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An Examination of Reverse Logistics Factors Impacting the 463-L Pallet Program

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AN EXAMINATION OF REVERSE LOGISTICS FACTORS IMPACTING THE 463-L PALLET PROGRAM

THESIS

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Abstract

During peacetime operations, the process of tracking and managing 463-L assets within the Air Mobility Command (AMC) airlift system results in infrequent imbalances or accountability issues. However, during contingency operations, AMC loses control of 463-L assets as they are turned over to the intra-theater distribution system. Since current contingency operations began in October of 2001, the Air Force has been unable to account for over 97,000 463-L pallets and 220,000 cargo nets (Brogden 2004). With a single pallet and net set costing over $1,300, the total value of the equipment unaccounted for exceeds $126 million. If not corrected, this failure to account for 463-L equipment may negatively impact the flow of sustainment cargo to the warfighter.

The Department of Defense (DOD), United States Transportation Command (USTRANSCOM), and AMC are currently investigating the problem from multiple angles, to include new technologies, inventory replenishments, Critical Asset Recovery Teams (CARTs), and Defense Transportation Regulation (DTR) rewrites. Rather than focusing on these current efforts, this research attempted to determine if concepts of resource-based theory (RBT) and established best practices of reverse logistics (RL) could be used to evaluate the 463-L program. Using a collective case study methodology, this research sought to identify resource related factors in existing RL literature that tend to impact program performance, and then draw comparison between the 463-L program and the similar programs of industry leading air cargo carriers based on those factors.

To my Mother and Father…all that I am, you have made me.

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First, I must thank my beautiful wife. Yours is truly the most important job in any family. You selflessly love and nurture our children as only a mother can. We are all blessed to have you in our lives.

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AN EXAMINATION OF REVERSE LOGISTICS FACTORS IMPACTING 463-L PALLET PROGRAM PERFORMANCE

I. Introduction

Background

The 463-L pallets, nets, and associated cargo tiedown equipment are key components of the airlift portion of the Defense Transportation System. They allow for the efficient utilization of available aircraft space, reduce aircraft ground times by allowing for advanced load planning and pallet buildup, and help to expedite the aircraft loading and unloading processes. The efficient operation of the 463-L system is critical during contingency operations when large volumes of cargo must be moved long distances in a short period of time. As such, the nonavailability 463-L assets can disrupt the flow of sustainment cargo to the warfighter and negatively impact the outcome of operations.

While the 463-L system has been effective at moving large volumes of cargo during every contingency and humanitarian operation since the Vietnam War, there has also been a long history of high attrition rates during large-scale operations. For example, pallets were consumed at rapid rate during Operation DESERT SHIELD/STORM. During that conflict, nearly all of the 120,000 War Reserve Material (WRM) pallets were quickly depleted, becoming a potential war-stopper (Schroeder and Martinez 1997). Similar losses have been documented during humanitarian operations in

Bosnia. Nearly 55% of all pallets shipped to that theater were never returned, a loss of nearly $3.6 million in assets (Schroeder and Martinez 1997). The Air Force is currently experiencing these same high attrition rates. Since the ongoing contingency operations began in October of 2001, the Air Force has been unable to account for roughly 97,000 463-L pallets and 220,000 cargo nets, representing approximately 53 percent of the pre-war inventory of pallets.

The high attrition rates are partly due to how the movement of 463-L pallets differs during contingency operations from normal peacetime operations. During peacetime operations, the majority of loaded pallets are broken down at the aerial port and the cargo is transferred to the user. This leaves the pallet in the custody of the aerial port, where it re-enters the airlift system for repeated use. This is often referred to as a closed-loop system. However, during contingency operations, the majority of the cargo entering the theater is not broken down at the aerial port of debarkation. For reasons of efficiency, palletized cargo is transshipped to the receiving unit, allowing the 463-L assets to leave the airlift system. Once these assets leave the airlift system they are often used for unauthorized purposes, such as tent floors, bunker roofing, and walkways, or are simply discarded by the recipient.

There have been many previous attempts to solve the pallet depletion problems. Pallet recovery teams in the theater, stronger accounting and inventory procedures, and increased regulations have all been tried without success since the Vietnam era (Schroeder and Martinez 1997). In 1993, AMC issued a Mission Need Statement for a Contingency Air Cargo Pallet. This request explored the solution of a contingency air cargo pallet, also referred to a sub-pallet, which would allow the more expensive 463-L pallet to remain in the airlift. Many of these same actions are presently underway in an effort to remedy the current pallet crisis. Several contingency pallet prototypes are being evaluated, pallet recovery teams (CARTS) have been contracted in the theater, and numerous messages have been released from all levels of command.

Problem Statement

Currently the Air Force is experiencing critical shortages of 463-L pallets and nets that may negatively impact the flow of sustainment cargo to the warfighter. Rather than focus on the current improvement efforts, this research will look at the 463-L pallet problem from a reverse logistics (RL) perspective; exploring an ever-increasing body of literature to identify factors that tend to impact reverse logistics program performance. For further support, this research will also explore the implications of resource-based theory (RBT) as it relates to RL program performance. Once these factors are identified, they will be used to draw comparison between the current 463-L program and the similar programs of industry-leading air cargo carriers.

Research Question

The focus of this research is to answer the question: How does the current Air Force 463-L program compare to similar programs managed by industry-leading air cargo carriers?

Investigative Questions

1. What are the factors that tend to impact reverse logistics program performance?
2. How does resource-based theory apply to reverse logistics program performance?
3. What activities does the Air Force and AMC consider to be reverse logistics activities?
4. How does the Air Force's 463-L pallet program compare to similar programs of industry-leading air cargo carriers in the areas identified as critical to reverse logistics operations?

Methodology

The methodology used to answer the investigative questions and the research question will be the case study. In order to answer Questions 1 and 2, a literature review will be conducted to gain an in-depth knowledge of the commercial industry applications of reverse logistics and resource-based theory, and to identify those factors that tend to impact RL program performance. To answer Question 3, existing studies and publications will be reviewed to determine the extent of current RL initiatives within the Air Force and AMC. Next, both the Air Force 463-L program and the comparable programs of industry leaders will be examined using a collective case study methodology to satisfy Question 4. Finally, the research question will be addressed through an analysis of the responses to interview questions presented to both the commercial air cargo carriers and Air Mobility Command and Air Force Material Command program managers. Interview questions will be derived from the review of reverse logistics and resource-based theory literature.

Summary

This chapter introduced the current problem, presented the research and investigative questions, and provided a summary of the methodologies used in this study. Chapter II presents an in-depth review of the existing literature on the subjects of reverse logistics and resource-based theory, and details the history and current guidance governing the 463-L program. Chapter III further describes the research and data collection methodologies used to accomplish the objectives of this study. Chapter IV presents the findings and analysis, while Chapter V provides conclusions and offers areas for further research.

II. Literature Review

Introduction

This literature review will begin with a discussion of the history and activities of reverse logistics (RL), explain the connection between RL and reusable shipping platforms, and identify the key factors that tend to impact RL program performance. Next, the topic of resource-based theory (RBT) will be introduced, with specific focus on applications to reverse logistics. The chapter will then shift focus and detail the 463-L pallet program; discussing the pallet's origin, program guidance, current inventory policy, and an assessment of the current pallet crisis.

Reverse Logistics

There is an emerging focus on reverse logistics in the private sector. According to 1999 estimates, RL costs in the United States account for approximately four percent of total logistics costs, amounting to nearly $37 billion annually (Stock 2001; Rogers and Tibben-Limbke 2001). Reverse logisitcs is no longer an afterthought for many companies. Instead, it has become a competitive necessity and has gained increased acceptance as a profitable business strategy. It has been documented that the efficient management of reverse processes can save as much as 10 percent from a company's total logistics costs (Daugherty, Meyers, Richey 2002). As few as ten years ago very little literature existed on the subject of RL. Today there are entire textbooks devoted to the subject, yet many of today's Air Force logisticians are unfamiliar with the concepts of RL.

Reverse Logistics Defined

Reverse Logistics has many definitions. One of the more notable is derived from the Council of Supply Chain Management Professionals (CSCMP)—formally the Council of Logistics Management (CLM)—definition of Logistics Management, which has in recent years incorporated the management of reverse material flow into their definition.

> *Logistics Management is that part of Supply Chain Management that plans, implements, and controls the efficient, effective forward* ***and reverse*** *flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers' requirements.* (CSCMP 2003)

Drawing on the CSCMP definition of logistics management, Rogers and Tibben-Lembke define RL as:

> *The process of planning, implementing, and controlling the efficient, cost effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of recapturing or creating value or proper disposal.* (Rogers and Tibben-Limbke 2001)

History

The genesis of reverse logistics has been attributed, at least in part, to the emergence of inexpensive materials and advanced technologies that accompanied the Industrial Revolution of the 1800's. Experts contend that during this time Western societies fell into a practice of mass production and routine throw away, with little concern for environmental matters or sustainable development. (de Brito and Dekker 2002). The negative effects of such practices did not become readily apparent until nearly a century later.

By the 1970's, The Club of Rome, a non-profit, global think-tank, argued that there was a limit to the ongoing world growth trend. They concluded that if the then present trends in population, industrialization, pollution, and resource depletion continued unchanged, the limits to growth on this planet would be reached sometime within the next century, resulting in an uncontrollable decline in both population and industrial capacity (Meadows 1972). Throughout the decade that followed, this report along with several prominent environmental disasters kept the minds of academia, industry, and society in general, focused upon such environmental issues (de Brito and Dekker 2002).

This increased social concern led to new laws and regulations that changed the relationship between business and the environment. Many companies quickly learned that the success of proactive and value-seeking waste reduction programs often hinged on effective logistics programs. Source reduction, recycling, and reuse posed new challenges to logistics professionals, who had generally not been involved with these types of environmental issues in the past. Because of these new challenges, the logistical management of environmental programs quickly became a new area of focus for both industry and academia.

As a result, the subject of reverse product and material flow began to surface in the academic arena during this same period of the 1970's. Guiltinan and Nwokoye

(1975) were among the first to identify distinct reverse channel structures and functions, as well as channel members that are unique to reverse distribution. Because of the environmental focus of this era, the topic of reverse channel management was often labeled *green logistics* or *environmental logistics*. The actual term *reverse logistics* did not surface until a 1981 trade publication authored by Douglas Lambert and James Stock. In their article, Lambert and Stock described RL as "going the wrong way down a one-way street, because the majority of product shipments flow in one direction" (Lambert and Stock 1981). Stock later published the first known formal definition of RL:

> *…the term used to refer to the role of logistics in recycling, waste disposal, and management of hazardous materials; a broader perspective includes all relating to logistics activities carried out in source reduction, recycling, substitution, reuse of materials and disposal*. (Stock 1992)

Stock's definition was clearly environmentally focused. However, it is important to note that while modern RL practices have evolved from green logistics, the two differ significantly. Green logistics considers the environmental aspects of all logistics activities, and concentrates specifically on forward logistics operations rather than reverse channels (de Brito and Dekker 2002). Similarly, Rogers and Tibben-Lembke (2001) describe green logistics as the efforts to minimize the environmental impact of logistics activities, while reverse logistics should be reserved for the flow of products or materials going "the wrong way on a one-way street".

Although green logistics and reverse logistics focus on distinctly different operations, the two can also be equally applied to many similar activities. For example, reusable shipping containers may be classified under either concept, as these containers tend to reduce waste and also cut costs when collected and reused. Figure 1 demonstrates the differences and overlap between the two concepts.

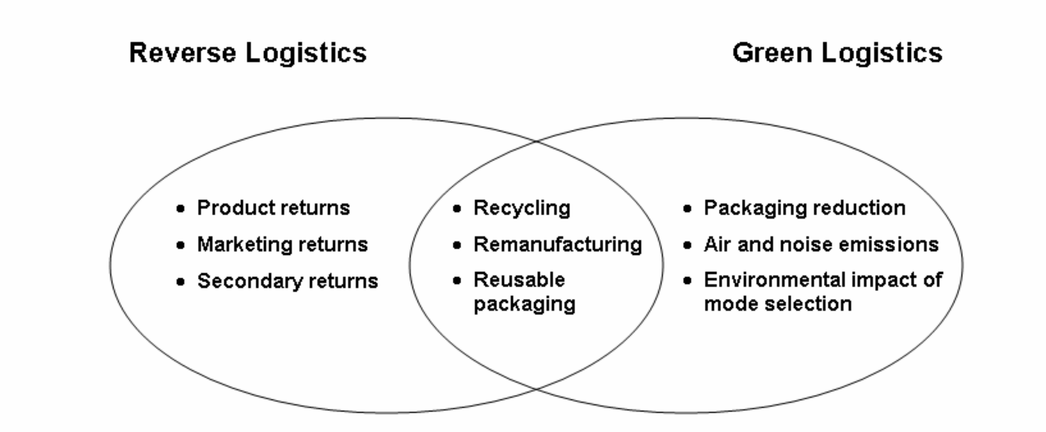

Figure 1. Comparison of Reverse Logistics and Green Logistics (Rogers and Tibben-Lembke 2001)

Differences between Forward and Reverse Logistics

It is often assumed that reverse logistics programs can be successfully implemented and maintained by simply reversing the forward supply lines (Gooley 1998). On the contrary, reverse logistics activities have very different and often more complex issues that affect program performance. Table 1, developed by Ronald Tibben-Lembke and Dale Rogers details the key differences between forward and reverse logistics operations. Although the table is focused on the retail sales environment, many of these differences exist equally in other RL applications.

Table 1. Differences between Forward and Reverse Logistics

Forward	Reverse
Forecasting relatively straightforward	Forecasting much more difficult
One-to-many transportation	Many-to-one transportation
Product quality uniform	Product quality not uniform
Product packaging uniform	Product packaging often damaged
Destination and routing clear	Destination and routing unclear
Standardized channels	Exception driven channels
Disposition options clear	Disposition not clear
Pricing relatively uniform	Pricing dependent on many factors
Importance of speed recognized	Speed often not considered a priority
Forward distribution costs closely monitored	Reverse costs less visible
Inventory management consistent	Inventory management not consistent
Product life-cycle manageable	Product life-cycle issues more complex
Negotiations between parties straightforward	Negotiations complicated by additional factors
Marketing methods well known	Marketing complicated by many factors
Real-time tracking information available	Visibility often less transparent

(Tibben-Lembke and Rogers 2002)

Comparison of Forward and Reverse Logistics Costs

Reverse logistics, like most complex business operations requires a wide range of resources, including manpower, information systems, assets, and infrastructure. Because of the noted differences between forward and reverse logistics activities, reverse operations can be much more resource demanding to implement and maintain (Tibben-Lembke and Rogers 2002). Despite the potential for positive economic benefits, companies often fail to allocate sufficient resources to facilitate RL program success. Table 2 illustrates the increased costs associated with RL activities.

