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**Fully Burdened Cost of Retrograde, Redeployment,
Reconstitution, and Reset and Analysis of Alternatives
(FBCR4 & AoA): New Model to Formulate Strategic Decisions
for Deployed Ground Vehicle Equipment**

5 November 2012

by

**Capt. Jonathan P. Farrar, USMC, and
Capt. John P. Lloyd, USMC**

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ABSTRACT

The retrograde cost for Afghanistan is complex and involves many uncertainties, yet is a part of military operations when nations go to war. This thesis introduces the fully burdened cost of retrograde, redeployment, reconstitution, and reset and analysis of alternatives (FBCR4 & AoA) as an estimating tool that can be used to analyze many of the different variables included in bringing equipment home. The tool can be tailored for future major retrogrades. The distinctive characteristic of this tool, in comparison to conventional estimating tools, is that it aggregates all major activities, while synchronizing data from multiple DoD agencies. The primary objective of this thesis is to aggregate the numerous variables, fees, and constraints of R4 for any combat theater in order to contemporaneously assist in executing the Commandant's strategy while informing key leadership of critical R4 cost analysis. The second objective is to equip DoD planners with the framework for solving retrograde dilemmas in future conflicts. By conducting the FBCR4 process for vehicles, the researchers developed an estimated cost of 63 percent of the vehicle's original procurement cost. Our analysis of the data gathered also indicates, a total estimated cost savings of \$139.8M, by selling all M-ATVs to foreign allies.



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Disclaimer: The views represented in this report are those of the author and do not reflect the official policy position of the Navy, the Department of Defense, or the Federal Government.



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LIST OF ACRONYMS AND ABBREVIATIONS

A/D	Abandonment and Destruction
AAO	Approved Acquisition Objective
APOD	Aerial Port of Debarkation
CBO	Congressional Budget Office
CJCS	Chairman of the Joint Chiefs of Staff
CONUS	Continental United States
DLA	Defense Logistics Agency
DOD	Department of Defense
DRMO	Defense Reutilization Marketing Office
DSA	Defense Supply Agency
DSCA	Defense Security Cooperation Agency
EDA	Excess Defense Articles
FBCR4 & AoA	Fully Burdened Cost of Retrograde, Redeployment, Reset, and Reconstitution and Analysis of Alternatives
FEPP	Foreign Excess Personal Property
FMS	Foreign Military Sales
GAO	U.S. General Accounting Office (before July 2004)
GAO	U.S. General Accountability Office (since July 2004)
GEMS-MC	Ground Equipment Management Simulation-Marine Corps
HQMC	Headquarters, Marine Corps
HMMWV	High Mobility Multipurpose Wheeled Vehicle
I&L	Installations and Logistics (within HQMC)
JP	Joint Publication
LTI	Limited Technical Inspection
LX	Logistics Operations Analysis Division (within HQMC, I&L)
M-ATV	MRAP All-Terrain Vehicle
MCCLL	Marine Corps Center for Lessons Learned
MCLC	Marine Corps Logistics Command



MRAP	Mine-Resistant Ambush Protected
M/T	Measurement Ton
NATO	North Atlantic Treaty Organization
NDN	Northern Distribution Network
OCONUS	Outside the Continental United States
ODS	Operation Desert Storm
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
PDB	Property Disposal Branch
R2	Retrograde and Redeployment
R4	Retrograde & Redeployment in Support of Reset & Reconstitution
SPOD	Sea Port of Debarkation
TAMCN	Table Authorized Materiel Control Number
USC-06	Universal Services Contract-06 General Contract
USMC	United States Marine Corps
USTRANSCOM	United States Transportation Command



I. INTRODUCTION

A. BACKGROUND

Throughout history, nations and their militaries have faced the logistical challenges of moving personnel, materiel, and supplies to and from the battlefield. Friction can occur in supply chains and support networks during the rapid movement of offensive operations, across stretched defensive lines, or even in the retrograde of combat forces after a perceivable victory. The United States is currently confronted with similar challenges in returning personnel and equipment from Afghanistan as security responsibilities transition to the local populace and Operation Enduring Freedom (OEF) comes to a close.

The eventual withdrawal from Afghanistan is not the first time that the U.S. has conducted a large-scale retrograde abroad, and, most likely, it will not be the last. Within the previous century, the Department of Defense (DoD) and U.S. military services actually have a significant record of retrogrades and lessons learned from the challenges in each event. Notable and concrete examples were retrogrades following World Wars I and II, Vietnam, Operation Desert Storm, and, most recently, Operation Iraqi Freedom. Nevertheless, no prior operation potentially compares to the logistical challenges that decision-makers face in considering how to effectively and efficiently retrograde from Afghanistan, a country landlocked 1,000 miles from the nearest seaport.

