# Notes and Comments

JILL L. MAYNARD
JOHN E. BELL
ALAN W. JOHNSON

# Frustrated Hazardous Material: Military and Commercial Training Implications

The U.S. Air Force's Air Mobility Command has been investigating the efficiency of its cargo movements for decades. In response to worldwide deployments, the movement of hazardous materials (HAZMAT)—a category of material that ranges from simple cleaning solutions to the most dangerous munitions—has increased. HAZMAT cargo provided by commercial firms and destined for overseas military installations often arrives at Aerial Ports of Embarkation (APOE) in the U.S., where they are accepted for shipment through the Defense Transportation System (DTS), or become "frustrated." Frustrated items include those shipments arriving at APOEs with missing documentation, incorrect labels, damage, or incorrect packaging (Ellison 2004; Christensen 2006). These frustrated items are delayed until the commercial firm responsible for the shipment can fix the frustration causes. Since almost every function within the military relies on HAZMAT to complete its mission, an increase in frustration levels at APOEs hinders the effectiveness of deployed troops overseas. In recent years, as the military has increasingly relied on commercial sourcing and shippers, its role in APOE frustration levels has become even more of an issue for the Air Force. This study takes a direct look at the training and procedures used by commercial shipping companies as they ship HAZMAT to the Air Force's aerial ports.

U.S. federal regulations and international guidelines that govern HAZMAT shipments—both through the DTS and via commercial shippers—are available to the public and are constantly updated and published by the U.S. Department of Transportation (CFR 49 2006, Labelmaster 2006). In accordance with these regulations, HAZMAT shipments entered into the DTS require a trained and certified shipper, proper packaging, and proper documentation upon arrival at the APOE. In 2003, new military policy established a set of business rules for suppliers shipping cargo through the DTS (Wynne 2003). The policy's intent was to reduce frustration levels at APOEs and ensure on-time delivery of cargo. Unfortunately, frustration levels have not decreased in the few years since the policy was established, suggesting that further changes in either procedure or policy may be needed. The purpose of this research was to help address this problem by examining whether shipper training procedures might be impacting frustration levels at APOEs.

*Ms. Maynard, SM-AST&L, is graduate research assistant, Capt USAF, Air Force Institute of Technology, Wright-Patterson AFB, Ohio 45433. Mr. Bell, EM-AST&L, is LtCol USAF and adjunct professor of logistics management, Georgia College and State University, Milledgeville, Georgia 31061. Mr. Johnson is associate professor of logistics management, Air Force Institute of Technology, Wright-Patterson AFB.*
*The views expressed are those of the authors and do not represent the official policy or positions of the United States Air Force, Department of Defense, or the U.S. Government.*

## Previous Research

The literature related to HAZMAT transportation is primarily limited to safety (Mejza et al. 2003, Sweet 2006), optimal routing studies (Revelle et al. 1991, Erkhut and Verter 1995, Zhang et al. 2000), and, more recently, studies on security and supply chain disruptions (Sheffi 2001, Russell and Saldanha 2003,

# Report Documentation Page

*Form Approved*
*OMB No. 0704-0188*



| 1. REPORT DATE | 2. REPORT TYPE | 3. DATES COVERED |
|---|---|---|
| **2008** | | **00-00-2008 to 00-00-2008** |

| 4. TITLE AND SUBTITLE | 5a. CONTRACT NUMBER |
|---|---|
| **Frustrated Hazardous Material: Military and Commercial Training Implications** | 5b. GRANT NUMBER |
| | 5c. PROGRAM ELEMENT NUMBER |
| 6. AUTHOR(S) | 5d. PROJECT NUMBER |
| | 5e. TASK NUMBER |
| | 5f. WORK UNIT NUMBER |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **USAF, Air Force Institute of Technology,Wright-Patterson AFB,OH,45433** | 8. PERFORMING ORGANIZATION REPORT NUMBER |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) | 10. SPONSOR/MONITOR'S ACRONYM(S) |
| | 11. SPONSOR/MONITOR'S REPORT NUMBER(S) |

12. DISTRIBUTION/AVAILABILITY STATEMENT
**Approved for public release; distribution unlimited**

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

| 16. SECURITY CLASSIFICATION OF: | | | 17. LIMITATION OF ABSTRACT | 18. NUMBER OF PAGES | 19a. NAME OF RESPONSIBLE PERSON |
|---|---|---|---|---|---|
| a. REPORT **unclassified** | b. ABSTRACT **unclassified** | c. THIS PAGE **unclassified** | **Same as Report (SAR)** | **14** | |