Table 2. Comparison of Forward and Reverse Logistics Costs

Cost Category	Comparison to Forward Logistics
Transportation	Greater: lower-volume channels
Inventory holding costs	Lower: lower-value items
Shrinkage (theft)	Much lower: limited use without repair
Obsolescence	Obsolescence: may be higher due to delays
Collection	Much higher: less standardized
Sorting, quality diagnosis	Much greater: item-by-item
Handling	Much higher: nonstandard sizes and quantities
Refurbishment	Significant for RL, nonexistent for forward
Change from book value	Significant for RL, nonexistent for forward

(Tibben-Lembke and Rogers 2002)

Characterization of Items in Reverse Flow

In simple terms, reverse logistics is an organization's management of material resources obtained from its customers. Giuntini and Andel (1995) divide these resources into two primary categories: organization-owned and customer-owned resources. They describe organization-owned resources as fixed assets that can include transportation packaging, shipping containers, and pallets, while customer-owned resources generally refer to product returns. Similarly, Kroon and Vrijens (1995) suggest that both the materials management part and the physical distribution part of the logistics chain are potential areas of RL application. They propose that material management typically refers to products while physical distribution generally consists of packaging and containers.

Products and packaging can be in the reverse flow for many different reasons. Consumers often return items because the item is defective or unwanted, while suppliers and retailers may return items to better manage inventories or recapture value. Packaging generally flows back because it is reusable (e.g., pallets or plastic totes), or due to disposal concerns (e.g., corrugated cardboard) (Rogers and Tibben-Lembke 2001). Table 3 summarizes the most common reasons why a product or packaging enters the reverse channel.

Table 3. Characterization of Items in Reverse Flow by Type and Origin

	Supply Chain Partners	**End Users**
Products	Stock balancing returns Marketing returns End of life/season	Defective/unwanted products Warranty returns Recalls Environmental disposal issues
Packaging	Reusable totes Multi-trip packaging Disposal requirements	Reuse Recycling Disposal restrictions

(Rogers and Tibben-Lembke 2001)

Reusable Packaging and Shipping Containers

Growing concerns for the environment and increased governmental regulations initially prompted the use of returnable containers in industry. However, many companies quickly discovered that the efficient management of reusable shipping assets and packaging materials could also be economically rewarding. Saphire (1994) described both the environmental and economic benefits associated with reusable containers. He identified the primary environmental benefits as waste prevention and resource conservation, to include both energy and raw materials, while the economic benefits include the reduced costs of packaging, disposal, product damage, freight, labor, and storage.

Saphire (1994) further divided reusable packaging into three major categories: primary or consumer packaging, secondary packaging, and transport or distribution packaging. Primary packaging is the basic package that contains a product, and is used by the consumer until the product is consumed (e.g., soup can or soda bottle). Secondary packaging is the additional packaging to facilitate self-service sales, to prevent theft, to advertise a product, or to facilitate use by the customer (e.g., toothpaste box or soda case). Transportation packaging is used to ship goods from a point of origin to their destination, and consists of boxes, crates, pallets and other shipping containers. Even with the potential for significant economic returns, the management of returnable container programs has long been recognized as a difficult, expensive, and labor intensive task (Tibben-Lembke and Rogers 2002; Witt 2000; Saphire 1994; Kelle and Silver 1989; Kroon and Vrijens 1995; Biciocchi 1992). The potential savings from reusable containers must out-weigh significant upfront investments; ongoing tracking and accounting costs; increased transportation costs associated with recovery, as well as increased labor costs to manage these functions (Saphire 1994).

As reusable containers increasingly made their way into industry, many companies conducted extensive studies to determine return on investment and justify such programs. One such company was Xerox. A 1991 report concluded that an $8 million investment in reusable containers would save the company's manufacturing facilities $80 million in the first five years (Augsburger 1991). Similarly, General Motors reported a $1.4 billion investment in returnable containers after completing a comparable study (Witt 2000). Other companies, such as Toyota, require all suppliers to purchase and maintain reusable containers. While suppliers make the initial investments, over time they recover the costs by realizing greater profits from sales to Toyota (Saphire 1994).

The successful management of reusable container programs often presents unique and complex issues that can be distinctly different from other logistics operations. When companies decide to establish RL programs, be it reusable containers or managing product returns, it is important they do so properly to achieve objectives while minimizing costs.

Factors Impacting Reverse Logistics Program Performance

In recent years, considerable research has been conducted on the subject of establishing effective RL programs. An extensive review of the literature has identified numerous reoccurring factors that tend to impact RL program performance.

Importance of RL Relative to Other Issues

While most logistics professionals contend that RL can be an important tool in developing a competitive advantage, other issues often take priority and leave RL activities as an afterthought. The relative importance of a firm's RL programs or operations will directly impact how the firm allocates its limited resources. For many companies, the management of returns and reusable containers simply does not rank high on the list of priorities. More often than not, companies focus their efforts on getting products to customers. According to a recent survey of over one hundred large companies, over 40 percent did not have strong reverse logistics programs in place because of the seemingly low importance of returns management (Zieger 2003). Similarly, in a survey of over 300 CSCMP members, the perceived low importance of RL activities was cited as the single largest barrier to the implementation of RL solutions (Rogers and Tibben-Lembke 2001). Many firms have yet to justify large investments in RL. However, in today's highly-competitive global market, traditional factors such as quality, pricing, and reliability are no longer differentiating characteristics, and firms that cannot meet these basic standards can no longer compete (Stock 2001).

By realizing the strategic implications of effective reverse channel management, companies have used RL to reduce costs, improve customer service, recover assets, and recapture value. For companies like WalMart, the importance of RL operations is evident; they have nearly 17,000 trailers specifically dedicated to the transportation of approximately $6 billion in returns they process annually (Ortiz 2004). From examining the reusable container programs of GM and Toyota, and the returns management programs of retailers like WalMart, it appears that many in industry are keenly aware of the importance of RL operations.

Company Policies

Company policy is the second most commonly cited barrier to good RL programs (Rogers and Tibben-Lembke 2001). Company policy can directly impact the allocation of personnel, financial, and technological resources within an organization, and dictate a firm's organizational objectives. Reverse logistics activities should be part of an overall business strategy for those organizations engaged in product return and/or reusable shipping platform activities, and company policies should support this strategy. Often companies believe that once a product is delivered, the firm's responsibility ends (Stock 2001). Conversely, the efficient handling of product returns can be important as delivering them in the first place. By reducing the cost associated with returns management, retailers can offer more liberal return policies, which can in-turn, improve customer service and increase sales (Rogers and Tibben-Limbke 2001). Additionally, more companies are following Toyota's lead; demanding that their vendors take back the non-value-added material, such as packing material, shipping containers, and pallets (Saphire 1994). Company policy must address these and other important issues regarding RL operations.

Top Management Support

Mintzberg (1973) asserted that top management commitment is the dominant driver of corporate endeavors. The research of Daugherty, Autry, and Ellinger (2001) offers empirical evidence to support to Mintzberg's position. Their findings indicate that firms who commit more managerial resources to RL have better overall program performance, and that a reluctance to commit the required managerial resources is often a barrier to the development of effective RL programs. In fact, they contend that the commitment of managerial resources often has a greater influence on achieving program goals than does financial resource commitment. Rogers and Tibben-Lembke offer additional support from their 2001 CLM survey, in which nearly one-third of respondents cited management inattention as a significant RL barrier. Top-level managers often assume that product returns and packaging reuse will take care of themselves if given enough time, and therefore fail to allocate sufficient resources to these types of programs. Stock (2001) explains that reverse channel problems typically do not go away by themselves. In fact, he claims that if RL activities continue to go unmanaged, the only thing that will go away will be the customer.

Mid Level Management Support

While top-level management support may be the driving factor in policy implementation; it alone is not enough to ensure proper policy execution. At the operational level, mid-level management commitment is essential to successful RL programs, as they are often responsible for the daily activities such programs. Drumwright (1994) labels these mid-level managers as “policy entrepreneurs”, as they have the political savvy, communication skills, drive, and commitment needed to implement programs, and persuade others to adopt and internalize them as well.

Personnel Resources

Reverse Logistics activities involve multiple tasks including “unpacking, inspection, testing, repair, refurbishment, parts retrieval/replacement, cleaning, repackaging, reshelfing, redeployment, recording, reporting and communication” (Lee, McShane, Kozlowski 2002). Because of the diverse and complex nature of these tasks, labor costs tend to be a significant portion of total RL activity costs, and part-time efforts will likely yield less than optimal results. In describing the “Seven Deadly Sins of Reverse Logistics”, Stock (2001) contends that many firms who are efficient at forward distribution assume that part-time RL efforts are sufficient to deal with RL activities. Often, RL activities become a side job for mangers and employees who are focused on other tasks and higher priorities. The result is often higher costs and increased delays (Stock 2001). Rogers and Tibben-Lembke (2001) provide further support for the importance of personnel resource commitment; 20 percent of logistics managers surveyed cited insufficient personnel resources as a significant barrier to the successful implementation of RL programs.

Separating FL and RL Systems

The benefit associated with the separation of forward and reverse channel functions has been well documented in the existing literature (Lee, McShane, Kozlowski 2002; Witt 1997; Stock 2000; Rogers and Tibben-Limbke 2001). The recovery of resources is complicated by the fact that most logistics operations are not equipped to handle both forward and reverse material flow. Return goods are often collected, stored, handled, and transported differently than outgoing goods (Tibben-Lembke and Rogers 2002; Guide, Jayaraman, and Srivastava 2000). This can result in reverse distribution costs that may be several times higher than the original distribution costs, making it difficult to justify high recovery and transportation costs for lower value products (Tibben-Lembke and Rogers 2002; Sarkis 1995). Rogers and Tibben-Limbke (2001) provide further insight into this area. They contend that to be effective RL must function as a separate entity; to combine forward and reverse functions often results in the problem of "serving two masters". When resources are shared between functions, reverse activities often become subordinate to the forward channel when problems occur or crises arises.

Centralized Return Centers

Centralized return centers can offer a cost-effective single point of collection and decision-making, which in turn can reduce transportation costs and ensure better utilization of reusable containers (Gooley 1998). Rogers and Tibben-Limke (2001) define centralized return centers (CRC) as a distribution center or a portion of a distribution center where returns originating from multiple locations flow back to a central collection point. In their survey, nearly 70 percent of respondents used CRC for processing returns. Additionally, centralized collection points can aid in the inventorying, cleaning, and maintaining of reusable shipping containers for future use (Kroon and Vrijens 1995).

Incentives

Carter and Ellram (1998) indicate a need to establish an incentive program to reward RL program participants for actions associated with desired outcomes. They propose that the success of RL programs is directly related to the existence of incentive systems that reward employees and channel members for their involvement in RL activities. Carter and Ellram (1998) also state that the absence of such systems can cause resistance the implementation of such programs. Other authors have noted the benefits of incentive systems associated with reusable shipping containers and have advocated the use of some type of deposit or fee system to aid in their timely return (de Brito and Dekker 2002, Kroon and Vrijens 1995).

Information Technology Systems

Information technology (IT) has long been recognized as a competitive weapon within logistics operations (Daugherty, Meyers, Richey 2002). Currently, most logistics information systems are designed and installed with forward logistics in mind. However, with the complex nature of RL, information systems are becoming increasingly important. Information technology has been described as “the critical thread that interweaves every aspect of the RL process” (Lee, McShane, Kozlowski 2002). Despite the importance of information technology in RL activities, over one third of supply chain executives said they still did not have the right systems in place to effectively manage reverse channels (Rogers and Lembke 2001). In logistics operations, managers rely on the timely and accurate information provided by capable IT systems for strategic planning and decision making on both forward and reverse ends of the supply channel.

Resource-Based Theory

Background

In the 1980’s a variety of authors began to explore the competitive implications of a firm's internal strengths and weaknesses. Many contributions were influenced by the early work of Edith Penrose, who in 1959 published a book titled “*The Theory of the Growth of the Firm*”. In this book, Penrose presented a firm as a bundle of resources, whose growth and success is based on the firm’s accumulation and allocation of its resources (Penrose 1959). This field of study has come to be known as the resource-based theory (RBT) of the firm. Because this research identified multiple resource-based factors that affect RL program performance, the topic of RBT was explored to help explain the relationship between resource commitment and RL program performance.

The RBT of a firm is just one theoretical view that attempts to explain how firms develop and sustain competitive advantages. There are three key concepts that are central to the resource-based view of a firm: firm resources, competitive advantage, and sustained competitive advantage. They are defined as follows (Barney 1991):

> *Firm resources* – includes all assets, capabilities, organizational processes, firm attributes, information, knowledge, etc. that improve a firm's efficiency and effectiveness.
>
> *Competitive advantage* – when a firm is implementing a value creating strategy not simultaneously being implemented by current or potential competitor.
>
> *Sustained competitive advantage* - when a firm is implementing a value creating strategy not simultaneously being implemented by current or potential competitor and these other firms are unable to duplicate this strategy.

In simple terms, RBT suggests that collecting and properly allocating specialized resources will allow a firm to achieve and maintain a competitive advantage (Barney 1991). This is because firms with superior resources can better serve customers in a more cost efficient manner, and therefore realize greater economic profits. Whether or not a particular competitive advantage is sustained ultimately depends on the possibility of competitive duplication. Barney (1991) presents two factors that limit the possibility of duplication: imperfect imitatibilty and imperfect substitution.

Resources that are easily substituted or imitated cannot be sources of sustained competitive advantage, thus cannot be strategic resources. To be strategic, resources must be scarce. However, simply accumulating scarce resources does not afford a firm a competitive advantage. Resources must also provide the firm *economic rents*, that is, they must provide returns in excess of their opportunity costs. Additionally, one must understand the difference between assets and capabilities. Assets are related to *having*, while capabilities are related to *doing* (Olavarrieta and Ellinger 1997). This makes capabilities less visible, and therefore much more difficult to duplicate. Olavarrieta and Ellinger (1997) suggest that these knowledge-based capabilities reside in the collective memory of the organization and make the firm unique, socially complex, and systematic.