Many retrograde variables and factors come into play and are of concern, the foremost being the safe transition of personnel leaving Afghanistan, but other concerns include available lines of communication, transportation capacity, geopolitical arrangements, concurrent combat operations, and cost. Another consideration is the eventual disposition of all equipment, including obsolete, degraded, and surplus items. During conflicts, the DoD typically procures large amounts of supplementary equipment to sustain continuous operations and to address specific enemy threats. An example is the rapid procurement of the mine-resistant, ambush-protected (MRAP) vehicles to counter the devastating effects of enemy improvised explosive devices (IEDs).



Equipment or items in excess potentially could strain supply chains and maintainers, so analyzing and forecasting approved acquisition objectives (AAOs) is an important factor during the retrograde process. The U.S. military is additionally susceptible to the nation's contemporary fiscal issues and likely budget reductions, leading to sizably smaller forces to manage current operations and support future requirements. These undetermined factors are mentioned because even they could have far-reaching impacts and could influence the outcomes in an Afghanistan retrograde.

A particular problem of concern for the Marine Corps and the broader DoD is grasping all of the retrograde variables, logically summarizing them, and determining a reasonable and credible cost to the entire process. Currently, the analysis of retrograde lacks cohesion and clarity on the question of costs. We plan to help resolve this problem by proposing a new cost model, the fully burdened cost of retrograde, redeployment, reconstitution, and reset and analysis of alternatives (FBCR4 & AoA), as a way to help commanders more accurately gauge all associated costs with R4 and therefore make more informed decisions for the particular case of Afghanistan. Comparable to DoD Instruction 5000.2 (OUSD[AT&L], 2008) requiring the fully burdened cost of delivered energy to be analyzed, our model applies the same concept to the retrograde of equipment (p. 59). Most important to the Marine Corps is that the FBCR4 & AoA concept and model could be valuable in supporting and executing the Commandant's *Operation Enduring Freedom Ground Equipment Reset Strategy* (United States Marine Corps [USMC], 2012). Additionally, due to its combination of strategic scope, simple design, and itemization of common processes in each step, our FBCR4 & AoA concept (Figure 1) and model could be adopted institutionally to assist policy-makers' decisions in any future military operation.



