXII) considering outbound missions during November 1969 operating in the Pacific area with all associated departure stations. The process consisted of using the AFICCS QUEST capability on the IBM 1410 to select certain J-2 records. Manual analysis was performed to refine the selection and calculate recoverable flying hours. The result was 1856 RFH which converts to 231 C-141 working days and $803,600.

Table XXI

MPO Model

Sample Sets and Results

Constant Factors

Reasons For Underutilization
- Excessive Scheduled Capability
- Non-generation
- Negative-on-hand
- Insufficient Setup Time

Source: J-2 Reports

Type Aircraft: C-141

Type Mission: Channel Cargo

Variable Factors

Step	Time Frame	Geographic Area	Mission Destination	Departure Stations	Monthly Unused Flying Hours	Monthly Recoverable Flying Hours	Equivalent C-141 Working Days	$ (000)
I	Nov 1969	Pacific	Outbound	All	803.05	1,855.81	231	803.6
II	Nov 1969	Pacific	Westbound	High Frequency*	693.32	1,602.23	200	693.8
III	2ndQ FY70	MAC-wide	Outbound	All	677.79	1,566.35	195	678.3
IV	2ndQ FY70	Pacific	Westbound	High Frequency*	479.65	1,108.45	138	480.0
V	July 1968 - May 1970	MAC-wide	Outbound	All	698.88	1,615.08	201	699.3

*High frequency stations include all CONUS ports, ports in Vietnam and Thailand, Hickam, Wake, Guam, Clark, Yokota, Kadena, and Elmendorf.

Table XXII

UFH — Application I

Departure Station	21AF	22AF	Total
CONUS			
CHS	21.192	--	21.192
DOV	63.492	--	63.492
SBD	--	13.818	13.818
SUU	--	48.208	48.208
TCM	1.532	31.488	33.020
Subtotal	86.216	93.514	179.730
OFFSHORE			
AWK	--	16.945	16.945
CRK	3.420	48.249	51.669
DAD	--	0.932	0.932
DNA	26.444	39.007	65.451
EDF	96.900	56.550	153.450
ENT	--	7.020	7.020
FUK	--	1.635	1.635
HIK	--	46.853	46.853
KUZ	0.402	--	0.402
KWJ	--	2.376	2.376
MSJ	--	0.648	0.648
OKO	67.068	132.154	199.222
OSN	--	1.664	1.664
SGN	15.791	40.872	56.663
UAM	--	18.375	18.375
Subtotal	210.025	413.280	623.305
TOTAL	296.241	506.794	803.035*

*These UFH convert to 1856 RFH which are 5.54% of the accomplished flying hours.

Application II

Refinement of the results of the initial application yielded 693 UFH (Reference Table XXIII). The refinement consisted of limiting our sample set to: (1) only westbound missions; and (2) only high frequency stations thereby eliminating missions with less than daily frequency. It was assumed that the latter missions were in the category of those directed by higher headquarters, such as assured frequency missions. High frequency stations included: all CONUS ports, ports in Vietnam and Thailand, Hickam, Wake, Guam, Clark, Yokota, Kadena, and Elmendorf. The process was manual and used as its basis the output of the previous application. The RFH amounted to 1602 which converts to 200 C-141 working days and $693,800.

Upon conclusion of this application, it was decided to expand our time frame and geographic area and to automate the manual procedures. These decisions led to further considerations. First, the leg flying times vary for each month and were not readily available in computer form. The decision was made to use March flying hours as the sample month since during March and September wind factors have less influence than other months of the year. Second, by automating the manual analysis performed by a transportation analyst, we eliminated many low frequency missions. Hence, many cargo missions which carry some passengers on a "hop-a-flight" basis (especially characteristic of the low frequency missions) were eliminated from consideration.

Application III

The third application of the MPO Model yielded 678 UFH (Reference Table XIV). The varying factors of our sample set consisted of outbound missions operating MAC-wide during 2nd Quarter, FY 1970 for all associated departure stations. The process consisted of executing the IBM 1410 MPO program and calculating a monthly average. The result was 1566 RFH which convert to 195 C-141 working days and $678,300.

Application IV

Refinement of the previous application yielded 480 UFH (Reference Table XVI). The sample set was limited to westbound missions and high frequency stations. The process was manual and resulted in 1108 RFH which convert to 138 C-141 working days and $480,000. Upon conclusion of this application, it was decided to expand the sample set to 23 months.