Essentially, strategic resources consist of both superior assets and distinct capabilities. In order to maintain a competitive advantage, these assets and capabilities must be properly committed to right organizational programs.

RBT and Logistics

In the past, logistics functions were simply viewed as necessary cost centers. However in recent years, many firms have begun to realize that properly managed logistics programs can not only reduce operating costs, but can dramatically increase the firm's bottom line. Likewise, researchers have looked to apply RBT to logistics operations in an effort to understand the development and sustainment of competitive business advantages. While many companies have attempted to upgrade their logistics capabilities through integrated supply chain management and complex information technologies, there are still relatively few companies that excel in the area of logistics (Closs and Xu 2000).

According to RBT, this is due to the fact that distinctive logistics capabilities result from a complex arrangement of physical assets, managerial assets, and organizational policies, which are often difficult to duplicate (Olavarrieta and Ellinger 1997). Accumulating key logistics assets and capabilities is a costly and time-consuming effort, therefore logistical expertise is rare and difficult to duplicate.

The logistical expertise of companies like WalMart and Federal Express can be used to illustrate this point. Their effective dedication of resources has focused on improving information technology and logistics systems through the generation of economic rents. This has enabled them to remain market leaders in their respective fields. As a result, competing firms like K-Mart and United Parcel Service, even after continuous efforts to benchmark their competitor's logistics systems, have been unable to close the competitive gap (Olavarrieta and Ellinger 1997).

Reverse Logistics Objectives of AMC

Reverse logistics activities have been performed in one form or another for as long as armies have met on the battlefield. Terms like redeployment, retrograde movement, reparable item management, and reutilization have existed since before the inception of the Air Force, yet only in recent years has the management of reverse channels received distinct attention. Thus far, most of this attention has been focused on the movement of reparable assets to depot-level repair stations.

Reparable item management is a critical process, as these items are intended to be a source of future serviceable items for various mission-critical systems. The management of these items can be a complex and expensive task, typically even more so than traditional forward logistical operations. This is due in part to the fact that reparable items are often moved via premium transportation to points of repair to expedite their return to stock and reduce inventory investments (Diener 2004, Kahler 2004). For example, the US Army handled over 600,000 unserviceable equipment maintenance parts, valued at nearly $2 billion in fiscal year 2000 alone. (Diener 2004). Almost half of these items were repaired and returned to stock. Similarly, the Air Force shipped over 250,000 reparable parts, incurring approximately $40 million in transportation costs in just the period between January and July of 2002 (Kahler 2004). Because of the critical nature and high costs involved, the management of reparable items as a distinct reverse channel operation has been the primary focus of several studies focusing on RL across the DoD (Banks 2002, Diener 2004, Kahler 2004).

A recent Air Force Institute of Technology study examined the RL practices and objectives of AMC, and determined them to be almost exclusively focused on the retrograde of reparable assets (DeVoure 2004). According to the study, AMC's primary roles in the reverse logistics initiatives are:

1. The movement of cargo flowing back from overseas locations and / or United States locations to maintenance depots for repair and regeneration.

2. To synchronize retrograde cargo centric networks (both air and land) to maintenance depot repair cycle schedules for minimum wait times at the depot.

3. Provide a system of visibility to all users for the effective and efficient tracking of assets whether it be land, air, or sea based. This level of visibility should be easily tied into by all services and components of the process.

4. To decrease the amount of time it takes to move cargo through aerial ports.

5. Ensure reverse logistics movement requirements are forecasted and known to increase the efficiency of scheduling and reduce wasted carrying capacity.

6. Use the Transportation Capital Working Fund for cost minimization across the program.

AMC's RL objectives, as identified by DeVoure, do not include the management of reusable containers or 463-L assets. This is in contrast to the majority of current RL literature, which clearly categorizes reusable shipping assets as an important aspect of RL operations.

463-L Program

Early History of the 463-L System

The transportation of air cargo has served a critical role in military strategy since World War II. In the China-Burma-India Theater, C-47 transport planes were successfully used to supply China, which had been cut off by the Japanese capture of Burma in 1943. After the war, the dramatic impact of airlift was once again evident as the United States was able to effectively sustain the communist blockaded West Berlin for 11 months. During the times of these operations, most cargo was loaded manually, piece by piece. Often, larger pieces were completely disassembled to fit through narrow aircraft doors. Although these manual techniques proved effective during these operations, they were time consuming and labor intensive.

With the introduction of large cargo aircraft in the early 1950's, such as the C-124, C-130, and C-133, came the need for an improved cargo loading system (Harvey 1988). During this period, significant progress was made toward the mechanization of cargo handling by both the military and the civilian sector. While Lockheed studied the practicality of a pallet system for the C-130 aircraft, Douglas Aircraft Corporation developed a similar system for the C-133. Douglas later concluded that, "…the key to any effective cargo loading system is the platform used to transport the cargo, in essence, a pallet of some sort." (Harvey 1988).

Later in the decade, the Air Force developed Specific Operational Requirement 157 (SOR 157) to address this requirement. SOR 157, dated 8 Mar 1957, called for the development of a complete materials handling system, compatible with the various modes of transportation required for accomplishing the Air Force's air logistics mission (SSP 1962). In August of 1961, the Department of the Air Force, in conjunction with the Army and Navy, was directed to prepare a joint development and implementation plan for such a system (SSP 1962). The Air Force Systems Command released the resulting document, titled *System Package Program (SPP) for Materials Handling Support System*, in November of 1962. The SPP detailed all relevant specifications, including system requirements, implementation schedules, and cost data. The package also broke down the material handling system into five families of equipment (SSP 1962).

1. *Terminal Family* - Air transport terminals for airhead operations, conveyorized terminals that provide sorting capabilities and automated terminals consisting of conveyors, power and automatic sorting in terminals in terminals of high traffic flow.

2. *Cargo Preparation Family* - Pallets, restraining nets and consolidation containers are designed to increase the speed and efficiency in cargo preparation, loading, and unloading.

3. *Ground Handling Family* - Includes a variety of self propelled and adjustable height loaders, trailers, and modified forklifts designed for the rapid loading and unloading of cargo aircraft.

4. *Aircraft Systems Family* - Rails, rollers and locks which attach to the floor of cargo aircraft provide for rapid loading, offloading, and restraining of

pallets. The aircraft systems are compatible with aerial delivery where required.

5. *Intransit Control*. - The requirement for documentation and clerical operations associated with the receipt of cargo, its progress through the terminal, and the preparation of manifests.

The 463-L Designator

There has been considerable discussion regarding the origin of the 463-L designator associated with this system. Anecdotal evidence, as well as some published reports, traces the designator to a particular milestone in the system's development or inception (Harvey 1988; Schroeder and Martinez 1997). An Air Force Armstrong Laboratory report from 1997 claims the system officially entered service in April of 1963, while others have claimed the original logistics study began at this time. Thus, "463" represents April of 1963, and the "L" is a logistics designator (Harvey 1988; Schroeder and Martinez 1997).

The archival data uncovered in this study loosely supports Armstrong Laboratory's position. The original study began with the release of SOR 157 in November of 1957. This led to the first Systems Package Plan of 1962 which included the 463-L designator, as did other documentation from as early as 1961 (SSP 1962, Crawford 1961). Although the origin of 463-L designator seems to predate April of 1963, the master schedule contained in the revised Systems Package Plan from November of 1965 shows that the first aircraft, C-133's, were in fact equipped with the 463-L system during the second quarter of calendar year 1963 (SSP 1962). Because documentation exists referencing the 463-L system from years prior to 1963, the contention would have to be that the program designator was based on a forecasted inception date for the system, which then turned out to be accurate.

463-L Pallet Construction

The materials and basic design of the 463-L pallet have changed very little since the system was first introduced in the early 1960's. The weight of the 463-L pallet is 290 pounds and its overall dimensions are 88 X 108 X 2.25 inches, with usable dimensions of 84 X 104 inches (T.O. 35D-33-2-2-2). The pallet is made with an aluminum skin and balsa wood core, and is framed on all sides by aluminum rails. The rails have 22 tie-down rings attached with six rings on each long side and five ring on each short side.

Problems with the pallets design have long been a topic of concern. Studies from the mid 1980's and early 1990 have resulted in thicker bottom skins and reinforcement of the pallet corners to help increase durability. Yet a 1997 Armstrong Laboratory report identified the need to further improve the pallet materials to remedy several problems associated with the design. Specifically, the separations of the aluminum skin caused by water seeping into the balsa wood core continued to be a major cause of pallet damage (Schroeder and Martinez 1997).

In their 1997 study, Schroeder and Martinez estimated annual pallet repair costs to be in excess of $5 million dollars. With the current operational tempo, pallet repair costs have far exceeded those estimates. In fact, the Air Force has funded nearly 60,000 repairs since the Global War on Terrorism (GWOT) began in late 2001 (Brogden 2004).

With an average repair cost of $810, total costs have reached nearly $48 million dollars during this time period, as indicated in Table 4.

Table 4. 463-L Pallet Repairs FY 2002 to FY 2004

Fiscal Year	Repairs Funded	Cost
2002	11,980	$9,703,800
2003	17,007	$13,775,670
2004	30,116	$24,393,960
TOTALS	**59,103**	**$47,873,840**

WR-ALC/ LESVG (2004)

463-L Pallet Vendor

The current source for 463-L pallets is AAR Corporation, which is headquartered in Wood Dale, Illinois. AAR Corp. has been at the forefront of air cargo handling and logistics systems for military applications for more than 40 years. In the late 1950's, the company—then known as Brooks and Perkins—began working with the Air Force on the 463-L system. Brooks and Perkins designed, tested, and produced the roller conveyor, aerial delivery system, and pallets for the newly introduced Lockheed C-130 transport aircraft. Although other sources of pallet manufacturers can be found in early acquisition data, Brooks and Perkins/AAR Corp. quickly became the sole source vendor for new 463-L pallets.

AAR Corp. is also the sole source for depot level repair of 463-L pallets. The continuous requirement for pallet repair allows AAR Corp. to remain proficient and profitable when not producing new 463-L pallets for the Air Force. AAR Corp also allows the free storage of unfunded 463-L repairs at its repair facility, which is of benefit to the Air Force. While AAR Corp. has indicated a maximum repair capability of 10,000 per month, current funding allows for repair rates of only 2,500 monthly (Brogden 2004). As of December 2004, there approximately 30,000 pallets waiting for repair at AAR Corp.

Though AAR Corp. has been the only source for both new purchase and repairs in recent years, the Air Force continues to solicit bids from other manufacturers for new acquisition and repair contracts. However, due to their efficient production capabilities, knowledge, and expertise in manufacturing of 463-L pallets, no other manufacturer has been awarded a contract through the competitive bidding process, which focuses primarily on per unit acquisition costs.

The Air Force has explored the idea of organic pallet repairs in the early 1980's, and again in the early 1990's. In both instances such repairs were deemed to be economically unfeasible due to the large upfront capital requirements for facilities and specialized equipment.

Current Program Management Guidance

The Defense Transportation Regulation 4500.9-R, Part VI (DTR 4500.9-R), titled "Management and Control of Intermodal Containers and System 463-L Equipment", outlines DOD policies, responsibilities and procedures governing the management and control of intermodal containers and management of system 463-L pallets, nets, and tiedown equipment.

The DTR dictates that 463-L pallets and nets be divided into two separate categories: daily operational assets and War Reserve Material (WRM) assets. WRM assets are kept separate from operational assets and are not authorized for normal operational use without the approval of the Item Manager (IM) at WR-ALC. Any Service or DOD organization may be authorized pallets, however, whether operational or WRM, all 463-L assets are funded and purchased by the Air Force Material Command, and therefore remain Air Force property.

According to the DTR, 463-L asset management is accomplished through a collaborative effort between AF MAJCOM and DOD Component pallet and net monitors, who have daily operational control of the assets, and the System Program Manager (SPM) and Item Manager (IM), both at WR-ALC, who provide acquisition and engineering support for the 463-L assets. New production and repaired WRM and operational assets are distributed by the IM. Once in the inventory, the respective AF MAJCOM or DOD Component pallet and net monitors manage pallets and nets and redistribute them as required within their respective commands. Command level pallet and net monitors rely on weekly reports generated by all organizations possessing 463-L assets to identify overages and shortages, and make adjustments. Command level monitors are required to submit a consolidated report to the IM at WR-ALC on a quarterly basis. The IM uses this report to determine if transfer of assets between MAJCOMS or DOD Components is required.

Contingency Program Guidance

> *The efficient operation of the 463-L air cargo handling system becomes more crucial during contingencies when large volumes of cargo must be moved on an international scale over a short period of time. The availability of air cargo pallets, nets, and tiedown equipment for the prepalletization of cargo during these contingencies is assumed in the logistics distribution planning process. Consequently, their nonavailability could totally disrupt the scheduled airlift flow of cargo and ultimately impact the outcome of the operation.* (DTR 4500.9-R Jun 2002)

When an actual contingency or crisis exists, WRM assets are incorporated into the operational inventory through a joint effort between the separate Command monitors and WR-ALC. When instructed, all organizations possessing WRM assets release them for immediate redistribution. Once the total combined inventory has been established, the DTR tasks the IM with estimating the attrition, damage, and usage for the operations at hand, and initiating accelerated production or repairs as required.

The inventory objectives for the 463-L asset program are based on retrograde pallets flowing back for redistribution during a contingency. Therefore it is essential that deployed units break down pallets as quickly as practical and return the assets to the airlift system. The use of pallets for purposes other than palletizing and transporting cargo is strictly prohibited by DTR, even during contingency operations. During these operations, supported geographic commanders are specifically tasked by the DTR with establishing and enforcing effective pallet and net return programs, although no specific guidance is provided in the DTR for accomplishing this objective.

Assignment of AMC as the Single Process Owner for the 463-L System

A September 2004 message from USTRANSCOM assigned AMC as the single process owner for 463-L system equipment worldwide. By assigning this responsibility to AMC, which is the aircraft owner and single largest user of 463-L assets, USTRANSCOM hopes to eliminate the existing fragmented responsibilities between AMC, other AF MAJCOMs, and WR-ALC concerning the 463-L system (USTRANSCOM 2004). The specific details of this initiative where not yet available at the time of this study.