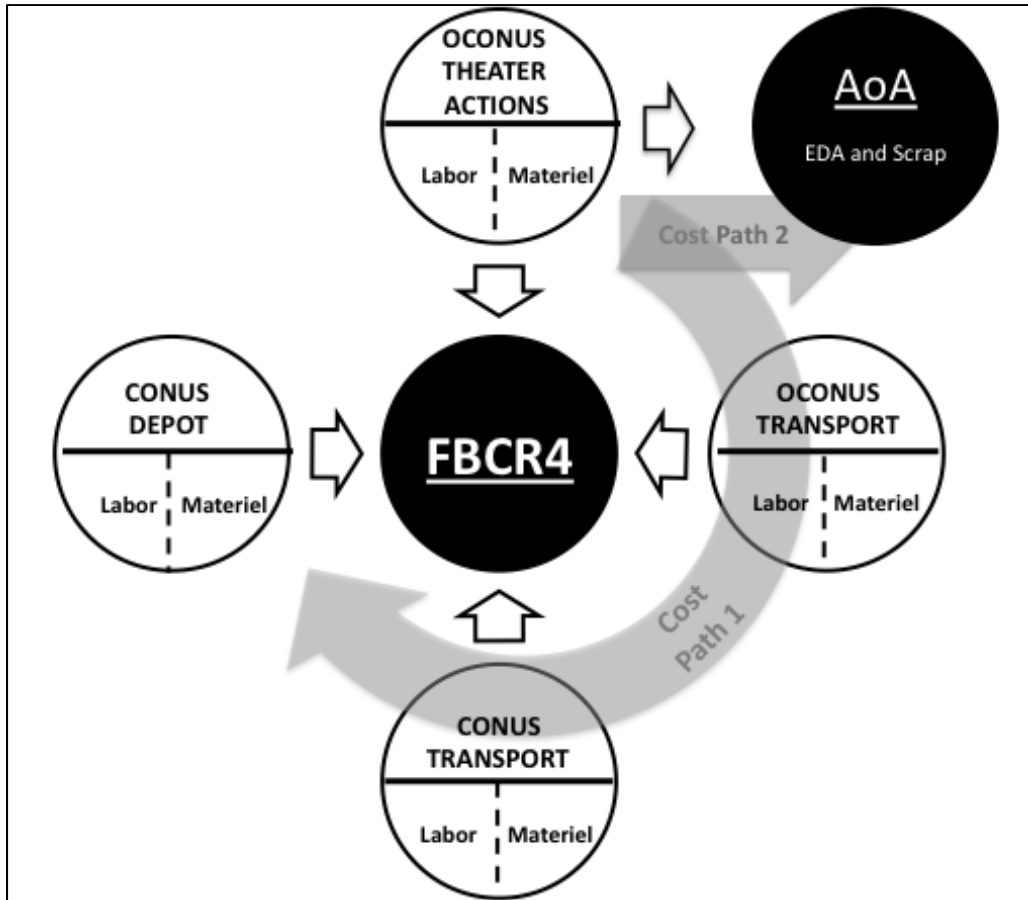


Figure 1. The FBCR4 & AoA Conceptual View

The FBCR4 & AoA concept and model estimates and summarizes all average labor and materiel costs associated with a particular defense article retrograded through these processes:

1. outside continental U.S. (OCONUS) item preparation at the point of origin in theater;
2. OCONUS transportation through $1 + \dots + n$ modes of transport;
3. continental U.S. (CONUS) transportation through $1 + \dots + n$ modes of transport;
4. CONUS depot-level reset and repair;
5. excess defense article (EDA) transfer option minus revenues; and
6. scrapping option minus revenues.



Defense articles or pieces of equipment being shipped and transported are grouped in one of two broad categories: vehicular (also called break-bulk) or container compatible. Combat vehicles leaving the theater can require significant coordination and extra means of transport, like flatbed haulers, rail cars, or more cubic space on aircraft, all for one item. It is most likely that combat vehicle quantities will comprise the majority of weight leaving Afghanistan, and we only analyze combat vehicle types for the purposes of this thesis due to data availability and for the sake of simplicity.

Additionally, we identified a few trends in the historical analysis of retrogrades and then incorporated them into the model. In every drawdown that we researched, there were three options exercised to retrograde equipment: (1) transport out of theater, (2) transfer to foreign allies as EDA, or (3) scrap to an inoperative level. Usually, a combination of all three activities was exercised to some degree, with transportation being the most utilized. These activities are our model's base options and decisions at the point of origin. Our other observation is that there are only three methods of transportation: (1) air, (2) land, or (3) sea. This may seem mundane, but it is essential in the model to calculate all legs of transportation and associated costs in order to understand the total estimation.

B. OBJECTIVE

The primary objective of this thesis is to aggregate the numerous variables, fees, and constraints of R4 for any combat theater in order to contemporaneously assist in executing the Commandant's *OEF Ground Equipment Reset Strategy* (USMC, 2012) and informing key leadership of critical R4 cost analysis. This objective is accomplished through illustrating historical trends from past conflicts and evaluating a broad range of data.

The second objective of this thesis is to equip DoD and Marine Corps planners with the framework for a permanent planning tool not only for today's complex logistical issues, but also for solving retrograde dilemmas in future conflicts.



C. SCOPE

The scope of the FBCR4 & AoA model allowed us to estimate a funding range requirement to retrograde all Marine Corps M-ATV from Afghanistan to CONUS as a base case scenario, and it provided the alternative costs associated with EDA transfers and scrapping for M-ATVs. Although we analyzed one vehicle, we developed our model for the general utilization of calculating costs for any combat vehicle in any retrograde.

D. METHODOLOGY

The methodology we used in researching this thesis is depicted in Figure 2 and described as follows:

1. Conduct a background review of all major organizations and stakeholders that have processes and input relevant to the retrograde of equipment and materiel.
2. Conduct a background/literature review of past retrogrades in order to understand past processes and identify major lessons learned.
3. Define each R4 cost element, purpose, and method.
4. Construct a model that analyzes and fully calculates the three retrograde options of transportation, EDA transfers, and scrapping costs of an item.
5. Collect data from major organizations and stakeholders.
6. Develop a base case with one military vehicular item.
7. Analyze the data between the three retrograde options.
8. Conduct sensitivity analysis on the results.
9. Summarize the conclusions and offer recommendations for current and future military retrograde operations.



