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**Hazardous Material Cargo Frustration at
Military Aerial Ports of Embarkation**

THESIS

Neil Eric Christensen, USAF

AFIT/GLM/ENS/06-03

**DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY**

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

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AFIT/GLM/ENS/06-03

Hazardous Material Cargo Frustration at Military Aerial Ports of Embarkation

THESIS

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THESIS

Presented to the Faculty

Department of Operational Sciences

Graduate School of Engineering and Management

Air Force Institute of Technology

Air University

Air Education and Training Command

In Partial Fulfillment of the Requirements for the
Degree of Master of Science in Logistics Management

Neil E. Christensen

Captain, USAF

March, 2006

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED.

Hazardous Material Cargo Frustration at Military Aerial Ports of Embarkation

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Abstract

Since military units often require critical hazardous materials in an expedited manner, identifying choke points within the supply chain is necessary to improve logistic support to front line forces. Hazardous materials are some of the most critical assets for the war fighter, as well as the most restrictive and often most time consuming for transportation.

This research quantifies the extent that vendor and depot supplied cargo is being delayed at Aerial Ports of Embarkation. By looking at frustrated hazardous material at Charleston Air Force Base, South Carolina and Dover Air Force Base, Delaware, a case study methodology is used to determine the top causes of frustrated HAZMAT cargo, the average time shipments were frustrated and determines the vendor these shipments are coming from. Data include documented frustrated cargo over a four month period in 2005 at Dover and Charleston Air Force Base and highlight trends. The results and analysis of this research compare the frustrated cargo record at these bases as well as pin pointing specific trends from the vendors that provide the cargo.

This is for my family:
The love and support has guided me every step of the way

Acknowledgments

The bulk of my data came from Dover Air Force Base (AFB). Customer Service deserves a great deal of credit for the information I received. This outstanding support provided the access necessary to both Dover and Charleston AFB frustrated HAZMAT reports to conduct this research and has given me the tools required to do my research and look at this data in a different way.

I would like to express my sincere thanks to Major John Bell; his constant optimistic perspective and guidance served as a great motivator throughout this entire process.

Thanks to the close group of friends I met here in Dayton. I don't know if I could have made it without the much needed relief from turning up cards and cocktails.

Lastly, and most of all, thanks to my wife for supporting me and being so understanding through this stressful thesis. I love you baby!

Neil Eric Christensen

This Note is not to be included with the Acknowledgments – it is for information only: It is prohibited to include any personal information in the following categories about U.S. citizens, DOD Employees and military personnel: social security account numbers; home addresses; dates of birth; telephone numbers other than duty officers which are appropriately made available to the general public; names, locations and any other identifying information about family members of DOD employees and military personnel.

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HAZARDOUS MATERIAL CARGO FRUSTRATED AT MILITARY AERIAL PORTS OF EMBARKATION

I. Introduction

1.1. Background

The U.S. Department of Transportation (DOT) estimates over 800,000 Hazardous Material (HAZMAT) shipments occur each day and 1.5 billion tons of HAZMAT is moved each year. (Luedtke, 2002). HAZMAT by definition is “Material that exposes one to risk” and this material can be found in all aspects of the military (Webster, 2004). Bombs, bullets, oil, batteries, liquid oxygen, gasoline and paint are all examples of HAZMAT that require extra care when handling. The transportation of hazardous cargo is a continuous challenge that requires extreme caution to ensure proper training, safety requirements and security precautions are taken into account. HAZMAT as it relates to the military represents a critical piece of material that allows any combat or cargo movement to take place.

1.2. Problem

Air Mobility Command (AMC) continues to see Hazardous Material, destined to support overseas operations, being unprepared for flight or “frustrated” at the major

deployment locations. In general, HAZMAT transportation requires extra restrictions, care and training when being moved with a forklift or truck. When HAZMAT is transported by air, an even greater requirement exists for packaging, handling and paper work requirements. Currently, the Air Force has four major airlift hubs or Aerial Ports of Embarkation (APOE). These locations provide a meeting point or cargo collection place for ground and air cargo transportation. Cargo that is purchased by the United States to support the war fighter overseas is delivered by truck or mail to these four major locations so that it can be loaded on cargo aircraft and delivered to the intended final destination. According to headquarters Air Mobility Command (AMC) cargo management branch website, 170 items of cargo scheduled for air transportation by AMC are frustrated right now world wide. (AMC, Jan 2006). This number represents only a sample of critical HAZMAT stuck in transition that is vital to the troops and the mission. How to reduce or eliminate frustrated HAZMAT at the APOEs is the primary problem studied by this research.

1.3. Previous Research

Previous research by Ellison studied this problem and very little previous research had been done prior to her effort. (Ellison, 2004) The findings in Ellison's research left a great deal of potential for further analysis and study. Ellison's research identified communication problems between the vendor (depot and commercial supplier) and the Aerial Port of Embarkation (APOE). Her research also showed that communication and supply requirement problems existed between the user in the field and the supplier back home. Additionally, purchases the Government Purchase Card program was often the

method for ordering the required cargo for the user. However, very limited communication between the supplier and the aerial ports was identified as a cause for frustrated shipments and or double orders. The research conducted by Ellison began the first step to identify why HAZMAT cargo was frustrated at the aerial ports and began an effort to look at what could be done by APOEs and commercial carriers to make cargo more air worthy.

1.4. Research Question

The scope of this research is to look at the aerial port cargo operations directly and determine what problem areas impede the delivery of HAZMAT. The following is the over arching research question that is focused on throughout this study:

What are the current reasons for frustrated cargo at Dover and Charleston AFBs and what improvements can be made to the HAZMAT delivery process that will allow cargo to move faster and cheaper on departing inter-theater aircraft?

To analyze the research question more specifically, the investigative questions in the next section ask about the specific components of the shipping process that is analyzed in this study.

1.5. Investigative Questions

To answer the main problem of this research, the following investigative questions have been formulated for this study. First, since the data for this study is made from two different Air Force Bases, question one looks at how the Customer Service operations vary. It asks: *What are the major differences between the Customer Service*

Operations at Dover and Charleston AFB and how do these differences affect the transport of HAZMAT?

The next question looks at one category of HAZMAT and focuses on frustrated cargo that comes from the major Air Force depots. The following is question two: *What are common causes for depot HAZMAT frustrated cargo at Charleston and Dover AFB?*

Question three looks closer at depot frustrated cargo by analyzing how long depot cargo is prevented from being transported to the war fighter. The following is question three: *What is the average time delay for Depot HAZMAT frustrated cargo?*

The next question identifies the trends that can be seen over time to see if any current improvements are being made. By analyzing the current published metrics, question four determines if the HAZMAT frustration problem is improving or getting worse. It asks: *What trend is observed from the frustrated HAZMAT performance metrics at Charleston AFB and Dover AFB?*

Question five is perhaps the most important question of the research, and it looks closely at HAZMAT coming from vendors. The research compares the causes of frustrated HAZMAT cargo to the vendor that supplied it. The following is question five of the investigative questions: *What trends can be identified when cross referencing reasons for frustrated HAZMAT and the vendor who supplied the cargo?*

These secondary questions support investigative question five:

- A. *What reasons primarily cause vendor supplied HAZMAT to be frustrated?*
- B. *What commercial vendors have the most occurrences of frustrated HAZMAT?*

In addition to these investigative questions, this research also looks at how the current results compare to the data collected by Ellison in 2004. Difference between current data and Ellison's data are identified and where possible the causes are also identified.

1.6. Research Methodology

The research looks closer at the frustrated HAZMAT problem and identifies key components that slow down the cargo delivery process. By looking at each investigative question, a foundation can be expanded upon to improve the supply chain process that is slowing down the delivery of HAZMAT cargo.

Frustrated HAZMAT cargo at the key mobility hubs of Dover and Charleston Air Force Base (AFB) are looked at very closely in this study. The research is also taken a step further by analyzing the vendor's specific track record at each of these locations. More specifically, this research looks at the common reasons, length of delay and frequency of HAZMAT frustrations at Charleston and Dover AFB. In addition, this research project looks at how the bases fix the frustrated items and how long this process takes.

This research also looks at the current causes for frustrated cargo and expands on previous research. Additionally, comparisons were made between two AMC bases to look at the different ways frustrated HAZMAT is handled. By flagging reoccurring problems, improving the process and using suppliers that provide air worthy cargo an opportunity to decrease HAZMAT frustrations may be achieved.

1.6.1. Data and Analysis

Data come directly from Dover and Charleston AFB and identify the source of incoming frustrated HAZMAT from state-side suppliers. All frustrated HAZMAT occurrences during a four month period of time consisting of over 400 frustrated items is analyzed to see where it came from and to see if trends exist on how this cargo is prepared. Statistical analysis on frustrated cargo is conducted during the research and a Chi Square analysis between commercial vendor and reason for delay is completed. By collecting this data and analyzing it in a statistical model, trends are identified to determine what vendors are demonstrating problems and which type of cargo results in the longest delay. In addition, by directly contacting officials at Dover and Charleston AFB, supplementary data was collected. Visits of each base helped identify the HAZMAT processes and helped to accomplish comparisons. These site visits allowed the researcher to interview key personnel who run the transportation operations and get first hand insight to the HAZMAT frustration problems that are perceived.

1.7. Scope and Limitations of the Research

Much of the research is limited to the specific problems or issues at the time the research was conducted. This may seem intuitive but the requirements and type of cargo moved from one month to the next vary greatly. From a statistical point of view, it would be easy to say that having over 400 data points is sufficient for proper research. However, as the research shows, data collected from one year to the next, and from one month to the next, seems to change dramatically based on the requirements and types of

cargo being deployed. The scope of this research only analyzes a four month window during 2005.

The same limitations apply to this research that have been seen in Ellison's previous research. "The necessity of the item are not studied. They are assumed to be valid requirements." (Ellison, 2004) This same assessment applies to this research also. Additionally, the research only looks at the cargo that comes through the APOEs of interest. HAZMAT shipments have been studied at Charleston and Dover AFB. No other AMC APOEs have been looked at and these bases act as a representative of cargo being shipped out of C-17 and C-5 APOEs, respectively.

Commercial suppliers and commercial transportation services have been analyzed based on those having problems providing airworthy cargo. The scope is limited to those suppliers causing the frustration and a look at their process to improve delivery of HAZMAT. The research does not show what portion of the cargo coming from each vendor was frustrated, and the research only shows the frequency of shipments that a vendor is the source of the frustrated cargo in question.

Finally, the cause of the frustration may not be because of anything the vendor or depot did wrong. The cargo may have been shipped from the vendor or depot air worthy but due to circumstance while in transit or in holding at the APOE, something happened to the cargo or the documentation. This research does not study frustrations caused because of errors during transportation to the APOE.

1.8. Summary

Our forces that are overseas in combat fighting and dying for their country need the required tools to accomplish the mission and to save their lives. HAZMAT items are some of the most critical assets required for our soldiers and the most strictly regulated for air transportation. Finding solutions that continue to decrease the existing delays for HAZMAT to depart on AMC aircraft is absolutely vital. Only by analyzing specific details of the process can time, man-hours and money be saved and our troops be properly re-supplied and equipped.

II. Literature Review

2.1 Chapter Overview

This Chapter reviews the literature on HAZMAT and frustrated cargo that has been done before this study. The review focuses on studies that deal with causes of delay and analysis of the process. A look at some of the systems in place to track frustrated HAZMAT is reviewed and provides some of the data in this research project. The transportation HAZMAT specialists from Dover and Charleston provided valuable insight as to how the process was being conducted.

To gain a better understanding of HAZMAT delivery process from ordering to departure of aircraft from CONUS APOEs, a review of Department of Defense (DoD) and Air Force literature was conducted. This review included established and draft policy, prior research by Ellison, and other information such as HAZMAT regulations, training requirements in the case of paper work errors, and the published guidelines and regulations on HAZMAT preparation. Through this review and focus on key connections, or lack of connections, to hazardous material supply chain from ordering to delivery on AMC aircraft, an understanding of the process will be gained. Also, data from studies currently underway will be reviewed. These studies will show insight into the current trends, pending guidance, and problems surrounding frustrated hazmat vendor cargo. These studies will show what systems are in place and what, if any, improvements have been made by these systems or programs.

The most critical and valuable research for this study came from the data collected at Charleston AFB and Dover AFB. These sets of data show all of the specific items frustrated from vendor suppliers over a five month period, why they were frustrated and what supplier provided the item.