Inventory Summary

Policy for determining both the operational and WRM 463-L pallet inventory objectives is outlined in DTR 4500.9. Each organization authorized possession of 463-L pallets in responsible for updating their individual operational and WRM requirements annually. The DTR provides basic rules for determining WRM requirements at the unit level, and assigns AMC the responsibility of determining requirements to support non-organizational and re-supply cargo for the first 90 days of contingency operations. This 90 day supply of assets (increased from 30 days following Desert Storm) is intended to satisfy the sustainment requirements of deployed forces until a pallet and net return program can be established in the theater and effective back-haul of pallets can occur.

Prior to Desert Shield/Storm, the Air Force's inventory objective for 463-L pallets was approximately 144,000 (AAP 1992). Although at the onset of the war, less than 120,000 were actually on-hand. Approximately 35% of these were considered lost at the conclusion of the war (AAP 1992).

After the war, the Air Force took steps to replenish the depleted inventory. In February of 1992, the Air Force purchased an additional 45,000 pallets with a $50 million grant from the Japanese government, as part of that country's contribution to the war efforts (AAP 1992, Brogden 2004). As the new acquisition pallets began to enter the airlift system, so too did many of the pallets thought to be lost during the war. The Air Force also continued to purchase approximately 5000 new pallets annually, and by the late 1990's, the on-hand inventory of pallets had far exceeded the established inventory objective levels. In fact, inventory levels became so high that in 1998 the Air Force was forced to pay for contracted storage of surplus pallets and new acquisitions were halted (Brogden 2004). By September of 2001 the Air Force had 183,138 pallets on-hand, some 30,000 more than required by the inventory objective (Brogden 2004). Although a large surplus of pallets existed prior to the Global War on Terror (GWOT) and Operation IRAQI FREEDOM (OIF), the Air Force began to realize significant attrition rates as these operations progressed and inventory objectives were re-evaluated, resulting in a an inventory objective of 229,003.

Assessment of Current Situation

Current estimates of 463-L losses surpass those of Desert Storm, with little relief in sight. Table 5 details the recent changes in inventory objectives, on-hand pallet numbers, losses, and the number of pallets awaiting repair. Monthly losses continue to significantly outnumber the incoming new acquisitions and depot repairs. Of the over 183,000 463-L pallets on-hand prior to September 2001, the Air Force can only account for approximately 85,000 as of December 2004. Inventories of pallet nets have been similarly impacted with approximately 220,000 nets unaccounted for.

Table 5. Pallet Inventory History August 2001 to Dec 2004

	Aug 2001	Jan 2003	Oct 2003	Dec 2004
DOD Inventory Objective	152,804	170,434	171,658	229,003
Total Pallets On-Hand	183,134	155,972	98,479	85,704
Objective minus On-Hand	30,330	(14,462)	(73,179)	(143,299)
Actual Losses Since Aug 2001	N/A	27,162	84,655	97,430
Assets Awaiting Repair	7,476	17,599	19,810	30,000

WR-ALC/ LESVG (2004)

There are many factors contributing to the current high attrition rates. As has been the case in every major operation since Vietnam, a large number of 463-L pallets are being used for unauthorized purposes; many times out of necessity, as other suitable materials are not readily available for deployed troops. Another possibly more significant factor may be the physical enormity of the supply chain required to provide logistical support to the ground forces deep within Iraq. Operation IRAQI FREEDOM is one of the largest logistical supply and support efforts that the U.S. military has ever undertaken. Of the $28 billion that the DOD obligated for OIF prior to July 31, 2003, more than 50 percent was dedicated to support and transportation costs (GAO 2003). So far, OIF combat and sustainment operations have lasted substantially longer than those of Desert Storm. Additionally, combat forces are operating much farther into Iraq and in greater numbers than ever before, resulting in extremely long and dangerous supply channels (GAO 2003). With almost daily insurgent attacks on military convoys within

Iraq, putting extra trucks on the road to return empty 463-L pallets is a risky proposition. Until coalition convoys can safely move assets from far inside Iraq to points of reclamation, the retrograde of pallets, which is the key to determining WRM inventory levels and planning logistical requirements, will continue to be a major operational constraint.

III. Methodology

Chapter Overview

This chapter begins by presenting the research paradigm and describing the research methods used to conduct the study. Next, the issues of validity and credibility are addressed, with emphasis on the topic of triangulation. Finally, the sampling methodology employed to select the interview candidates is presented, along with an explanation of the standardized questions used to make the comparisons.

Research Paradigm

Due to the nature of this study, qualitative methods will be use to address the research problem and answer the investigative questions outlined in Chapter One. Specifically, a literature review will be conducted to identify common or reoccurring factors that tend to impact RL program performance, and to determine how RBT applies to RL operations. Once these factors are identified, a collective case study methodology will be applied to make comparisons between the current 463-L program and a similar program of an industry leading air cargo carrier. Additional relevant information concerning the 463-L program that is outside the scope of the direct comparison will also be presented as it relates to specific factors presented.

Qualitative Research Purpose

Qualitative research refers to any kind of research that produces findings not arrived at by means of statistical procedures or any other means of quantification (Strauss and Corbin 1990), and generally serves one or more of the following purposes (Peshkin 1993):

- *Description.* They can reveal the nature of certain situations, settings, processes, relationships, systems, or people.
- *Interpretation.* They enable a researcher to (a) gain insight about the nature of a particular phenomenon, (b) develop new concepts or theoretical perspectives about the phenomenon, and/or (c) discover the problems that exist within a phenomenon.
- *Verification.* They allow the researcher to test the validity of certain assumptions, claims, theories, or generalizations within real-world contexts.
- *Evaluation.* They provide a means through which a researcher can judge the effectiveness of particular policies, practices, or innovations.

Qualitative Research Methods

Prior to selecting a particular research design, five different qualitative methods were reviewed for the purposes of this study. Of the five designs considered, case study methodology was determined to be the best fit, and was used to conduct this study. Table 6, summarized from Leedy and Ormrod (2001) describes each of the five methods.

Table 6. Summary of Qualitative Research Methods

Design	Purpose	Focus	Methods of Data Collection
Case Study	To understand one person/event in depth	One/few case(s) within natural setting	- Observations - Interviews - Written documents
Ethnography	To understand how behaviors reflect the culture of the group	A specific field site in which people share a common culture	- Participant observation - Interviews -Artifact/document collection
Phenomenological Study	To understand an experience from the participants' point of view	A particular phenomenon as it is typically lived/ perceived by humans	- In-depth interviews - Purposeful sampling
Grounded Theory Study	To derive a theory from data collected in a natural setting	Human actions/ interactions, and how they influence one another	- Interviews - Any other relevant data sources
Content Analysis	To understand specific characteristics of a body of material	Any verbal, visual, or behavioral form of communication	-Identify sampling of material to be studied - Coding of the material

(Leedy and Ormrod 2001)

In a case study, a particular individual, program, or event is studied in-depth in an effort to understand more about a little known or poorly understood situation (Leedy and Ormrod 2001). Case studies can focus on a single case, or two or more cases can be studied in an effort to make comparisons or propose certain generalizations (as is the case for this particular study). Such an approach is called a multiple or collective case study (Leedy and Ormrod 2001).

The case study approach to qualitative research represents a specific method of collecting, organizing, and analyzing data. When a particular program is the focus of the study, data can include program documents, statistical profiles, program reports and proposals, interviews with program participants and staff, observations of the program, and program histories (Patton 2002).

The analysis of case study data is typically a five-step process, as described by Creswell (1998)

1. *Organization of details about the case.* The specific facts about the case are arraigned in a logical order.

2. *Categorization of the data.* Categories are identified that help cluster the data in to meaningful groups.

3. *Interpretation of single instances.* Specific documents, occurrences, and other bits of data are examined for the specific meanings that they might have in relation to the case.

4. *Identification of patterns.* The data and their interpretations are scrutinized for underlying themes and other patterns that characterize the case more broadly than a single piece of information can.

5. *Synthesis and generalizations.* An overall portrait of the case is constructed. Conclusions are drawn that may have implications beyond the specific case that has been studied.

Data Collection Methodology

The data collection methods for this study will be reviews of existing literature and documents, interviews, and observations. First, an extensive review of Air Force regulations, instructions, and technical orders, as well as interviews with persons involved in the operation and management of the 463-L pallet program will be used to provide the researcher with the necessary background information about the topic. Next, a review of literature in the areas of reverse logistics and resource-based theory will be conducted to identify factors that impact reverse logistics program performance and identify the basic concepts of RBT. Finally, these factors will be used to formulate interview questions that will be emailed to the participants of this study, allowing for comparison between the 463-L program and similar programs of leading air cargo carriers.

Validity vs. Credibility

The concepts of internal and external validity originated in the early 1960's (Campbell and Stanley 1963). However, many modern qualitative researchers have questioned their relevance in qualitative research design (Creswell 1998; Guba and Lincoln 1988; Lather 1991). Because of this, Creswell (1998) suggests that the term validity be replaced by words like *credibility, dependability, confirmability, verification, and transferability.*

According to Patton (2002), the credibility of qualitative research depends on three distinct but related elements: *rigorous methods, credibility of the researcher, and a belief in the value of qualitative inquiry.*

Rigorous methods

Patton (2002) contends that qualitative analysis depends from the beginning on the astute pattern recognition of the researcher. For this study, the researcher will attempt to identify and review all published works in the field of reverse logistics that have identified either pitfalls or best practices as they relate to reverse logistics program performance. The researcher will also review all available literature documenting the applicability of resource-based theory to RL program performance to provide additional support.

Credibility of the researcher

The suspicion that a researcher has somehow shaped the findings according to certain predispositions or biases can be a significant barrier to credibility (Patton 2002). Patton suggests several strategies for overcoming such suspicions. These include stating one's predispositions and biases, and acknowledging one's orientation as it relates to the research, as well as a technique called triangulation.

The first step in overcoming personal biases is a method called *epoche.* Derived from the Greek word e*poch*, meaning to refrain from judgment, e*poche* is a process that the researcher engages in to remove, or at least identify prejudices, viewpoints, or assumptions regarding the phenomenon under investigation (Patton 2002).

Having been assigned to the AMC for 13 years, the researcher was familiar with the 463-L cargo system prior to conducting this research. However, the researcher was not aware of the problems of 463-L pallet accountability until shortly after September of 2001. During this period, the researcher directed the airfreight operations at the 735th Air Mobility Squadron, Hickam Air Force Base, Hawaii and began to develop a basic understanding of the current pallet problem. As a result, the researcher entered this project with the predisposition that a problem existed with management and accountability of 463-L assets during contingency operations, however, the magnitude of the problem did not become apparent until later in the project.

As previously stated, the goal of this research was to determine what factors affect reverse logistics program performance, and determine how the Air Force's 463-L program compares to the programs of leading commercial carriers with respect to those factors. To this objective the researcher had very few, if any predispositions. Knowledge of reverse logistics and resource-based theory was limited to very broad academic concepts. If fact, at the outset of this project, the researcher was unsure if sufficient literature even existed in the field of reverse logistics to allow for the identification of multiple impacting factors.

The fact that multiple factors were identified from multiple sources, from both reverse logistics and resource-based theory literature helps to overcome the intrinsic bias that comes from a single researcher (Patton 2002). This method is called triangulation and will be discussed in detail in later paragraphs.

The value of qualitative inquiry

Much of the controversy surrounding qualitative research stems from doubts about the nature of the research itself. While quantitative or statistical analysis follows specific rules and procedures, qualitative research often relies on the insights and capabilities of the researcher. Additionally, quantitative research is typically used to measure the relationship between measured variables with the purpose of explaining, predicting, or controlling phenomenon, while qualitative research is typically used to answer questions about the complex nature of a phenomenon (Leedy and Ormrod 2001). Because of these differences, qualitative research is often criticized as failing to meet the minimum requirements for scientific comparison, therefore being scientifically worthless (Cooper and Irwin 1995). However, well-defined case studies often challenge theory and yield conclusions that promote a better understanding of the phenomenon, enabling more accurate predictions about future events (Leedy and Ormrod 2001).

Triangulation

The term *triangulation* is taken from land surveying. Knowing a single point along with one's own coordinates simply locates one along a line in a direction from that point, whereas two points will allow for a precise location at their intersection. This method can be applied metaphorically to research. Patton (2002) presents four methods of triangulation that can contribute to the credibility of research.

1. *Methods triangulation:* Checking out the consistency of findings generated by different data collection methods
2. *Triangulation of sources:* Checking out the consistency of different data sources within the same method
3. *Analyst triangulation:* Using multiple analysts to review findings
4. *Theory/perspective triangulation:* Using multiple perspectives or theories to interpret data

Methods triangulation

The factors presented in this study were complied from a large pool of literature that utilized varying methods of data collection. Rogers and Tibben-Lembke (2002), among others, conducted notable survey work with diverse groups of logistics professionals to identify barriers to RL program performance. Others, such as

Daugherty, Autry, and Ellinger (2001) and Ross (2002) were able offer empirical evidence to support their conclusions. In many cases, multiple authors using different methodologies identified similar factors presented in this study.

For the data collection portion of this study, the researcher conducted face-to-face and telephone interviews, and used electronic mail to distribute, and follow-up on, interview questions.

Triangulation of sources

The literature reviewed for this study included professional journals and trade publications, conference papers, and logistics textbooks that were authored by both logistics professionals and academics experts. In each case, a minimum of four distinct sources were identified to support each of the factors identified in this study.

For the data collection portion of this study, the researcher interviewed program managers, engineers, acquisition personnel, and other subject matter experts within the Air Force to collect data regarding the 463-L program. Data from the commercial carrier was provided by a single point of contact within the organization that disseminated interview questions to the appropriate internal experts.

Analyst triangulation

Feedback from colleagues, academic advisors, and other logistics professionals was sought to help develop interview questions and to determine if logical conclusions have been reached based on the data collected.

Theory/perspective triangulation

As previously stated, this study investigated the topics of resource-based theory as it applies to both logistics and reverse logistics operations, and documented factors that impact RL program performance. Any convergence of these two separate bodies of literature, presented by different authors, may provided multiple perspective support and credibility for the factors identified.