Kleindorfer and Saad 2005). Also, rail transportation has specifically been an area of research interest for chemical and HAZMAT transportation (Young et al. 2002, Closs et al. 2003). However, only one study could be found on the hazardous materials training differences by shippers (Rothwell et al. 2002) and no known work has looked at the occurrence and causes of frustrated HAZMAT shipments in the Defense Transportation System. Therefore, with funding from the Air Force Institute of Technology, a line of research was begun in 2004 to investigate frustrated HAZMAT shipments in the DTS. In the initial study, Ellison tracked the impact of the Government Purchase Card program on frustration levels, identifying a lack of communication between the military members ordering the items and the civilian shipper about DTS transportation requirements (Ellison 2004). Next, Christensen sought to identify the main reasons for frustration at Charleston and Dover Air Force Bases and to compare cargo frustration procedures at the two locations (Christensen 2006). He noted that the respective military customer services sections had different management styles for handling frustrated hazardous cargo. One would fully require the shipper to fix all problems, while the other would actually make minor corrections after speaking to the shipper to expedite the process (Christensen 2006). Additionally, Christiansen's research noted that both military and commercial shippers were the source of frustrated HAZMAT at the aerial ports; however, the reasons for frustration varied, with the military shippers' causes being mostly "Missing Documentation" and "Incorrect Regulation References," and civilian shippers' reasons being mostly "Incorrect Certifications" and lacking the shipment "Transportation Control Number" (TCN). These findings seem in contrast to the findings of Rothwell et al. (2002), who found no significant difference in the knowledge of military verses civilian HAZMAT shippers.

Though limited research previously investigated the effects of a shipper's training program on its customers, there is significant research on training effectiveness. Kirkpatrick's 1959 four-level model evaluated Reaction, Learning, Behavior, and Results components to assess the effectiveness of training or teaching programs (Kirkpatrick 1996). Additionally, a recent study has shown that unless a company's training program is aligned with its departments' goals, the training is a waste of employee time and company money (Clark and Kwinn 2005). Researchers developed seven routes through which companies can ensure effective training programs, each of which highlights the importance of direct contact between the training manager and the company's upper and departmental management. Understanding a company's needs ensures that employees acquire the necessary training to meet the company's goals (Clark and Kwinn 2005).

In addition to choosing appropriate training programs, it is important to ensure the provided information is retained. In 1992, Ford and his colleagues investigated how students retained information, and found that retention was affected by the number of opportunities a student had to perform the learned activity and the activity's level of difficulty (Ford et al. 1992). They also concluded that task performance requires both knowledge and a level of self-efficacy (Ford et al. 1992). Thus, while a training program may be adequate, resulting performance may not be (Ford et al. 1992).

## Methodology

This research investigated how commercial shippers train their employees to ship HAZMAT through the military and commercial airlift systems, with the goal of determining whether training practices at commercial hazardous material shippers affect frustration levels at APOEs. There are numerous hazardous material shippers within the United States; therefore, a multiple case study method was used to develop logic replication and provide more meaningful findings (Yin 2003). The first step in the case study methodology (Creswell 1994; Yin 2003) was to develop a list of questions and standards of comparison that would be used to draw the individual cases into a cohesive framework. We formulated two research questions to address this first stage of the case study process, and addressed them by researching commercial and military regulations, including international guidelines from the Department of Transportation, Department of Defense, United Nations, and other international organizations. These two research questions are as follows:

**Table 1. Factor-Level Explanations**

| Factors | Levels | |
|---|---|---|
| Number of Employees | Large > 100 | Small < 100 |
| Company Volume | Large > 100 | Small < 100 |
| Training Program | Internal | External |

1. What significant differences exist in the way military and commercial shipper personnel are trained on how to ship hazardous cargo?
2. What are the training requirements for commercial shippers to ship within the defense transportation system?

The data collected during this portion of the study, summarizing the regulations that govern how HAZMAT items are shipped via the DTS, were used as baseline requirements for the ideal training program, and to develop a comparative checklist for data collection.

Our second step in the multiple case study methodology was to compile and organize a pool of shipper companies for analysis. We obtained a list of 100 shippers that had at least one piece of HAZMAT frustrated at either Charleston Air Force Base, SC or Dover Air Force Base, DE between August 2005 and August 2006 (Eidsun 2006, Simmons 2006). This list provided data on the number and type of frustrations recorded for each firm. The shippers were organized into a $2^3$ factorial experiment design, categorizing them by size, volume, and training method, as shown in Table 1.

The final step in our multiple case study was to select shippers for interviews and collect data for analysis and comparison. We used two additional research questions to guide data collection and analysis, in accordance with the baseline training program requirements established from research questions 1 and 2:

3. What standardized guidelines (instructions or checklists) are established for the shipper for completing the shipping documentation prior to shipping to the military APOEs?
4. If not standardized, how would establishing better guidelines for military and/or commercial hazardous cargo training reduce documentation frustration levels at the APOEs?

We collected the data through telephone interviews with the training managers at qualifying shipper companies using a standardized list of questions developed from the comparative checklist. We also used the interviews to elicit each shipper's overall approach to training. Data included training methods, unique characteristics used to keep employees informed, and the interaction between the shippers and the APOE Customer Service Sections.

For this research, we assigned an alphabetic code to the interviewed shippers to maintain anonymity. After the interviews were completed, we realigned the shippers with their frustration habits for further analysis and to draw conclusions about each shipper's training practices. We compared each shipper's program to the Department of Defense standards and then against each other. The shipper training programs were evaluated by type along with their ability to comply with Department of Defense and Department of Transportation standards. Our cross-sectional analysis of the cases investigated common areas of deficiency and identified best practices.

