A COST COMPARISON BETWEEN MODES IN THE SHIPMENT OF MISSION CAPABLE PARTS WITHIN THE CONTINENTAL UNITED STATES

THESIS

Jason L. Masciulli, First Lieutenant, USAF

AFIT/GLM/ENS/01M-17

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

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Jason L. Masciulli, B.S.

First Lieutenant, USAF

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Jason L. Masciulli, B.S.
First Lieutenant, USAF

Approved:

William A. Cunningham, III, PhD (Chairman) — 5 Mar 01 — date

Marvin A. Arostegui, Maj, USAF (Member) — 6 Mar 01 — date

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Jason L. Masciulli

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Abstract

A numerous amount of Mission Capable Parts (MICAPs) are shipped throughout the world by the Air Force. These parts are required in order to meet mission requirements. MICAPs are often shipped via an express, small parcel air carrier, like Federal Express (FedEx). However, there is a lower cost alternative: Less-Than-Truckload express carriers. In using actual Air Force MICAP shipping data, an 11 percent savings was shown if the lowest cost carrier, either FedEx or Roadway Express, an LTL express carrier, was used in shipping these MICAPs. Also, in using simulated shipping data, over 50 percent of all types of shipments, based on weight and distance, would be shipped less expensively using Roadway than FedEx.

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I. Introduction

Background

Modal choice is a concept where shippers choose which mode, or modes, to ship their products or cargo. Carrier choice is a concept where shippers choose which carrier, or carriers, within a mode to ship their products or cargo. This thesis relates to the topic of modal/carrier choice and the costs related to it. Modal/carrier choice allows the manager to choose which mode/carrier best fits his or her company's needs. There are certain characteristics that each mode/carrier has. Air is very fast, yet expensive, while ships are slow, yet comparatively inexpensive. The manager has to look at each mode and decide on which mode, or modes, to use for his or her shipments. Carriers also have characteristics as well. Trucking companies can offer different service terms for the shipments it carries. The manager needs to again look at each carrier and decide which one, or ones, to use.

There are many criteria which a manager looks at in order to decide which mode(s) and carrier(s) to choose. The criteria managers look at for each mode/carrier include handling of shipments, packaging requirements, time between pickup and delivery, and cost to make the shipment. Each shipper needs to decide which criteria are more important than others. Some shippers deal in perishable items, so the mode/carrier would have to be fast. Other shippers deal in making large and very heavy shipments, so the mode/carrier would need to be able to handle those shipments.

Overall, modal/carrier choice decisions are made by finding the lowest cost mode/carrier that is still able provide the service that is needed to meet the shipper's needs. Often times, the shipper's needs are often the same as those of its customers. Managers need to weigh each of their criteria to select a mode or carrier in its own way in order to get the best value for its transportation dollar.

The Department of Defense (DoD) and the Air Force's managers also have to deal with the modal/carrier choice decision as well. However, more emphasis put on service rather than cost as a criterion for selecting a mode or carrier. This is mainly due to the idea that the need to meet mission requirements comes before costs. As opposed to the corporate sector, the Department of Defense is less concerned with costs, and is not concerned with revenues and profits. It is concerned with mission completion. Mission completion is the measure of success, as opposed to profits in the corporate sector. In DoD's case, the mode or carrier's ability to meet mission requirements is the primary criterion for modal/carrier selection.

The Department of Defense has traditionally left modal/carrier choice to the local traffic manager. However, they have set policies that regulate how carriers will be selected. Also, the Military Traffic Management Command has set policies and negotiated rates with carriers for commodities. Also, the DoD has set up policies that regulate modal/carrier selection as well. There are some cases, as stated in Air Force Instruction 24-201, that, for certain shipments, a particular carrier must be used (Department of the Air Force, 1999:22). This restricts the modal/carrier choice decision for the Air Force and does not give the local traffic manager the discretion to choose a mode or carrier to meet mission requirements.

This shortsightedness on DoD's part may result in wasted monetary resources. The DoD has been burdened with higher operations tempo, but with a smaller budget than is actually needed in order to meet its mission requirements. This type of environment should lend itself to modal/carrier choice research in order to determine the optimal use of the DoD's monetary resources for transportation. However, based on a literature search by the author, there has been no research done previously regarding modal/carrier choice within the DoD. This thesis will be the first foray into research for modal/carrier choice, that the author knows of, in the DoD, or the Air Force. This thesis will investigate modal/carrier choice for expedited shipments. This thesis will investigate the use of two modes: air and ground. These modes will be researched by using information for two carriers: Federal Express (FedEx) as the air carrier, and Roadway Express (Roadway), as the ground carrier.

FedEx is an express, small parcel delivery company that delivers their packages via a network of trucks, terminals, and aircraft, in order to deliver these packages overnight. In FedEx's case, it means delivery before 10:30 AM local time the next morning (Federal Express, 1999:7). The definition of a small parcel for FedEx's government service contract for shipments within the Continental United States, including Alaska, Hawaii, and Puerto Rico, is that is can weigh up to 150 pounds, and be no greater than 119 inches in length, and 165 inches in length and girth, combined (Federal Express, 1999:7).

Roadway is what is known as an LTL, or less-than-truckload, carrier. Roadway has the ability to handle small parcels as well as larger shipments. LTL carriers handle shipments up to 10,000 pounds in weight. These shipments are less than a full truckload,

hence the name LTL. Roadway and other LTL carriers consolidate the small shipments at a terminal and put them on a line-haul truck that hauls them to another terminal. At this terminal, the shipments are then broken out and delivered to their destinations (Coyle and others, 2000:99-101).

Problem Statement

The specifics of this thesis topic relates to sustaining operational aircraft, vehicles, and equipment. In order to maintain these certain items, the Air Force has what is known as the depot system. Depots are large logistics centers where the Air Force's operational wings send certain aircraft parts to be repaired. Some of these parts need to be shipped very quickly from the depots to the operational wings in order to meet mission requirements. To move these parts, the depots ship using a very fast mode of transportation. The fastest mode of transportation currently and readily available is air. There are companies, such as Federal Express, DHL, Emery, and UPS, which are able to get shipments from one place to another within 24 hours. This method of shipment is known as expedited air. The depots use these companies in order to ship these important aircraft parts to the units that need them. There are also cases where units have to ship parts to the depots very quickly, and use expedited air for these shipments.

The parts that have to be shipped from and to locations via expedited transportation are known as MICAPs, or Mission Capable Parts. These parts are needed in order to keep mission critical aircraft, vehicles and equipment fully operational. These MICAPs are parts that are not in the inventories of the supply warehouses at the bases they are needed. MICAPs are shipped from locations where the parts are in stock to the bases where the parts are not available, but needed. These parts come from various

locations around the world. They come from depots where they have undergone repair. They also come from contractors who either repair or manufacture them. These parts may also come from bases whose supply squadrons have them in their inventory. These parts are needed usually within one day in order to meet mission requirements. Hence, there is the need to use expedited transportation to ship them.

Expedited air shipments are expensive compared to shipments using other modes of transportation. The Air Force uses expedited air shipping extensively, but at a great cost. The research question is based on the idea that expedited ground can be just as fast as expedited air, but with a lower cost. The use of expedited ground transportation can result in a cost savings for the United States Air Force. The overarching question for this thesis is: is the current modal/carrier choice policy for the Air Force and DoD optimal for the shipment of MICAPs?

Reductions in the Defense budget have resulted in the Air Force looking into more ways it can save money. This thesis looks into another way in which the Air Force, and the Department of Defense can do this. First, some background is needed on the topic. Basically, this topic is based on the concept of Agile Logistics. It is based on Agile Logistics. One of the principles of Agile Logistics is that expedited transportation will increase transportation costs. However, this will reduce overall logistics costs by reducing the amount of inventory that the Air Force depots and supply squadrons have to carry (Department of the Air Force, 1999:9).