Commercial Air Cargo Carrier Interview Selection

For this study, express air cargo carriers were thought to be the closest commercial equivalent to the Air Forces air cargo operation. Commercial carriers also utilize reusable shipping platforms, referred to as Unit Load Devices (ULDs). ULDs serve the same basic role in the commercial air cargo industry that the 463-L pallets do in military applications. During peacetime operations the two systems operate similarly, as the majority of assets remain in the custody of the shipper and a relatively small number are lost. Although the management of 463-L assets becomes increasingly difficult during contingency operations, this comparison still provides a valid base-line evaluation of resource allocation to the respective programs. That is to say, if the 463-L program becomes more complicated during contingency operations, the resource dedication to the program should be, at the least, equal to that of the less complicated commercial operation.

When performing a collective case study, extreme or deviant case sampling is often employed to select comparative cases. Extreme case strategy involves selecting cases that are particularly information rich because they are unusual in some way, such as outstanding successes or notable failures (Patton 2002). For the purposes of this study, candidates were selected based on rankings complied in Air Cargo World's (ACW) annual "Top 50 Cargo Airlines" report for 2004, which ranks air cargo carriers based on the total number of freight-ton kilometers (FKT's) flown annually (ACW 2004). Federal Express (FedEx) and United Parcel Service (UPS) were the top ranked cargo carriers based in the United States, and were asked to participate in this study. Additionally, ABX Air, formally Airborne Express, was selected due to its close proximity to the researcher. This is known as convenience sampling (Leedy and Ormrod 2001).

All three companies contacted agreed to participate in the study. However, due to the increased seasonal workload during the data collection period (November through early January), only one company was able to provide responses in the timeframe required for this study. These responses were provided under agreement of non-attribution, and as such the company will be solely referred to as the *commercial carrier* throughout the remainder of this study.

463-L Program Interview Selection

According to the DTR, the management of the 463-L asset program is a collaborative effort between the acquisition team at WR-ALC and the AF MAJCOM pallet and net monitors. However, as previously stated, recent USTRANSCOM guidance has directed AMC to take ownership of the worldwide DOD system 463-L equipment. Therefore, the AMC command-level pallet and net monitor, along with the acquisition and engineering team at WR-ALC, were both interviewed to gather general information regarding the 463-L program as well as specific data to allow for comparison with the selected cargo carriers.

Interview Questions

Interview questions where developed with the goal of comparing the 463-L program and the programs of commercial carriers based on the identified RL factors, and to provide background information to allow for a basic comparison of the programs. The main focus of the questions centered on the dedication of personnel, management, and technological resources to each respective program, as identified in both RL and RBT literature. The interview questions are included in Appendix 1.

Summary

This chapter provided an explanation of the methodology used to answer the basic research question. The chapter began with an introduction to qualitative research, provided a justification for the selection of the case study for this research, discussed the credibility of the research, and explained the interview selection and data gathering processes. The next chapter will present the findings and analysis followed by the conclusions and recommendations.

IV. Results and Analysis

Chapter Overview

This chapter presents the analysis and results of the research study. Findings of the literature review, interviews with Air Force and commercial carrier subject-matter experts, and other observations are analyzed by examining each of the original investigative questions presented in Chapter One.

Investigative Question One

What are the factors that tend in impact RL program performance?

This study began with a review of the most current literature available on the subject of RL, and the sources most commonly cited in these works were further examined. Additionally, the work of Carter and Ellram (1998) provided a detailed summary of RL literature existing at the time of their research that proved useful in identifying other relevant works. In all, over seventy publications on the topics of reverse logistics and resource-based theory were examined for this research. The study initially identified 16 reoccurring factors that either helped or hindered RL operations. Of the 16 factors, several were very similar and thus grouped together (i.e. top management support and top management inattention), reducing the list to 10 factors. Of the remaining 10 factors, eight were further categorized as resource-related factors.

A decision was made to investigate only the resource-related factors for this study. This decision was made for two reasons. First, the two non-resource related factors focused more on specific operational aspects of RL operations that may not be applicable in a broad range of situations. Second, investigating the topic of resource-based theory as it applies to both logistics and reverse logistics operations provided additional theoretical support for the remaining factors. A consolidated list of factors is provided in Table 7, along with an index of the authors who have identified, described, or otherwise investigated the respective factors.

Table 7. Factors Impacting Reverse Logistics Program Performance

Factor	Resource Type+	Noted By*
Relative importance of RL	Managerial	1,6,8,9,13,19
Company policies	Managerial	1,6,9,19
Top management support	Managerial/Financial	1,9,10,19,20
Mid level management support	Managerial	2,3,10,11
Use of centralized return centers	Non-resource (operational)	1,3,6,7,10
Separating FL and RL systems	Non-resource (operational)	1,3,4,5,13,16
Use of return incentives	Financial	6,7,11,14
Personnel resource commitment	Financial	1,3,9,10,17,18,19
Financial resource commitment	Financial	1,6,8,9,10,13,15,17,18,19
Information/technology systems	Technological	1,3,6,9,10,11,14,15,17,20

\+ Daugherty et. al (2002, 2004)

* Described by the following authors:

1. Rogers & Tibben-Lembke (2001)
2. Drumwright (1994)
3. Lee, McShane & Kozlowski (2002)
4. Guide et. al (2000)
5. Sarkis (1995)
6. Gooley (1998)
7. Kroon et. al (1995)
8. Zieger (2003)
9. Stock (2001)
10. Daugherty et. al (2001)
11. Carter & Ellram (1998)
12. Daugherty et. al (2002)
13. Tibben-Lembke & Rogers (2002)
14. de Brito & Dekker (2002)
15. Witt (2000)
16. Jayaraman & Strivastava (2000)
17. Giuntini & Andel (1995)
18. Olavarrieta & Ellinger (1997)
19. Stock (1998)
20. Ross (2002)

With reverse logistics, a broad range of resources is often required. Grant (1991) identified six major categories of resources: financial, physical, human, technological, reputation, and organizational. Others have more broadly categorized resources as managerial, financial, or technological (Daugherty 2002 et al., Daugherty 2004 et al.). All of the resource-based factors identified in the RL literature fall into one or more of these resource categories.

Investigative Question Two

How does resource-based theory apply to reverse logistics program performance?

When applied to reverse logistics, RBT suggests that relationship between resources committed to RL operations and program performance will be positively correlated (Daugherty, Autry, Ellinger 2001). Several researchers have offered empirical evidence to support parts of this theory. In 2002, Anthony Ross, a professor of supply chain management at Michigan State University was able to identify a positive relationship between information technology investment and productivity of logistics operations, supporting the findings of earlier researchers (Ross 2002, Armstrong and Sambamurthy 1999). Similarly, the work of Daugherty, Autry and Ellinger (2001) identified a positive correlation between the level of managerial resource commitment and RL program performance. Attempts to identify significant correlations between financial commitment and RL program performance have thus far not been successful, although researchers have little doubt that such correlations do exist (Daugherty 2004). This may be, at least in part, due to the fact that observed firms continue to commit relatively low levels of financial resources to RL operations and allocations may not have been high enough to positively impact RL program performance (Daugherty, Autry and Ellinger 2001).

The documented relationship between certain aspects of RBT and RL program performance seems to provide further support for the relevance of the resource-based factors identified in the reverse logistics literature.

Investigative Question Three

What activities do the Air Force and AMC consider to be reverse logistics activities?

Nearly all of the articles, studies, and government publications reviewed for this study focus almost entirely on the management of depot-level reparable assets when examining applications of RL within the DOD (Diener 2004; Banks 2002; DeVoure 2004; Walden 2001; Wang 2001; AFMC Background Paper 2003). No specific guidance was identified categorizing the management of 463-L pallets as a RL activity.

AMC is the largest single user of 463-L pallets and may soon be the agency responsible for the daily operational management of the entire program. As stated in Chapter 2, DeVoure (2004) identified six primary roles that AMC serves in the current DOD reverse logistics initiatives. They are:

1. The movement of cargo flowing back from overseas locations and / or United States locations to maintenance depots for repair and regeneration.

2. To synchronize retrograde cargo centric networks (both air and land) to maintenance depot repair cycle schedules for minimum wait times at the depot.

3. Provide a system of visibility to all users for the effective and efficient tracking of assets whether it be land, air, or sea based. This level of visibility should be easily tied into by all services and components of the process.

4. To decrease the amount of time it takes to move cargo through aerial ports.

5. Ensure reverse logistics movement requirements are forecasted and known to increase the efficiency of scheduling and reduce wasted carrying capacity.

6. Use the Transportation Capital Working Fund for cost minimization across the program.

The management of 463-L pallets has not been identified as one of AMC's reverse logistics objectives. This is in contrast to most trade publications, books, and RL articles that specifically categorize the management of reusable shipping assets as a distinct RL activity. Professional groups, such as the European Working Group on Reverse Logistics, and the Reverse Logistics Executive Council have taken similar positions on the management of reusable shipping containers and pallets, as have many of the leading researchers in the field (Stock 1998, Carter and Ellram 1998, Rogers and Tibben-Limbke 2001, De Brito and Dekker 2002).

The fact that Air Force has yet to identify the management of reusable shipping assets as a reverse logistics activity seems to indicate a lack of awareness of evolving commercial logistics practices. Additionally, it may also indicate that the program is viewed as relatively less important than other RL activities, such as reparable item management, which the Air Force has classified as an RL activity.

Investigative Question Four

How does the current Air Force 463-L program compare to similar programs managed by industry-leading air cargo carriers in the areas identified as critical to reverse logistics operations?

General Comparison

Commercial air cargo shipping assets, called Unit Load Devices (ULDs), serve the same basic role in the commercial air cargo industry that the 463-L pallets do in military applications. They enable individual pieces of cargo to be pre-assembled into standardized units to assist the rapid loading and unloading of cargo aircraft. This enables the increased utilization of available aircraft capacity while decreasing aircraft ground times.

During normal peacetime operations, the movement of ULDs and 463-L pallets through their respective airlift systems is very similar. Often referred to as closed-loop systems, the assets generally remain in the custody of the shipper. In AMC, pallets are strategically pre-positioned at AMC aerial ports, where they are used to build-up and ship outbound cargo to various other military installations, often other AMC operated aerial ports. Under this system, the majority of 463-L pallets remain in AMC custody for continual reuse, as evidenced by rather low attrition rates experienced during these times.

Commercial air cargo carriers operate in much the same manner; the majority of company owned assets generally remain under company control. This is not always the case however, as ULDs do travel outside of the individual airline's own system on a regular basis. Although the percentage is relatively low when compared to the overall number of shipments, it represents a major concern and expense for commercial carriers. While the price of the Air Force 463-L pallet is approximately $1,000, the price of a commercial ULD can be as high as $5,000 per unit (Brogden 2004, Commercial Carrier 2004).

During contingency operations, the movement of 463-L pallets operates much less like a traditional closed-loop system. Many 463-L pallets are built entirely for a specific unit that is often operating far beyond the reach of the in-theater aerial port. Under what has been titled the "pure-pallet initiative", pallets are not broken down at the aerial port; instead the entire pallet is transported to the user via surface mode. Although this process is ultimately more efficient, it presents challenges that are distinctly different and more complex than those faced by the commercial air carriers. Though the 463-L and ULD programs operate differently at these times, a comparison of the two may still prove useful in evaluating the dedication of resources to the Air Force's 463-L program. For example, if in fact the 463-L program is much more complex and difficult to manage than the similar programs of the commercial sector, one could logically conclude that the dedication of financial, technological, and managerial resources would have to be some degree higher than the commercial carrier to facilitate equivalent program success.

For this study, a comparison between the Air Force's 463-L pallet program and the program of a leading air cargo carrier was performed. The general details of each program are provided below, followed by specific comparisons as they relate to each of the factors identified in Question 1.

Table 8. Summary of Military vs. Commercial Program

	Air Force 463-L Program	Commercial ULD Program
Number of Assets	183,134[1]	74,600
Cost per Unit	$1,000	$2,400[2]
Total Cost of Inventory	$180,410,000	$179,040,000
Annual Ton-Miles Flown	6.27 billion[3]	8.28 billion[4]
Average Annual Pallet/ULD Losses	5,000[5]	4,600

(WR-ALC 2004, Commercial Carrier 2004)

1. On-hand inventory prior to September 2001
2. Average cost of 12 different types of assets in inventory
3. Includes channel cargo, passenger movements, Special Assignment Airlift Missions, exercises, and training (FY 2004)
4. Data for calendar year 2003
5. Peacetime estimate

A comparison of the two programs in general terms was designed to help evaluate the similarities between the programs during normal peacetime operations and establish a valid basis for comparison. Although the Air Force maintains a higher inventory, the dollar values of the inventories are nearly identical. The fact that the inventory values are so close is of particular importance because it establishes a similar level of financial significance for each program and a similar level of responsibility on the part of each program manager.

Also of note are the average annual losses experienced by each organization. The data collected indicates a similar average attrition rate of assets for the two programs, even though the commercial carrier flew 2.01 billion more ton-miles than did AMC. Although inconclusive, this may be an indication of better asset accountability on the part of the commercial carrier.

Company Policies

In order to be effective with RL, companies must establish policy that addresses the complex issues involved with reverse operations. Table 9 summarizes the results of the comparison of organization policy. Both the Air Force and the commercial carrier have specific company policy in place governing their respective programs. In both cases, company-wide policy is established at the upper levels of management and includes technical publications, instructions, maintenance manuals, official messages, and various bulletins. With both organizations, policy is disseminated to the lowest levels using a variety of methods, including hardcopy publications, CD ROM, email, and internet access. Both organizations update policy on an ongoing basis.

Table 9. Comparison of Program-Specific Policy

	Air Force 463-L Program	**Commercial ULD Program**
Program Specific Policy in Place	Yes	Yes
Types of Policy	Technical orders, regulations, operating instructions, messages	Maintenance manuals, operations manuals, ULD alerts, quality bulletins
Company-Wide, Regional or Local Policy	Company-wide	Company-wide
How Policy is Disseminated	Hard-copy publications, CD-ROM, internet, email	Hard-copy publications, CD-ROM, internet, email
Frequency of Update or Review	Ongoing	Ongoing

It is important to note that this study only looked at the physical presence and characteristics of company policy in the two organizations and that the actual policy of the commercial carrier was not released for this project.