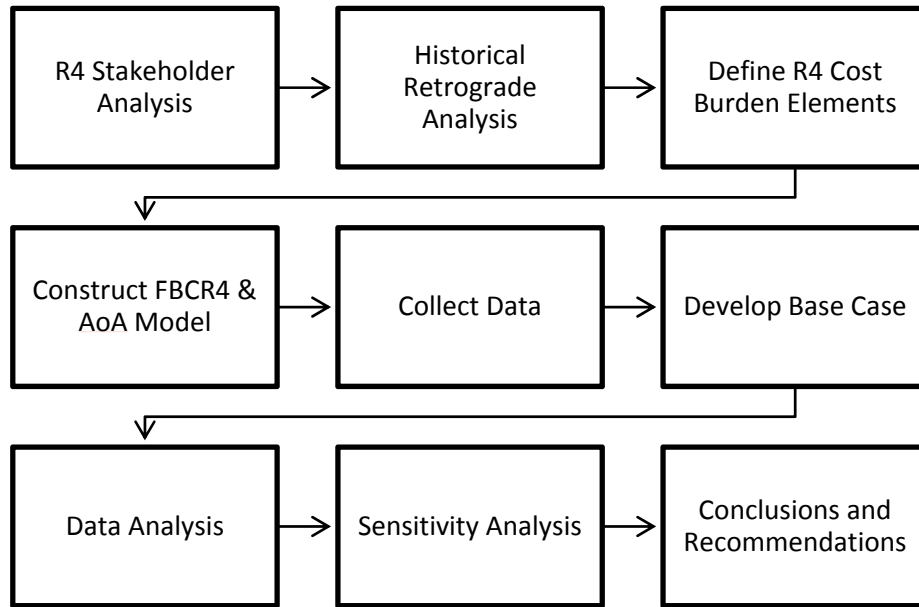


Figure 2. Methodology Flow Chart



II. LITERATURE REVIEW

A. PRELUDE TO LITERATURE REVIEW

The purpose of this chapter is to give background information regarding four key organizations central to our thesis and then follow up with a discussion of historical retrograde examples of U.S. equipment from a variety of countries. Due to the robust and complex nature of DoD logistical support, which we discuss first, it is important to have a firm understanding of each mission set and the factors that affect the FBCR4 & AoA model. The two cost paths in our conceptual model deal directly with the organizations mentioned in this chapter.

After we conclude laying out the stakeholder background, we then present historical lessons of retrograde and redeployment (R2) decisions critical to understand the precepts of the FBCR4 & AoA model and thesis. We discuss the following five conflicts/operations: (1) Operations in France; (2) Vietnam War; (3) Operations in Thailand; (4) Operation Desert Storm; and (5) Operation Iraqi Freedom. We then conclude the chapter by discussing current initiatives, challenges, and logistical complexities surrounding the conundrum that military leaders face when deciding whether or not it is beneficial to send all equipment from Afghanistan back to the United States.

B. DEFENSE LOGISTICS AGENCY

The Defense Logistics Agency (DLA) is a large component of the DoD with the primary mission of being a “logistics combat support agency” for the nation’s military Services in “peacetime and wartime” (DLA, 2012c). The DLA headquarters is located at Fort Belvoir, VA, and the agency has a workforce of over 26,000 employees (DLA, 2012c). The services provided by the DLA are broad in scope and range from stockpiling strategic war materiel to reusing precious metals and disposition services (or scrapping). The scrapping activity is a topic of focus in this research.

Within the DLA is Disposition Services, which was formerly the Defense Reutilization and Marketing Service (DRMS) and is still commonly referred to as the



Defense Reutilization and Marketing Office (DRMO). DRMO provides and executes the overall policy for demilitarizing, handling, and disposing of excess military equipment and supplies. Almost every military base has a disposition function, most often for recycling ammunition casings, dunnage, and range refuse expended during military training. Currently, three DLA Disposition Services offices (or DRMO sites) exist in Afghanistan to support ongoing operations. They are located at Bagram, Kandahar, and Camp Leatherneck (DLA, 2012a). There are also other OCONUS Disposition Services offices located at Camp Arifjan, Kuwait, and Abu Dhabi, United Arab Emirates (DLA, 2012a). All of these sites and a few others in neighboring countries compose the DLA's Disposal Region–Central, which primarily supports the Middle East and Persian Gulf region, the past Operation Iraqi Freedom (OIF) drawdown, and OEF (DLA, 2012a).