Research Significance

The reason this topic is significant is due to the large amount of money that is spent annually by the Department of Defense (DoD), the Defense Logistics Agency

(DLA), and the United States Air Force on its shipment of reparable parts to and from Air Force bases, DoD depots, and contractors who supply parts. The main purpose of this thesis is to determine the cost effectiveness of shipping MICAPs via a less expensive mode of transportation: LTL. MICAPs are shipped via air, which is the most expensive mode. However, if there is a less costly method of transporting MICAPs, with little or no degradation of service, then it should be considered. However, no known research has been done on the cost effectiveness of shipping MICAPs via expedited ground. This thesis will help to break new ground in the research of modal costs in the DoD, and perhaps lead to a change of policy for the shipment of MICAPs. Air Force Instruction 24-201 states "Commercial air express small-package delivery service, through approved GSA/AMC contracts or AMC/MTMC approved tenders, is the norm for Agile Logistics/2LM/Rapid Parts Movement shipments to meet Air Force sustainment goals" (Department of the Air Force 1999:9-10). If commercial ground tenders can provide the same service as commercial air tenders at a lower cost, then the Air Force and DoD should ship this way in order to save money. The goal of this thesis is to show that using commercial ground tenders is a viable alternative to shipping via commercial air tenders.

Research Objectives

The maximum expected gain from the research is an actual policy change, or change in how MICAPs are shipped from the depots to the operational units, in order to result in a cost savings for the Air Force. The minimum expected gain from the research is to increase awareness for Air Force and DoD traffic managers to look at expedited ground shipment when shipping MICAPs, as opposed to just using expedited air.

The least result this research will show is the cost savings within the period

examined for the Department of Defense that could result if expedited ground transportation had been used when it was feasible.

II. Literature Review

A literature search was conducted in order to find the results of relevant research that has been done on the topic of modal choice. This literature search turned up nothing from the defense arena on research that has been done on this topic. In the civilian sector, several articles were discovered pertaining to research done on modal choice. However, none of the articles found were about research done on modal choice from the perspective of service level being equal between modes and comparing the costs of the modes. There was also nothing discovered regarding the results of survey research done where shippers were asked their perceptions of modes if the service level was equal. Most of the research that has been discovered deals with the perception between modes based on surveys conducted of shippers.

Another part of the literature review will be the aspect of the current policies and procedures of the Air Force in regards to how modes are chosen in order to ship MICAPs to the depots from the operational bases.

Review of Modal/Carrier Choice Literature

Michael McGinnis published an article in which he summarized the results of transportation choice studies that were done before and after transportation deregulation, which took place in the early 1980's. In his article, "The Relative Importance of Cost and Service in Freight Transportation: Before and After Deregulation", the studies before 1980 were determined to be before deregulation, while studies done after 1980 were determined to be after deregulation (McGinnis, 1990:13). He looked at twelve studies total. Six were done before 1980 and six were done after 1980 (McGinnis, 1990:13). Seven of the studies he looked at researched carrier choice, two studied modal

choice, two looked at both carrier and modal choice, and one studied the reasons for using private transportation (McGinnis, 1990:13). After looking at these twelve studies, the variables that he found to affect freight transportation choice were, in no particular order:

- freight rates (costs, charges, rates)
- reliability (reliability, delivery time)
- transit time (time-in-transit, speed, delivery time)
- loss, damage, claims processing, and tracing
- shipper market considerations (customer service, user satisfaction, market competitiveness, market influences)
- carrier considerations (availability, capability, reputation, special equipment) (McGinnis, 1990:17).

In the twelve studies, the variables that determined the dimensions of service were found to be, in no particular order:

- reliability (reliability, delivery time)
- transit time (time-in-transit, speed, delivery time)
- over, short, and damage (loss, damage, claims processing, and tracing)
- shipper market considerations (customer service, user satisfaction, market competitiveness, market influences)
- carrier considerations (availability, capability, reputation, special equipment) (McGinnis, 1990:17).

What McGinnis found was that all the "prederegulation studies indicated that service variables were more important than freight rates on the average" (McGinnis, 1990:17). However, service criteria are the only criteria in which a carrier can be judged during prederegulation. This is because, by law, each carrier had to charge the same rate for the same type of shipment. The only true way to differentiate between carriers, during prederegulation and deregualtion, is on their service.

The postderegulation studies showed that service remained more important overall than freight rates, with two exceptions. The first exception was that two of the

postderegulation studies concluded that "rates may be more important than service in some situations" (McGinnis, 1990:17). One study, conducted by Chow and Poist, concluded that transportation rates are slightly more important than service in modal selection, while transit time reliability is more important than rates in the carrier choice selection (McGinnis, 1990:15). However, in the second study where there was variation, conducted by Quinn, the overall conclusion was that shippers placed more importance on service than on price in the motor carrier selection decision (McGinnis, 1990:17).

The second exception was in a study conducted by Bardi, Bagchi, and Raghunathan, which stated "the increase in emphasis on rates was greater than the increase in emphasis on customer service after deregulation" (McGinnis, 1990:17). However, McGinnis states "customer service continued to be of greater importance than rates" (McGinnis, 1990:17).

Based on the information provided by these studies, McGinnis makes the following caveats: "1. Freight rates are an important variable that should not be ignored. 2. When freight transportation choice data are segmented, the relative ranking of freight rates will exceed service in some segments. 3. The priorities among service variables vary. 4. The increased flexibility on the part of carriers and shippers since deregulation suggests that the methods for satisfying service and rate priorities have changed." (McGinnis, 1990:17-18). Finally, McGinnis states that service will be more important than rates to shippers. However, he states, "price becomes a major factor after service objectives have been met and in some instances may be the most variable to the shipper" (McGinnis, 1990:18). His overall conclusion is that "shipper priorities have not changed fundamentally as a result of deregulation" (McGinnis, 1990:17).

Paul Murphy and Patricia Hall did a follow-up study based on the McGinnis article. What Murphy and Hall did is look at transportation choice studies done after McGinnis' article to see if there were any changes in the variables in transportation choice. They also tried to validate McGinnis' conclusions. Murphy and Hall looked at studies that were done between 1990, when McGinnis' article was published, and 1993. Murphy and Hall state that the results of the studies of the 1990's showed the emergence of new variables in the transportation choice decision (Murphy and Hall, 1995:33). These variables include: rate negotiation, service negotiation, carrier response in emergencies, willingness to improve service quality, and quality of dispatch personnel (Murphy and Hall, 1995:33-34).

The results of Murphy's and Hall's analysis in including the studies of the 1990's with the studies McGinnis looked at showed that reliability is the top ranking variable over the three decades of the 1970's, 1980's, and 1990's (Murphy and Hall, 1995:35). Freight rates fluctuated in its ranking over the decades studied. Transit time has steadily declined in importance from the 1970's to the 1990's, while freight rates have fluctuated in importance being ranked around fifth in the 1970's, second in the 1980's and dropping to about fourth in the 1990's (Murphy and Hall, 1995:35-36). Another result of Murphy and Hall's study showed that, in a comparison of motor carrier selection studies versus non-motor carrier selection studies, carrier considerations ranked third in studies of motor carrier selection, versus sixth in non-motor carrier studies (Murphy and Hall, 1995:36). Reliability ranked first in both motor carrier and non-motor carrier studies. Freight rates ranked about sixth in motor carrier studies, while it ranked second in non-motor carrier studies (Murphy and Hall, 1995:36).

In supporting McGinnis caveats, Murphy and Hall state that McGinnis' first caveat is supported because "rates are ranked as high as second most important" (Murphy and Hall, 1995:37). They state that McGinnis' second caveat is not supported because Murphy and Hall found that over all the studies analyzed, rates only appear 10 percent of the time in the top three variables. McGinnis' third caveat is supported because Murphy and Hall found variation between non-motor carrier studies and motor carrier studies in the rankings of freight rates and service variables (Murphy and Hall, 1995:37). Murphy and Hall's results partially support caveat 4. This is because in the prederegulation studies, reliability, transit time, and over, short, and damaged are ranked ahead of freight rates, while all of the service variables, except reliability, are consistently ranked below freight rates in the post deregulation studies (Murphy and Hall, 1995:37). Finally, Murphy and Hall's study partially supports McGinnis' overall conclusion that shippers' priorities haven't changed due to deregulation. Even though reliability has maintained the top ranked variable in both pre- and postderegulation studies, transit time was the second ranked variable in prederegulation studies, while freight rates has been the second ranked variable in postderegulation studies (Murphy and Hall, 1995:37).