In exploratory case study research, construct validity, external validity, and reliability are critical to the production of factual results (Yin 2003). We developed construct validity by working with subject matter experts and technical advisors. We established external validity by using currently operating shippers that have shipped HAZMAT to APOEs within the last year. Reliability, which allows subsequent researchers to use the same tactics as prior investigators to reproduce the same case study, was achieved by using simple, thoroughly documented procedures that could be replicated with proper approval. We believe the results are generalizable to other military APOEs since the list contained 100 shippers across the United States, which reflects a broad sample of those shipping to the APOEs.

The scope of the research is limited to shipper companies that have shipped frustrated HAZMAT through either Charleston or Dover Air Force Base within 2005–2006, excluding other APOEs. Only shipper names, number of frustrated items, and reasons for frustration were available to the study. It was assumed that each shipper appearing on the list with frustrated cargo during the research time period shipped at least one piece of frustrated HAZMAT through an APOE annually. An extended research time period could reveal that a shipper's effectiveness over several years is greater than indicated in this one-year study. Additionally, shippers have the option of sending employees to a government-conducted HAZMAT training program. Our study was limited in scope to the evaluation of the shipper's training plan, and did not address the training plans of any government training facilities. Our objective was to ensure that the shipper was obtaining the required training for its employees.

Other research limitations arose in the interview process. We used telephone interviews due to budget and time constraints, while on-site interviews may have provided greater insight and more opportunity for collecting secondary data. Another limitation was confirming that we indeed spoke to the most knowledgeable HAZMAT training manager, and it had to be assumed that all statistics and data provided by the interviewee were accurate. Our interviews also revealed that the listed data provided by the APOEs, while assumed to be current and accurate, might have also included rare instances where paperwork was correct but the cargo was accidentally frustrated. We made every attempt to verify that the shippers interviewed had actually incurred legitimate HAZMAT shipment frustrations.

## Hazardous Materials Procedures

Commercial shippers and government agencies abide by numerous HAZMAT regulations depending on the affected government agency and mode of transportation. Since our research focused on the transport of hazardous materials to overseas locations via military airlift, we investigated the training requirements for the movement of HAZMAT by air.

### Department of Transportation

The Department of Transportation has established the Code of Federal Regulations (CFR) Title 49, Subpart H, Part 172, for U.S. hazardous materials training requirements (CFR 49 2006). Under this regulation, the material shipper is responsible for training its employees in their respective areas of hazardous materials. The shipper has the option to train employees in-house or send them to an external program; however, it is ultimately the shipper's responsibility to ensure that its employees meet training standards (CFR 49 2006).

The U.S. Department of Transportation Web site provides links to firms qualified to provide external training. These firms provide a wide range of services and can be divided into two categories: location or in-house training. Location training requires shippers to send employees to a training facility. The Department of Transportation also sponsors classes at the Transportation Safety Institute, located in Oklahoma City, OK, which provides initial and refresher training courses. The courses span three days, with an optional fourth day that focuses on military airlift requirements (Kramer 2006). In-house training is conducted by a hired professional at the shipper's location. The hired professional uses their own training program to train the shipper's employees to the requested specifications.

Shipper employees can also receive internal HAZMAT transportation training provided by their respective company. Instructors work for the shipper and teach from an established training program. The instructor does not need to attend formal training classes; however, it is common for instructors to have attended an external training class (Kramer 2006). Another option is to procure a training plan through an external training firm. Several external training firms sell computer-based programs and videos to train shipper employees, such as *LabelMaster* and *SafetyVideoDirect*. These materials allow shippers the flexibility to train employees professionally without incurring added personnel costs (Labelmaster 2006, Safety).

Shippers that ship hazardous materials through the DTS must also be trained on duties related to military air transportation (AFMAN 24-204 2004). Additionally, the training must

support the business rules set forth by the Under Secretary of Defense (Wynne 2003).

### Department of Defense

The Department of Defense provides HAZMAT training to military personnel and defense civilian employees at five designated sites. The training requirements are agreed upon in the Interservice Training Review Organization Task Group on Hazardous Materials Training Memorandum of Understanding (AFMAN 24-204 2004). The same training plan is used at each location to ensure cohesiveness throughout the different military branches. Certifying officials, those responsible for ensuring documentation and packaging is correct prior to shipment, represent the standard to how the shipper's employees should be trained. The Department of Defense recognizes three types of certifying officials (AFMAN 24-204 2004):

*Preparers* – employees trained on all HAZMAT, allowing them to review and sign HAZMAT documentation prior to an item being accepted into the DTS. They are the overall trainer for personnel at their installation.

*Technical Specialists* - These people certify only the hazardous materials they are qualified to maintain. They are trained by a preparer and identified by the Commander to represent a particular unit. Technical specialists can certify materials only for tactical/contingency operations and routine cargo movement.

*Medical Personnel* – People that handle and ship laboratory samples and specimens. Available only to them, the associated course encompasses all modes of transport.

The three types of certifiers work together to ensure that personnel handling, packaging, and shipping hazardous materials are familiar with requirements. The individuals that certify hazardous materials are typically rotated in and out of the position; however, their training is specifically intended to prepare them for this duty.