Other sources of information were qualitative in nature and based on observations from visits to the two APOEs of interest. This qualitative research was important and looked at the drastic differences between the two operations. Primarily this review looks closely at the Customer Service Section at Charleston and Dover AFB.

2.2 Terms and Definitions:

The following definitions and acronyms are commonly accepted and used as follows: (USTRANSCOM, 2004, Eidson, 2005, Ellison, 2005):

120 Days: No Release Event – An audit of cargo listed as frustrated after 120 days. The item will be released from the system once it is confirmed that it is no longer frustrated.

Aerial Port of Debarkation (APOD) – the point of arrival in a theater or on arrival in the CONUS and generally the last node in the air segment of the DT

Aerial Port of Embarkation (APOE) – the point of departure for shipments entering the airlift component of Defense Transportation System, and generally the last transit point for shipments departing the CONUS.

Airlift Clearance Agency (ACA) – Military Service representatives that approve and validate the movement of DOD shipments via organic airlift.

APOE Damage – Damage to the cargo occurred while located at the Aerial Port of Embarkation

Commercial carrier – a private common user shipping company. For purposes of this process architecture, the term commercial carrier applies to organizations providing carriage that is not managed by the Defense Transportation System (see “lift provider”).

Container Consolidation Point (CCP) – A DLA (Defense Logistics Agency) processing location at which government shipments can be originated, transshipped, or integrated into larger composite shipment units (air pallets, sea

containers, etc). For the GPC pilot, the CCP may be the first point of entry into the DDS.

Customer -- The ordering agent or intended recipient of the merchandise.

DDRV – Defense Distribution Depot Richmond Virginia—Provide the full range of distribution services and information enabling a seamless, tailored, worldwide DoD distribution network that delivers effective, efficient and innovative support to combatant commands, military services, and other agencies during peace and war. (DDRV, Website)

Defense Transportation System (DTS) -- The organizations, personnel, equipment and infrastructure that are owned, operated or managed by the DOD in support of the transportation activities within the DOD Supply Chain.

Documents Lost – Documents required for shipment were not present and had to be completed before shipment could take place

DOD Distribution Nodes – a functional activity in the DOD organic distribution system.

DOD Distribution System (DDS) -- The organizations, personnel, equipment and infrastructure that are owned and operated by the DOD in support distribution activities within the DOD Supply Chain activities. DDS is synonymous with the phrase DOD Organic Distribution System.

Incorrect Certification – HAZMAT paperwork is present but part or all of the paperwork is improperly filled out or is in a wrong format. Examples include missing signature or missing/inaccurate HAZMAT identification, HAZDEC does not have red boarder or is a copy of a red boarder. Paperwork is present but wrong.

Incorrect Proper Shipping Name – The shipping name was not accurate and had to be changed before shipment could take place

Incorrect Regulatory Reference – An inaccurate regulation was cited in the shipping document and had to be corrected before shipment could take place

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA) -- group of airline members who adopted the rules set forth by the International Civil Aviation Organization (ICAO) and included additional requirements which are more restrictive, reflecting industry standard practices or operational considerations.

INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO) -- group which sets the standards for international transport of dangerous goods by air.

Lift Provider – this a general role term for any organization provide carriage that is managed by the Defense Transportation System.

MATERIAL SAFETY DATA SHEETS (MSDS) -- informational sheets provided by the manufacturer to buyers of chemicals produced; information includes chemical ingredients, physical data, fire and explosion hazard data, health hazard data, spill procedures, product trade name, manufacturer's address, and emergency telephone number.

Merchant -- the commercial product seller. This is not necessarily a government contracted seller. For purposes of the study, the term merchant and vendor are synonymous.

Miscellaneous (MSDS, Info, PSN, Markings, ect) – Cargo is frustrated for any item not covered by the other categories. Examples are listed but many other items fall into this category

Missing HAZMAT Documents – Some or all of the required HAZMAT shipping documents were not present. Required documents had to be found or redone before shipment could take place

Missing Signature – Required signatures for shipment were not present and were needed for shipment

No 1502 Re-Icing, Frozen/Chilled – This item is frustrated for not having a specific type of paperwork that is required for time sensitive items. Items that require dry ice such as blood fall into this category. This reason has few examples but is important to note because often times the item can not be used and must be destroyed.

No Documents – Required documents for shipment were not present and needed to be found or created for shipment

No Shipping Papers/Declaration -- Shipping papers, HAZMAT Declarations, or shippers declarations are not present or could not be found.

Other – Cargo was frustrated for a reason not covered by the other categories.

Packaging Incorrect or Damaged – Cargo is not packaged properly or the packaging has been damaged.

Repeat Exception: Cleared in GATES – The item frustrated was identified twice and needed to manually released from the system

Routing and Clearance -- The group of processes that approve and authorize the use of the DTS. Additional definitions that will add to the understanding of shipping requirements, agencies involved, and language used (DLA DDC, 2004):

TCN – Transportation Control Number, when used as a category, something is wrong with the TCN such as not present, inaccurate or used for a different piece of cargo

TCMD -- Transportation Control Movement Document.

Wrong Frustration Code – Cargo was frustrated for a reason inaccurately and needed to be fixed in the system before cargo could be shipped

Wrong Net Explosive Weight – Item is frustrated for HAZDEC having an inaccurate Net Explosive Weight. This is an important and less frequent category due to the danger of transporting explosives with errors that describe it.

2.3 HAZMAT Frustrated Cargo Data:

Looking at previous research by Ellison, we see how this study compares to her findings and similar data in her research. This thesis research project looks very closely to determine what can be improved in the HAZMAT shipping process. This study does not look at the government travel card but does look closely at the data that was collected as it relates to frustrated cargo at these same locations. Ellison's data is analyzed closely to see if it agrees with the findings in this research or if other conclusions can be made after looking at additional data from the two APOEs.

Ellison's research focused on many key points of importance that look at solutions to help the cargo delivery process. The research refers to a very important Memorandum that will also be highlighted in this research. This memo discusses the responsibilities the vendors must follow. The research references that this memo was distributed to many vendors to educate them on the current policy in place and how little effect this is having. (Ellison 2004) Additionally, this research by Ellison also suggested

that the memo should be revised to include responsibility being shared by both the vendor and the transportation officer and that the memo does not go far enough to provide requirements or enforce responsibility for repeated frustration occurrences. (Ellison, 2004) In fact, the research in Chapter 4 shows that no accountability exists because no established communication bridge is formed. No requirement could be found or exists for the Customer Service Section to respond in any particular way. Vendor's requirements that are viewed through this published document would therefore see this information as an advisory and the only accountability would be based on how each Customer Service organization runs their operation.

The Virtual Help Desk mentioned in Ellison's research, could not be found. (Ellison, 2004) This site was scheduled to come out six months after the close of Ellison's research. The website was advertised as the "one stop shop" to help vendors find the resources required for compliance was not available in my search. However, a similar source of help was found at the "USTRANSCOM Customer Portal" and has many resources to include regulations. (USTRAN, 2006) This is essentially USTRANSCOM's home page. This site provides news and weather but also has many useful links readily available for vendors to use.

The government purchase card (GPC) was also a major section of the previous research. (Ellison, 2004) This program and the training requirement for members before government cards can be issued, is essential to ensure military members are using the tax payers money properly. Additionally, GPC program is essential for members to know what vendors should use as a source of supply. The focus of this research will be on the

vendor's responsibility and not GPC program but that do not diminish the importance of the users responsibility and this program.

2.4 Active Performance Management

An in-depth review of a pilot program called Active Performance Management (APM) was conducted from November 2003 to December 2005. (APM, 2005) This system integrated Data from multiple systems, including the Global Air Terminal Execution System (GATES), Distribution Standard System (DSS), Standard Automated Material Management System (SAMMS), and Defense Automatic Addressing System Center (DAASC). (APM, 2005) Coincidentally, the data that APM compiled was the frustrated HAZMAT cargo at both Charleston AFB and Dover AFB. By having access to the data the researcher had a unique opportunity to review this raw data and compile the data into a format that could show trends.

Simply put, this pilot program gave the researcher a large foundation of second hand source data to conduct the research for this thesis. The data was able to be reviewed and graphed to provide a baseline for the more specific research that was conducted. This information was compared to the data Ellison compiled in 2004. The depot second source data provided by APM could be compared to the vendor second hand source data provided by Dover AFB. (Eidson, 2005) The most useful information from this study was that it provided the frustrated HAZMAT data from the depot. The pilot program provided data for this research but is limited in scope as addressed in previous sections. Not only is it limited to the two bases that are being studied in this research, but the pilot program just ended and is no longer the system being used to monitor these HAZMAT frustration problems.

2.5 Regulations on HAZMAT

HAZMAT is an extremely regulated and controlled item that requires very specific detailed instructions and regulations for air delivery. The Air Force regulation that controls this movement and packaging requirements is “AFMAN 24-204 Preparing Hazardous Materials for Military Air Shipments”. (AFMC 2004) This regulation is over 500 pages long and provides the exact requirement for transportation of every type of HAZMAT. Everything from a D-size battery to a nuclear warhead has a shipment-by-air requirement and these requirements are detailed in this regulation. If there is any improper documentation on the HAZMAT paperwork or if the packing requirements deviate in any way, the cargo is “frustrated” and can not be delivered by aircraft.

When vendors receive an order from service members overseas, they have very little knowledge of what is required by the Air Force regulations to transport these HAZMAT items. However, vendors are responsible for making sure these items are prepared properly for air shipment. (Ellison, 2004) In a memorandum from the Under Secretary of Defense, before a contract can be established with a vendor for the purchase of goods or a purchase can be made by a Government Purchase Card (GPC) holder, the contract and delivery order must require the vendor to comply with a set of specific “business rules”. (UndSecDef, 2003) These nine business rules explain the requirements that any commercial vendor must agree to abide by before they will be allowed to do business with the government. The requirements include providing standard documentations, shipping address, provide Transportation Control Number (TCN), ensure packing slip is posted outside the box and easy to find, make sure items are

properly packaged to ensure safe arrival at destination, include hard copies of HAZMAT data sheets or packing slips, package HAZMAT properly, provide In Transit visibility (ITV) and “provide advanced shipping notice to the first point of the DoD organic transportation system.” (UndSecDef, 2003)

The Customer Service sections at both Charleston and Dover AFBs are responsible for ensuring these vendors adhere to the rules and the vendors are given the proper tools and information to have the cargo prepared for continued shipment once the item is received by the APOE. (Eidson, 2004)

In an email forwarded to the researcher by the Dover AFB Customer Service for this study, the vendor is requesting an address from the Chief of Customer Service at Dover AFB to send cargo too in Dover, Delaware. This item was purchased under an approved contract. In contracts such as these, the vendor is required to know the process and how cargo needs to be sent. When Customer Service at Dover asked very simple questions such as the Transportation Control Number (TCN) to help identify the cargo, the vendor did not know what that was.