Murphy and Hall, in their conclusions, rewrite McGinnis' second and fourth caveats to be:

> "2. The absolute importance of freight rates will vary across situations. In particular, freight rates will show higher importance in more general, as opposed to more specific, transport choice studies.
>
> 4. Shippers in the United States value reliability more highly than cost and other service variables in the freight transportation choice process."(Murphy and Hall, 1995:37).

Murphy and Hall also rewrite McGinnis' overall conclusion to read: "Excluding reliability, shipper priorities in the United States have changed, and will continue to change, as a result of deregulation" (Murphy and Hall, 1995:37).

Bagchi, Raghunathan, and Bardi published an article titled "The Implications of Just-In-Time Policies on Carrier Selection" in which they studied the importance of certain criteria when selecting a carrier. They especially were interested in the importance of these criteria in carrier selection for companies using just-in-time (JIT) inventory principles in their logistics network (Bagchi and others, 1989:375). Their research was conducted by surveying individuals within the company who made decisions regarding carrier selection (Bagchi and others, 1989:377). Bagchi and others, tried to determine if there were significant differences in the responses between companies that used a JIT system, and those that did not (Bagchi and others, 1989:379). Bagchi and others, used four factors to determine the shippers' perceptions. These factors were: 1. Rate related characteristics, such as door-to-door transportation rates, 2. Customer service, 3. Claims handling and follow-up, and 4. Equipment availability and service flexibility (Bagchi and others, 1989:379).

Bagchi and others discovered that organizations that use a JIT system perceive all of these factors more importantly than those organizations that do not use a JIT system (Bagchi and others, 1989:381). They found that "JIT firms place a greater importance (significant at the .05 level) on each of the factors"(Bagchi and others, 1989:381). They found that the JIT firms placed the greatest importance on the factor of customer service, which encompasses transit time and reliability of the transit time (Bagchi and others, 1989:381). They state that this is so because of "the JIT system's emphasis on reduced

inventory levels and an increased reliance on transportation to provide products when needed" (Bagchi and others, 1989:381). Bagchi and others found that JIT firms place a comparable importance on the factor of rate-related characteristics to customer service. The next two factors, claims handling and follow-up, and equipment availability and service flexibility, received slightly lower importance than the first two factors discussed, but were still more important to organizations using JIT than those that did not (Bagchi and others, 1989:380-381). Interestingly, in comparing large JIT and non-JIT firms, there were no widespread differences in their perceptions of the factors studied (Bagchi and others, 1989:382).

Evers, Harper, and Needham published an article entitled "The Determinants of Shipper Perceptions of Modes." The purpose of their study was to "identify the impact that shipper perceptions of various individual transportation service characteristics have on overall shipper perception of transportation modes" (Evers and others, 1996:13). They did this by mailing questionnaires to high-level executives (typically presidents or chief operating officers) of 695 manufacturing companies in Minnesota. The questionnaire attempted to determine intermodal rail-truck services and facilities available to these companies. Also, the questionnaire attempted to determine the companies' use and perceptions of intermodal services (Evers and others, 1996:15). They looked at seventeen variables for three modes. The modes studied were: intermodal rail-truck, rail, and truck (Evers and others, 1996:16). The variables were:

1. Availability at origin point(s)
2. Availability at destination point(s)
3. Availability of equipment
4. Equipment free time for loading/unloading

5. Suitability for commodity(s) to be carried
6. Suitability for shipment size(s)
7. Reliability of service
8. Directness of service
9. Frequency of service
10. Amount of handling
11. Pickup/delivery times
12. Transit time
13. Cost
14. Amount of loss and damage
15. Processing of loss and damage claims
16. Communication
17. After sale service (Evers and others, 1996:16-17).

The shippers ranked their perceptions of each variable on a scale of 1 for poor to 5 for excellent for each of the modes. The shippers surveyed also ranked their overall perception of each mode (Evers and others, 1996:17). The seventeen variables, for analysis, were later combined into six factors, which were:

1. Timeliness (transit time, reliability of service, directness of service)
2. Availability (availability of equipment, at destination point(s), and at origin point(s))
3. Suitability (suitability for shipment size(s) and commodity(s) to be carried)
4. Firm Contact (after sale service)
5. Restitution (processing of loss and damage claims, amount of loss and damage)
6. Cost (Evers and others, 1996:18).

Based on the responses, they determined that the shippers' perception of modes is based on the six factors discussed previously (Evers and others, 1996:23-24). They also found that these same six factors were closely related to the six selection criteria determined by McGinnis in the article reviewed previously to be used by shippers when selecting transportation (Evers and others, 1996:23-24). The authors state, "as a shipper's perception of these individual factors associated with a particular mode improves, the shipper's overall perception of the mode should improve, and the

likelihood of that mode being used should also increase" (Evers and others, 1996:24).

Overall, Evers and others found that, while firm contact, cost, restitution, and suitability are important, the shippers' overall modal perceptions are affected greatly by the factors of timeliness and availability for the modes studied (Evers and others, 1996:24). The authors state that the two limitations of their research are that it concentrates on the shippers' perception of modes and not on the shippers' perceptions of carriers, and their research only concentrates on the perceptions of manufacturing firms (Evers and others, 1996:24).

Review of Relevant Defense Regulations

The next portion of the literature review is of the Department of Defense and Air Force traffic management regulations and instructions. The regulations that will be examined are Air Force Instruction (AFI) 24-201: Cargo Movement, DOD 4500.9-R, Defense Transportation Regulation (DTR), Part II: Cargo Movement, and Air Mobility Command (AMC) Freight Traffic Rules Publication No. 5.

AFI 24-101 is the publication that regulates cargo movement for the Air Force. It does not specifically state a mode that should be used in the shipment of MICAPs within the CONUS. It does state that the MICAP must move via the fastest traceable means, and aboard a General Services Administration contract carrier (Department of the Air Force, 1999:14, 22). AFI 24-101 also states "commercial air express small-package delivery service ...is the norm for Agile Logistics/2LM/Rapid Parts Movement shipments to meet Air Force sustainment goals" (Department of the Air Force, 1999:9-10). AFI 24-101 also establishes shipment time standards. DTR, Part 2, which AFI 24-101 is based, states that expedited service can be used when the shipment is urgently needed

(Department of Defense, 1999:202-6). DTR, Part 2 also establishes required shipment time standards (Department of Defense, 1999:202-15, 202-16). Finally, AMC Freight Traffic Rules, Publication No. 5 states that "commercial air service will not be used for transportation of shipments to be delivered within 500 surface miles from the shipping point except when commercial air is the low cost mode or is the only mode that can meet shipment requirements" (Air Mobility Command, 1999:1-2).

However, the definitive word comes from AFI 24-201. It states in paragraph 6.1:

> "**6.1. General Services Administration (GSA) Small Package Contract Carrier.** High priority shipments, that meet the contract terms, will move via GSA contract carrier to DoD and contract addresses to/from CONUS, Alaska, Hawaii, and Puerto Rico. Therefore, high priority shipments, 999, NMCS, MICAPS, Agile Logistics/2LM/Rapid Parts Movement, destined to/from CONUS Alaska, Hawaii, and Puerto Rico should be moving by the GSA contract carrier from pick-up to delivery at the consigned destination. The DoD is a mandatory user of this contract, **EXCEPT** in the following instances:
>
> 6.1.1. DoD shipments between 0 and 500 miles from origin.
>
> 6.1.2. DoD shipments under DoD contracts or Guaranteed Traffic Agreements in effect prior to award of this contract until expiration of the existing contracts or agreements.
>
> 6.1.3. When required by wartime contingency operations.
>
> 6.1.4. When shipments are outside the scope of the contract. (Presently, International Merchant Purchase Authorization Card (IMPAC) micropurchase accounts cannot charge transportation costs under the GSA small package contract contract service to obtain the special government rates).
>
> 6.1.5. Individual shipments with a gross weight of 151 pounds or more are outside the scope of this contract." (Department of the Air Force, 1999:22).