### International Civil Aviation Organization (ICAO)

ICAO is comprised of delegated members that develop standards of international air navigation and encourage planning and development of future endeavors (Wells and Wensveen 2004). Additionally, ICAO agrees upon shipping standards and practices involving HAZMAT. These guidelines are updated yearly and published in *Technical Instruction for the Safe Transport of Dangerous Goods by Air* (ICAO 2006).

### International Air Transportation Association (IATA)

IATA members are nominated by individual airlines and are governed by an elected executive committee (Wells and Wensveen 2004). IATA publishes the *Dangerous Goods Regulations* yearly. This publication outlines the requirements and procedures for companies shipping hazardous items (IATA 2005).

### Training Requirements

The different governing agencies have a wide spectrum of training policies and programs. Although it is the employer's responsibility to ensure employees are trained to specification, Table 2 summarizes the similarities and differences among the respective agencies' requirements.

## Data Analysis

During our data collection process, we identified several observations and obstacles. First, the Air Force currently does not have a central database that records the shippers that experience frustrated HAZMAT at the APOEs. There are a few information systems available that list the reasons why a particular HAZMAT shipment was frustrated at each APOE; however, consolidated database use is not mandatory for either Department of Defense or commercial shipper frustrations in the DTS. Because of this limitation, the study could not determine the total amount of HAZMAT cargo that a particular company ships to a particular APOE during a set time period. This lack of tracking and visibility also impacts the ability to manage and respond to frustration instances, and a recommendation of this research is for the DoD to assign a responsible organization to track HAZMAT frustrations and initiate management action related to DTS HAZMAT frustration trends.

Next, the lists obtained from the respective Charleston and Dover AFB Customer Service Sections identified 100 shipper names and

**Table 2. Regulation Requirements**

| Requirement | DoD | CFR 49 | IATA | ICAO |
|---|---|---|---|---|
| General familiarization | X | X | X | X |
| Limitations | X | | X | X |
| General requirements for shippers | X | | X | X |
| List of dangerous goods | X | | X | X |
| General packing requirements | X | | X | X |
| Packing instructions | X | X | X | X |
| Labeling and marking | X | X | X | X |
| Shipper's Declaration and other relevant documentation | X | | X | X |
| Acceptance procedures | X | | X | X |
| Storage and loading procedures | X | | X | X |
| Training records | X | X | X | X |
| Function specific | X | X | | |
| Safety training | X | X | | |
| Emergency response | X | X | | |
| Security training | X | X | | |
| Test for competency | 80% | 70% | X | X |
| Initial training requirements | Prior to certification | Within 90 days | Within 90 days | Within 90 days |
| Refresher training | 2 years | 3 years | 2 years | 2 years |

reasons why their particular HAZMAT shipment was frustrated. We discovered that not all the listed shippers were readily contactable due to missing or incomplete contact information; this constraint removed twenty-six shippers from the list. Additionally, we excluded five shippers due to their geographic location outside the United States—although international shippers recognize ICAO and IATA regulations, enforcing U.S. defense regulations on a foreign commercial companies was felt to be outside the scope of the current research. Additionally, a small number of shippers refused to participate in the study due to company policy on providing information, thus excluding six more firms from the list. In sum, the original list of 100 companies was reduced to sixty-three companies who had at least one frustrated shipment. From this reduced list, we sought to contact a mix of hazardous material shippers that would balance the Table 1 research design. From the sixty-three companies, a total of fourteen firms both fit the experiment design and were willing to participate, for a response rate of 22 percent.

The original criteria used to separate the shippers into the Table 1 design had to be altered slightly following data collection. The company volume originally separated shippers into large and small classes by the amount of cargo they sent out monthly. However, in many cases the interviewees were unable to accurately determine the amount of hazardous cargo shipped by their respective firms through the DTS. Although we attempted to contact other shipper employees to obtain an accurate volume, data were not always available. Since approximations were given by the interviewees, we elected to use those estimates as a basis for separation. Therefore we considered a shipper "large" if it had 100 or more employees and if it had more than fifty HAZMAT shipments per month. Table 3 categorizes the firms interviewed.

Using information collected in the interviews, we analyzed the training program of each shipper while addressing each of the four research questions. The companies' answers to each research question provide a better understanding of how commercial shippers use military regulations and train their employees to ship hazardous materials. In addition, they show the differences between company practices and lead the study to making recommendations for improved HAZMAT transportation practices. The next several sections describe the results of the study.

**Table 3. Interviewed Companies**

| Number of Employees | Company Volume | Training Program | Government Contract | Company |
|---|---|---|---|---|
| Large | Large | External | Yes | D,E,M |
| Large | Large | Internal | Yes | C,G,K |
| Large | Small | External | Yes | L |
| Large | Small | Internal | Yes | |
| Small | Large | External | Yes | I |
| Small | Large | Internal | Yes | A |
| Small | Small | External | Yes | B,J,N |
| Small | Small | Internal | Yes | F |
| Small | Small | Internal | No | H |

## Results

### Research Question 1 – Commercial Shipper versus Military HAZMAT Training

Air Force Manual 24-204 establishes guidelines for how the military will train their hazardous materials personnel. Five designated locations are used to train military personnel, as listed in AFMAN 24-204. The curriculum is agreed upon by the Hazardous Material Training Working Group, which meets annually and maintains an inter-service memorandum of understanding that establishes the mandatory minimum training requirements to ensure consistency across the different branches of service (AFMC/LSO 2007). The CFR 49, IATA, and ICAO regulations state the training requirements for individuals certifying HAZMAT.