1. Brief History

Providing policy oversight and supply support to hundreds of thousands of troops is not an easy task, and it requires a consolidated effort by the U.S. government and the industrial base to accomplish this enormous mission. In the center of these efforts is the DLA, known as the Defense Supply Agency (DSA) until January 1, 1977 (DLA, 2012c). The DLA has continued to evolve since its inception in World War II (WWII). The DLA website reports that “the origins of the Defense Logistics Agency (DLA) date back to World War II when America’s huge military buildup required the rapid procurement of vast amounts of munitions and supplies” (DLA, 2012c), which took detailed coordination to accumulate in the United States.

In the early 1970s, the DLA continued to grow in its operations throughout the Vietnam War. A 1974 Armed Services Committee report reflects the DLA’s (then DSA) growing responsibilities:

On July 1, 1973, the Defense Supply Agency (DSA) assumed management responsibility for all DOD property disposal operations except those in Vietnam. Subsequently, the Assistant Secretary of Defense (Installations and Logistics) directed DSA to assume responsibility for the disposal program in Vietnam as of January 1974. This assigns to DSA worldwide responsibility for all DOD disposal operations. (Comptroller General of the United States, 1974, p. 12)



Vietnam required immense efforts to retrograde all U.S. forces and properly dispose of excess equipment, but two decades later the DLA experienced equally monumental post-conflict operations with the technological, high-tempo war of Operation Desert Storm (ODS).

In the aftermath of ODS, the DLA participated in and executed the multiphase Operation Desert Auction (General Accounting Office [GAO], 1992b, p. 1). During Desert Auction, the DLA ensured the collection and disposal of mostly unserviceable items. A GAO report stated,

Through May 1992, the DRMO in Saudi Arabia received 56,127 line items with an acquisition value of \$538.4 million. This amount includes items still in inventory, items reused, items sold or transferred to foreign countries, and items abandoned or destroyed. In addition, the DRMO in Saudi Arabia had a scrap inventory of 44.7 million pounds as of the end of May 1992. (GAO, 1992b, p. 4)

Although half a billion dollars does not seem like a lot in terms of today's trillion-dollar budgets, Operation Desert Auction illustrates the level of work that the DLA organization is capable of executing and highlights the logistical challenges to come at the close of OEF.

Disposal processes for excess equipment were eventually consolidated under DRMS, which is currently called Disposition Services within the DLA, as previously mentioned. The Disposition Services website illustrates its importance and its recent operations:

In fiscal [year] 2008, \$2.2 billion worth of property was reutilized. Every dollar's worth of property reutilized is a tax dollar saved. DLA Disposition Services also supports disaster relief at home, humanitarian assistance and foreign military sales [FMS] programs. (DLA, 2011a)

2. Property Categories

Government property is segregated into two broad categories: real property and personal property, as seen in Figure 3. Personal property includes general military equipment ranging from aircraft carriers to pencils to MRAP vehicles, while real property is principally land, buildings, and other DoD structures (see Figure 3; Navin, 2010,



pp. 16, 18). Personal property is subcategorized as non-standard equipment (NSE; i.e., commercially obtained items) or military-type property that has a hierarchical significance (see Figure 3) and dollar range depending on the individual defense article, like the multimillion-dollar MRAP program. NSE procurement in OIF and OEF, funded predominantly with overseas contingency operations (OCOs) money, is typically for items not found on a Marine Corps table of organization and equipment (T/O&E). Instead, NSE procurement is for articles that help address urgent needs or minor gaps (e.g., low-powered lasers for escalation of force [EOF] equipment to reduce civilian casualties). Additionally, per DoD 4160.20-M (ODUSD[L], 1997), military-type property being considered for disposal outside the United States or a U.S. territory is classified as foreign excess personal property (FEPP) (p. 9-1).