Currently, the carrier that has the GSA small package contract is Federal Express (Federal Express, 1999:7). This research will use their rates for this contract in comparison to ground rates.

Conclusion of Literature Review

Overall, this literature review has shown that shippers, in general, often rank service above cost. There are instances where certain aspects of service are ranked below cost, but, overall, service aspects are ranked above cost. Most of the DoD and Air Force publications are vague in regards to the modal choice in the shipment of MICAPs. However, AFI 24-201 states that the GSA small package contract carrier, currently Federal Express, will be used in the shipment of MICAPs in the CONUS for shipments under 151 pounds. This thesis will compare the modes to determine if lower shipping costs will result from using ground carriers in the shipment of MICAPs.

III. Methodology

No previous research was found that compared the costs of modes, either in the DoD or in the civilian sector. Therefore, a methodology was created in order to do the cost comparison between the modes. This methodology uses two sets of data in order to compare the costs between air and ground in the shipment of MICAPs.

One set is of simulated data. These simulated data will be shipments that can be shipped either via air or ground modes. These shipments will only have two pieces of information to them: the weight, ranging form 1 to 150 pounds, and a distance range, from 0-50 miles, to 3401-3500 miles from the origin to destination. Each datum will represent one of the 11,100 possible shipments that a rate can be acquired for both air and ground. This is so a comparison can be made between the air rates and the ground rates for every possible type of shipment where the rate can be determined for the air and ground carriers.

Actual MICAP shipping data about the parts that are traditionally shipped via expedited air is also used. This data will be of MICAP shipments that were shipped in July of 2000. These shipments were shipped predominately to and from Air Mobility Command bases. However, there will be a few exceptions of shipments where the shipments were shipped to and from other locations.

Rate tables were acquired for Federal Express, which has the U.S. Government's small package express contract, and for Roadway Express, which has the U.S. Government's express LTL shipping contract. The simulated data will also be used to show the cost differences between air and ground. The actual shipping data will be used

to show possible savings that could have occurred if the ground mode was used for certain shipments.

Actual Data Collection & Characteristics

The initial data set used for the research was a data set for 5,636 MICAP shipments shipped by air carriers during the month of July of 2000 between various locations. AFMC LSO/LOT provided these data in a Microsoft Excel spreadsheet. The original categories for this data set were: Transportation Control Number (TCN), requisition date, ship date from the depot, delivery date to the base, ship time in days, overall order and ship time in days, supply priority code, transportation priority code, requested delivery date (RDD), project code, depot code, National Stock Number (NSN), Retrograde (yes or no), supply address, carrier, tracking number, origin, destination, weight, cube, PCS, pickup calendar date, pickup Julian date, delivery calendar date, delivery Julian date, transit time between pickup and delivery, on time (yes or no), and air shipment cost. All dates were in Julian form, unless noted otherwise. The destinations in the data set were mostly Air Force bases, with a few city locations, along with some unknown and overseas locations. The origins were predominately cities, with a few unknown and overseas locations.

Simulated Data Characteristics

After looking at the actual data set, and the commercial FedEx rate table, it was determined that simulated data could be used. This would be done in order to show the whole range of possible shipments that could be shipped either using air or ground, and would be used to calculate the rate difference between each air and ground rate for a shipment. FedEx's rates for the commercial rate table are based on distance from the

origin, not on the specific origin and destination combination. For example, a shipment weighing 65 pounds from Charleston Air Force Base (AFB) SC to McGuire AFB NJ is approximately 685 miles. On the commercial FedEx rate table, this would translate into a 65-pound shipment going from Region 1, the origin, to Region 5. However, FedEx would charge the same rate for a 65-pound shipment from Hill AFB UT to Travis AFB CA, which are approximately the same distance apart.

FedEx's government contract rates were based strictly on weight. Distance from the origin was not a criterion for the rate. The FedEx rates were for shipments traveling within the Continental United States (CONUS), and to and from Hawaii, Alaska, and Puerto Rico regardless of distance from the origin from 1 to 150 pounds in weight, in one-pound increments. Roadway's table, however, was based on hundredweight, and distance. This resulted in simulated shipments ranging from 1 to 150 pounds in weight, in one-pound increments, and 74 different distance intervals. This resulted in 11,100 different shipments that were simulated.

FedEx Rates

The air rates that were used came from the rate table in the March 1999 FedEx U.S. Government Service Guide. This rate table consisted of three columns: weight, Rate for FedEx Priority Overnight, and rate for FedEx 2Day. Rates for the FedEx Priority Overnight were used and put in one row of an Excel worksheet, with the weight that corresponded with the rate. The weight ranged from 1 to 150 pounds. The only factor that decides the rate is the weight of the shipment. Table 1 is a portion of the rate table put into Excel format, showing weight and the rate for FedEx Priority Overnight.

Table 1. Portion of FedEx Rate Table (FedEx Government Service Guide, 1999)

Weight	1	2	3	4	5	6	7	8	9	10
Rate	$3.50	$3.57	$3.62	$3.67	$4.17	$4.92	$5.67	$6.42	$7.17	$7.92

Roadway Rates

The ground rates came from a Roadway Class 100 rate table supplied by the 436th Aerial Port Squadron's Traffic Management Flight, located at Dover AFB, DE. This rate table is called a Class 100 table, because the rates are regulated by MTMC Class Rate Publication No. 100A (Octavo, 2000). "This publication is designated to afford motor carriers a simple, flexible, computer-oriented method of expressing and filing Freight All Kinds (FAK), DOD unique commodities and specific commodity class rates for Department of Defense (DOD) less-than-truckload and truckload shipments" (Militray Traffic Management Command, 1989:7). The baseline Class 100 rates set in the publication are the basis for the carriers' actual rates for shipments originating and arriving in the CONUS, Alaska and Canada for DoD shippers. However, it does not dictate to the carriers the rates they charge to DoD shippers. It only gives a baseline, which is the Class 100 rate (Military Traffic Management Command, 1989:7). The Roadway rate table is laid out according to this publication. Table 2 is a portion of the Roadway rate table in Excel format.

Table 2. Portion of Roadway Rate Table (Octavo, 2000)

		WT	
MILEAGE	**MIN CHG**	0	**56%**
BASE	**100%**	499	**RATE**
0-50	**$ 36.00**	$ 11.79	**$ 6.60**
51-75	**$ 36.00**	$ 12.84	**$ 7.19**
76-100	**$ 36.00**	$ 13.73	**$ 7.69**
101-125	**$ 36.00**	$ 15.36	**$ 8.60**
126-150	**$ 36.00**	$ 15.96	**$ 8.94**
151-175	**$ 36.00**	$ 16.80	**$ 9.41**
176-200	**$ 36.00**	$ 18.19	**$ 10.19**
201-225	**$ 36.00**	$ 18.95	**$ 10.61**
226-250	**$ 36.00**	$ 19.56	**$ 10.95**
251-275	**$ 36.00**	$ 20.03	**$ 11.22**
276-300	**$ 36.00**	$ 20.49	**$ 11.47**

Simulated Data Methodology

The FedEx table needed to have distances for each weight in order to be compared to the Roadway table. In order to do this, the rate was copied down into each column, with the column representing one weight. It was copied for each distance interval on the Roadway table. Since the FedEx rates are not related to distance, the rate is the same for each distance interval. Table 3 is a portion of that rate table.