Top Level Management Support

As previously stated, top level management support is arguably the most critical factor in the success of corporate programs (Mintzberg 1973). Recent research has shown this to be equally true for RL programs (Daugherty et al. 2001). However, the level of top management commitment to a program can be particularly difficult to measure. As such, this study attempted to compare certain aspects of each program that could be considered indications of top management's commitment. Areas such as senior management interaction with the program, the number of management levels above the program manager, and the average turnover rate of the program manager position were compared as indicators of top management support. Many of the factors identified in this study are interrelated, and other areas such as technological investments, personnel dedication, and financial resource dedication can also be indicative of top management support. However, these areas will be compared as stand-alone factors as identified in the literature.

The first area of comparison focuses on the level of communication between the program manager and senior management. The purpose of this comparison is to evaluate the level of senior management interaction with the respective programs. The level of interaction can be interpreted as an indication of top management's commitment to the program. The results of the comparison are provided in Table 10 below.

Table 10. Program Manager to Senior Manager Communication

Method	Air Force 463-L Program	Commercial ULD Program
Telephone	3 per week	Daily
Email	6 to 7 per week	Daily
Face-to-Face (informally)	3 per week	Weekly
Formal Meetings	2 per week	Daily
Written Correspondence	2 per week	Monthly

The comparison of the frequency of communication between the program manager and senior management indicates more frequent contact for the ULD program manager than for the 463-L program manager. Most significant of which seems to be daily formal meetings between the ULD program manager and senior management, opposed to only two such meetings per week for the 463-L program. The ULD program manager also indicated daily telephone contact with senior management, whereas the 463-L program manger indicated only three contacts per week on average. The higher frequency of communication between the program manager and senior management may suggest that the senior management of the commercial carrier views the ULD program as more critical to the overall success of the company and therefore is more active in the daily operations of the program. Written correspondence seems to be used much less frequently in the commercial ULD program than in the 463-L program. It is possible that the daily formal meetings of the ULD program reduce the need for such formal written communications.

A comparison of the number of reporting levels between the program manager and the head of air cargo operations at each organization was intended to determine the relative position or rank of the program manager within the company. The hierarchal level of a particular position within a company can be used as an indication of the relative importance of the position, as viewed by top management. The 463-L manager reported five reporting levels of management between that position and the Commander of the Air Mobility Command, whereas the ULD program manager reported four levels to the head of air cargo operations. Because the responses are very similar, additional information relating to the organizational structure of each company would likely be needed to draw any meaningful conclusions.

The average turn-over rate for the program manager position was also intended to evaluate senior management support for the program. The rationale for this comparison is that if senior management views the program manager as a position critical to the company’s success, steps would likely be taken to ensure that a highly qualified candidate continued to fill the position. As it can take considerable time to institutionalize change in large organizations with complex operations such as these, the program manager should be allowed remain in the position long enough to understand the intricacies of the program, be able to assess the current capabilities, constraints, and shortfalls, and take steps to improve the effectiveness and efficiency of the program.

A comparison of the average turn-over rates of the program manager positions revealed a potentially significant difference between the two programs. The ULD program manager has historically remained in that position for approximately five years, while the 463-L program manager usually remains in that position for only one year. With a program that is as historically problematic as the 463-L asset program, a turn-over rate of one year may not provide sufficient continuity to facilitate program success. While frequent shuffling of positions is common in the military environment, steps can be taken to improve continuity, such as creating a civilian program manager position, if top management desires to take such actions.

Mid Level Management Support

While top-management support may be required for establishing effective policy, mid-level managers are critical to policy implementation and responsible for the success of daily operations. The mid-level managers in this study were identified as the program managers. The program manager was determined to be the highest person in each organization whose primary responsibility is the management of reusable air-cargo shipping assets.

Similar to top-level management, mid-level management support is difficult to measure. For this study, the frequency of communication between the program manager and operationally subordinate personnel was used as an indication of mid-level management support for each program, and is summarized in Table 11.

Table 11. Program Manager to Operationally Subordinate Personnel Communication

Method	Air Force 463-L Program	Commercial ULD Program
Telephone	10 per week	Daily
Email	10 per week	Daily
Face-to-Face (informally)	0 per week	Daily
Formal Meetings	0 per week	Daily
Written Correspondence	1 to 2 per week	Monthly

A comparison of the frequency of contact between the program manager and operationally subordinate personnel indicates a higher frequency of communication within the ULD program than within the 463-L program. The ULD program manager indicated daily formal meetings and daily informal, face-to-face contacts with operationally subordinate personnel. No such interaction exists within the 463-L program. This may be due to a number of factors. First, the 463-L program manager is located at Scott Air Force Base, Illinois, which is not one of the Air Forces main aerial ports. As such, he is physically removed from the operational locations where most 463-L pallets are maintained and utilized. Conversely, the ULD program manager is located at the company's largest and busiest air cargo hub, making this type of interaction more practical. Second, the 463-L program manager is the only person in AMC that is dedicated to the program on a full-time basis, and therefore does not have full-time subordinate personnel at his location. Meanwhile, the ULD program manager has approximately 20 dedicated full-time persons on-site that are under his operational control.

Use of Return Incentives

Incentives can be used to reward users and other channel members for actions supporting desired program objectives, and aid in the timely return of reusable shipping assets. The commercial carrier interviewed in this study participates in a return incentive program established by the International Air Transportation Association (IATA). The program is called the Interline ULD Control User Group (IULDUG). Established in 1971, the IULDUG is a self-funded business unit, supported by approximately 60 participating airlines and cargo carriers (IATA 2004). Its main focus is to expedite the return of ULDs to carriers, but at the same time provide compensation to a ULD owner for the temporary absence of a unit by crediting the carrier with a daily demurrage. If a ULD is not return to the owner within 180 days, a non-return penalty is assessed that is roughly equal to the replacement value of the unit (IATA 2004). Consequently, the IULDUG is essentially a large accounting system, transferring funds from carriers who do not promptly return assets to the unit's owning company. According to IATA (2004), the benefits of this program include:

1. Quick return of ULDs
2. Compensation for units not promptly returned
3. Retrieval of lost units
4. Compensation for damaged units
5. Opportunity for increased revenue
6. Weekly accounting information provided for analysis

As a non-profit, user funded program, the cost for participation is relatively low. According to IATA (2004), the annual membership fee is $1,500 for the first three years and $500 for each year after. Currently there is an additional $1.40 fee for each accounting transaction. With the average cost of $2,400 per unit, the IULDUG appears to be a cost efficient and operationally effective way to provide return incentives for commercial ULDs.

Currently, no such incentive program exists for the 463-L pallet. That is not to say that incentives do not exist all together. As the retrograde of 463-L pallets is required for the uninterrupted flow of sustainment cargo, there is in fact incentive to return pallets at a strategic level. However, at the operational level, this may be difficult for users to fully understand. Often field-level personnel have more compelling reasons to not return pallets, ranging from the absence of other suitable building materials to threat of hostile actions against road convoys. Unless the on-hand supply of 463-L pallets becomes so critically low that the flow of sustainment cargo to deployed units is truly impeded, there will continue to be very little incentive to properly return pallets at the operational level.

Personnel Resource Commitment

Because RL operations involve a multitude of tasks which can be inherently more complex than many forward distribution operations, RL programs can be very labor intensive. Many companies fail to allocate sufficient personnel to RL programs. This study attempted to compare the number of personnel dedicated to each program as an indication of the respective levels of personnel resource commitment. It was discovered that there are literally hundreds of personnel in each organization that work with the programs in some respect. Estimates of total personnel involved with the ULD program were provided by the commercial carrier, however, key breakdowns of specific duties were not provided, making comparison difficult. For example, an unknown portion of the commercial carrier's program personnel are dedicated to ULD maintenance, a function that is contracted for the 463-L program. Consequently, a decision was made to compare the functional positions dedicated to the respective programs in lieu of a comparison of actual personnel assigned to each program.

Table 12. Summary of Program Functional Positions

	Air Force 463-L Program	**Commercial ULD Program**
Full-Time Dedicated Positions	-- Manager	-- Manager -- Planning and forecasting -- Data analysis -- Maintenance -- Computer support
Not Full-Time or Dedicated Positions	-- Acquisition -- Engineering support -- Operational monitors -- Computer support	-- Purchasing -- Engineering -- Training developer/Instructor -- Operational monitors

A cursory examination of the functional positions in Table 12 seems to indicate a greater level of personnel resource commitment of the part of the commercial carrier. However, as previously stated, a detailed examination of the numbers of personnel involved with each program was not performed.

Financial Resource Commitment

Proprietary restrictions prevented the commercial carrier from releasing actual cost or budgetary data relating to the company's ULD program. Therefore an actual comparison of financial resource dedication to the program was impossible to perform. Since the programs are nearly identical in terms of total asset value ($180 million), a decision was made to evaluate the program manager's position as an indication of the financial commitment top management has made to the management of the program. Other areas such as technological resource commitment and personnel resource commitment can also be used to evaluate overall financial resource dedication to a particular program. However, for this study, those factors were evaluated and compared separately.

Table 13. Summary of Military vs. Commercial Program Managers

	Air Force 463-L Program	**Commercial ULD Program**
Educational Level	Associates Degree	Bachelor's Degree
Annual Salary	$55K-$60K[1]	$85K-$95K[2]
Years with Company	19 years	31 years
Years in Current Position	1 year	1 year
Years in Logistics Field	19 years	20 years

1. Salary based on E-7 with over 18 years time-in-service, with-dependent housing allowance based on the location of commercial ULD program manager, and basic allowance for subsistence.
2. Stated salary range for position at commercial carrier

Table 13 provides a summary of the program managers from the respective organizations. In the areas of corporate knowledge and experience, the managers are quite similar. The ULD and 463-L program managers have been with their current organizations for 31 and 19 years, respectively, and both have approximately 20 years experience in logistics related operations.

However, the comparison did reveal several differences between the managers in the other areas examined for this study. Most notable is the considerable imbalance in the salary of the program managers. The salary range for the program manager position at the commercial carrier is approximately 50 percent higher than the salary of the current 463-L program manager. While the current 463-L program manager is an E-7 with over 18 years time-in-service, the salary range of the ULD program manager is most closely equivalent to the annual salary of an O-4 with over 12 years time-in-service (approximately $87,000 annually), up to a Lieutenant Colonel with over 16 years time-in-service (approximately $97,000 annually). This difference indicates a greater commitment of resources from the commercial carrier in the area of the program manager's salary that may also be indicative of a greater overall financial commitment to the program by the commercial carrier.

Also of notable difference are the educational levels of the program managers. The commercial program manager has a Bachelor of Science Degree in Business; the 463-L program manager has an Associates Degree in Transportation Management. However, the results of the comparison are inconclusive, as the actual degree requirement for the ULD program manager position were not established. The 463-L position does not have a degree requirement; therefore any degree awarded would simply be reflective of the program manager's personal ambitions.

Information Technology Systems

As previously stated, information technology capabilities can have a direct impact on reverse logistics program performance. In this area, there are a variety of differences between the two programs that may indicate a greater level of resource commitment of the part of the commercial carrier, as indicated in Table 14. As the commercial ULD program is a closed-loop system, and often considered to be much easier to manage than the 463-L system, these results may be counterintuitive.

Table 14. Summary of Military vs. Commercial Program Information Technologies

	Air Force 463-L Program	**Commercial ULD Program**
IT System Specific to Program	No	Yes
Stand Alone or Integrated IT System?	Stand alone; web-based	Integrated EPR type system
How Long has Company Used This Type of System?	2 years	20 years
Assets Tracked Individually?	No	Yes
Other Technologies in Use?	No	Individual asset barcodes
Real-Time Inventory Visibility?	No	Yes
System Satisfactory?[1]	Yes	No

1. Opinion of respective program managers

There is currently no single IT system used to track and manage 463-L pallets across the DoD. The Air Force seems to have just recently made strides toward updating the IT systems used to manage the 463-L program. Within the last 2 years, the Air Mobility Command has implemented a web-based, stand alone system to track and manage all Materials Handling Equipment belonging to the command, including 463-L pallets and nets. This system was developed and implemented by the 375th Airlift Wing Communications Squadron at Scott Air Force Base, Illinois. Once each week, all AMC units authorized 463-L pallets are required to report their current inventory levels by accessing the AMC maintained website and entering the applicable inventory data. Individual unit inventory levels are determined by a weekly physical inventory of on-hand assets performed by the reporting unit's pallet and net monitor. Once the 463-L program manager at AMC receives all the weekly inputs, inventory levels can be adjusted by routing assets from bases with excess pallets to those bases that are operating at lower levels. This system is a dramatic improvement over the manual processes of email, facsimile, and telephone reporting that were in place just two years earlier.

Conversely, the commercial carrier utilizes a commercially purchased software system designed specifically for the company's ULD program. This system has been in place for approximately 20 years, and has been frequently updated to keep pace with changing technologies. The system is tied into an enterprise-type information system that allows the ULD data to be shared by multiple users across the globe for a variety of functions, including forecasting, planning, tracking, and inventory management.

Another important aspect of the commercial carrier's system is its ability to track individual asset through the use of barcode technology. Each ULD in the company's inventory has a unique barcode identifier that can be scanned at each location as the ULD travels through the system. This allows the program manager to view real-time inventory levels at each location and trace the movements of a particular ULD over a specified period of time. The current 463-L system does not have the capability to track individual assets for inventory, accountability, or life-cycle cost analysis.

Proprietary restrictions would not allow the commercial carrier to release actual system cost data. However, the fact that the commercial carrier has a more capable, company-wide system in-place that has been specifically designed for their operation by an outside agency, while AMC operates a less capable, in-house designed and implemented system, seems to indicate a greater level of resource commitment in the area of IT systems by the commercial carrier.

Additionally, while the ULD information system appears to outperform the current 463-L information system, it is interesting to note that the 463-L program manager perceives the current information system as satisfactory in meeting program requirements, while the ULD manager does not. The ULD program managers cites the need for improved trend analysis capabilities to better capture and analyze life-cycle and repair costs of the various types of ULDs the company uses, and to improve the electronic data interfacing capabilities of the current system.