Many tools exist so that vendors can determine shipment requirements before it is sent to the APOE. (DLA 2004). The tools are readily available and the vendors should be properly trained on how to send HAZMAT cargo properly. One site that seems the most inclusive is the Defense Logistics Agency’s home page that has links to most tools necessary for defense transportation requirements.(DLA 2004)

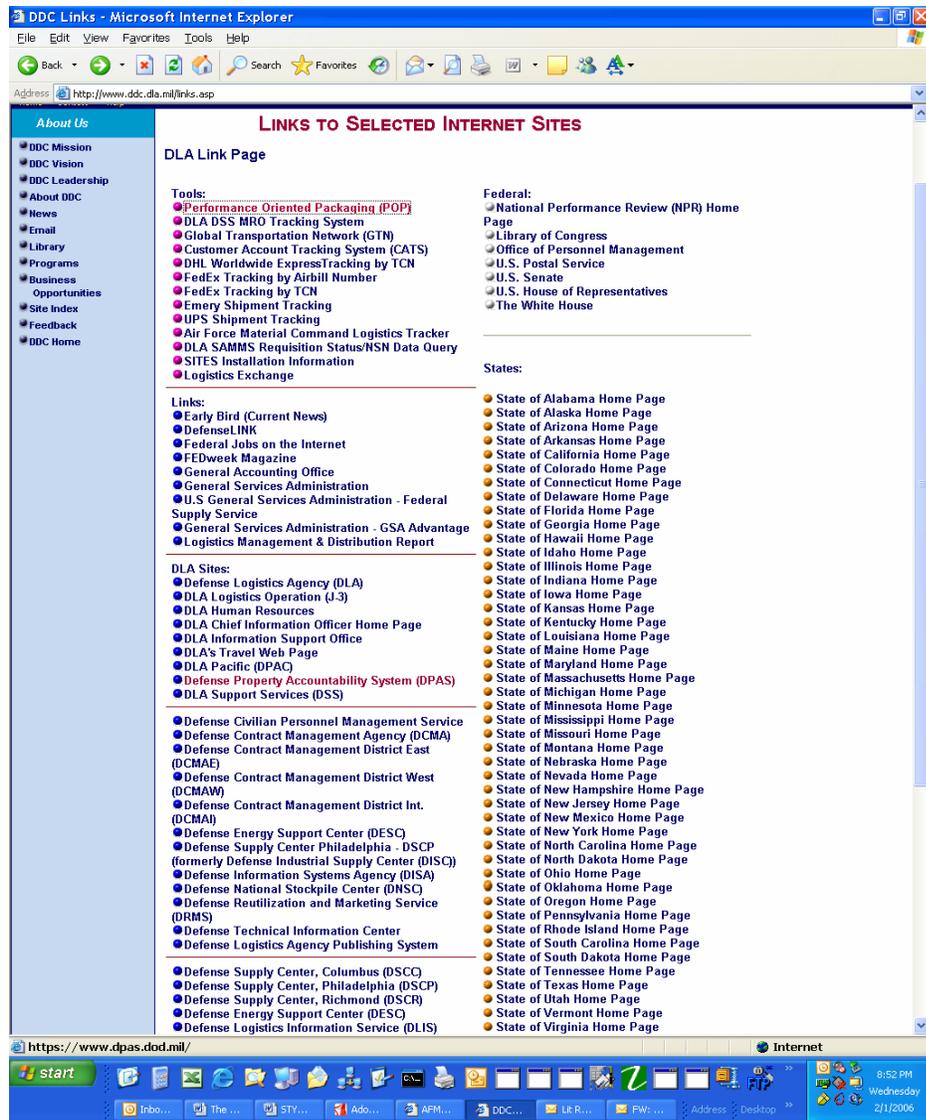


Figure 1. Defense Logistic Agency Home Page (DLA, 2005)

Here vendors can use the tools necessary to determine what is required for shipment to the user. Additional tools such as the Global Transportation Network, FedEx, TCN tracking tools and sites used to determine packaging requirements are listed.

Many references exist and are readily available for order on disk or online for commercial vendors to use and ensure that they are in compliance. Defense Transportation Regulation 4500.9 provides requirements for all forms of shipping. This

regulation includes chapter 204 that has the specific requirements for HAZMAT. (DTR, 2006) Online resources offer websites for vendors to make these purchases online and buy the required Hazardous Material Regulations (HMR's) or Federal Motor Carrier Safety Regulations. (HMR, 2006) Both of these items can be purchased for between \$30 and \$50 and provide many of the requirements needed for HAZMAT shipments.

2.6 Summary

This chapter looked at previous literature and tools available for HAZMAT transportation. The tools and resources are available to support the vendor, user and APOE and are critical sources of support to move critical HAZMAT material. This literature review not only shows what has been studied in the past but looks at a number of tools available for every part of the supply chain. These tools are easily accessible to help manage and move the cargo properly. In this review, it becomes apparent that the key to moving HAZMAT materials is the education of DoD vendors and for them to be given the proper training and requirements so that the cargo arrives at the APOE prepared to be loaded and delivered by air transportation.

The next chapter looks at the methodology of how this research is conducted. The chapter will revisit the investigative questions and go over the specific process that is used to conduct the research.

III. Methodology

3.1 Introduction

The research focuses on frustrated HAZMAT from Dover and Charleston AFB in an effort to determine and analyze problem areas with the quantitative data collected. HAZMAT delivery is a top priority by our leadership due to the critical nature of this cargo. With very little research being done in the past, this research continues to build on Ellison's research and opens large opportunities for future study. The lack of research is primarily due to the difficulty in quantifying the problem areas. These investigative questions are looked at separately to find out what impact each area has on the overall HAZMAT cargo delivery mission. A personal look at the two separate Customer Service section shows the vast difference in operational protocols. Analyzing causes and the average length of frustrated cargo that are sourced from the depot shows main areas that can be improved on from this source. Next, the research looks at overall trends seen for HAZMAT frustrated cargo at Charleston AFB and Dover AFB. Finally, a close look at the HAZMAT coming from vendor sources shows the main causes of frustration and what vendors are most often responsible.

3.2 Problem Statement

What current reasons are frustrating cargo at Dover and Charleston AFBs and what improvements can be made to commercial supplier's and carrier's HAZMAT packaging and delivery process that will allow cargo to move faster and cheaper to departing inter-theater aircraft?

3.3 Methodology

The basis for this research is to look at a problem that faces two very similar bases. Charleston and Dover Air Force base have a very similar mission using two different types of aircraft. From afar without looking closely at the operation, the only difference that could be seen would be the C-17 that flies for Charleston AFB and the C-5 that flies for Dover AFB. This research started with site visits and interviews at these two bases and visits with each Customer Service section. During these visits more differences became apparent. Since the basis for this thesis is a close look at the transportation operations and how HAZMAT is handled, a close personal look at each of these bases is required. It was important to interview the Customer Service Chief for each operation and get a first hand perspective on how things are managed. This aspect of the research focused on how they were performing the mission and how the entire shop perceived the operation to be handling frustrated HAZMAT shipments. To be able to compare these two locations accurately, the qualifications and attitudes of the personnel and their work environment was looked at. Interest in this area of the study became noteworthy when observations identified the large contrast between the two locations.

The research next takes a quantitative approach looking at historical data of frustrated HAZMAT cargo at Dover and Charleston Air Force Base. By breaking down the reasons for frustration, the most common reasons for frustration are analyzed. These results are then compared to Ellison's previous results to see how the most recent year compares to the similar data that was collected during 2003-2004 research. In

preliminary collection it was realized that no research was conducted that looked at the differences between vendor supplied HAZMAT and depot supplied HAZMAT.

Therefore, these two categories were analyzed separately. This allowed for an accurate picture to be illustrated that showed the different problems causing HAZMAT frustration.

Vendor frustrated cargo and depot frustrated cargo was looked at differently based on the data that was present or provided for each base. Personnel at Dover AFB were more able to provide records or were more willing to provide the data that was requested. From Dover AFB, four months of data was collected that showed over 400 data points of frustrated HAZMAT. Trend analysis is used to see if anything can be improved in the transportation preparation to make this HAZMAT more airworthy. These data points also showed what the cargo was, what company provided the item, and what shipper was used for delivery. By conducting a regression model with this data, the research identifies what items of cargo are being frustrated most often. The research also determines what vendors are having the most problems and providing frustrated cargo the most often.

Focus is given to the entire supply chain and the research looks at how the HAZMAT cargo was delivered. The research also looks at how this HAZMAT was prepared and what could be improved in the ordering, production and shipping process to improve cargo preparation to make HAZMAT cargo more airworthy when it arrives at APOE.

3.4 Research Approach

The initial approach was to analyze the data gathered from two APOEs. However, once both Customer Services were visited, basic differences in how these sections were managed became apparent. Observing how employees conduct their customer service operations showed two very different approaches and styles to manage the process. Informal questions were asked as to how long members have worked there and how different situations are handled. In both cases, the answers were very different between Charleston and Dover AFB. Although not originally intended for this research, a qualitative investigative question was developed to analyze these differences. *What are the major differences between the Customer Service Operations at Dover and Charleston AFB and how do these differences affect the transport of HAZMAT?* This question asked and explained the major differences between the Customer Service Operations at Dover AFB and Charleston AFB and how do these differences affect the mission?

The next two investigative questions look at frustrated cargo that comes from the depot and breaks down what the most common causes are for the frustration. This research provides a quantitative analysis comparing the length of delay to the causes of the frustration. The data from Active Performance Management System compiled through GATES shows the reasons and number of occurrences that depot HAZMAT is frustrated. This data is broken down by base showing a break down of the most repeated problems. The next research question takes this same data and looks at the average time delay for this HAZMAT frustrated cargo. Outliers are identified and analyzed and the overall delays are discussed. The following are the second and third investigative question: *What are common causes for depot HAZMAT frustrated cargo at Charleston*

and Dover AFB and what is the average time delay for Depot HAZMAT frustrated cargo?

Investigative question four asks, *What trend is observed from the frustrated HAZMAT performance metric at Charleston AFB and Dover AFB?* This part of the research shows what patterns exist and studies if the HAZMAT cargo frustration is improving or if indications from data show the problem is getting worse. A tool called Activity Performance Management compiles data from the GATES and GTN information systems and displays this information in a graph for a weekly update. As mentioned before, this system was a pilot program for Charleston and Dover AFB but served as an excellent tool to use for the research this thesis is focusing on. The table presented in chapter four is from the last report Active Performance Management produced and it studies the necessity for this research by showing trends for frustrated HAZMAT. Finally, questions were sent to the Chief of Customer Service at Dover AFB to help analyze what is causing these trends. The questions, answers and analysis are expanded on in chapter four.

Investigative question five analyses the specific HAZMAT frustrated cargo at Dover AFB to determine what vendors are supplying the most frequently frustrated cargo. A more in depth analysis is conducted to study vendors that frequently source frustrated HAZMAT cargo. The cargo from the most frequent suppliers of frustrated HAZMAT is looked at to determine what the most frequent cause of frustration so that potential problems with the vendor can be identified. At Dover AFB this data is compiled by Eidson into an Excel document on a monthly basis. Similar data including

the same information was not recorded by Charleston AFB and is therefore not available.

The following is asked in Investigative question five:

What trends can be identified when cross referencing reasons for frustrated HAZMAT and the vendor who supplied the cargo?

- A. *What reasons primarily cause HAZMAT to be frustrated?*
- B. *What commercial vendors have the most occurrences of frustrated HAZMAT?*

A few adjustments had to be made to the data so that it could be sorted into a manageable product and the “Reasons” descriptions could be better categorized:

About 50 reasons were noted from the raw data to explain why something was frustrated.

These reasons are organized into different seven categories so that a clear picture of the problem could be understood. These reasons were broken down into the following manageable explanations:

1. No Shipping Papers/Declarations
2. Miscellaneous (MSDS, Info, PSN, Markings, etc.)
3. Incorrect Certification
4. TCN
5. No 1502 Re-Icing, Frozen/Chilled
6. Wrong Net Explosive Weight
7. Packaging Incorrect or Damaged

As many as ten different Reasons were identified that indicated something was wrong with the Transportation Control Number (TCN). These reasons ranged from too many digits in the TCN, too few digits in the TCN, No TCN, incorrect TCN, and

duplicate TCN. To manage this reason in a more concise manor, anything wrong with the TCN was changed just to “TCN” as the reason.

Many items were identified as missing paper work. Many examples existed to include No HAZMAT Declarations (HAZDEC), improper labeling, no air HAZDEC or missing required paperwork. Anything that was missing paperwork of any kind that was required for shipment to be processed was labeled as “No Shipping Papers/Declaration”

An even larger number of reasons were identified that indicated the HAZMAT cargo had the right paper work present but something on the paper work was not done properly. Examples noted were incorrect packing paragraph, HAZDEC did not have proper red boarder, incorrect quantity noted, no signature on HAZDEC, wrong packaging paragraph, No shipper information or phone number, no hazardous markings and incorrect ULN Number. All of these examples were labeled “Incorrect Certification”

Packaging incorrect or damaged was used as an explanation when something was wrong with the packaging itself. Some reasons put into this category included packaging was damaged, package was not sealed or properly used, packaging did not meet requirements for transportation, in one case the vehicle was damaged and was not sent so that it could be repaired.

The category “Wrong Net Explosive Weight” did not have many occurrences but justified its own category because of the serious safety concern. These items were frustrated because the total weight of explosive material was inaccurate on the paperwork and had to be fixed before shipment.

When a number of other reasons for frustration occurred, they were categorized as Miscellaneous. Reasons for this category could be split shipments. A split shipment is

when the cargo present at the APOE is frustrated and waiting on the rest of the cargo to arrive to the APOE. Another situation involved the vehicles keys being locked in the car. Any reason that was not covered by the other six categories was listed as Miscellaneous.