Table XXIII

UFH — Application II

Departure Station	21AF	22AF	Total
CONUS			
CHS	21.192	--	21.192
DOV	63.492	--	63.492
SBD	--	13.818	13.818
SUU	--	48.208	48.208
TCM	1.532	31.488	33.020
Subtotal	86.216	93.514	179.730
OFFSHORE			
AWK	--	16.945	16.945
CRK	3.420	46.149	49.569
DNA	19.654	20.024	39.678
EDF	96.900	56.550	153.450
HIK	--	39.033	39.033
OKO	66.868	117.481	184.349
SGN	10.020	2.171	12.191
UAM	--	18.375	18.375
Subtotal	196.862	316.728	513.590
TOTAL	283.078	410.242	693.320*

*These UFH convert to 1602 RFH which are 4.78% of the accomplished flying hours.

Table XXIV

UFH — Application III

	Mission Type	Oct	Nov	Dec	Total	Average
21st	ABW	158.83	137.06	164.36	460.25	153.417
	ABD	18.36	27.57	20.15	66.08	22.027
	ABA	95.38	61.14	116.35	272.87	90.956
	ABC	--	--	.48	0.48	.160
21st	Subtotal	272.57	225.77	301.34	799.68	266.560
22nd	PBP	267.58	214.38	349.77	831.73	277.243
	PBD	168.39	81.28	152.29	401.96	133.987
22nd	Subtotal	435.97	295.66	502.06	1,233.69	411.230
	TOTAL	708.54	521.43	803.40	2,033.37	677.790*

Ref. Table **XXV** for explanation of mission identifiers.

*These UFH convert to 1566 RFH which are 4.60% of the accomplished flying hours.

Table XXV

Mission Identifier Conversion Factors

<u>1st Character</u> - Carrier

A - 21AF line aircraft

P - 22AF line aircraft

<u>2nd Character</u> - Type Mission

B - Channel Cargo

<u>3rd Character</u> - Mission Purpose

A - 21AF area - CONUS/offshore - (e.g., Dover - Rhein Main)

C - 21AF area - intratheater - (e.g., Rhein Main - Athens)

D - 22AF area - intratheater - (e.g., Yokota - Clark)

P - 22AF area - CONUS/offshore - (e.g., Travis - Saigon)

W - 21AF CONUS/22AF offshore - (e.g., Dover - Yokota)

Table XXVI

UFH — Application IV

Departure Station	Oct	Nov	Dec	Total	Average
CONUS					
CHS	2.46	13.94	9.84	26.24	8.747
DOV	33.54	35.88	37.44	106.86	35.620
SBD	8.57	17.08	4.27	29.92	9.973
SKF	1.08	.43	1.35	2.86	.953
SUU	30.47	35.64	56.22	122.33	40.777
TCM	10.49	3.30	9.55	23.34	7.780
TIK	--	.32	--	.32	.107
Subtotal	86.61	106.59	118.67	311.87	103.957
OFFSHORE					
AWK	44.12	9.78	20.50	74.40	24.800
CRK	28.10	33.89	32.10	94.09	31.363
DNA	56.02	31.41	76.01	163.44	54.480
EDF	80.00	78.62	118.28	276.90	92.300
HIK	61.61	45.39	73.37	180.37	60.123
OKO	98.01	55.17	90.81	243.99	81.330
SGN	6.36	10.56	--	16.92	5.640
UAM	16.29	12.95	45.13	74.37	24.790
VCR	--	1.40	1.20	2.60	.867
Subtotal	390.51	279.17	457.40	1,127.08	375.694
TOTAL	477.12	385.76	576.07	1,438.95	479.650*

*These UFH convert to 1108 RFH which are 3.26% of the accomplished flying hours.

Application V

This final application of the MPO Model yielded 699 UFH (Reference Table XXVII). The sample set consisted of outbound missions operating MAC-wide during July 1968 through May 1970 for all departing stations. The process consisted of executing the IBM 1410 MPO program, previously outlined, and calculating a monthly average. The result was 1615 RFH which convert to 201 C-141 working days and $699,300.

OBSERVATIONS

The applications of the MPO Model led to the determination of the maximum, the minimum, and the average amount of monthly recoverable flying hours MAC can expect.