Importance of RL Relative to Other Issues

There is no way to measure the relative importance of a program with any degree of certainty. However, by examining the other factors identified in this research it becomes clear that these factors can be used to evaluate how management views the importance of a program. Rogers and Tibben-Lembke (2001) concluded that the low importance of RL activities is the single largest barrier to the successful implementation of RL programs. That is likely due to the fact that the perception of a program's importance in the eyes of the most senior levels of management dictates how the program is viewed throughout the organization. If top management views a program as less important than other activities, company policy and focus will likely reflect this view, and the levels of personnel, financial, and technological resource commitment to those programs will likely negatively impacted.

As previously established, the total asset values of the two programs are nearly identical, and the 463-L program is often viewed as much more difficult to manage. However, the fact that pallet management is not included as one of AMC's reverse logistics objectives, coupled with what seems to be significantly less resource dedication in the areas of information systems and program personnel, indicates that the commercial carrier may place more relative importance on the management of their ULD program than the Air Force places on the 463-L program. While it would be hard to argue that the Air Force does not possess the required assets and capabilities to facilitate program success, having assets and capabilities is not enough; organizations must continue to properly channel those assets and capabilities to achieve the desired objectives.

Summary

The purpose of this chapter was to answer the research question by addressing each of the investigative questions posed in Chapter One. It discussed how the Air Force's 463-L program compares to the ULD program of a leading air cargo carrier in the resource related areas identified in the RL and RBT literature. Conclusions and recommendations concerning this comparison are presented in Chapter Five.

V. Conclusions and Recommendations

Chapter Overview

This chapter summarizes the research effort. It will answer the research question and discuss other relevant observations relating to this study. Additionally, it will discuss the factors that limited the research and propose topics for future research.

Research Objective

The focus of this research was to answer the following question: How does the current Air Force 463-L program compare to similar programs managed by industry-leading air cargo carriers? To answer the question, this research presented the 463-L program as a reusable shipping platform, and therefore a potential example of a reverse logistics operation. Next, it explored the topic of reverse logistics and identified factors that tend to impact RL program performance. These factors were then used to formulate interview questions that established a basis for comparison between the 463-L program and the ULD program of an industry leading commercial air cargo carrier. This research also introduced the subject of resource-based theory to further explore the relationship between targeted resource commitment and RL program performance.

Results of the Research

This research determined there are many similarities between the Air Force's 463-L pallet program and the ULD programs of commercial air cargo carriers, as identified in

Investigative Question 4. However, from an operational standpoint, there are also many significant differences. The complexity, danger, and enormity of the supply channels required to support combat units present challenges that are unique to military logistics. Even with what appears to be a much less complicated system, the results of this research seem to indicate a more focused commitment of resources on the part of the commercial carrier. Consequently, this research has identified potential shortfalls in the 463-L program that should be addressed.

First, and likely the most significant finding is the difference in the information technologies used by the organizations compared in this study. The commercial carrier has a much more capable and specialized IT system in place to manage their ULD program. Even with the capabilities of the current system, the ULD program manager has indicated the need for a better integrated and more powerful system to further reduce costs and improve program efficiency. Conversely, the Air Force, as the sole owner of all 463-L pallets, has yet to implement a standardized IT system for 463-L management that can be utilized by all asset possessing agencies across the DoD. A system that can provide the same level of real-time asset visibility, on-hand inventory reporting, and lifecycle data analysis capability as the systems of the commercial carrier may help the Air Force better manage this program.

Only in recent years has AMC, the largest single user of 463-L pallets, instituted a web-based inventory reporting system for use within the Command. Although an improvement over the previous system, it still falls short in many areas, including the fact that it is used to manage only AMC controlled assets, even though a large portion of the total assets are utilized by other MAJCOMS, the Defense Logistics Agency, as well as the other Services. According to the 463-L program manager, there are also ongoing problems of late or missing weekly input data from the reporting units. This requires the program manager to track-down the missing data by telephoning or emailing a number of the reporting units nearly every week. The current system also does not provide for real-time queries of inventory levels, only a snap-shot inventory of each unit on a weekly basis that is established by each unit's pallet and net monitor after a physical inventory of all on-hand assets. With the current high demand for pallets at certain locations, weekly accounting and adjustment of inventory levels may be less than ideal.

Overshadowing all other IT system shortfalls may be the inability to track and account for individual 463-L pallets in an automated fashion. Such a system could help to identify locations, determine real-time inventory levels, and facilitate life-cycle cost analysis. The data entry problems and snap-shot inventory issues could be resolved by an automated tracking system for individual 463-L pallets using barcodes or radio-frequency identification (RFID) tags to track individual assets through the airlift system. This would allow for real-time visibility of aerial port inventory levels as assets enter and exit each port. Additionally, the program manager would no longer be required to track down missing updates from pallet-owning units, or rely on day or week-old inventory data for decision making. Real-time asset visibility would also eliminate the need for the manually inventorying on-hand assets, which can sometimes number in the thousands at a single location.

Another substantial benefit to tracking individual assets is the ability to track life cycle costs of specific pallets. Currently, 463-L pallet life-cycle costs are largely unknown, and pallet durability has been a topic of discussion for many years, as has the need for alternate pallet designs, materials, and manufacturers. For now, the Air Force continues to rely on ARR Corp. as the sole provider and repair source for 463-L pallets. While the experience, efficient operations, and economies of scale have allowed the current supplier to keep new acquisition prices around $1,000 per unit, the true costs may be substantially higher due to frequent and expensive repairs. As previously stated, the Air Force has funded the repair of approximately 60,000 pallets in the last three years, at a cost of nearly $47 million (Brogden 2004). With an operating inventory of roughly 100,000 to 120,000 during this time, it is unlikely that the Air Force is achieving the 10-year lifespan required by the contract specifications (MIL-DTL-27443F 2003).

As the Air Force looks for alternative designs for the 463-L pallet, a true estimate of the current life-cycle costs must be calculated. Without such an estimate, it is impossible to make sound decisions regarding new designs that may come at a higher per unit acquisition cost, but provide for lower overall life-cycle costs. Such alternative designs to the balsa core 463-L pallet have already been constructed. SATCO Corporation of El Segundo, California has designed a prototype pallet using a hollow core and brace system, similar to that of floor-joist construction. Several of these pallets were discovered at Warner Robbins Air Logistics Center during the course of this research. The pallets, delivered to the Air Force in mid 1990's, have yet to be tested for operational use.

Recently, the engineering and acquisition team at WR-ALC added a provision to the contract specifications calling for barcodes to be placed on all new acquisitions, as well as future repairs (MIL-DTL-27443F 2003). However, there are currently no plans to incorporate this technology into the existing AMC cargo tracking system. Called the Global Air Transportation Execution System (GATES), this system has the ability to read barcode technology but would likely require software updates to become functional in this capacity.

Another significant observation centers on the program manager position at AMC. If the Air Force fills the current inventory objectives of 463-L pallets and nets, and AMC becomes the 463-L pallet system process owner, the program manager would be responsible for the daily operations of a $300 million program that plays an absolutely critical role in our Nation’s defense. With a program that has both the strategic importance and the long problematic history; it may be time to reevaluate the manning requirements for this position. As documented in Chapter 4, the program manager of the commercial carrier has the salary that is more comparable to that of a Major or Lieutenant Colonel than with the program’s current Master Sergeant authorization.

One possible solution is to create a civilian position to manage the Air Force’s 463-L program. As such, the Air Force could determine the requirements for the position, such as educational level and previous work experience. Additionally, the Air Force faces a serious problem with the lack of continuity in the 463-L program, as the entire staff has been replaced since current operations began following September 2001. A civilian manager would not only ensure that the Air Force had the right person in the position, but would also introduce a level of continuity that the program is currently lacking.

A final observation speaks to the relative importance of the 463-L program compared to other issues confronting the Air Force and the Department of Defense. Essentially, the allocation of resources to the 463-L program is influenced by one of the most basic principles of economics—the choice of resource allocation under scarcity. There is no doubt that the Air Force could fix nearly every problem with the 463-L program if willing and able to dedicate sufficient time and resources to the program. However, with a limited defense budget there is always competition for program funding, and this situation is no different.

In September of 2002, shortly after contingency operations began, the 463-L pallet acquisition team at WR-ALC initiated a purchase request for new pallets. The request called for $90 million in new-purchase pallets over a five-year period to cover the high attrition of pallets that had just begun to occur (Brogden 2004). More than three years later, the inventory of pallets has been depleted by nearly 100,000 units, and the contract has yet to be awarded. As a result, only 98 new pallets have been purchased and delivered since September of 2001 (Brogden 2004).

Under a separate repair contract with AAR Corp., the Air Force has funded the repair of 2,500 pallets per month. Although the per-unit price would be higher due to increase labor and material costs, AAR Corp. has indicated a maximum repair capacity of 10,000 per month. At the time of this study, there are over 30,000 pallets awaiting repair at AAR Corp., and only 10,000 are funded through the current contract before its expiration.

Improving 463-L assets accountability during contingency operations is a daunting challenge. There are a multitude of complex issues surrounding the problem; ranging from individual accountability at the operational level, to the support of the organization's most senior leaders and the policy they establish. The military operates in an environment where financial decisions are based not on profits or return on investment, but on current requirements, readiness, and capabilities. In such a setting, the priorities of the present often outweigh the potential rewards of the future. Such has been the case with the 463-L program, as a history of accountability problems has existed for over 40 years. Undoubtedly there will be lessons learned from the current operations, just as there have been in other operations, such as Desert Storm and Bosnia. However, unless actions are taken to address the current problems, lessons learned may again be soon forgotten.

Limitations of the Research

Although three commercial air cargo carriers agreed to participate in this study, only one carrier was able to provide the responses in the timeframe required. This was due to the seasonal peaks in workload that occurred during the data gathering phase of November and December. Thus the results of this research were based on a comparison with a single commercial air cargo carrier. As such, additional comparisons with other carriers may or may not yield results that are consistent with this study.

Additionally, a single contact was established at the participating commercial carrier who acted as a liaison between the interview question respondents and the researcher. This prevented dialog from occurring between the researcher and the various subject matter experts within the organization, and did not allow for follow-up questions to be asked. The commercial carrier requested this type of relationship to prevent the disclosure of proprietary information regarding the company's ULD program. As a result, some portions of the interview responses where not completed and instead marked, "This Information is Proprietary". Because of this, actual cost and budgetary data was not available for this study, making those types of comparisons impossible to perform.

Future Research

The problems of 463-L accountability have existed in every major military operation since the Vietnam War. However, few formal studies have been conducted on the subject, and none in recent years. As industry continues to seek new technologies to reduce costs and increase efficiency, so too must the military. This research has identified shortfalls in the current information systems used to manage the 463-L pallet program. Future research targeted at addressing program requirements, with specific focus on individual asset tracking through the use of barcode or RFID technology could prove useful in improving overall program performance.

Another possible focus of future research is an examination of the current 463-L pallet lifecycle costs and an evaluation of possible pallet alternatives. At a recent industry-day event, at least 12 vendors showed interest in producing an alternative pallet design for the Air Force (Brogden 2004). As previously discussed, the current repair costs for 463-L pallets have exceeded $47 million in the last three years alone. As the Air Force looks to examine alternative pallets, the lifecycle cost of the current platform must be known. Without an examination of true costs, it will be difficult to justify new pallet alternatives that may come at a higher per unit cost, but may cut overall costs by reducing the high repair figures associated with the current design.

Appendix A.

Interview Questions

The following interview questions were constructed to provide a basis for comparison between the 463-L asset program and the similar programs of industry leading air cargo carriers in those areas previously identified as critical to the success of RL programs.

Background Questions

The following questions seek to determine background information on your company's reusable air cargo shipping asset program. These questions cover the types and quantities of assets, replenishment information, and annual air cargo shipping statistics.

1. What type(s) of reusable shipping assets does your company use for air cargo shipments?

2. Please indicate the approximate quantity of each type of shipping asset presently in your company's inventory (consider both operational and reserve inventories if applicable).

3. What is the approximate cost per unit of each type of shipping asset indicated in Question 1?

4. Approximately how many of each type of shipping assets indicated in Question 1 are lost or condemned annually?

5. If required, are replacements of the indicated shipping platforms available for purchase and delivery in 30 days or less?
   If no**:** What is the anticipated lead time for replacement orders?

6. Is historical data of losses and/or condemnations available?
   If yes: Can this data be made available for this study?

7. Are losses and/or condemnations of reusable shipping assets forecasted?

If yes: a. How long is the forecasted period?
b. What are the forecasts used for?
c. Is forecast data shared with asset suppliers?

8. Do the reusable shipping assets leave the "system" (i.e., out of company custody)?
   If yes: How are these assets recovered (i.e., plans, agreements, or incentives)

The information gathered from questions 9-15 will be used to make comparisons to the United States Air Force 463-L program, with specific focus on airlift volume.

9. How many air cargo shipments are made annually using reusable assets?

10. What percentage of air cargo is shipped with reusable shipping assets?

11. How many pieces of air cargo are shipped annually using reusable assets?

12. What is the total annual tonnage of all air cargo shipments?

13. What is the total annual tonnage of air cargo shipments moved with reusable shipping assets?

14. What is the total number of ton-miles flown annually?

15. Is there equivalent data available for Question 9 through Question 14 that covers only the annual holiday surge period (Nov and Dec)?

16. Please provide either the annual budget allocation or annual expense data for your company's reusable air cargo shipping asset program.

Managerial Resource Questions

Managerial resource commitment has been repeatedly identified as a significant factor in the success of logistics and reverse logistics programs. The following questions will be used to gauge the level of managerial resource commitment to the reusable air cargo shipping asset program in your organization.

17. What is the rank/title of the highest person in the organization whose primary responsibility is the management of reusable shipping assets? This person will later be referred to as the “program manager”.

18. What is the program manager’s hierarchical position within the company’s air cargo function (where does this person’s position fall within the company’s organizational chart)?

19. How many reporting layers or management layers are between the program manager and the overall head of the air cargo operation?

20. Please indicate the program manager’s education level and provide the field of study for any degrees earned?

<u>Degree Held</u>	**<u>Field of Study</u>**
[ ] High School or less	
[ ] Associate’s degree	
[ ] Bachelor’s degree	
[ ] Master’s degree	
[ ] Doctorate	

21. How long has the program manager worked for their current company?

22. How long has the program manager filled this position?

23. What is the average rate of turnover for a person in this position (on average, how long could you expect a person would hold this position)?