These reasons were tabulated on a spreadsheet with the name of the vendors frequency of occurrences added up. A list of these companies with two or more occurrences is highlighted. Seven companies with the most occurrences were separated into another chart and a break down of why these items were frustrated was tallied. A Chi Square statistical analysis is conducted to determine if these items are dependent or independent. These results and analysis are also found in chapter four.

Finally, the research found number of other findings and are presented in the Additional Findings section. The 400 data points used in investigative five is grouped into 45 day blocks of data and compared to the research conducted by Ellison. Ellison's data consisted of one and half months of data from 2004. this previous data is compared to two different subsets of equal time from the most current four months of data collected. The research and analysis of this study can be found in chapter four.

3.4.1 Reverse Approach

The approach of this research study is to review the supply chain process of HAZMAT in reverse order to identify problems that could speed up the process and get this critical cargo to the war fighter. The analysis looks at the frustrated HAZMAT by looking at the cargo itself and works backwards analyzing the communication that leads to a frustrated product arriving at the APOE. A close look to see what trends exist and what improvements can be made to get this cargo where it is needed. Ellison discovered

that the communication of required cargo is flowing from the troops out in the field directly to the vendor or depot. This is telling the supplier what is needed but not how it needs to be prepared for transportation to meet the airlift requirement. The users in the field do not necessarily know the requirements for the cargo to be shipped and are only able to purchase what is needed. After the cargo is ordered and delivered from the vendor or depot, the user only knows that the cargo is in the transportation system and often times assume the cargo is lost (Ellison, 2004). Often times the result is a duplicate order being made due to the critical need for the cargo. Because the vendor is not sending the item through the transportation system properly, the delay at the APOE happens frequently leaving the lack of communication with the APOE a significant problem. The figure XXX illustrates the current system:

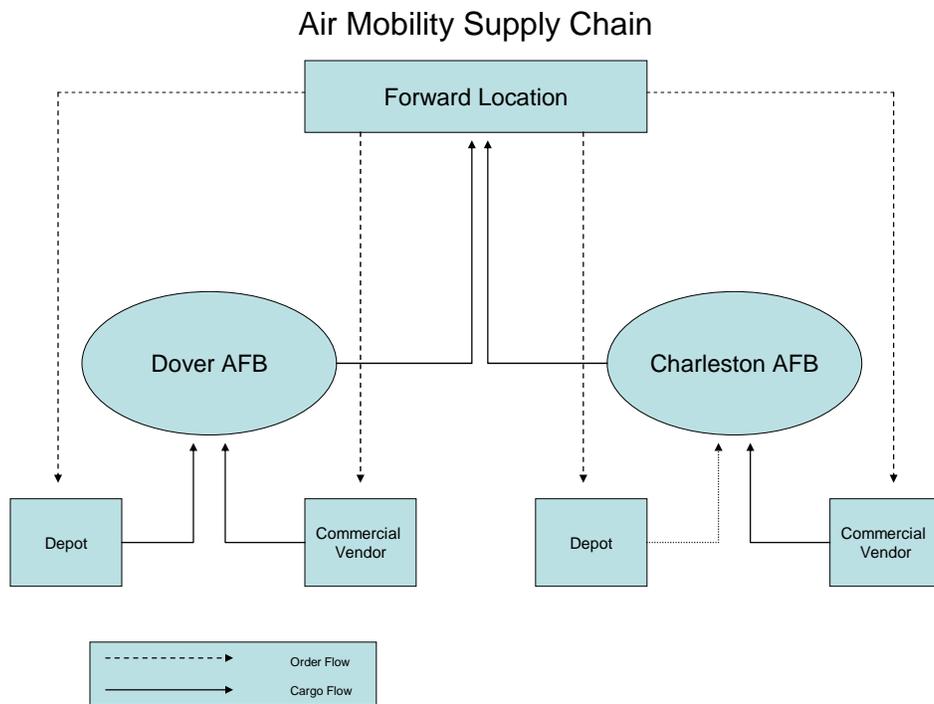


Figure 2. Air Mobility Supply Chain

Studying the communication sources, order and cargo flow, leads to identification of trends and further recommendations in chapter four.

3.5 Data Sources

Dover and Charleston Air Force base handle most of the eastbound cargo destined for Europe and the Middle East. Since the research of interest is to look at how that process is run for HAZMAT material, a close look at Dover and Charleston AFB was the primary data source for this study. During a site visit, the existing process was studied and key officials interviewed to determine how the process was run. All of the data used for the quantitative research was gathered from the respective Customer Service Sections at Dover and Charleston and AFBs. The data was also limited to available information that they had or were willing to provide.

3.6 Summary

This chapter describes the methodology used to analyze the frustrated HAZMAT at Dover and Charleston AFB. This chapter also shows how data for vendor and depot supplied cargo will be organized and presented in chapter four. The research investigative questions were looked at to show how each one will be quantified and what approach will be used to answer them. The next chapters will analyze the results of this data, provide results, conclusions and a spring board for other research to be continued.

IV. Results and Analysis

4.1 Chapter Overview

The purpose of this chapter is to present and analyze the results the data, provided by Dover and Charleston Air Force Base. The metrics of interest look at the frustrated HAZMAT cargo at both locations and show various trends and analysis. The overall research question of the study is restated and the results and analysis of each investigative question is presented. Additionally, a conclusion and additional findings are also presented. Two types of data were analyzed: frustration cargo from depot shipments and from commercial vendors. In total, 615 occurrences from both sources are used for this research from the period August to November 2005. The following is a detailed analysis of these occurrences.

4.2 Restatement of Research Question

What are the current reasons for frustrated cargo at Dover and Charleston AFBs and what improvements can be made to the HAZMAT delivery process that will allow cargo to move faster and cheaper on departing inter-theater aircraft?

4.3 Investigative Question One

What are the major differences between the Customer Service Operations at Dover and Charleston AFB and how do these differences affect the transport of HAZMAT?

Significant differences are noted in the operational approach between Dover and Charleston AFB. These differences include a very different command structure, different approaches to how frustrated cargo is handled, as well as a difference in the overall perspective of how the mission should be handled.

The supervisor is in charge of the Customer Service Section for Dover AFB has been in this position for over 15 years and has provided a great deal of support to this research project. (Eidson, 2005) A very experienced extra effort was observed in how the supervisor runs the Customer Service Section during the four day observation period. Among other things, the section reviews and handles all frustrated HAZMAT that comes through the Dover AFB APOE. During an informal interview with the supervisor, the researcher learned in detail what the job consists of on a daily basis and how the supervisor personally handles all cargo discrepancies that come through Dover AFB. Specifically, in most cases as a general rule, when Dover AFB has frustrated HAZMAT cargo, and the discrepancy is determined to be the fault of the vendor, the item is sent back to the vendor so it could be fixed.

Observations and discussions from 5 through 8 September, is when the researcher first learned, from the supervisors perspective, that the handling of the entire operation at Dover AFB is very different than Charleston AFB. The next week, the researcher drove down to Charleston AFB to observe their Customer Service Operations and to determine what differences existed.

During a similar three day observation visit, Charleston AFB appeared to handle the Customer Service Operations very differently. The reasons for these differences are very apparent by observing the personnel running the Customer Service Shop. The

Customer Service section chief position is currently vacant and has been for almost a year. A newly promoted NCO has been appointed NCO In Charge (NCOIC) of customer service and has been “in charge” for about a month. Unlike the senior leader of customer service at Dover AFB, the Charleston AFB NCOIC is working in this section for the first time in his career and readily admits he is not as familiar with the operation as required. As the senior member in charge he explained that his primary duty was learning the operation. Many of the researcher’s questions about the operation and procedure policies were best answered by the civilian staff assigned to the section. Two other individuals are assigned to Customer Service Section, both government employed civilians, who have worked in this operation for a combined 25 years.

The following figure illustrates the current chain of command structure for Customer Service at Charleston AFB:

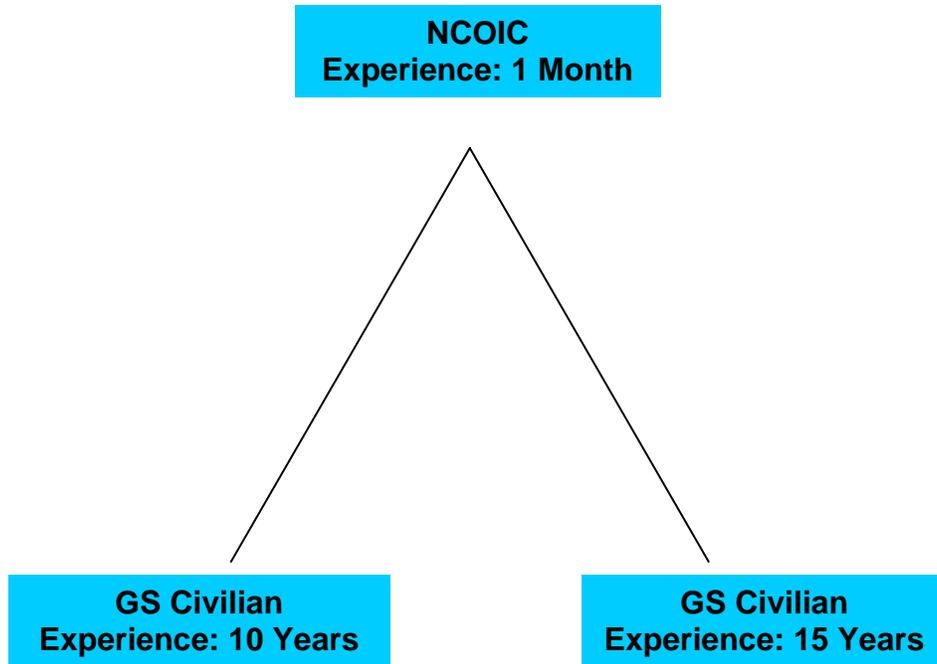


Figure 3. Charleston AFB Customer Service Organization Chart

This figure shows the major differences in experience between the leadership and the customer service representatives. It shows the vast differences in leadership that are in charge at Charleston AFB Customer Service Section and no experience requirement is in place for this very critical section.

Additional differences observed were in basic procedures and how HAZMAT cargo frustrations are handled. The basic procedure differences between Charleston and Dover AFB are very clear. In most situations and as a matter of policy, when an item delivered to Dover from a vendor is frustrated for discrepancies caused by the vendor, the item is sent back for the vendor to fix. Eidson explained that vendors will continue to have problems providing cargo in the proper air-worthy configuration unless they realize what they did wrong. In drastic contrast, when HAZMAT cargo is frustrated at

Charleston AFB, the discrepancies are fixed when ever possible and shipped right away. The rational is that the war fighter needs these HAZMAT items quickly and the quickest way to fix the frustrated item is to fix the discrepancy so the cargo can be transported sooner.

The most interesting detail about these findings is that both bases are aware of how the other base handles the customer service operation. Both customer service offices equally stood behind how they manage their operation and strongly criticized how the other base handles theirs. Both methods have advantages and disadvantages that are very clear and have rippling ramifications through out the entire supply chain. The advantages of sending cargo back to the vendor force them to fix the problem that they created and learn from the mistake of sending cargo improperly. The disadvantage is that the critical cargo destined for the war fighter is delayed and the increased shipping cost is incurred by sending the cargo back to the vendor. A copy of the memorandum published by the Under Secretary of the Air Force explaining vendor requirements is often accompanied (Ellison 2004). The advantages to fixing the problem on site are that the cargo is delivered to the war-fighter quicker but the vendor is never corrected for sending the cargo improperly. The quantitative data on cargo delay times in the sections below supports these unit level policies and the investigative questions below analyze these two very different approaches.

4.3.1 Investigative Question One: Analysis

From the research conducted at both locations, it seems apparent that the Customer Service Section is the most important section for HAZMAT Transportation

Management in the Aerial Port. They represent the Air Force as the link between civilian vendors and deployed forces overseas for HAZMAT shipments. Furthermore, Customer Service controls the data of all cargo coming through and is charged with the responsibility to educate commercial vendors on DoD HAZMAT shipping procedures. At the very least, the Customer Service Section is responsible for providing tools to vendors so they can educate themselves. This requirement is the shipper's responsibility to deliver the cargo in the proper method and it is required that the shipper pay for the expense (AFMAN 24-204, 2001).