Table 3. Portion of FedEx Rate Table with Distances

WEIGHT (IN POUNDS)	1	2	3	4	5
DISTANCE (IN MILES)					
0-50	$3.50	$3.57	$3.62	$3.67	$4.17
51-75	$3.50	$3.57	$3.62	$3.67	$4.17
76-100	$3.50	$3.57	$3.62	$3.67	$4.17
101-125	$3.50	$3.57	$3.62	$3.67	$4.17
126-150	$3.50	$3.57	$3.62	$3.67	$4.17
151-175	$3.50	$3.57	$3.62	$3.67	$4.17
176-200	$3.50	$3.57	$3.62	$3.67	$4.17
201-225	$3.50	$3.57	$3.62	$3.67	$4.17
226-250	$3.50	$3.57	$3.62	$3.67	$4.17
251-275	$3.50	$3.57	$3.62	$3.67	$4.17
276-300	$3.50	$3.57	$3.62	$3.67	$4.17

Calculations had to be done in order to determine the Roadway rates. There is a minimum charge for shipment via Roadway. The minimum charge was compared against was the 56% rate in the table (see Table 2). The 56% rate is the cost per hundredweight. The weight of the shipment is divided by 100 and multiplied by the 56% rate. If the minimum charge is greater than the calculated 56% rate, then the minimum charge is the rate for the shipment. Otherwise, the calculated 56% rate is used. This was done in a 150 cell by 74 cell matrix in Excel using an IF statement. In all cases, the minimum charge was greater than the calculated 56% rate. So, the Roadway table rates are based on distance for shipments between 1 and 150 pounds. Table 4 is a portion of the table that was calculated.

Table 4. Portion of Calculated Roadway Rate Table

WEIGHT (IN POUNDS)	1	2	3	4	5
DISTANCE (IN MILES)					
0-50	$36.00	$36.00	$36.00	$36.00	$36.00
51-75	$36.00	$36.00	$36.00	$36.00	$36.00
76-100	$36.00	$36.00	$36.00	$36.00	$36.00
101-125	$36.00	$36.00	$36.00	$36.00	$36.00
126-150	$36.00	$36.00	$36.00	$36.00	$36.00
151-175	$36.00	$36.00	$36.00	$36.00	$36.00
176-200	$36.00	$36.00	$36.00	$36.00	$36.00
201-225	$36.00	$36.00	$36.00	$36.00	$36.00
226-250	$36.00	$36.00	$36.00	$36.00	$36.00
251-275	$36.00	$36.00	$36.00	$36.00	$36.00
276-300	$36.00	$36.00	$36.00	$36.00	$36.00

Finally, a rate difference was calculated for each simulated shipment. The calculated rate from a cell in Figure 4 was subtracted from the rate in the corresponding cell in Figure 3 in order to do the comparison. A portion of the rate difference table is Table 5.

Table 5. Portion of Rate Difference Table

WEIGHT (IN POUNDS)	1	2	3	4	5
DISTANCE (IN MILES)					
0-50	-$32.50	-$32.43	-$32.38	-$32.33	-$31.83
51-75	-$32.50	-$32.43	-$32.38	-$32.33	-$31.83
76-100	-$32.50	-$32.43	-$32.38	-$32.33	-$31.83
101-125	-$32.50	-$32.43	-$32.38	-$32.33	-$31.83
126-150	-$32.50	-$32.43	-$32.38	-$32.33	-$31.83
151-175	-$32.50	-$32.43	-$32.38	-$32.33	-$31.83
176-200	-$32.50	-$32.43	-$32.38	-$32.33	-$31.83
201-225	-$32.50	-$32.43	-$32.38	-$32.33	-$31.83
226-250	-$32.50	-$32.43	-$32.38	-$32.33	-$31.83
251-275	-$32.50	-$32.43	-$32.38	-$32.33	-$31.83
276-300	-$32.50	-$32.43	-$32.38	-$32.33	-$31.83

Actual Data Methodology

The initial data set that was provided by AFMC/LSO in order to see if cost savings would be realized by using ground transportation instead of air for actual

shipments. In scrubbing the data, all of the columns on the spreadsheet were eliminated, except for origin, destination, and weight of the shipment. Shipments were eliminated that had blank cells for origin, destination, and weight. Shipments were eliminated that had a weight over 150 pounds. Shipments were eliminated that had an origin or destination outside the United States, or origins or destinations in Hawaii, Guam, and Puerto Rico. Shipments were eliminated that had an unknown or unclear origin, destination, or weight. This left 3,451 shipments.

On the edited data spreadsheet, a column was created for the distance between origin and destination, and for the distance range in which the distance is within, which corresponds with the distance ranges on the calculated rate tables.

In another workbook, a table was created that showed all the origin-destination pairs in the scrubbed data. The data was sorted in alphabetical order by destination. The Defense Table of Distances website (http://dtod-mtmc.belvoir.army.mil) was used to find the distances between each origin and destination. The general routing option for freight in the website was used. Ten distances at a time with a common origin were able to be looked up at once, using the hub routing option. The destination was used as the origin, and the origins as the destination, if there was more than one that had to be looked up. Otherwise, the origin was used as the origin, and the destination as the destination in the page that only allowed for one origin and one destination. All distances were in miles, to the nearest one tenth of a mile. The origin-destination pair was deleted if the distance between them was over 3,500 miles.

After finding the distances, they were rounded up to the nearest whole mile. A column was created for the distance ranges on the rate tables in which the distance fit.

This was done by creating a small table of the different distance ranges and using a VLOOKUP function. Then, the distance ranges were copied next to the respective origin-destination pair in the edited data set. Three columns were created: one for the FedEx rate, one for the Roadway rate, and one for the lowest rate. The FedEx rates were put in using an HLOOKUP function using the shipment weight referencing the FedEx rate table. The Roadway rates were put in using a VLOOKUP function using the shipment distance range referencing the Roadway table minimum charge for those shipments' weights. For the lowest rate column, a MIN function was used to find the minimum rate between the FedEx rate and the Roadway rate for the shipment. Then, a sum was calculated for each column of rates. The difference was taken by subtracting the Roadway rates sum from the FedEx rate sum, and by subtracting the lowest rates sum from the FedEx rates sum. The mean, median, mode, standard deviation, and skewness were found on the shipment weights. Also, a histogram was developed for the weight and the distance ranges. These results will be discussed in Chapter 4.

IV. Results and Analysis

Simulated Data Results

The simulated data set used, which was discussed in Chapter 3, resulted in 11,100 rate differences between air and ground. There were 5,522 rate differences where the rate difference was negative, which means that ground was more expensive than air. There were 5,572 rate differences were the difference was positive. This means that the air rate was greater than the ground rate. There were 6 rate differences where the rate difference was zero, meaning that the air and ground rates were equal. Figure 1 shows the breakdown of the rates to show the size of the differences.