	MAX	MIN	AVERAGE
Recoverable Flying Hours	1856	1108	1615
C-141 Working Days	231	138	201
Monetary	$803,600	$480,000	$699,300

The average RFH is the 23-month average while the maximum is the result of Application I and the minimum is the result of Application IV. The following facts about the 23-month average are worth noting: first, the month we started with (November 1969) was 25.7% below the 23-month average; second, the 521 UFH of November 1969 were within 7.5% of the minimum of 480 UFH; and, finally, the 23-month average of 699 covers the time period when MAC aircraft were flying less hours due to the easing of the Vietnam conflict and the entry of the C-5s into the MAC force.

Prior to concluding this appendix, a number of observations regarding the 23-month results are worth noting. First, grouping the monthly averages of UFH by mission identifier (Reference Table XXV) yields:

	AVERAGE	%
PBP	284.12	40.6
PBD	96.76	13.9
ABW	228.68	32.7

Table XXVII

UFH — Final Application

	PBP	PBD	ABW	ABD	ABA	ABC	TOTAL
July'68	285.92	24.57	218.75	9.22	46.45	9.89	594.80
Aug	203.72	22.53	209.94	7.44	14.31	--	457.94
Sept	398.77	63.70	400.20	16.67	35.70	.96	916.00
Oct	410.60	75.42	460.41	8.60	35.44	.61	991.08
Nov	281.30	72.20	377.74	11.85	28.49	--	771.58
Dec	322.55	111.38	368.01	38.32	62.04	--	902.30
Jan'69	243.37	128.67	323.89	12.01	31.37	--	739.31
Feb	265.30	95.18	335.74	15.74	54.13	--	766.09
Mar	231.59	113.31	230.79	14.47	71.66	--	661.82
Apr	193.35	108.62	203.64	17.39	53.80	--	576.80
May	233.84	136.68	191.68	20.98	41.45	--	624.63
June	203.72	106.23	141.50	22.71	47.85	--	522.01
July	320.88	112.13	155.22	18.28	57.14	--	663.65
Aug	223.36	110.87	137.57	16.54	70.05	--	558.39
Sept	306.59	138.83	188.90	30.41	73.42	--	738.15
Oct	267.58	168.39	158.83	18.36	95.38	--	708.54
Nov	214.38	81.28	137.06	27.57	61.14	--	521.43
Dec	349.77	152.29	164.36	20.15	116.35	.48	803.40
Jan'70	410.00	67.91	234.22	19.72	105.82	33.07	870.74
Feb	396.89	91.29	155.73	14.08	95.51	50.69	804.19
Mar	231.59	113.31	230.79	14.47	71.66	--	661.82
Apr	266.92	66.97	110.69	13.24	135.63	38.30	631.75
May	272.68	63.64	122.90	24.35	68.00	34.84	586.41
TOTAL	6,534.67	2,225.40	5,258.56	412.57	1,472.79	168.84	16,072.83
Monthly Average	284.12	96.76	228.68	17.94	64.04	7.34	698.88*

*These UFH convert to 1615 RFH which are 4.59% of the accomplished flying hours.

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13. ABSTRACT

The potential benefits in airlift operations that MAC can expect from MACIMS have been analyzed and are reported herein. MAC has the dual responsibility of: first, deploying combat forces with their immediate supplies and equipment into the combat zone; and, second, sustaining the combat forces as long as they remain in the combat zone. During the Pueblo Crisis and Tet Offensive of 1968, MACIMS would have aided MAC in reducing the closure time by reducing excess ground times at enroute stations and by increasing ACL utilization of military channel (resupply) missions. In the post-1974 era MACIMS will aid MAC in improving ACL utilization through the capability to plan the use of aircraft pallet spaces for each mission segment prior to mission launch. This document contains the rationale and techniques we used to arrive at these conclusions. Supplement I contains classified material supporting the conclusions.

14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
AIRCRAFT LOADING PLANS						
AIR CARGO						
AIRLIFT (TRANSPORTATION)						
AIR TRANSPORTATION						
MILITARY AIRLIFT COMMAND						
MILITARY TRANSPORTATION						
MOVEMENT CONTROL (TRANSPORTATION)						
SHIPPING (PROCESS)						
TRANSPORTATION						
TRANSPORTATION MANAGEMENT						
TRANSPORTATION MODELS						