24. How many years experience does the program manager have in a logistics related career field?

25. Has the program manager received any formal training relating to the reusable shipping asset program?

If yes: Please provide training type and duration of training.

<u>Type of Training</u>	**<u>Duration in hours</u>**

26. Please indicate the closest appropriate salary range for the reusable shipping assets program manager.

[ ] Less than $35K
[ ] $35K to $49K
[ ] $50K to $64K
[ ] $65K to $79K
[ ] $80K to $94K
[ ] Greater than $94K

27. On average, how many times per week does the program manager communicate with senior management concerning issues related to reusable shipping assets via the following methods:

Method	**# of contacts per week**
Telephone	
Email	
Face-to-Face (informally)	
Formal meetings	
Written Correspondence other than email	

28. On average, how many times per week does the program manager communicate with operationally subordinate personnel concerning issues related to reusable shipping assets via the following methods:

Method	**# of contacts per week**
Telephone	
Email	
Face-to-Face (informally)	
Formal meetings	
Written Correspondence other than email	

29. How many full time personnel are dedicated to the company's reusable shipping asset program?

30. How many personnel are involved in the company's reusable shipping asset program on a regular basis but are not considered fulltime or dedicated to the program?

31. Does your company have policies in place specific to the reusable shipping asset program?

If yes: a. How are these policies published and disseminated?

b. Are these policies company-wide, regional, or local?

c. How often are these policies reviewed, updated or revised?

Technological Resource Questions

Technological resource commitment is also frequently identified as a factor in the success of logistics and reverse logistics programs, as well as a key strategic resource for all logistics operations. The following questions will be used to gauge the level of resource commitment to the technological aspect of your company's reusable air cargo shipping asset program.

32. What technologies does your company use in the management of reusable air cargo shipping containers?

33. Are shipping assets individually tracked and/or accounted for electronically and/or automatically (such s barcodes, RFID, etc.) or is tracking and accounting a manual task?

34. Does your company have computer software in place specifically for the management of reusable shipping assets?

35. Is the current software stand alone, or part of a larger system?

36. How long has the current software used to manage the reusable shipping asset program been in place?

37. Please provide the total cost of procurement and installation of the current software used to manage the reusable shipping container asset program.

38. Please provide a cost of annual maintenance and updates for the current software used to manage the reusable shipping container asset program.

39. Are there Information Technology (IT) personnel dedicated to the reusable shipping assets program?

If yes: How many personnel are dedicated to the reusable shipping assets program?

If no: Please provide an estimate of the number of hours per week non-dedicated IT personnel are engaged in activities supporting the reusable shipping assets program.

40. In the opinion of the reusable shipping assets program manager, is the current IT system satisfactory in meeting program requirements?

Bibliography

Air Force Material Command. *Reversing Logistics Know How*. Background Paper. https://www.afmc.mil.wpafb.af.mil/HQ-AMC/LG/trans/sep03/retro1.doc.

Armstrong, Curtis P. and V. Sambamurthy. "Information Technology in Firms: The influence of senior leadership and IT infrastructure." *Information Systems Research*, 10: 304-339, (1999).

Augsburger, Robert. *"Corporate Environmental Solutions"* Independent Study Project, Stanford Graduate School of Business, Stanford, California, June 10, 1991.

Barney Jay. "Firms Resources and Sustained Competitive Advantage." *Journal of Management*, 17: 99-120, (1991).

Biciocchi, Steve. "Pallet Management is No Lightweight Issue." *Industrial Engineering*, 24: 18, (November 1992).

Brogden, John. Materials Handling Equipment Program Manager, WR-ALC/LESVG, Warner Robins Air Force Base, GA. Interview, 13 December 2004.

Campbell, Donald. T. and Julian C. Stanley. *Experimental and Quasi-Experimental Designs for Research.* Chicago: Rand McNally (1963).

Carter, Craig R. and Lisa M. Ellram. "Reverse Logistics: A review of the literature and a framework for future investigation." *Journal of Business Logistics*, 19: 85-101, (1998).

Closs, David J and Kefeng Xu. "Logistics Information Technology Practice in Manufacturing and Merchandising Firms – An International Bemchmarking Study Versus World Class Logistics Firms." *International Journal of Physical Distribution & Logistics Management*, 30: 689, (2000).

Cooper, Donald E and William Emory. *Business Research Methods*. Burr Ridge, Ill.: Irwin, (1995).

Crawford, R.C. "Joint Implementation of System 463L." AFORQ-OS Memorandum. 29 September 1961.

Creswell, John W. *Qualitative Inquiry and Research Design: Choosing among five traditions*. Thousand Oaks CA: Sage Publications (1998).

Daugherty, Patricia J., Chad W. Autry, and Alexander E. Ellinger. "Reverse Logistics: The Relationship Between Resource Commitment and Program Performance." *Journal of Business Logistics,* 22: 107-123, (2001).

Daugherty, Patricia J., Mathew B Meyers, and R. Glenn Richey. "Information Support for Reverse Logistics: The Influence of Relationship Commitment." *Journal of Business Logistics*, 23: 85-106 (2002).

Daugherty, Patricia J., R. Glenn Richey, Stefan E. Genchev, and Haozhe Chen. "Reverse Logistics: superior performance though focused resource commitments to information technology." *Transportation Research Part E: The Logistics and Transportation Review,* (April 2004).

De Brito, Marisa P. and Rommert Dekker. "Reverse Logistics—a framework." Econometric Institute Report EI 2002-38, Erasmus University, Rotterdam, 10 October 2002.

Department of the Air Force. *463-L Cargo Pallets.* USAF Technical Order 35D33-2-2-2, 9 July 2004.

Department of the Air Force. *Materials Handling, System 463-L System Program Package (SSP)*, United States Air Force Systems Command, November 1962.

Department of Defense. *Management and Control of Intermodal Containers and System 463-L Equipment,* Defense Transportation Regulation 4500.9-R, Part VI, June 2002.

Diener, David et al. *Value Recovery from the Reverse Logistics Pipeline.* Rand Corporation, (2004)

Dowlatshashi, Shad. "Developing a Theory of Reverse Logistics." *Interfaces,* 30: 143-151, (May/Jun 2000).

Drumwright, Minette. "Socially Responsible Organizational Buying: Environmental Concern as a Non-economic Buying Criterion." *Journal of Marketing,* 58: 1-19 (1994).

Giuntini, Ron and Tom Andel. "Reverse Logistics Role Models." *Transportation and Distribution,* 97-98, (April 1995).

Gooley, Toby B. "Reverse Logistics: Five Steps to Success." *Logistics Management and Distribution Report,* 37: 45-50, (1998).

Grant, Robert H. “Resource Based Theory of Competitive Advantage: Indications for Strategy Formulation.” *Strategic Management Journal*, 12: 95-117 (1991).

Guba, Egon G. and Yvonna S. Lincoln. “Do Inquiry Paradigms Imply Inquiry Methodologies?” *Qualitative Approaches to Evaluation in Education*, 89-115, (1988).

Guide, Daniel R., Vaidyanathan Jayaraman, and Rajesh Srivatava. “Supply Chain Management for Recoverable Manufacturing Systems.” *Institute for Operations Research and Management Sciences*, 30: 125-142, (2000).

Guiltinan, J.P., and N.G. Nwokeye. “Developing Distribution Channels and Systems in the Emerging Recycling Industries.” *International Journal of Physical Distribution*, 6: 29-38 (1975).

Harvey, Randolph J. “Carrying the Load.” *Airlift Magazine*, 6-9, (Fall 1988). HQ/AFMC, September 2003.

International Air Transportation Association. “Interline ULD Control Group-IULDUG” n. pag. http://www1.iata.org/ps/services/iuld.htm. 2004.

Kahler, Harold M. *An Analysis of Depot Repair Capacity as a Criterion in Transportation Mode Selection in the Retrograde Movement of Reparable Assets.* MS thesis, GLM/ENS/04-08. Graduate School of Engineering and Management, Air Force Institute of Technology (AU), Wright-Patterson AFB OH, March 2004.

Kelle, Peter, and Edward A. Silver. "Forecasting the Return of Reusable Containers." *Journal of Operations Management*, 8: 17-35, (1989).

Kroon, Leo., and Gaby Vrijens. “Returnable Containers: an example of reverse logistics.” *Journal of Business Logistics,* 25: 56-68 (1995).

Lambert, Douglas M. and James R. Stock. *Strategic Physical Distribution Management.* Hollywood: Irwin, 1981.

Lee, Jade, Howard McShane, and Wayne Kozlowski. “*Critical Issues in Establishing a Viable Supply Chain/Reverse Logistic Management Program.*” Institute of Electrical and Electronics Engineers, technical publication 0-7803-7214-X/02, (2002).

Leedy, Paul D. and Jeanne E. Ormrod. *Practical Research: Planning and Design*. Upper Saddle River: Prentice Hall, 2001.

Logistics Division, Air Forcew Material Command. Abbreviated Acquisition Plan for 463-L Pallets, WR-ALC/LVKA, 14 February 1992.

Meadows, Donnela, Dennis Meadows. *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind.* Hollywood: Universe Publishing, 1972.

Mintzberg, H. *The Nature of Managerial Work*. New York: Harper Row 1973.

Olavarrieta, Segio, and Alexander E. Ellinger. "Resource-Based Theory and Strategic Logistics Research." *International Journal of Strategic Logistics Research*, 27: 559-588, (1997).

Ortiz, John. "Retailers Review Return Policies." *The Sacramento Bee*, 27 December 2004.

Patricia Lather, *Getting Smart: Feminist Research and Pedagogy with/in the Postmodern.* New York: Routledge, (1991).

Patton, M. *Qualitative Research and Evaluation Methods*. Thousand Oaks CA: Sage Publications (2002).

Penrose, Edith T. *The Theory of the Growth of the Firm*. London: Basil Blackwell, (1959).

Peshkin, Alan. "The Goodness of Qualitative Research." *Educational Researcher*, 22: 24-30, (1993).

Rogers, Dale S. and Ronald Tibben-Lembke. "An Examination of Reverse Logistics Practices." *Journal of Business Logistics*, 22: 129-147 (2001).

Rogers, Dale S. and Ronald Tibben-Lembke. *Going Backwards: Reverse Logistics Trends and Practices.* Pittsburg PA: Reverse Logistics Executive Council, 1998.

Ross, Anthony. "A Multi-Dimensional Empirical Exploration of Technology Investment, Coordination, and Firm Performance." *International Journal of Physical Distribution and Logistics Management*, 32: 591-609, (2002).

Saphire, David. "Delivering the Goods: Benefits of Reusable Shipping Containers." INFORM Special Report, 1994.

Sarkis, Joseph. "Supply Chain Management and Environmentally Conscience Design and Manufacturing." *International Journal of Environmentally Conscience Design and Manufacturing*, 4: 42-55, (1995).

Schroeder, John and Christine Martinez. "463L Pallet and Dunnage System Evaluation." United States Air Force Armstrong Laboratory. Report No. 19981201 114. October 1997.

Stock, James R**,** *Development and Implementation of Reverse Logistics Programs*, Oak Brook Illinois: Council of Logistics Management, 1998.

Stock, James R. " The 7 Deadly Sins of Reverse Logistics." *Materials Handling Management*. 56: 5-11 (Mar 2001).

Stock, James R. *Reverse Logistics.* Oak Brook, Illinois: Council of Logistics Management, 1992.

Strauss, Anselm and Juliet Corbin. *Basics of Qualitative Research*. Newbury Park: Sage Publications, 1990.

"Supply Chain Visions Logistics Terms and Glossary." Excerpt from Council of Supply Chain Management Professionals website. http://www.cscmp.org/Downloads/Resources/glossary03.pdf October 2003 2001.

Tibben-Lembke, Ronald S. and Dale S. Rogers. "Differences Between Forward and Reverse Logistics in a Retail Environment." *Supply Chain Management: An International Journal,* 7: 271-282. (2002).

United States General Accounting Office (GAO). *"Defense Logistics: Preliminary Observations on the Effectiveness of Logistics Activities during Operation Iraqi Freedom."* Washington, DC, December 18 2003.

United States Transportation Command & Defense Logistics Agency, "Strategic Distribution Reverse Logistics (Final Draft)", 1 October 2003.

Untied States Transportation Command. "Responsibility for the Global System 463-L Equipment Management Under Distribution Process Owner Authority." Official Message, 29 September 2004.

Walden, Joseph L. *Reverse Logistics*. U.S. Army Command and General Staff College School of Advances Military Studies, Fort Leavenworth, Kansas, January 2001.

Wang, Mark Y.D., et al., *Velocity Management: the Business Paradigm that has Transformed U.S. Army Logistics*. Santa Monica, California: RAND Corporation,

Witt, Clyde, E. "Are Reusable Containers Worth the Cost?" *Transportation and Distribution,* 41: 105-108, (September 2000).

Witt, Clyde, E. “How to be Successful with Reusable Containers.” *Materials Handling Engineering,* 52: 79-82, (December 1997).

“The World's Top 50 Cargo Airlines.” *Air Cargo World Online,* http://www.aircargoworld.com/features/0904_1.htm (2004).

Zieger, Anne. “Reverse Logistics: The New Priority?” *Frontline Solutions,* 4:20-24, (November 2003).

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14. ABSTRACT

During peacetime operations, the process of tracking and managing 463-L assets within the Air Mobility Command airlift system results in infrequent imbalances or accountability issues. However, during contingency operations, AMC loses control of 463-L assets as they are turned over to the intra-theater distribution system. Since current contingency operations began in October of 2001, the Air Force has been unable to account for over 97,000 463-L pallets and 220,000 cargo nets. With a single pallet and net set costing over $1,300, the total value of the equipment unaccounted for exceeds $126 million. If not corrected, this failure to account for 463-L equipment may negatively impact the flow of sustainment cargo to the warfighter.

The Department of Defense, United States Transportation Command, and AMC are currently investigating the problem from multiple angles, to include new technologies, inventory replenishments, Critical Asset Recovery Teams, and Defense Transportation Regulation rewrites. Rather than focusing on these current efforts, this research attempted to determine if concepts of resource-based theory and established best practices of reverse logistics could be used to evaluate the 463-L program. Using a collective case study methodology, this research sought to identify resource related factors in existing RL literature that tend to impact program performance and then draw comparison between the 463-L program and the similar programs of industry leading air cargo carriers based on those factors.

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