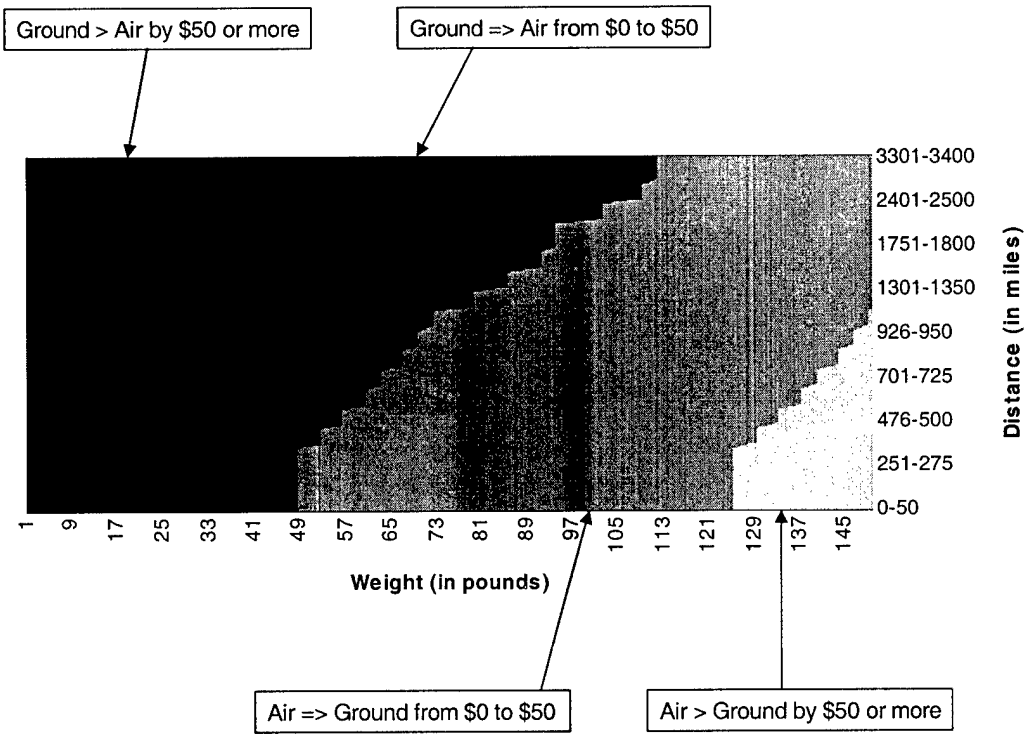

Figure 1. Carrier Rate Differences Based on Weight and Distance

The chart shows the breakdown of the rate differences for the shipments. It shows that ground becomes greater than air as the distance increases, and the weight decreases. It also shows that air becomes greater than ground as the weight increases, with a smaller distance range. The border between the dark gray and gray regions is the breakpoint where there is minimal difference in using either air or ground. So, basically, the shorter the distance and the more it weighs, the ground mode is favored, while air shipping should be used if the shipment is light and traveling a longer distance. Overall, heavier shipments should go ground regardless of distance from the origin, while lighter shipments should go air. Where the shipment's weight and distance needed to be traveled are known, the rate difference table can help to make a decision on whether the shipment is less costly to go by ground or air.

Overall, Figure 1 shows that there can be shipments where it is advantageous to use the ground mode versus the air mode in shipments, and vice versa in regards to cost. The simulated data also shows that, out of the 11,100 simulated shipments, 5,572, or 50.19 percent, would be less expensive to ship via Roadway than FedEx. These results show that cost savings would be realized if those shipments within the weight and distance range criteria where Roadway is the lower cost shipper were shipped via Roadway.

Actual Data Analysis and Results

When looking at the actual shipment data for July of 2000, provided by AFMC/LSO, there are trends with the data. Figure 2 is a histogram of the shipment weights from 1 to 150 pounds in bins of 10.

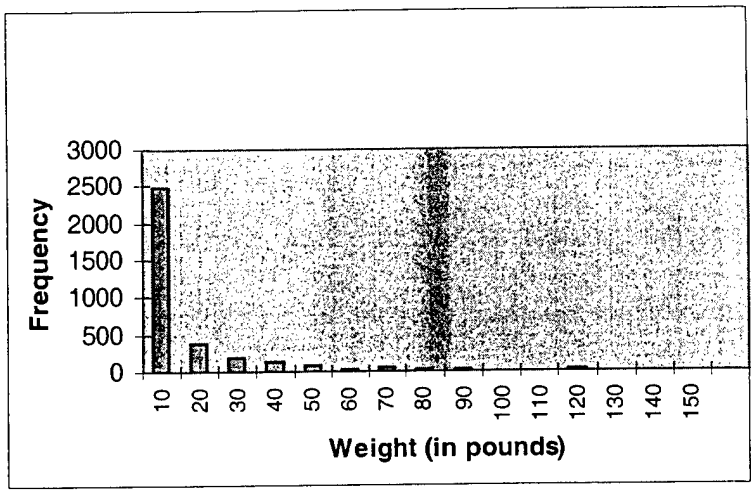

Figure 2. Histogram of Weights in Actual Shipment Data

This figure shows an example of Pareto's Law. Out of the 3,451 shipments, 2,479 weighed 10 pounds or less, or 71.86% of the shipments. There were 1,084 shipments that weighed one pound, or 31.41% of the shipments. Table 7 is the statistical data on the shipments' weights.

Table 6. Statistical Data on Shipments' Weights

MEAN	12.1
MODE	1
MEDIAN	4

The statistical data shows that these weights' distribution is a highly skewed right distribution. These data show that the shipments, based on their weights, are more conducive to shipping via FedEx, as opposed to Roadway.

The distance range data for the shipments shows little, if any, trend. Figure 3 is a histogram of the distance ranges for the shipments.

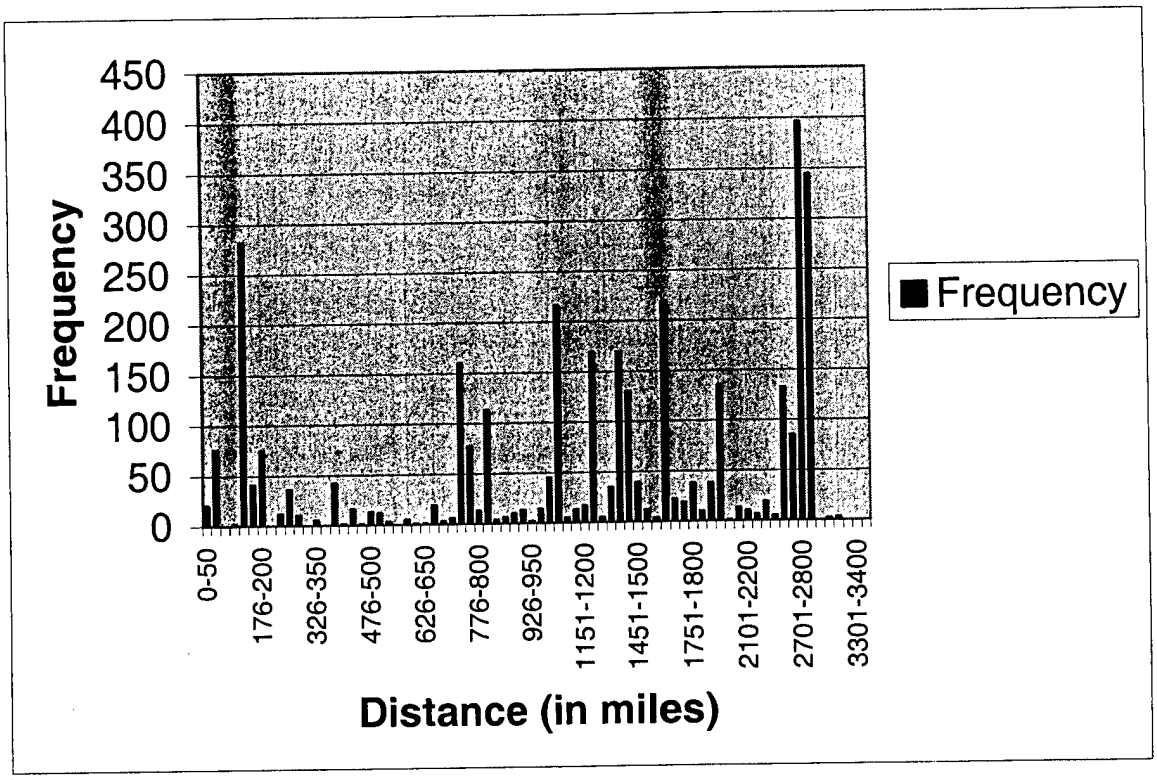

Figure 3. Histogram of Distance Ranges for Shipments

The data on the distance ranges shows that the shipments are grouped in several areas. They are grouped predominately toward the longer distance ranges, with a peak at 2701-2800 miles, and a slightly shorter peak at 2801-2900 miles. There is also a shorter peak at the lower end of the distance ranges at 126-150 miles. Of the 3,451 shipments, 633, or 18.34%, are 500 miles or lower. Technically, these shipments should not have been shipped via FedEx, as stated in Chapter 2. On the other hand, 2,818, or 81.66%, of the shipments were shipped greater than 500 miles. So, the shipments' distance ranges are conducive for the use of an air carrier. Overall, the weight and distance range data show that the shipments are conducive to using FedEx. However, there are shipments in the data that are better shipped via a ground carrier, which, in this study, is Roadway.