We asked the fourteen interviewed shippers questions about their training program. Table 4 provides a general overview of each respective shipper's training programs and practices.

U.S. commercial firms are obligated to follow CFR 49, which requires them to ensure their employees are trained within ninety days of employment, meet the established guidelines, and can pass a standardized test with a minimum 70 percent score.

Shippers B, D, E, I, J, L, M, and N use an outside agency to conduct their training. Shippers B and I indicated that they selected external training firms because it was inexpensive and convenient. Also, Shipper B chose a company that trains on DTS requirements. Shippers D and E choose the external training program at random when their employees are due for training. While Shipper L recertifies its employees per the CFR, which is every three years, versus the international two-year standard. Shipper J chose its external training program based on reputation, while Shipper N employees are trained by the shipper firms they use. Lastly, Shipper M chose a strict external program, where employees use exportable courses that require them to pass a test with a 75 percent or better at the end of each section. Even though these firms each chose an external program, they receive the training in a different manner.

Shippers A, C, F, G, H, and K developed their training programs internally. However, the instructors from Companies C, G, and K received their training certification from an external training company. Additionally, Company A uses an outside agency to conduct training for its medical personnel. Company F and G do not have a standardized test their employees must follow; however, Company G is developing a monthly refresher course for its employees and Company F is implementing a test. Company G sends its employees that handle military orders to an external training company that encompasses DTS regulations. Company H hires a contractor to fulfill its shipping requirements and the company is responsible for all of its training needs. The end-of-course test for Company K must be passed with a 70 percent or better; however, the trainer makes employees that miss four or more questions retake the course. Each of the companies developed courses from the regulations and the information gained from the external courses their instructors attended.

Even though the training methods for the military and commercial companies vary

**Table 4. Shipper Training Programs**

| Company | Training Program | Reason for type of training | Location | Test Requirement |
|---|---|---|---|---|
| A | Internal | Small company | Classroom/on-the-job | 80% |
| B | External | Outside company met their needs | On-site/ classroom | Decided by training company |
| C | Internal* | Large number of employees to train | Classroom presentations | 75% or better |
| D | External | Used for years | On-site training | Decided by training company |
| E | External | Encompassed all the requirements | Off-site training | Decided by training company |
| F | Internal | | On-the-job | Test not developed-estimated Jan 2007 |
| G | Internal* | Numerous personnel | Classroom presentations | No standard- has monthly refresher |
| H | Internal | Outside contractor working for larger organization | Classroom presentations | 70% or better |
| I | External | Price and a small company | On-line | Decided by training company |
| J | External | Good relationship with training company | On location and off-site | Decided by training company |
| K | Internal* | | Classroom and on-the-job | 70% |
| L | External | Close and good reputation | Off-site | Decided by training company |
| M | External | Prior individual choose | On-site | 75% |
| N | External | Small Company | Off-site | Decided by training company |

* The trainer and some employees were trained externally

greatly, the documentation and testing requirements are similar. Both the military and commercial industries must keep a training folder on each individual trained. It must include the individual's name, the location of the training, the type of training, and a completed training certificate (CFR 49 2006; AFMAN 24-204 2004). Commercial industries are required to keep training documentation on hazardous materials only, whereas the military requires the member to keep documentation on all training courses. The military and commercial industry both require a standardized test to be given at the end of the training, but the military also requires a member to pass two tests with a 75 percent or better before they are certified (MOU 2002). The commercial industry's standardized test must be passed with a 70 percent or better, but it does not appear from our research that this is strictly enforced. These aspects are the only common thread between the military and commercial industries' training programs.

The information outlined above indicates there are significant differences in how the military and commercial industries train their personnel. The military uses a standardized curriculum, while commercial companies use a variety of methods to base their curriculum on the military regulations. The emphasis in the commercial training industry is geared toward the proper handling, security, and safety of the hazardous materials, while little emphasis is placed on shipping documentation. The military trains on the safety and security of HAZMAT as well, but also strictly addresses the proper way to complete the documentation. The difference in training and

requirements leads us to investigate the next research question.

**Research Question 2 – Commercial Shipper Training Requirements**

The requirements for commercial industry personnel to ship hazardous cargo through the DTS are outlined in AFMAN 24-204. Section A25.7 of AFMAN 24-204 explains that all non-DoD personnel preparing and shipping hazardous cargo through the DTS must do so according to the regulation (AFMAN 24-204 2004). A specific number of annual training slots or "billets" are allotted to each of the DoD training facilities. The billets are then requested by a government agency for employees that require certification. A commercial company can request that its employees be sent to a defense-sponsored course; however, they must request a slot through the government contracting office that oversees their work (345 TRS 2007).

The companies interviewed knew of the established military training requirements. Companies B and F had taken an extra step and received additional training that meets military requirements, while Companies G and D had a separate department within the company that handled military shipments. Companies B, E, and F shipped 50 percent or more of their HAZMAT to a Defense Logistics Agency (DLA) center. Company F stated that DLA personnel actually completed all the HAZMAT documentation for them, and that their company shipped only a small percentage directly to an APOE.