For a section as important as the Customer Service Section, providing highly trained and experienced individuals should be a top priority. Much of the data collected for research was provided by Dover's Customer Service. However, collecting data and required metrics is not universally accepted and varies between locations. A uniformed standard between Aerial Ports for information gathering on frustrated HAZMAT shipments and customer service requirements for handling frustrations seems to be the most lacking element to making aerial port customer service operations a standardized success.

4.4 Investigative Question Two

What are common causes for Depot HAZMAT frustrated cargo at Charleston and Dover AFB?

Below is data compiled from Active Performance Management System (APMS) through the Gates information system, that shows in descending order, the "Reasons" and "number of occurrences" that depot HAZMAT is frustrated. This cargo comes from all

of the depots in the United States or over two dozen locations. (Eidson, 2006) This data is separated by base and shows a breakdown of the most repeated problems at each location. The 92 total occurrences between the two bases is from a four month period between 1 August to 31 November 2005. Some of the data included in this timeframe is from frustration occurrences which began as early as March 2005 but are in the system during the four months represented.

A definition of the “Reason” can be found in the Literature Review to help identify what the problem consists of. Currently, the most common reason cargo is frustrated at Charleston AFB is for an Incorrect Regulatory Reference. This indicates that part of the HAZMAT paperwork is not accurate and the paperwork needed to be corrected before the cargo could be released from frustration.

Table 1. Number of Depot Frustrated Cargo Occurrences: Charleston AFB

Number of Depot Frustrated Cargo Occurrences by Type: Charleston Air Force Base		
Reason	Number	Percent
Incorrect Regulatory Reference	10	27.78%
Not Regulated	9	25.00%
No Documents	8	22.22%
120 Days: No Release Event	3	8.33%
APOE Damage	3	8.33%
Incorrect Proper Shipping Name	1	2.78%
Missing Signature	1	2.78%
Other	1	2.78%
Repeat Exception: Cleared in Gates	0	0.00%
Wrong Frustration Code	0	0.00%
Total	36	100.00%

Table 2 shows the same information for Dover AFB during the same time frame of four months. The most common reason cargo was frustrated at Dover AFB was for

No Documents. This indicates that either the HAZMAT, shipping or some other paperwork is not present and needed to be found or completed before the cargo could be released from frustration.

Table 2. Number of Depot Frustrated Cargo Occurrences: Dover AFB

Number of Depot Frustrated Cargo Occurrences by Type: Dover Air Force Base		
Reason	Number	Percent
No Documents	10	17.86%
Incorrect Regulatory Reference	9	16.07%
Other	8	14.29%
Repeat Exception: Cleared in Gates	7	12.50%
Not Regulated	6	10.71%
Missing Signature	5	8.93%
120 Days: No Release Event	5	8.93%
Wrong Frustration Code	3	5.36%
Incorrect Proper Shipping Name	2	3.57%
APOE Damage	1	1.79%
Total	56.00	100.00%

4.4.1 Investigative Question Two: Analysis

Both bases appear to have similar reasons and frequency for occurrences. Dover AFB had more occurrences but this could be explained by the larger quantities of Depot cargo coming through this APOE. 15 of the 92 exceptions are from human error due to a previously frustrated item not being released from the system or for a single frustrated occurrence being entered twice. These items are part of the “Reason” category “120 Days: No Release Event” and “Repeat Exception: Cleared in Gates” respectively. It is important to note that 12 of these 15 occurrences are from Dover AFB. Nine occurrences are in the category “other” and apply to any frustration that does not fit into this category.

Examples range from keys locked in the vehicle to the shipment being incomplete and waiting for additional cargo.

4.5 Investigative Question Three

What is the average time delay for Depot HAZMAT frustrated cargo?

The tables below show the most common causes and average number of days for depot frustrated cargo at Charleston and Dover AFB in the months of August and September 2005. These cause for frustrated cargo were chosen because they represent the most significant causes for delay and are therefore the most significant to focus on. The first Table below is for Charleston AFB and has examples of delay for five of the eight categories.

**Table 3. Average Delay Depot Cargo is Frustrated:
Charleston AFB (2 Months)**

Average Days to Resolve Frustrated Cargo: Charleston AFB-Aug-Sep 2005	
Reason	Average Delay
Other	44.1
No Documents	3.0
Incorrect Regulatory Reference	2.4
Not Regulated	2.0
APOE Damage	0
Missing Signature	0
Repeat Exception	0

The most significant cause for delay listed as other is “120 Days: No Release Event” of 44 days. It is important to note that this is not frustrated HAZMAT cargo. This is a previously frustrated item that was not cleared from the system when the

original frustration problem was fixed. The frustrated item was fixed but Gates never tracked the cargo leaving and does not have accountability of the cargo. If the item is not found anywhere at the APOE and is still in the system as not sent, it falls into this category. It is assumed the item was either shipped overseas or back to the vendor. The next table shows the same data for Dover AFB during the identical time frame. Dover AFB had examples of eight different reasons for frustrated HAZMAT cargo and the average time delay is represented.

**Table 4. Average Depot Delay Cargo is Frustrated:
Dover AFB (Two Months)**

Average Days to Resolve Frustrated Cargo: Dover AFB-Aug-Sep 2005	
Reason	Average Delay
Other	13.3
No Documents	5.7
Incorrect Regulatory Reference	5.8
Repeat Exception	5.4
Missing Signature	3.6
Not Regulated	1.8
APOE Damage	1.7

Analyzing the data shown in Tables 3 and 4, causes for depot frustrated cargo is significant at Charleston AFB and not as significant at Dover AFB. The data consists of frustrated cargo from August 2005 to September 2005. Examples of the “120 Day” no release have occurred at Charleston AFB and is an example of Gates not being updated properly and the cargo’s location unknown. Comparing the two tables seems to confirm how the finding in Investigative Question One, due to the longer delay’s at Dover AFB.

When this data is expanded from a two month period to a four month period, a different look is represented. When the data is expanded, it appears to smooth out the results and causes of frustration. Table 5 below shows the most common causes and average number of days for depot frustrated cargo at Charleston for the four month period from August 2005 to November 2005:

**Table 5. Average Delay Depot Cargo is Frustrated:
Charleston AFB (Four Months)**

Average Days to Resolve Frustrated Cargo: Charleston AFB- Aug to Nov 2005	
Reason	Average Delay
APOE Damage	58.0
Not Regulated	7.7
Missing Signature	6.3
Incorrect Proper Shipping Name	4.9
Incorrect Regulatory Reference	4.1
No Documents	3.0
Other	0.2
Wrong Frustration Code	0

In this data set, Charleston AFB has a number of different reasons that were not represented in the previous table. Six categories represent Average Delay's of four days or more. The reason "APOE Damage" is skewed by one item that was damaged on site. This cargo was a vehicle that could not be moved till damage caused by a minor accident was fixed. Table six below shows data for the same four month period at Dover AFB. Like Charleston AFB, the table shows the most common causes and average number of days for depot frustrated cargo for a four month period from August 2005 to November 2005:

Table 6. Average Delay Cargo is Frustrated: Dover AFB (Four Months)

Average Days to Resolve Frustrated Cargo: Dover AFB – Aug to Nov 2005	
Reason	Average Delay
Wrong Frustration Code	13.05
No Documents	5.77
Other	5.35
Not Regulated	4.51
Incorrect Proper Shipping Name	3.63
Missing Signature	3.59
Incorrect Regulatory Reference	3.49
APOE Damage	1.73
Missing HazMat Documents	0.00

Similar to Charleston AFB, the data is much more smoothed and has examples of frustration from most reason categories. The longest delay was caused by entering the wrong frustration code that was frustrated for some other reason. When an error is created by documenting the error wrong, time is wasted to fix a problem that does not exist and than the actually frustration cause needs to be fixed. The next section below analyzes the most significant findings and analysis of this data.

4.5.1 Investigative Question Three: Analysis

Although not confirmed with the Customer Service sections at Dover and Charleston AFB, the data for Research Question Three supports the findings from Research Question One. For eight of the nine reasons cargo is frustrated at Dover and Charleston AFB, the delay is longer at Charleston AFB. Six of these nine categories and most of the reasons represented in this data, are caused by the depot not providing the cargo with proper paper work or the paper work not being properly completed. The next

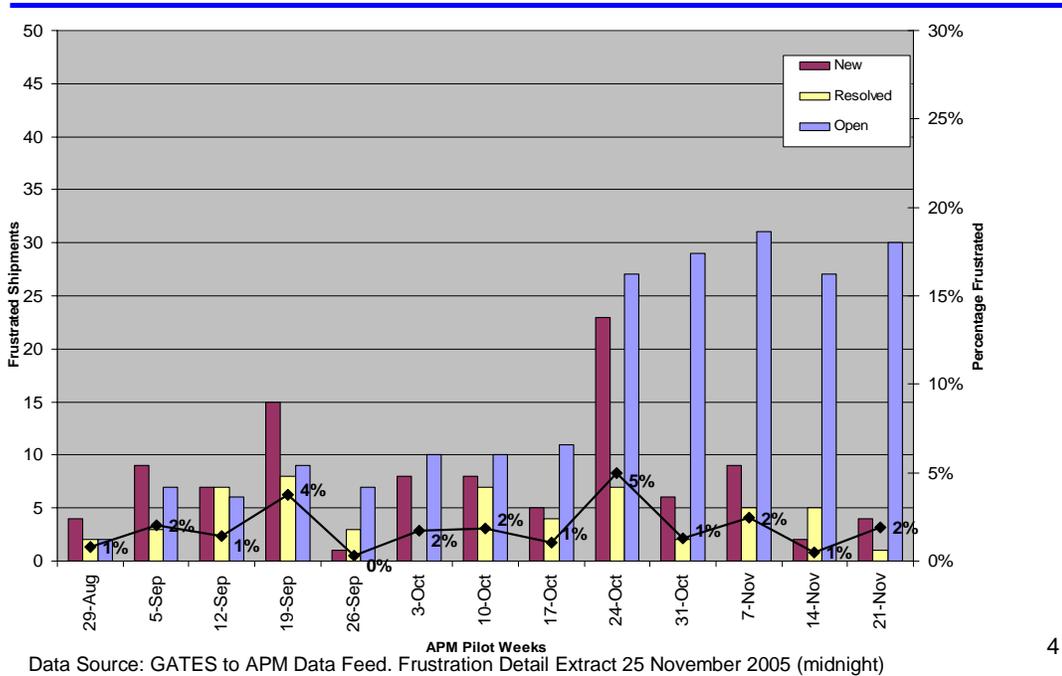
research question looks at the trends over time to see if HAZMAT cargo frustration rates are improving or if the problem is getting worse.

4.6 Investigative Question Four

What trend is observed from the frustrated HAZMAT performance metrics at Charleston AFB and Dover AFB?

Below is a table that shows a Frustration Summary report provided by Gates and APM that illustrates the number of New and Resolved Frustrations for each week. The data on the left axis shows the number of HAZMAT frustrated shipments. On the right axis is the percentage of HAZMAT that is frustrated. This data is displayed by week and is separated into three categories for “New” Frustrations shown in red, “Resolved” frustrations shown in yellow and “Open” frustrations shown in Blue. This metrics is a combined set of data for Charleston and Dover AFB and was used during the weekly tele-conference APM meetings between the two bases as well as the Defense Logistics Agency (DLA). Below is the final table for the last APM meeting that concluded the APM test evaluation in December, 2005.

Table 7. Frustrated HazMat Shipments: Dover and Charleston (APM, 2005)



4

4.6.1 Investigative Question Four: Analysis

The Frustration Summary Metrics Report initially shows very consistent performance; with a low number and percentage of frustrations occurring each week. These frustrations appear to be matched by resolutions that keep the number of open frustrations minimized. However, the last few weeks show a significant pattern of Open items of frustrated HAZMAT. Specifically, a large number of frustrations the week of 24 October have generated a spike in the backlog of open exceptions at Dover and Charleston AFB. The table shows the percentage of frustrated cargo has spiked for Dover and Charleston AFB, doubling and even tripling open items in a one month time

frame. It is important to re-emphasize that this data is coming from APM which was in a test period at the time and ended 1 December 2005. The validity of this data may be questionable but illustrates that the Air Force is trying to find a product that can show a clear picture of frustrated HAZMAT problems. However, the data could illustrate a significant problem and a back log of frustrated HAZMAT. When the chief of customer service at Dover AFB, was asked why the surge existed, the response was:

We usually get a surge of cargo in the middle of Oct thru Nov. Then it tapers off somewhat over the holidays. It slows down middle of August thru September due to the fiscal year. The transportation account codes (TAC) have to be revalidated each year for funding. Many holders of TACs don't revalidate in a timely manner and they don't have any money to ship. So, therefore, they start shipping in October all their backed up requisitions. This causes the surge. (Eidson 2006)

4.7 Investigative Question Five

What trends can be identified when cross referencing reasons for frustrated HAZMAT and the vendor who supplied the cargo?