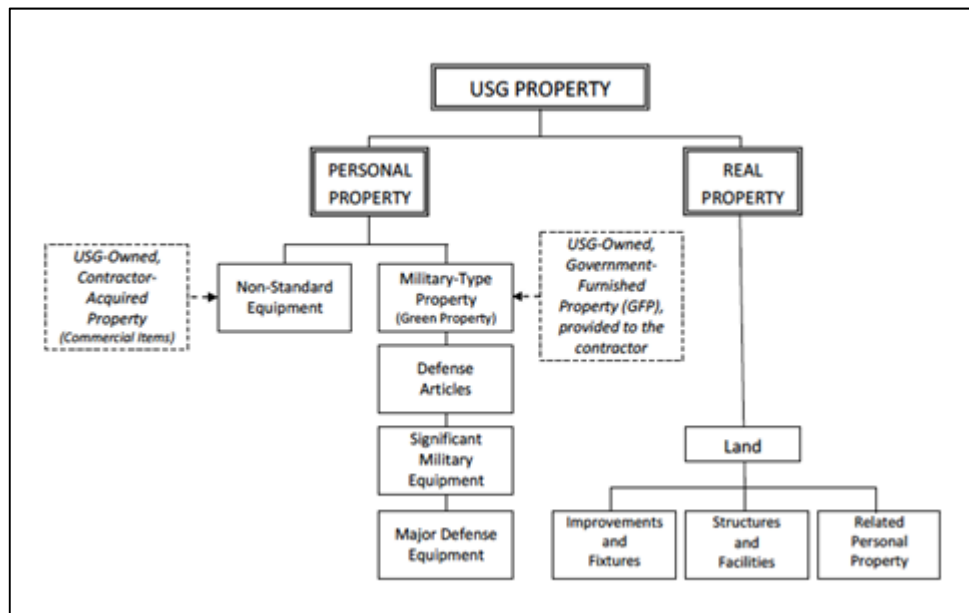


Figure 3. Property Classification Framework
(Navin, 2010, p. 40)

The reuse of DoD equipment, which is categorized as reutilization, is a large program within the DLA and other federal agencies. However, when discussing disposition approaches to military-type property (e.g., degraded high mobility multipurpose wheeled vehicles [HMMWVs] or MRAP vehicles), it is important to differentiate between the DLA’s disposal operations abroad and stateside. We only focus



our research on the efforts to dispose, scrap, or resell excess equipment in and from Afghanistan.

Disposing of FEPP has different forms and definitions. One aspect of disposal can refer to FMS through EDA transfers to foreign allies, as we will describe in Section C of this chapter, and the DLA plays an important role in coordinating and executing FMS. As described in the *2010–2017 Defense Logistics Agency Strategic Plan* (DLA, 2010a), the DLA “also partner[s] directly with the services to meet the needs of Foreign Military Sales customers. [They] support 115 allied nations with more than \$2 billion in annual sales, playing a pivotal role in sustaining DOD’s Security Assistance Program” (p. 2). Disposal can also mean abandoning or destroying an item, or it could refer to the process of scrapping military equipment down to an unrecognizable and unusable state. These definitions are further described in following subsections.

3. Definition of Code Conditions

There are multiple sets of materiel condition codes used to classify the physical state of DoD equipment. The federal condition code is the primary distinguishing classification in the *Defense Materiel Disposition Manual*, and it incorporates two subsets: supply and disposal condition codes (ODUSD[L], 1997, pp. xxii, 9-4). Supply condition codes, as seen in Appendix A, are assigned by individual DoD components and are the basis for determining whether equipment or materiel is serviceable, in excess, or transferable to DLA’s Disposition Services (ODUSD[L], 1997, pp. xxii, 3-7). Disposal condition codes, as seen in Appendix B, are assigned by Disposition Services after an item is received from the DoD component, inspected, and verified (ODUSD[L], 1997, pp. xxii). For the purpose of this research and model, only federal condition codes, as seen in Appendix C, are utilized because they reflect the combination of both supply and disposal codes, and they establish “fair value rates” for determining an item’s potential transfer price (ODUSD[L], 1997, pp. xxii, 3-7, 9-4, 9-5). The federal condition codes are alphanumerically categorized and are listed in Appendix C along with the associated fair value percentage rates.



4. Definition and Criteria for Abandonment and Destruction

Abandoning and/or destroying military articles and supplies is a dire and extreme way of disposing of equipment, and this equipment disposition option prevents the Marine Corps from salvaging those defense articles or recouping any original acquisition costs. Most commanders would consider this action the least desirable or acceptable method to retrograde their unit's equipment and would consider it a means of last resort. However, abandonment and destruction (A/D) is detailed here in order to differentiate it from other disposal methods in DoD 4160.21-M (ODUSD[L], 1997). Chapter 8 of the *Defense Materiel Disposition Manual* lists important criteria for A/D (ODUSD[L], 1997). One or more of the following conditions must be met for materiel to qualify for A/D (ODUSD[L], 1997, pp. 8-1, 8-2):

- The materiel has been documented with health, safety, security, or environmental hazards.
- U.S. or host country law, DoD policy, or military Service regulations indicate that the materiel cannot be reutilized, transferred, donated, or sold.
- Donating the materiel has been determined and documented to be infeasible.
- The property has no commercial value, meaning that the property has neither utility nor monetary value (either as an item or as scrap).
- Sale of the property is uneconomical; that is, when the estimated costs of the continued care and handling of the property exceed the estimated proceeds of its sale and providing the estimated cost of disposal by A/D is less than the net sales cost.