Using FedEx's rates, the total cost of shipping all of the shipments is $35,056.53. Using Roadway's rates, the total cost of shipping all of the shipments is $132,644.00. The difference between these totals is $97,587.47. In other words, DoD would have spent $97,587.47 more if it had shipped these MICAPs via Roadway than FedEx. If the DoD had used the lowest rate between FedEx and Roadway for the shipment, then the total cost for these shipments is $31,228.26. The difference between the FedEx total shipping cost and the lowest rate total shipping cost is $3,828.27. This means that the DoD would have saved $3,828.27 by shipping these shipments using the lowest cost means between FedEx and Roadway. This is a cost savings of 10.92 percent versus using strictly FedEx for these shipments. If an 11 percent savings were realized over all MICAP shipments by using ground where the cost was less expensive to use compared to air, then significant money would be saved by the Air Force and Department of Defense. These calculations are based on the information available. It is possible that the actual costs would be different. Based on the information available, these calculations show that if the DoD used Roadway when Roadway's rate for the shipment was less costly than FedEx's rate for certain shipments, that a cost savings would be realized.

However, the problem when using Roadway, as opposed to FedEx, for shipments is that the transit time would not meet the standards as set by regulations. The transit time for Transportation Priority 1 or 2 shipments, which MICAPs fall under, from pickup to delivery within the CONUS, is 1 day (Department of the Air Force, 1999:62). FedEx can provide that level of service by the shipper using FedEx Priority Overnight service under the GSA Small Package Contract (Federal Express, 1999:6). As stated in Chapter 3, the rates for FedEx Priority Overnight were used for the analysis. The actual Roadway

standards were unavailable. According to MSgt Percival Octavo, who provided the Roadway rate table, the actual transit time varies depending upon the origin and destination. However, he stated that the standard transit times for LTL are in DOD 4500.9 DTR Part II Cargo Movements, Ch. 202N (Octavo, 2000). According to this reference, the standard transit time for Transportation Priority 1 shipments shipped LTL, the time between pickup and delivery is based on the state where the origin is and the destination state. For example, a shipment originating in Dover AFB DE being shipped via LTL (Roadway is an LTL carrier) to Charleston AFB SC has a transit time standard of 3 days (Department of Defense, 1999:202-15). This does not meet the transit time standard stated in AFI 24-201. In fact, the LTL standards on this table (Figure 202-3 in DoD 4500.9 DTR Part II Ch. 202.) do not meet the AFI 24-201 standard. The shortest transit time standard on this table is 2 days. However, an LTL carrier may be able to provide a transit time that meets that standard. So, if the LTL carrier, in our case, Roadway, can meet the time standard, and their rate is lower than FedEx's rate for the shipment, then the DoD should use the LTL carrier.

V. Conclusion

Thesis Objective

This thesis deals with what modal/carrier choice can do for an organization, whether it is for a company, or, for this case, the United States Air Force. Modal/carrier choice is a concept where management needs to choose the mode(s) and carrier(s) to best meet the needs of the organization. When dealing with companies, there is a strong profit motive. Modal/carrier choice helps to achieve profit goals, by lowering costs within the supply chain. Also, modal/carrier choice can help improve service to a company's customers. Improvements in service can be realized through using transportation modes and carriers that help achieve customer service goals. By improving customer service, a company can increase revenue, which in turn help to increase profits. So, modal/carrier choice can help to lower costs, and increase revenue, which can increase profits.

When dealing with modal choice in the Department of Defense, there is no profit motive. The objective of the Department of Defense lies with mission accomplishment. Also, costs seem to rank secondary to achieving mission objectives. In order to meet mission objectives, transportation is needed. Based on the author's search on relevant literature, there has been no research done on modal/carrier choice decisions within the DoD. In fact, there are regulations written which explicitly state the carrier that must be used for certain shipments. This thesis focused on Mission Capable Parts shipments, or MICAPs.

MICAPs are parts that are critical to meeting mission objectives in the Air Force. These may be parts on equipment, vehicles, and aircraft that are needed to bring the equipment, vehicles, and aircraft to fully mission capable status, so it can meet mission

requirements. These equipment, vehicles, and aircraft are often times needed to complete mission requirements immediately. So, MICAPs need to be shipped from locations, like depots, contractors, or other bases, to bases where the MICAP is required. This immediate need for the MICAP calls for the use of expedited transportation.

In the Air Force, the expedited transportation comes in the form of expedited air carriers. Specifically, the carrier used is Federal Express. FedEx, and other air carriers, are fast compared to other modes and carriers. However, air carriers are expensive compared to other modes. Also, the regulations state that FedEx must be used for MICAP shipments. This eliminates the use of other modes and carriers. The purpose of this thesis was to compare the shipping costs of another express carrier, Roadway Express, within another mode, ground, to FedEx's costs. The objective of this thesis was to show that cost savings could be realized if Roadway Express was also used for MICAP shipments in conjunction with FedEx.

The problem investigated is whether the use of a ground carrier can result in a cost savings over the use of FedEx in the shipment of MICAPs. The previous literature on modal choice indicates that most customers and shippers regard service level over cost in choosing the mode and carrier. There are also studies that show that transit time is a more important factor in choosing a mode or carrier than the cost to ship via a mode or carrier.

Results

Literature published by the Department of Defense and the Air Force states the rules involving expedited shipments and MICAPs. These publications state the expedited shipments and MICAPs must go via an air carrier, under certain restrictions.

The methodology involved the use of two sets of data, one that was simulated and another that was actual shipment data. The simulated data was used in order to compare rates between FedEx and Roadway, an LTL carrier. 11,100 simulated shipments were created and, for each shipment, FedEx's rate was compared to Roadway's rate. The differences between the air and ground rates for each shipment were calculated and the rate differences were shown.

In using the actual shipping data, a total cost was calculated for each mode, and for using the least expensive mode for the shipments. A total cost was calculated for using strictly FedEx, a total cost was calculated for using strictly Roadway, and a total cost was calculated when using the lower rate between FedEx and Roadway. The difference was determined by subtracting the Roadway total cost from the FedEx total cost, and by subtracting the lowest rate total cost from the FedEx total cost.

When using the simulated data, the results indicated that Roadway was a less expensive alternative for shipments that were heavy, and for those shipments traveling shorter distances. However, heavier shipments traveling long distances were found to be shipped via ground less expensively than air. Overall, the rate differences between FedEx and Roadway, when looking at exact type of shipments, showed that 50.19 percent of 11,100 simulated shipments would be shipped via Roadway Express at a lower rate than Federal Express. Of those 50.19 percent, Roadway rates were shown to be more than $50 lower than FedEx rates for 590, or 10.59 percent. Of all the shipments, these 590 simulated shipments equate to 5.32 percent of all shipments.

When looking at actual shipping data of 3,451 MICAP shipments in July of 2000, it was found that using the lowest cost carrier between Roadway and FedEx would have

saved $3,828.27. This equates to a 10.92 percent savings could have been realized by using the mode with the lower rate for each individual shipment, as opposed to using strictly air. If this 11 percent savings could be realized for all of DoD's MICAP shipments, significant amounts of money would be saved.

Conclusions

This research indicates that cost savings can be realized by the use of Roadway, as opposed to FedEx, in certain shipments, if cost of the shipment is the only criterion. The question is whether or not the Air Force and the Department of Defense will look at this issue further, or even implement changes. Based on the research done in this thesis, it shows that the Air Force's and Department of Defense's current modal/carrier choice policies are not optimal for the shipment of MICAPs. It needs to be investigated on what is needed in order for the Air Force's and DoD's modal/carrier choice policies for MICAPs to change in order to become more optimal.