- A. *What reasons primarily cause vendor supplied HAZMAT to be frustrated?*
- B. *What commercial vendors have the most occurrences of frustrated HAZMAT?*

Table eight shows the frequency and reason vendor sourced HAZMAT at Dover AFB was frustrated from 1 August to 31 November 2005. The 423 data points of frustrated HAZMAT are separated and categorized into one of these eight areas of major concern. This data is used to illustrate why the cargo was frustrated and what were the most common problems.

Table 8. Frustrated Vendor HAZMAT Shipments: Dover AFB (Eidson 2006)

Frustrated Vendor HAZMAT Shipments 1 August through 31 November 2005		
Reason	# Shipments	% of Total
No Shipping Papers/Declarations	67	15.84%
Miscellaneous (MSDS, Info, PSN, Markings, etc.)	45	10.64%
Incorrect Certification	105	24.82%
TCN	191	45.15%
No 1502 Re-Icing, Frozen/Chilled	2	0.47%
Wrong Net Explosive Weight	7	1.65%
Packaging Incorrect or Damaged	6	1.42%
Total Frustrated HAZMAT Shipments	423	100.00%

The most significant problem noted in the table above is that something is wrong with the Transportation Control Number (TCN). The cargo is arriving to the APOE from the vendor with the TCN either missing or inaccurate. This TCN number is used in Gates so that the cargo can be tracked properly and to ensure the cargo is not lost in the transportation system. Most of these items of frustrated cargo can be attributed to the vendor making some error that caused the frustration and the delay. The following table takes the same 423 items of vendor sourced frustrated HAZMAT and begins to look at the vendors that provided this cargo.

Table 9. Frustrated Vendor Sourced HAZMAT

# of Frustrated Occurrences	423
# of Vendors	225
Average Frustrated Cargo Per Vendor	1.88
Standard Deviation of Frustrated Cargo Per Vendor	3.59
Maximum Occurrences	37
Minimum Occurrences	1

A very large number of vendors have examples of frustrated cargo during this four month time frame. 225 vendors provided the 423 instances of frustrated HAZMAT. Furthermore, each vendor had an average of 1.88 occurrences of frustrated HAZMAT

during this time. 50 of the 225 vendors had two or more occurrences and are shown in Table 10. This data analyzes the specific vendor and shows how many occurrences of frustrated HAZMAT each company had during this four month period. 175 companies are not mentioned and had only one occurrence of frustrated HAZMAT during this time period.

Table 10. Frustrated HAZMAT Occurrences at Dover AFB for each Vendor

Frustrated Vendor HAZMAT Shipments 1 August through 31 November 2005		
Vendor	Occurrences	% of Frustrated Cargo
TOTAL	423	100.00%
GSA	37	8.75%
UNKNOWN	29	6.86%
THE INSITU GROUP	23	5.44%
HONEYWELL	11	2.60%
CUMMINS	10	2.36%
LOCKHEED MARTIN	10	2.36%
UNIVERSAL PROPULSION	8	1.89%
GTSI CORP	6	1.42%
KBR SERVICES INC	6	1.42%
ALLOY SURFACES CO	5	1.18%
GRAINGER	5	1.18%
ATK THIOKOL INC	4	0.95%
GATEWAY	4	0.95%
MCDOWELL RESEARCH	4	0.95%
OFFICE DEPOT	4	0.95%
RSPC	4	0.95%
AGILENT TECHNOLOGIES	3	0.71%
CDW-G	3	0.71%
DCMA	3	0.71%
DELL COMPUTER	3	0.71%
KIDDE	3	0.71%
LAB SAFETY SUPPLY	3	0.71%
NORTHROP GRUMMAN	3	0.71%
RAYTHEON MISSILE SYS	3	0.71%
SANDSTRON PRODUCTS	3	0.71%
SQUARE ONE ARMORING	3	0.71%
ABBOTT LAB	2	0.47%
ADVANCE SCIENTIFIC	2	0.47%
BENCO DENTAL SUPPLY	2	0.47%

DAY & ZIMMERMAN	2	0.47%
DTST	2	0.47%
EAST TEXAS LIGHTHOUSE	2	0.47%
GOVT SCIENTIFIC	2	0.47%
GOVT SCIENTIFIC SOURCES	2	0.47%
HARRIS CORP	2	0.47%
INTERNATIONAL SUPPLIES	2	0.47%
J&L INDUSTRIAL SUPPLY	2	0.47%
JC WHITNEY	2	0.47%
JUNIPER ELBOW CO	2	0.47%
MSC INDUSTIRAL SUPPLY	2	0.47%
NEW BEGINNINGS	2	0.47%
NOBLE SALES STORE	2	0.47%
OFFICE ZONE	2	0.47%
OLVA	2	0.47%
PHOENIX REMANUFACTURED	2	0.47%
ROBERTS RESEARCH LAB	2	0.47%
SKYLAND	2	0.47%
THERMO ELECTRON CORP	2	0.47%
ULINE INC	2	0.47%
WERNER	2	0.47%
Other Companies With One Occurrence	175	41.37%

Table 10. (Continued)

The data show that close to 59% of the frustrated HAZMAT comes from 22% of the vendors. Additionally, 40% of the frustrated HAZMAT comes from 7% or 16 of the 225 vendors. The table eleven looks at the top six vendors that have provided 21.5% of the frustrated cargo at Dover AFB. Frustrated cargo coming from an Unknown source was grouped together and is also presented.

Table 11. Vendors Providing Frustrated HAZMAT Most Frequently

Frustrated Vendor HAZMAT Shipments 1 August through 31 November 2005			
Vendor	Frequency	% of Frustrated Cargo	Reason Frequency
TOTAL	128		
GSA	37	8.75%	37
No Shipping Papers/Declarations			8
Miscellaneous			9
Incorrect Certification			16
TCN			2
No 1502 Re-Icing, Frozen/Chilled			
Wrong Net Explosive Weight			
Packaging Incorrect or Damaged			2
UNKNOWN	29	6.86%	29
No Shipping Papers/Declarations			10
Miscellaneous			3
Incorrect Certification			4
TCN			11
No 1502 Re-Icing, Frozen/Chilled			
Wrong Net Explosive Weight			
Packaging Incorrect or Damaged			1
THE INSITU GROUP	23	5.44%	23
No Shipping Papers/Declarations			
Miscellaneous			
Incorrect Certification			23
TCN			
No 1502 Re-Icing, Frozen/Chilled			
Wrong Net Explosive Weight			
Packaging Incorrect or Damaged			
HONEYWELL	11	2.60%	11
No Shipping Papers/Declarations			1
Miscellaneous			
Incorrect Certification			
TCN			10
No 1502 Re-Icing, Frozen/Chilled			
Wrong Net Explosive Weight			
Packaging Incorrect or Damaged			
LOCKHEED MARTIN	10	2.36%	10
No Shipping Papers/Declarations			4
Miscellaneous			
Incorrect Certification			2
TCN			2
No 1502 Re-Icing, Frozen/Chilled			1
Wrong Net Explosive Weight			1
Packaging Incorrect or Damaged			

CUMMINS	10	2.36%	10
No Shipping Papers/Declarations			
Miscellaneous			1
Incorrect Certification			
TCN			9
No 1502 Re-Icing, Frozen/Chilled			
Wrong Net Explosive Weight			
Packaging Incorrect or Damaged			
UNIVERSAL PROPULSION	8	1.89%	8
No Shipping Papers/Declarations			8
Miscellaneous			
Incorrect Certification			
TCN			
No 1502 Re-Icing, Frozen/Chilled			
Wrong Net Explosive Weight			
Packaging Incorrect or Damaged			

Table 11. (Continued)

4.7.1 Investigative Question Five: Analysis

The last table illustrates the greatest significance when analyzing research question five. The data clearly appears to be independent with each vendor represented appearing to have very different problems leading to the HAZMAT cargo being frustrated. Bad TCN’s seem to be the most reoccurring reason. This was also shown in the first table. However, “No Shipping/Declarations” and “Incorrect Certification” are also seen in large frequency for specific vendors. These vendors each appear to have points of emphasis that could be reviewed to improve the particular problem.

An interesting finding is that the largest source of frustrated HAZMAT comes from the Government Service Administration (GSA) and represents 8.75% of all frustrated HAZMAT. It could be easily be argued that the largest source of frustrated HAZMAT comes from a vendor that should be most familiar with the HAZMAT cargo delivery requirements. To fully understand the significance, further analysis is required

to determine the overall percentage of HAZMAT that comes from GSA. This is one organization that should be familiar with government regulations set by The Department of Transportation.

Cargo coming from an “Unknown” source could mistakenly represent a control group for this study since no specific vendor could be identified. However, cargo coming from an Unknown source would have specific reasons for the frustration that directly relate to the vendor being undetermined. Specifically, if the vendor is unknown often times this would mean that the shipping papers could not be found to identify what company sent the cargo. The next section analyzes additional findings of the study and also compares data collected in this research to similar data collected by Ellison two years ago.

This data is analyzed into a statistical model that could better understand the validity of this model. A hypothesis test determined if vendors were most likely to have various reason for frustrated cargo or if the different vendors generally the same problems. A null hypothesis was tested (Kaziska, 2006)

H_0 : Vendor and reason for distressed shipment are independent; versus the alternative

H_a : Vendor and reason for distressed shipment are not independent.

The results of this analysis conducted by Kaziska proved to be significant and the entire results are published in Appendix B.

4.8 Additional Findings

Previous research showed what the largest problems were for frustrated cargo in 2004. This research is reviewed and compared to the most current data available in this

study. By comparing identical lengths of time from two different years, we can see if any differences exist. Data Table 12 below is from Ellison's research and shows what the most common reasons and frequency HAZMAT was frustrated at Dover AFB. This data was collected from 1 June to 17 July 2004.

Table 12. Frustrated Vendor HAZMAT Shipments 1 June - 17 July 2004
(Ellison, 2004)

Frustrated Vendor HAZMAT Shipments 1 June through 17 July 2004		
Reasons	# Shipments	% of Total
No Shipping Papers/Declarations	29	40.28%
Miscellaneous (MSDS, Info, PSN, Markings, etc.)	20	27.78%
Incorrect Certification	9	12.50%
TCN	5	6.94%
No 1502 Re-Icing, Frozen/Chilled	3	4.17%
Wrong Net Explosive Weight	3	4.17%
Packaging Incorrect or Damaged	3	4.17%
Total Frustrated HAZMAT Shipments	72	100.00%

These data are compared to the most current information provided by Dover AFB to see if differences exist. The first of the following three tables looks at the data for a four month period. Table 13 shows the most current data available and analyzes frustrated vendor HAZMAT from 1 August to 31 November 2005:

Table 13. Frustrated Vendor HAZMAT Shipments 1 August – 31 November 2005
(Eidson, 2006)

Frustrated Vendor HAZMAT Shipments 1 August through 31 November 2005		
Cause	# Shipments	% of Total
No Shipping Papers/Declarations	67	15.84%
Miscellaneous (MSDS, Info, PSN, Markings, etc.)	45	10.64%
Incorrect Certification	105	24.82%
TCN	191	45.15%
No 1502 Re-Icing, Frozen/Chilled	2	0.47%
Wrong Net Explosive Weight	7	1.65%
Packaging Incorrect or Damaged	6	1.42%
Total Frustrated HAZMAT Shipments	423	100.00%

Table 13 above looks at the most current data compiled during a four month period. Since the data in Ellison’s research looks at one and a half months of data or 46 days, this four month data set is broken down into two separate groups looking at identical lengths of time. The following table breaks down the four month data set into a similar comparison from 1 August to 16 September 2005 or 46 days:

Table 14. Frustrated Vendor HAZMAT Shipments 1 August - 16 September 2005
(Eidson 2006)

Frustrated Vendor HAZMAT Shipments 1 August through 16 September 2005		
Cause	# Shipments	% of Total
No Shipping Papers/Declarations	26	16.35%
Miscellaneous (MSDS, Info, PSN, Markings, etc.)	16	10.06%
Incorrect Certification	47	29.56%
TCN	60	37.74%
No 1502 Re-Icing, Frozen/Chilled	1	0.63%
Wrong Net Explosive Weight	6	3.77%
Packaging Incorrect or Damaged	3	1.89%
Total Frustrated HAZMAT Shipments	159	100.00%

A similar comparison is made for the same amount of time but with a different segment of data. The following table breaks down the four month data set into a similar 46 day comparison from 1 October to 16 November 2005.