Commercial companies that ship HAZMAT through DTS aren't held to the same training standards as military personnel, but they are required to follow the same regulations. Additionally, all of the companies had a government contract that obligates them to abide by the details and responsibilities agreed to in their contract. Since the companies interviewed were located across the United States, we did not have sufficient resources to review each respective contract. Five of the interviewed companies were making an attempt to abide by the military regulations; however, active participation is needed by all commercial companies to reach success.

**Research Question 3 – Existing Standardized HAZMAT Guides**

Some of the documentation required by the military is similar to the commercial sector; however, there are specific guidelines that need to be followed when completing them. The Shipper's Declaration is used by both sectors, but the military's document is arranged in a different format and is not accepted unless it is properly completed. Some differences seem trivial—for example, the military requires that the proper shipping name be typed in all capital letters. The packaging paragraphs are also different: The commercial industry follows IATA packaging paragraphs that are separated by weight, while military packaging paragraphs are separated by container type (IATA 2005; AFMAN 24-204 2004).

The military also requires that a military shipping label (MSL) accompany shipments. This label contains the shipment's receiving organization, the shipping company's information, and the transportation control number (TCN). This label should be placed on the outside of the package and should be easily identifiable. Although all this information is contained elsewhere in the shipping documentation, it is required in case a smaller package is separated from a larger shipment.

Commercial industry can obtain military regulations through the Air Mobility Command, Air Force Material Command, or Department of Transportation Web sites. Table 5 demonstrates which items assist the companies in completing military documentation.

Five interviewed companies were unaware that the regulations could be accessed; however, Companies F and K kept the shipping documentation from previous shipments to use as references. Table 6 displays the number of frustrated hazardous shipments each company sent to the APOEs.

On first glance it appears that the five companies not using the regulations had the least amount of frustrated cargo. However, due to lack of data on the total volume of cargo shipped yearly by each company, broad assumptions should not be made. Note that Company F reported a majority of its shipments' documentation were completed by DLA personnel. Therefore, it is unclear if Company F is to blame for discrepancies

**Table 5. Regulation Use**

| Company | Aware of Regulation Access | Do Not Use Regulations | Phone DoD installations | On-line Regulations | Military Regulations On-Site |
|---|---|---|---|---|---|
| A | Yes | X | | | X |
| B | Yes | X | X | | |
| C | Yes | | | X | |
| D | Yes | | | X | |
| E | No | | | | |
| F | Yes | | X | | |
| G | Yes | | | | X |
| H | Yes | | | X | |
| I | Yes | | X | | |
| J | Yes | | | | X |
| K | No | | | | |
| L | No | | | | |
| M | No | | | | |
| N | No | | | | |

**Table 6. Reasons for Frustration**

| Company | Shipper's Declaration | | | | No Military Shipping Label | | APOE |
|---|---|---|---|---|---|---|---|
| | *Unknown Reason* | *Proper Shipping Name* | *Packaging Paragraph* | *No Transportation Control Number* | *Missing* | | *D=Dover C= Charleston* |
| A | | | | | 1 | | D |
| B | 1 | | | | | | C |
| C | 5 | | | 1* | | 2* | C/D |
| D | | | | | 1 | | D |
| E | | | | | 1 | | C |
| F | | 4 | 3 | | 10 | 1 | D |
| G | 1 | | | | 1 | | D |
| H | 1 | | | | | | C |
| I | | 1 | | | 1* | | D |
| J | | | | | | 1 | D |
| K | 2* | | | | | 2* | D |
| L | | | 1 | | | | C |
| M | | | | | 1* | 1* | D |
| N | | | | | 1 | | D |

* Indicates one or more shipments had multiple problems

or if DLA should be held accountable. For documentation purposes, the APOE customer service sections would attribute the frustration to Company F because it is listed as the shipper.

Most companies interviewed were aware of the military shipping requirements and a majority of the companies were aware of the reference material. Some companies even chose to contact the APOE or DLA location directly for assistance. Although the best method cannot be determined, it is clear that commercial companies have opportunities available to complete the documentation correctly.

### Research Question 4 – Standardizing the Guidelines

The study found that there is no single governing body for the commercial industry that investigates training practices. Eight of the fourteen companies had recently been inspected by the U.S. Department of Transportation; however, they were inspected in other

areas of operation. Two companies had been inspected by the Federal Aviation Administration on their shipping procedures and one company was inspected by a defense employee to ensure it was abiding by its contract. Even though several governmental agencies had visited the companies, their HAZMAT training programs were never investigated. The U.S. Department of Transportation and DoD need to establish procedures for standardization, inspection, and enforcement of HAZMAT training requirements.

The second area that needs standardization attention is documentation. Currently, the Shipper's Declaration is required for both commercial and military shipments, but is completed differently for each. Our discussions with AF headquarters personnel (who are responsible for authoring AFMAN 24-204) indicated that the new standards for the military Shipper's Declaration, which will be published in 2007, now duplicate those of the commercial industry. The revised Shipper's Declaration has recently been put into circulation, and the new revision of AFMAN 24-204 regulation is to be distributed late in 2007, making the form mandatory (AFMC/LSO 2007). The effects of this change may not be seen for months, but it is a step in the right direction. The second common documentation error is a missing military shipping label, but it is believed that through proper training this can be easily alleviated.