As the criteria indicate, A/D results in the total loss of accompanying equipment and resale value.

5. Definition and Criteria for Scrapping

Scrapping is a distinct process from A/D; scrapping requires that action be taken to demilitarize a defense article for some type of resale price. An item is classified as



unserviceable or condemned (i.e., supply/disposal condition code H or S) by both the DoD component and DLA Disposition Services before it is properly scrapped (ODUSD[L], 1997, pp. 3.3-2, 3.4-2). The DLA Disposition Services' definition of scrap is "materiel that has no value except for its basic materiel content" (DLA, 2011b). Further criteria are necessary to achieve a maximum net benefit from this process:

Scrap segregation at the generator's [unit's and service branch's] location is mandatory to keep the cost of handling scrap property to a minimum, and to enhance the value of the scrap (commingled scrap reduces/destroys the value of the basic materiel content). The Site is available to furnish scrap segregation guidance and, when possible, containers for scrap segregation. (DLA, 2011b)

Scrap proceeds are deposited either to the DLA Disposition Services Defense Working Capital Fund (DWCF) or to the U.S. Treasury to reimburse the individual Services (DLA, 2011b). The three Disposition Services sites located in Afghanistan conduct scrapping primarily on battle-damaged equipment and also to help redistribute excess equipment to other units in need. As highlighted in a recent article, "In an average month, they [the Disposition Services] receive an average 2.3 million pounds of scrap, verify the destruction of 350,000 pounds of demilitarization-required property and redistribute \$1.6 million in usable property to other units" (DLA, 2012b).

After DLA Disposition Services produces or accumulates enough scrap, it sells it to allied nations or on the open market via coordination with the State Department. The DLA Disposition Services website for Bagram, Afghanistan states:

Private companies and individual customers compete for property by participating in property sales which are ongoing. Usually a sale is for one broad category of property. Property is sold by local open or sealed bid auction, national sealed bid auction, or by negotiated sales when appropriate (e.g., with high-value items). (DLA, 2011b)

It is possible that scrapping excess, damaged, or obsolete equipment will save the U.S. government and the DoD millions of dollars in transportation, handling, and refurbishment costs during a full retrograde from Afghanistan, and this process is a viable option for potentially hundreds of line items and defense articles.



C. DEFENSE SECURITY COOPERATION AGENCY

Security cooperation is a critical dimension of U.S. national security. The *Security Assistance Management Manual (SAMM)*; DSCA, 2003) defines *security cooperation* as “all activities undertaken by the DoD to encourage and enable international partners to work with the U.S. to achieve strategic objectives” (p. 35). The Defense Security Cooperation Agency (DSCA) is an organization within the DoD that maintains foreign ally relationships by building strategic resources to advance allied national security. DSCA’s four core capabilities are international military education and training (IMET), foreign military financing (FMF), foreign military sales (FMS), and excess defense articles (EDA). Each of the four capabilities fosters stronger ties with allies and enhances their military capabilities. Arguments have been made that U.S. national security rests on its ability to “deter, defend against, and decisively defeat potential threats” by providing to our allies a “ring of access” (Williamson & Moroney, 2002, p. 81) around future global hotspots with tools such as security cooperation.

FMS provides various resources that most recently have been in support of requirements such as lethal defense articles that have helped equip the Iraqi and Afghan armies and police. Upward trends in equipment sales from wars in both theaters via the FMS process are depicted in Figure 4.