**Table 15. Frustrated Vendor HAZMAT Shipments 1 October - 16 November 2005
(Eidson 2006)**

Frustrated Vendor HAZMAT Shipments 1 October through 16 November 2005		
Cause	# Shipments	% of Total
No Shipping Papers/Declarations	27	15.52%
Miscellaneous (MSDS, Info, PSN, Markings, etc.)	20	11.49%
Incorrect Certification	31	17.82%
TCN	92	52.87%
No 1502 Re-Icing, Frozen/Chilled	1	0.57%
Wrong Net Explosive Weight	1	0.57%
Packaging Incorrect or Damaged	2	1.15%
Total Frustrated HAZMAT Shipments	174	100.00%

Comparing the total frustrated HAZMAT shipments in Table 14. and Table 15. to the data presented by Ellison in Table 12, the initial indication is that frustrated HAZMAT is a growing problem. Comparing Table 12 to 14 shows a 121% increase in the total frustrated cargo. Comparing Table 12 to 15, shows a 142% increase in the total frustrated cargo. The explanation by the chief of customer service at Dover AFB once again offers the explanation that a surge occurs in the middle of October through November before going back down before the holidays. (Eidson, 2006)

This would indicate that the fiscal year budget and the lack of timely TAC code updates are causing a strain on the Dover AFB transportation system which causes

frustration. A complete set of data for the entire fiscal year would need to be compiled for a more accurate understanding and study of this potential problem. Analyzing frustrated HAZMAT data from all 12 months would be the only way to confirm these findings and that data was not made available when requested since the detailed records provided have just been collected since 1 August through 31 November 2005.

Since HAZMAT requires such precise packaging, labeling and paperwork requirement, the lack of communication between everyone involved appears to be the leading cause of the delivery delay. As the first research question indicated, no standard relationship or communication process exists between the vendor and the APOE. The data collected at Dover AFB is not an Air Force requirement and they are compiling this data on their own. Similar data at Charleston AFB is available but it is currently not compiled in a format that can be easily analyzed. In either case, no one is standardizing the data between locations or scrutinizing the information in such a way so that vendors and depots could be looked at closer to see if an increasing trend or on going problem exists.

In Chapter Three, the research looked at the current system that cargo delivery and communication is being conducted. The units or users in deployed locations are ordering the cargo. The vendor is sending the cargo to the APOE and the APOE is frustrating any cargo with problems or sending it back to the vendor to be fixed. By looking at the cargo coming from these supply sources, a communication bridge can be created between the APOE and the supplier. This bridge could be established and required by both the APOEs and the vendors who provide cargo. Figure 4 below shows

this proposed communication bridge and represents a better alternative to the current system shown in Figure 2.

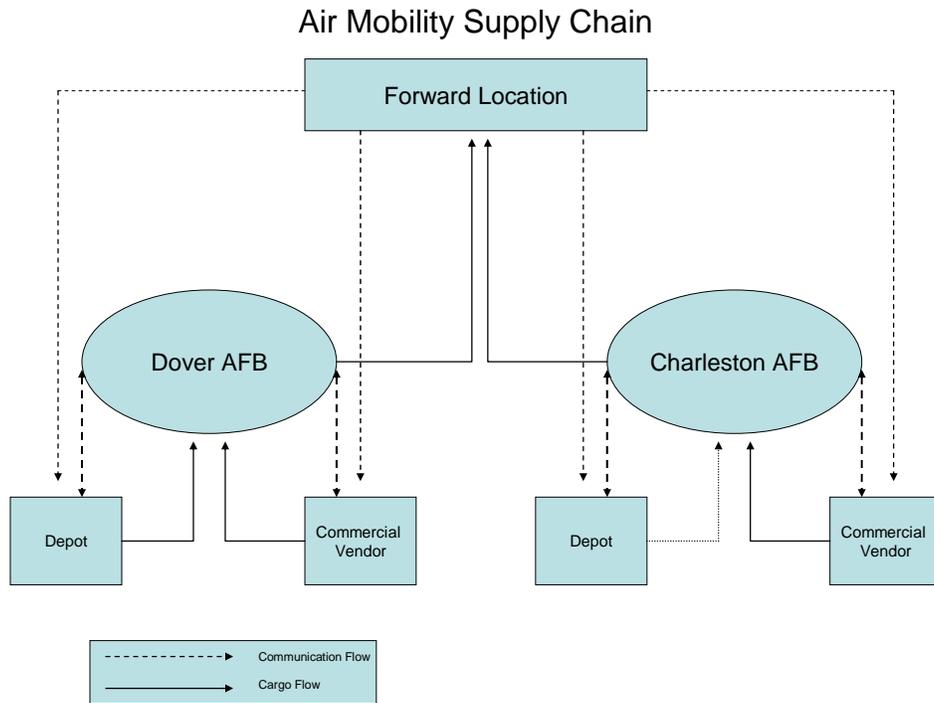


Figure 4. Improved Air Mobility Supply Chain

As mentioned earlier in the chapter, over two dozen depots all over the country are sources of cargo that come through Dover and Charleston AFB. (Eidson, 2006) In the case of Dover AFB, these depots are major sources of cargo that support the channel missions destined for Baghdad, Iraq to support our troops. When frustrated HAZMAT sourced from depots is compared to frustrated HAZMAT sourced from vendors, a drastic difference is observed. Table 16 and 17 below shows the entire depot frustrated occurrences at Dover and Charleston AFB compared to all of the vendor frustrated occurrences at Dover AFB.

**Table 16. Percentage of Depot Frustrated Occurrences: Dover and Charleston AFB
(Eidson 2006)**

Percentage of Depot Frustrated Occurrences: Dover and Charleston Air Force Base		
Reason	Percent	Number
Incorrect Certification	30.43%	28.00
Miscellaneous (MSDS, Info, PSN, Markings, etc.)	29.35%	27.00
No Shipping Papers/Declarations	19.57%	18.00
Not Regulated	16.30%	15.00
Packaging Incorrect or Damaged	4.35%	4.00
Total	100.00%	92.00

Table 17. Percentage of Vendor Frustrated Occurrences: Dover AFB (Eidson 2006)

Percentage of Vendor Frustrated Cargo Occurrences: Dover Air Force Base		
Reason	Percent	Number
TCN	45.15%	191
Incorrect Certification	26.48%	112
No Shipping Papers/Declarations	15.84%	67
Miscellaneous (MSDS, Info, PSN, Markings, etc.)	11.11%	47
Packaging Incorrect or Damaged	1.42%	6
Total	100.00%	423

With 45% of the frustrated HAZMAT being caused by TCN, a clear problem exists with TCN errors from vendors. As mentioned before, this could be an incorrect TCN, a missing TCN or the TCN being used with the wrong cargo. This is 191 pieces of frustrated HAZMAT in four months that could be avoided if the vendor could be

educated on how to use a TCN properly or know not to ship an item until a TCN has been established.

4.9 Summary

In summary, the research demonstrates many different approaches to analyzing problems that have no easy solutions. The importance of resolving frustrated HAZMAT problems properly and as fast as possible could not be over emphasized. However, the different variables and factors slowing down the delivery process are extremely complex. This analysis is not an attempt to highlight one cause of concern or emphasize any particular problem as the main hold up in the HAZMAT delivery process. The emphasis of this research is to identify causes of concern and analyze the problem in a way that has not been looked at before. Additionally, the research looked closely at some possible solutions that could be expanded on in the future. Simply put, if we could get all of DoD vendors and APOEs communicating and working the delivery of HAZMAT the same way, the problems could be better defined and clearer solutions could be identified. By highlighting many causes and sources of frustrated HAZMAT, further research can work toward fixing the problem areas. The next chapter looks at some of these opportunities for further research, and makes final conclusions about this research effort.

V. Conclusions and Recommendations

5.1 Chapter Overview

This chapter summarizes the research and analysis conducted in this thesis. It answers the research question through the investigative questions and makes recommendations for action. Finally, suggestions for further research efforts are offered to better understand and improve the time delays of frustrated HAZMAT within the supply chain.

5.2 Research Summary

This research set out to answer the following question: **What are the current reasons for frustrated cargo at Dover and Charleston AFBs and what improvements can be made to the HAZMAT delivery process that will allow cargo to move faster and cheaper on departing inter-theater aircraft?**

Five investigative questions followed to fully address the different factors of this issue. To answer the main problem of this research, the following investigative questions have been formulated for this study. *What are the major differences between the Customer Service Operations at Dover and Charleston AFB and how do these differences affect the transport of HAZMAT? What are common causes for depot HAZMAT frustrated cargo at Charleston and Dover AFB? What is the average time delay for Depot HAZMAT frustrated cargo? What trend is observed from the frustrated HAZMAT performance metric at Charleston AFB and Dover AFB? What trends can be identified when cross referencing reasons for frustrated HAZMAT and the vendor who supplied the*

cargo? What reasons primarily cause HAZMAT to be frustrated? What commercial vendors have the most occurrences of frustrated HAZMAT? In addition to these investigative questions, this research also looked at how the current results compare to the data collected by Ellison in 2004. Difference between current data and Ellison's data are identified and where possible the causes are also identified.

5.3 Findings

It appears that the greatest opportunity to improve the HAZMAT frustration delivery process is to continue to analyze and improve the existing process. One of the greatest pieces of information that the researcher learned in the Air Force Institute of Technology Logistics Management Program is that the entire Supply Chain pipeline is never perfect and opportunities for improvement always exist. The Customer Service Sections that manage the HAZMAT frustration problem are the only point of contact with the vendors and with the depot. Each of these sections is working as separate organizations and representatives for their respective APOE. Customer Service Section is practicing the best business practices as they see it and as they have determined it should be. Just by looking at the different practice of fixing a frustrated piece of HAZMAT at one location verses sending it back to the vendor or depot at another can appear to be a small detail. However, each one of these sections is making dramatic decisions that determine what everyone in the respective supply chain must assimilate too. This one seemingly minor decision could determine how every vendor must adjust their standard requirements. The unknowing soldier in the field would certainly know the difference based on how long it took to get their cargo.

Dover AFB had detailed records consisting of vendors that provided frustrated HAZMAT. Although unanalyzed, this offered the researcher an opportunity to find out what vendors are most responsible for frustrated HAZMAT and had the most room for improvement. This data only existed however, because of documentation that went above any standard requirement set by the Air Force. The data that was collected was most useful for Investigative Question. Investigative questions that showed comparisons to Ellisons research, trends in frustrated HAZMAT or numbers and percentages of frustrated items, have proven to be inconclusive in some cases, due to the wide gaps in cargo delivery numbers during the year. Trends need to be compared for years at a time comparing the same months for each year. This data should also be compared during times of national crisis and times of peace during periods when similar amounts of cargo are being processed. Therefore, this portion of the research started an opportunity that could be continued so that more data could be collected and a better understanding of the problems could be achieved.

HAZMAT packaging requirements are different for ground transportation versus the more restrictive air transportation. If the Air Force and government could place more restrictive requirements on the vendors who ship by ground, HAZMAT could be delivered to the war fighter from the APOEs quicker and cheaper. The vendors should not be allowed to do business with the Air Force and DoD organizations unless they comply with the very restrictive delivery and paper work requirements of air transportation. Since HAZMAT is such a critical and restrictive item, a Department of Defense (DoD) issued HAZMAT certification could be required by all vendors before commerce is authorized. This certification would require the proper training be in place

for vendors that wish to do business with the United States military and DoD. This training could educate on paperwork requirements such as TCN and the GPC program. The current method that exists is in the form of a policy letter and appears to serve as an advisory letter. No standard exists in the Air Force to determine the best business practice between APOEs. The memorandum is not setting a standard or requirement for depots and commercial carriers to follow.