The fourth research question cannot be answered completely without further investigation into the procedures and policies of several other governmental agencies. These government agencies produce HAZMAT regulations that govern the military and commercial industries, but it appears there is little unity across these agencies. The U.S. Department of Transportation and the Department of Defense need to work closely together on hazardous materials shipping policy and procedures, and it appears that communication between these two organizations still needs to be improved.

## Benchmarking for Success

Our research investigated how well companies met the hazardous material shipping standards established by the U.S. Departments of Defense and Transportation. Although some companies were more successful than others, no single company did it perfectly. However, there are a few key practices that could be duplicated to improve a company's chances of succeeding. We used Spendolini's (1992) five-stage generic process to find best practices due to its easy adaptability and use of established guidelines. Our research revealed five things a company can do to decrease the amount of frustrated cargo shipped to an APOE:

1. Acquire and become familiar with military regulations and acronyms.
2. Have a set of individuals that routinely prepare military shipping documents. This ensures familiarity and reduces additional training.
3. If problems arise and no answer can be found, contact the military APOE that is to receive the cargo and ask for clarification.
4. If the company has a government contract, ask the associated government contracting office for a tour of the APOE to become familiar with the acceptance requirements.
5. Ask the government contracting office for a personnel training slot to take the exportable HAZMAT course offered by one of the five designated military locations, or if negotiating a contract be sure to specify that a certain number of company employees will need to attend a military training course.

These five steps can improve a company's success rate when shipping HAZMAT to an APOE. Companies shipping HAZMAT to an APOE need to understand the stringent guidelines the military follows and be willing to comply with them.

## Summary

Our research examined how commercial companies train their employees to ship hazardous materials in the Defense Transportation System. The research questions investigated the APOE cargo frustration levels for a group of commercial companies. Overall, no two of the interviewed companies handled government shipments the same way, and their training plans had only a few similarities; therefore, all the employees likely have a different understanding of the proper way to ship hazardous materials to DoD customers.

Our first two research questions investigated the training requirement differences in the military and commercial companies. First, it was found that military and commercial training practices and curriculum vary significantly. Military training is fully standardized while paying close attention to required documentation. In contrast, commercial training uses a variety of methods aimed more at cargo handling and safety and security concerns. Our analysis discovered major differences; however, each party appears to be abiding by their respective regulations, with the exception of Company F and G. Unfortunately, it was discovered that five of the fourteen companies interviewed were completely unaware of the need or ability to access the required military regulations that govern transporting hazardous cargo in the DTS. Our third and fourth research questions established that AFMAN 24-204 provides the guidelines for completing HAZMAT documentation transported through the Defense Transportation System. A major advancement is that the new version of AFMAN 24-204 will more closely align required military shipping documents to those used by the commercial industry.

The curriculum taught to military members is the same at each defense training facility, thus ensuring that standardized procedures are followed. Similarly, we recommend that the U.S. Department of Transportation develop a standard curriculum for commercial companies to comply with, to ensure hazardous materials employees are properly trained. By developing a standard curriculum, the DoT would also have a better way of inspecting commercial companies. Currently, there appears to be a lack of coordination between government agencies and no single governing body appears to be standardizing, inspecting, and enforcing HAZMAT transportation training practices. The existing inconsistency creates shipping discrepancies, uninformed decisions to be made, and delayed shipments destined for overseas military customers. An additional recommendation is the establishment of a common database of HAZMAT frustration statistics by the DoD. Currently, it is difficult to measure the magnitude and trends of HAZMAT frustration occurring at the APOEs and future research would gain greatly from historical tracking of the number, volumes, and discrepancies of HAZMAT shipments at all APOEs.

In conclusion, since commercial companies train their employees to different standards than the military, a good bet is that commercial shipper employees have incomplete knowledge of the shipping requirements through the Defense Transportation System. Commercial shippers have access to military regulations but may not fully understand the rigidity of the military requirements, and currently there is no cohesive link between the military and commercial industry to assist them. Although the associated government contracting offices act as liaisons, they are not subject matter experts on HAZMAT transportation requirements. In conclusion, commercial shipper training for hazardous material appears to impact frustration levels at military APOEs, and until government regulations and guidelines are established that provide a common language for the military and commercial industry, this trend will continue.

## References

345th Training Squadron Instructor, Lackland Air Force Base, TX. Personal communication, February 2, 2007.

Christensen, N., *Hazardous Material Cargo Frustration at Military Aerial Ports of Embarkation*. Unpublished master's thesis, Air Force Institute of Technology, Wright-Patterson Air Force Base, OH, April 2006.

Clark, R. and A. Kwinn, "Aligning Training to Business Results," *T +D*, Vol. 59, No. 6, 2005, pp. 34.

Closs, D.J., S.B. Keller, and D.A. Mollenkopf, "Chemical Rail Transport: The Benefits of Reliability," *Transportation Journal*, Vol. 42, No. 3, 2003, pp. 17–30.