In translating the results into action for the Air Force and the DoD, as stated in Chapter 4, the shipping organization should use the LTL carrier for MICAP shipments, if the carrier's rate for the shipment is less than FedEx and the LTL carrier can meet the time standards required for delivery of the item. But, the results for the actual data are based on a sample of data. This sample may or may not be representative of all MICAPs shipped within the CONUS and Alaska. The sample size could be expanded to include more actual MICAP shipping data.

Overall, this thesis shows that Roadway is a viable alternative to FedEx in the shipment of MICAPs within the Continental United States and Alaska. By the Air Force and DoD having another carrier as an alternative to FedEx for MICAP shipments, it will

help to keep rates down. This is done because FedEx will not be the only carrier being used. FedEx would have to compete against another carrier, and in order to do that, it will have to keep its rates down to the level of its competitor. This conclusion is made with the assumption that FedEx and the LTL carrier can maintain the same level of service, or the same time standards between pickup and delivery of the shipment. This also keeps the other express air carriers from raising their rates. The carriers in the air mode would not have an incentive to form a cartel and raise rates if another mode, such as express ground, or LTL, was vying for the government and DoD's business. By the express air carriers forming a cartel, they would cut themselves out of the market for DoD's express shipping needs.

An aspect of the LTL marketplace is that most carriers are regionalized, as opposed to the air carriers, which are national. By the DoD and the Air Force using LTL, this would further increase competition not only between the competing modes, but also between the LTL carriers themselves. Furthermore, the DoD would not need to enter a contractual agreement with a national LTL carrier, because of the large number of regional LTL carriers. So, by the DoD, and the Air Force using LTL, it creates competition for business on a regional and national level. This competition will result in lower rates for DoD and Air Force shipments, resulting in further cost savings.

Recommended Research

This study only focused on MICAPs. The analysis done in this thesis could be expanded to all types of shipments that the Air Force and DoD ship. The type of study done here using data of all types of shipments, including MICAPs, may show other

modes of transportation being viable alternatives for traffic managers to use for shipments within and outside the CONUS.

Another analysis that can be done is looking at modal choice alternatives for MICAPs in another theater where the Air Force and DoD operates. For example, a study could be done looking at MICAP shipments in Europe using LTL as opposed to the World Wide Express contract for the leg of the shipment that can go LTL. This would be done to see if LTL would be a viable alternative to using the World Wide Express contract for MICAP shipping. This study could also be used for the same within Japan, Korea, and other theaters. Also, the data used in these studies can be expanded to include all types of shipments, including MICAPs.

In regards to transit time standards, this poses a question: does the customer really need it overnight? This question needs to be answered. Otherwise, the Air Force may be costing itself, and the DoD, a lot of money by insisting upon overnight delivery for MICAPs. In Chapter 2, it was stated that the Air Force transit time standards for Transportation Priority 1 and 2 shipments is 1 day. This begs the question on what the need is for 3 transportation priorities if the transit time standard is the same for the first two.

Several questions need to be asked of the customer to help determine if the part requires overnight delivery. Is the part that is being shipped overnight going to be put on the aircraft/vehicle/piece of equipment immediately upon delivery, or is it going to sit in a warehouse, or other storage facility, for hours, days, or weeks? Do MICAPs sit in storage for hours, days, or weeks before being installed? Is the MICAP needed for an

aircraft/vehicle/piece of equipment that is needed for deployment or other time-critical mission, or is the part a nice-to-have in order to increase mission capability rates?

Another question that should be asked about MICAPs is whether or not the Air Force and DoD are using the right carrier. Can MICAPs be shipped at a cheaper rate using UPS, Airborne Express, Emery, DHL, or some other overnight air carrier? Does the GSA contract restrict the DoD in its ability to get the best value for its money for shipping MICAPs?

Another question that needs to be asked is: has the Air Force and DoD ingrained in the corporate culture to use of FedEx so much, that, if it is a MICAP or other time-critical shipment, FedEx is automatically assumed and used as the carrier without regard to cost, distance, or other factors that should be considered? In the shipment data provided by AFMC/LSO, after it was scrubbed as stated in Chapter 3, there was one 69-pound shipment from Tacoma WA to McChord AFB WA that was shipped via FedEx. The distance between these two points, according to DTOD, of 11.4 miles. There were also twenty shipments, ranging in weight from 1 to 26 pounds, shipped via FedEx from Port Orchard WA to McChord AFB WA. The distance between these two points is 37.9 miles. There was a 2-pound shipment from Yuba City CA to Travis AFB CA, a distance of 72.5 miles, shipped via FedEx. All of these shipments went via FedEx Express, which is the company within FedEx that ships via air.

In the author's experience in the 305th Transportation Squadron, at McGuire AFB NJ, the squadron's Vehicle Operations Flight would pick up and deliver MICAPs to and from Dover AFB DE, and NAS Norfolk VA on an almost daily basis. However, in the data, there were two shipments from Dover DE to McGuire AFB NJ shipped via FedEx.

There were also five shipments from Norfolk VA to McGuire AFB NJ shipped via FedEx.

The shipments discussed in the previous two paragraphs could have been picked up and delivered by the vehicle operations flights at their respective bases faster, and most likely, cheaper, than using FedEx. As stated in Chapter 4, of the 3,451 shipments, 633, or 18.34%, were shipped distances 500 miles or less. The shipments discussed and the fact in the previous sentence implies that there may be mismanagement in the transportation of MICAPs. As stated in Chapter 2, in AFI 24-201, MICAPs are not to go via an air carrier if traveling less than 500 miles. These facts imply that the entire system used in managing the shipment of Air Force MICAPs needs to be investigated as to why these shipments are taking place, what should be taking place, and what needs to be done to fix it.

Another question that should be investigated is: can the LTL carriers time standards currently meet MICAP time standards for shipment? Also, can LTL carriers improve their time standards in order to meet MICAP shipping time standards? After looking at these two questions, it needs to be determined if LTL carriers can provide their current time standards with a lower rate through a negotiated contract with Military Traffic Management Command (MTMC) (MTMC is the agency that controls ground shipment contracts and actions within the CONUS). Another possibility is for MTMC to negotiate a contract with lower time standards and a lower rate for MICAP shipments. However, before these concepts can be investigated, it needs to be examined on how much additional shipping volume MTMC can promise to an LTL carrier with the improved service and lower rates. For example, would Roadway Express be willing to

negotiate a contract with MTMC with the same time standards and lower rates, if MTMC could promise a certain annual amount of shipments? Would Roadway Express be willing to negotiate a contract with MTMC with time standards meeting MICAP requirements, with Roadway's current, or lower, rates, if MTMC promised a certain annual amount of shipping volume? MTMC negotiating with an LTL carrier, where a certain percentage of DoD shipments are given to the carrier, may result in a greater cost savings for the Department of Defense for its shipments.

The questions posed for further research on the MICAP issue are all examples on why the Air Force's MICAP process should be investigated and analyzed to determine where problems lie. It should also be investigated to determine abuse and misuse of the MICAP processes by Air Force units. It should be investigated to see whether cost savings might occur through changes in other parts of the MICAP system. It should also be investigated to see if LTL carriers would be willing to offer better service and/or lower rates if they were promised a certain percentage of DoD's shipping volume. There is also the possibility to look at MICAP shipments in another theater of operations, and including data involving all types of shipments, including MICAP shipments, made by the Air Force and Department of Defense.

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14. ABSTRACT
A numerous amount of Mission Capable Parts (MICAPs) are shipped throughout the world by the Air Force. These parts are required in order to meet mission requirements. MICAPs are often shipped via an express, small parcel air carrier, like Federal Express (FedEx). However, there is a lower cost alternative: Less-Than-Truckload express carriers. In using actual Air Force MICAP shipping data, an 11 percent savings was shown if the lowest cost carrier, either FedEx or Roadway Express, an LTL express carrier, was used in shipping these MICAPs. Also, in using simulated shipping data, over 50 percent of all types of shipments, based on weight and distance, would be shipped less expensively using Roadway than FedEx.

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U	U	U	UU	54	19b. TELEPHONE NUMBER *(Include area code)* (937) 255-6565, ext 4283 william.cunningham@afit.edu

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