The Traffic Management Office (TMO) at each base has a list of certified/approved house hold goods transportation companies. These companies have met the standard and are provided the expectations that must be met for them to continue serving the government house hold good moving requirement. When violations to the newly established requirement are determined, they are documented and recorded. This documentation provides input into a track record or score that becomes a service record or reputation for the vendor. If the service record has too many violations, these companies can be suspended or permanently removed from the list. The opportunity to do businesses with the US government should be a privilege. If this standard already exists for moving military members during relocations, a similar standard Air Force wide should be in place for moving precious HAZMAT to the war fighters overseas.

5.5 Recommendations for Future Research

Future research can take on a number of different directions. The research can be duplicated to APOEs on the west coast such as Travis and McCord AFB and see if similar results exist. The research could expect to see a number of different vendors and

different types of cargo. If the communication problems exist between the suppliers and APOEs on the east coast, then it would be fairly safe to assume that this problem exists on the west coast as well.

At each major APOE, Dover, Charleston, Travis and McCord, interviews and discussions with specifically flagged depots and vendors could be conducted. This revolutionary communication bridge could be used to discuss opportunities for improvement directly with the source of our war fighting materials. Since this research identified problems that exist, the vendors could be asked about potential for change to fix the repeated problems. It could also open up an opportunity to receive input from the various suppliers. For vendors who continue to not comply, research could be done to see if alternative sources of the item can be found at a cheaper price. If commercial vendors are identified as unable or unwilling to change the packaging, delivery method or price, a better source of supply could be found.

As suggested in the previous section, a standard business practice and expectations could be established DoD wide. Some measure or standard for expectations needs to be applied to all of the APOEs. Having each aerial port conducting business how ever they see fit, is a wasted opportunity. Each location could share what works and a standard could be established Air Force Wide.

5.6 Conclusion

Our troops fighting in combat are useless without the proper tools to do their job. Businesses have learned decades ago how to maximize their profit through a stream lined supply chain management process. They are using technology and innovative ways of

thinking to help move goods quicker and cheaper. Fed Ex and UPS are innovative leaders in the transportation business. The importance of our transportation mission should make that level of cargo delivery the absolute minimum standard. DoD and Air Mobility Command should find ways to far exceed that standard. The difference between our job and these major corporations is that we do not make a profit and no direct motivators for personal gain exist. The lives we save or the wars we win are not readily apparent to the members responsible for moving this critical equipment. Therefore, the maximized potential is not achieved.

The standard and requirements must start at the top. Leadership must require our APOEs and vendors to learn from each other and implement a standard requirement for everyone to follow. Only by standardizing the best solutions to the problem of HAZMAT cargo delivery, can the highest levels of capability be achieved.

Appendix A: Acronyms

Acronym	Description
ADUSD (TP)	Assistant Deputy Under Secretary of Defense for Transportation Policy
AFMAN	Air Force Manual
AMC	Air Mobility Command
AMC-DDC-	Air Mobility Command-Defense Distribution Center Air Cargo
ACC IPT	Consolidation Integrated Process Team
APM	Active Performance Management
APOE	Aerial Port of Embarkation
APS	Advanced Planning System
CCN	Carton Control Number
CIO	Chief Information Officer
COP	Common Operating Picture
COTS	Commercial-Off-The-Shelf
DAA	Designated Approval Authority
DAASC	Defense Automatic Addressing System Center
DDC	Defense Distribution Center
DDRV	Defense Distribution Depot Richmond Virginia
DFWG	Distribution Focused Working Group
DITSCAP	DoD Information Technology Certification and Accreditation Process
DLA	Defense Logistics Agency
DODAAC	DoD Activity Address Codes
DoDAAF	Defense Activity Address File
DPO	Distribution Process Owner
DSCR	Defense Supply Center Richmond
DSS	Distribution Standard System
DVD	Direct Vendor Delivery
DVD IPT	Direct Vendor Delivery Integrated Process Team
EIDE	Enterprise Integrated Data Environment
EIS	Executive Information System
ERP	Enterprise Resource Planning Systems
GATES	Global Air Terminal Execution System
GPC	Government Purchase Cards
GSA	General Services Administration
HTTP	Hyper Text Transfer Protocol
IATO	Interim Approval to Operate
IDE	Integrated Data Environment

IPT Integrated Process Team

Acronym	Description
ITV	Intransit Visibility
JCS	Joint Chief of Staff
JDPO	Joint Deployment Process Owner
JFCOM	Joint Forces Command
MOA	Memorandum of Agreement
MRO	Material Requisition Order
OCONUS	Outside the Continental United States
OSD	Office of the Secretary of Defense
SAMMS	Standard Automated Material Management System
SCEM	Supply Chain Event Management
SQL	Standard Query Language
SSAA	System Security Authorization Agreement
TCMD	Transportation Control and Movement Document
TCN	Transportation Control Number
TFM	Trusted Facility Manuals
USTC JDDA	US Transportation Command Joint Deployment and Distribution Architecture
USTRANSCOM	United States Transportation Command

Appendix II: Chi Square Analysis (Kaziska, 2006)

To perform a formal hypothesis test indicating whether various vendors tended to have different reasons resulting in distressed shipments, we performed a chi square test of independence. We tested the null hypothesis

H_0 : Vendor and reason for distressed shipment are independent; versus the alternative
 H_a : Vendor and reason for distressed shipment are not independent.

We begin with a brief introduction to the chi square test. A more detailed explanation is available in Box, Hunter, Hunter, *Statistics for Experimenters*, John Wiley and Sons, Inc. (1978), or on the National Institute of Standards and Technology (NIST) website at <http://www.itl.nist.gov/div898/handbook/prc/section4/prc45.htm>.

The idea of the chi square test as implemented in this problem is that if the reasons for distressed shipments were independent of vendor, then the reasons would occur with approximately equal proportions for each vendor. The test is conducted by constructing a table whose rows list the reasons for distressed shipments and whose columns list the vendors. Then the (i, j)-th cell of the table indicated the number of time a distressed shipment occurred from the j-th vendor, with the i-th reason.

The observed count O_{ij} , in the (i, j)-th cell is compared to the expected number E_{ij} . The expected cell count in the (i, j)-th is

$$E_{ij} = \frac{R_i C_j}{N}$$

where R_i is the total number of times the i-th reason occurred and C_j is the total number of distressed shipments by the j-th vendor. The chi square test statistic is then

$$\chi^2 = \sum_{i,j} \frac{(E_{ij} - O_{ij})^2}{E_{ij}} \quad (1)$$

where E_{ij} is the expected cell count in the (i, j)-th cell and O_{ij} is the observed cell count in the (i, j)-th cell. A large value of this test statistic indicates a large difference between the observed and expected cell counts, which gives evidence that the rows and column are not independent. Under the null hypothesis, and statistical assumptions of a random sample, the test statistic has a chi square distribution with (r-1)(c-1) degrees of freedom, where r is the number of rows in the table and c is the number of columns in the table.

This analysis was limited to the four most prolific shippers plus the packages whose shippers were unknown; and to the four most common reasons (1. No Shipping Papers/Declaration; 2. Miscellaneous; 3. Incorrect Certification; 4. TCN). Limiting the

hypothesis test to these shippers and these four reasons was necessary to get adequate sample size for this chi square test. A table was constructed with these vendors in the columns and the reasons in the rows. In each cell of the table, the number of times each vendor had a distressed shipment due to each reason is indicated. The chi square test was conducted on this table of data. Following is the table:

Reasons	Vendors				
	GSA	UNKNOWN	INSITU	HONEYWELL	CUMMINS
No Shipping Papers/Declarations	8	10	0	1	4
Miscellaneous	9	3	0	0	0
Incorrect Certification	16	4	23	0	2
TCN	2	11	0	10	2

The Minitab output indicating the result of this test is as follows:

Chi-Square Test: GSA, Unknown, Institu, Honeywell, Cummins

Expected counts are printed below observed counts
 Chi-Square contributions are printed below expected counts

	GSA	Unknown	Institu	Honeywell	Cummins	Total
1	8	10	0	1	0	19
	6.21	4.97	4.08	1.95	1.78	
	0.513	5.085	4.084	0.465	1.776	
2	9	3	0	0	1	13
	4.25	3.40	2.79	1.34	1.21	
	5.301	0.047	2.794	1.336	0.038	
3	16	4	23	0	0	43
	14.07	11.25	9.24	4.42	4.02	
	0.266	4.674	20.476	4.421	4.019	
4	2	11	0	10	9	32
	10.47	8.37	6.88	3.29	2.99	
	6.849	0.824	6.879	13.687	12.075	
Total	35	28	23	11	10	107

Chi-Sq = 95.609, DF = 12, P-Value = 0.000
 13 cells with expected counts less than 5.

The conclusion for the hypothesis test comes from the chi square test statistic of 95.609, which produces a level of significance of 0 (to three decimal places). We reject the null hypothesis, and we have strong evidence that the vendor and the reason for distressed shipments are not independent.

Furthermore, this output aids in interpretation of the data, giving an indication of why the two variable were found not to be independent. In each cell, there are three numbers shown: The actual cell count, the expected cell count, and the contribution of the cell to

the chi square statistic. Large deviation between the actual and expected cell counts indicate that there is a large difference between the expected cell count and the actual count. In this context, a large contribution to the chi square statistic means a large difference between the expected and observed cell count.

For example, for the vendor Cummins and reason #4 (TCN), the three numbers shown are

9
2.99
12.075

The number 9 indicates the actual cell count, that is, 9 shipments from Cummins had problems with the TCN, as compared to the expected number of 2.99 in the second row. The number 12.075 is the contribution of this cell to the test statistic in Eq. (1). This cell was the largest contributor to the test statistic so it had great impact in affecting the conclusion to the hypothesis test. Additional interpretation of the large contributors to the chi square statistic can be undertaken to understand the dependence between the variables of vendor and reason.

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Vita

Captain Neil Eric Christensen graduated from Fork Union Military Academy High School in Fork Union Virginia. He entered undergraduate studies at George Mason University in Fairfax, Virginia where he graduated with a Bachelor of Science degree in Criminal Justice in August 1999. He was commissioned through the Detachment 330 AFROTC at the University of Maryland where he was nominated with a Regular Commission.

His first assignment was at Langley AFB and was assigned to the 1st Transportation Squadron and was the Traffic Management Officer. From November 2001 to August 2004, he was assigned to the 721st Air Mobility Operations Squadron, McGuire AFB, New Jersey where he served as an Operations and Aerial Port officer. While stationed at McGuire, he deployed overseas as a member of a Tanker Airlift Control Element, establishing or maintaining Air Mobility Operations capability in Jordan, Saudi Arabia, Kuwait, Germany and Iraq as an Operations and Aerial Port officer. In August 2004, he entered the Graduate School of Engineering and Management, Air Force Institute of Technology. Upon graduation, he will receive his Master's Degree in Logistics Management and be assigned to Air Mobility Headquarters, Scott Air Force Base, Illinois.

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Research Impact Statement

Student N.E. Christensen	Faculty Advisor Bell, J	Thesis Designator AFIT/GLM/ENS/06-02	Keyword #1	Keyword #2
Sponsor	Agent	Phone	Program	Funding
Related Thesis #1	Related Thesis #2	Related Thesis #3	Related Thesis #4	

Title: Hazardous Material Cargo Frustration at Military Aerial Ports of Embarkation

Subject: HAZMAT delivery through Aerial Ports of Embarkation

Air Force Program Description:

Since military units often require critical hazardous materials in an expedited manner, identifying choke points within the supply chain is necessary to improve logistic support to front line forces. Hazardous materials are some of the most critical assets for the war fighter, as well as the most restrictive and often most time consuming for transportation.

Impact Statement:

This research quantifies the extent that vendor and depot supplied cargo is being delayed at Aerial Ports of Embarkation. By looking at frustrated hazardous material at Charleston Air Force Base, South Carolina and Dover Air Force Base, Delaware, a case study methodology is used to determine the top causes of frustrated HAZMAT cargo, the average time shipments were frustrated and determines the vendor these shipments are coming from. Data include documented frustrated cargo over a four month period in 2005 at Dover and Charleston Air Force Base and highlights trends. The results and analysis of this research compare the frustrated cargo record at these bases as well as pin pointing specific trends from the vendors that provide the cargo.

Subject Terms:

Hazardous Material (HAZMAT), Aerial Ports of Embarkation (APOE), Frustration