*Code of Federal Regulations (CFR) Title 49, Parts 100–185*, "Hazardous Material Regulations," Retrieved November 16, 2006, from http://www.nsc-dot.com/regs.html

Creswell, J.W., *Research Design: Qualitative & Quantitative Approaches*. Thousand Oaks, CA: Sage Publications, 1994.

Department of the Air Force, HQ USAF/ILG. *Preparing Hazardous Materials for Military Air Shipments, Air Force Manual (AFMAN) 24-204*, 12 October 2004.

Department of the Army, *Memorandum of Understanding between SMPT, DAC, NSCS and 345 TRS*, 25 March 2002.

Eidson, B., Chief of Customer Service, Dover Air Force Base. Data retrieved via e-mail, 27 October 2006.

Ellison, V.L., *Analysis of Frustrated Vendor Hazardous Material Shipments within the Department of Defense*, Unpublished master's thesis, Air Force Institute of Technology, Wright-Patterson AFB OH, April 2004.

Erkut, E. and V. Verter, "A Framework for Hazardous Materials Transport Risk Assessment," *Risk Analysis*, Vol. 15, No. 5, 1995, pp. 589–601.

Ford, K., M. Quinones, D. Sego, and J. Speer Sorra, "Factors Affecting the Opportunity to Perform Trained Tasks on the Job," *Personnel Psychology*, Vol. 45, No. 3, 1992, pp. 511.

Headquarters Air Force Material Command, HQ AFMC/LSO, Wright-Patterson Air Force Base, OH, personal communication, 17 January 2007.

International Air Transportation Association (IATA), *Dangerous Goods Regulations, 47th Edition*, Montreal-Geneva: IATA, 2005.

International Civil Aviation Organization (ICAO), *Technical Instructions for the Safe Transport of Dangerous Goods by Air*, Montreal, Canada: ICAO, 2006.

Kirkpatrick, D., "Great Ideas Revisited: Techniques for Evaluating Training Programs," *T+D*, Vol. 50, No. 1, 1996, pp. 54.

Kleindorfer, P.R., and G.H. Saad, "Managing Disruptions in the Supply Chains," *Production and Operations Management*, Vol. 14, No. 1, 2005, pp. 53–58.

Kramer, P., Director Transportation Safety Institute, Oklahoma City, OK, personal communication, 18 August 2006.

LabelMaster, Retrieved 27 November 2006 from http://www.labelmaster.com/lmstore/ default.aspx?screen=product/catalog&cataloglevel=5981.

Mejza, M.C., R.E. Barnard, T.M. Corsi, and T. Keane, "Driver Management Practices of Motor Carrier with High Compliance and Safety Performance," *Transportation Journal*, Vol. 42, No. 4, pp. 16–29, 2003.

Revelle, C., J. Cohen, and D. Shobrys, "Simultaneous Siting and Routing in the Disposal of Hazardous Wastes," *Transportation Science*, Vol. 25, No. 2, pp. 138–145, 1991.

Rothwell, B.A., W. Harsha, and T. Clever, "Military versus Civilian Air Cargo Training for Hazardous Material," *Journal of Aviation/Aerospace Education and Research*, Vol. 12, No. 1, pp. 29-43.

Russell, D.M. and J.P. Saldanha, "Five Tenets of Security-Aware Logistics and Supply Chain Operations," *Transportation Journal*, Vol. 42, No. 4, 2003, pp. 44–54.

Simmons, O., Transportation Customer Service Specialist, Charleston Air Force Base, SC. data retrieved via email, 24 October 2006.

Sheffi, Y., "Supply Chain Management under the Threat of International Terrorism," *International Journal of Logistics Management*, Vol. 12, No. 2, 2001, pp. 1–11.

Spendolini, M., *The Benchmarking Book*, New York: AMACOM, 1992.

Sweet, K.M. "Emergency Preparedness for Catastrophic Events at Small and Medium Sized Airports: Lacking or Not?," *Journal of Air Transportation*, Vol. 11, No. 3, 2006, pp. 110–143.

Wells, A.T. and J.G. Wensveen, *Air Transportation: A Management Perspective*, 5th Edition, Belmont CA: Thomson/Brooks/Cole, 2004.

Wynne, M.W., Under Secretary of Defense for Acquisition, Technology and Logistics, "Acquisition Policy on Facilitating Vendor Shipments in the DoD Organic Distribution System, Memorandum for Secretaries of the Military Departments," Washington, D.C., 23 July 2003.

Yin, R.K., *Case Study Research: Design and Methods*, 3rd edition, Volume 5, Thousand Oaks, CA: Sage Publications, Inc., 2003.

Young, R.R., P.F. Swann, and R.H. Burn, "Private Railcar Fleet Operations: The Problem of Excessive Customer Holding Time in the Chemicals and Plastics Industries," *Transportation Journal*, Vol. 42. No. 1, 2002, pp. 51–59.

Zhang, J., J. Hodgson, and E. Erkut, "Using GIS to Assess the Risks of Hazardous Materials Transport in Networks," *European Journal of Operational Research*, Vol. 121, No. 2, 2000, pp. 316–329.