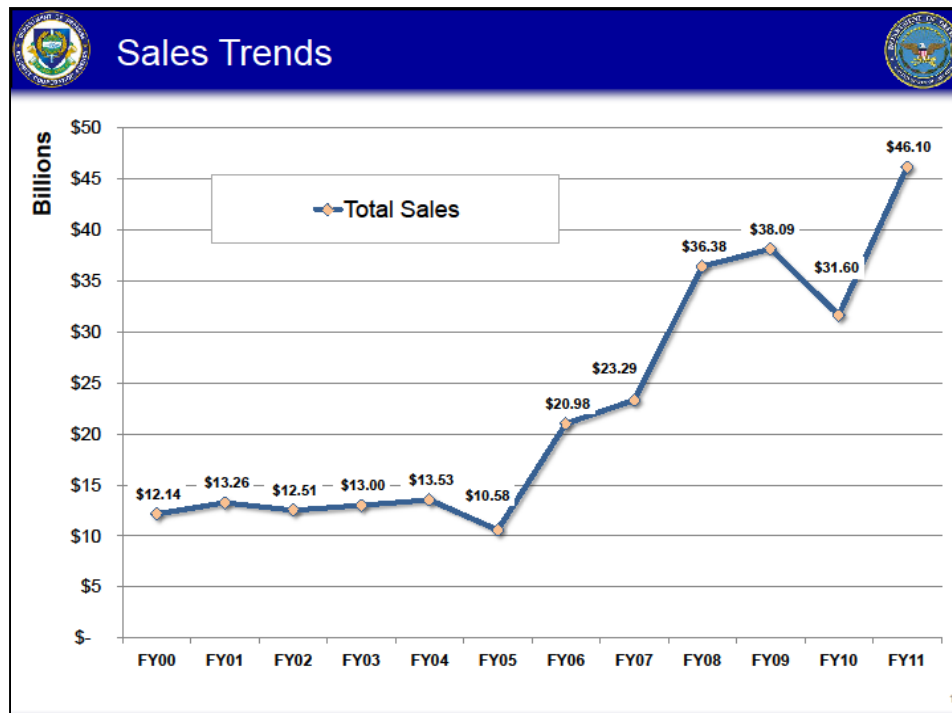


Figure 4. Recent Foreign Military Sales Trends
(DSCA, 2012a)

Delivery lead-times range from six months to two years for fulfillment of requested items to the customer, which is a common problem with FMS. A recent report conducted by the Security Cooperation Reform Task Force highlighted the challenges of FMS, which supports 117 different countries. The report was performed at the request of the Secretary of Defense and contained suggestions for making improvements in the following areas within FMS (DoD, 2011, pp. 5–6):

- Security cooperation planning is oriented at responding to requirements rather than at anticipating them.
- The FMS process has little ability to respond to urgent or unforeseen requirements.
- “DoD lacks formal means to prioritize competing requirements for defense articles and services among partner countries, and between partner countries and United States forces.” (DoD, 2011, p. 6)



Equipment provided through FMS to a foreign state is new or used, as facilitated via the EDA transfer process for used or outdated defense equipment. Studies completed by the Logistics Management Institute have claimed that retaining EDA from the Services and taking the long-term option of selling it to foreign nations via FMS would “generate 6 to 13 times more net revenue than disposal” (Kiebler, Horne, & Zimmerman, 1994, p. iv). With regard to excess defense articles, the *SAMM* states, “This excess equipment is offered at reduced or no cost to eligible foreign recipients on an ‘as is, where is’ basis. The EDA program works best in assisting friends and allies to augment current inventories of like items with a support structure already in place” (DSCA, 2003, p. 492).

As seen in Appendix C, EDA pricing is strictly enforced insofar that “items are priced between 5 to 50 percent of the original acquisition value depending on age and condition” (DSCA, 2003, p. 496). The low-end yield of 5 percent suggests major repairs and revenue will range up to 50 percent depending on the serviceability condition code. The Logistics Management Institute study states, “It is substantially more cost-effective to retain assets within constraints than to dispose of them even if only 10 percent of the original demand forecast is sold” (Kiebler et al., 1994, p. 3-3).

Over the years, there has been public concern about transferring defense articles with advanced technology. An example of this concern is in a recent Congressional Research Service report that illustrates threats to national security (Kan, 2010, p. 2). However, when an EDA transfer is completed, the technologically sensitive materiel is removed, retained, and properly screened.

The defense industrial base is one of many key stakeholders when these EDA transfers take place. Transfers, some of which include long-term maintenance contracts, could benefit industry leaders such as Oshkosh, Northrop Grumman, or Lockheed Martin by opening a new customer base, as is the case with recent contracts for logistical support negotiated with Kuwait (DSCA, 2012b, p.1).

Despite EDA transfers’ being conducted for many decades, a 1994 GAO report discussed the lack of a data management system to account for actual transfers of EDA as



well as Services that failed to follow DoD pricing directives and, as a result, understated the value of EDA transfers that were granted or sold (p. 2). No financial gain is achieved by granting defense articles as opposed to selling them through FMS as an EDA grant. From data collected from DCSA, Figure 5 expresses the current transfer price of total EDA grants (Foreign Assistance Act [FAA], 1961, §§ 516, 517, 518, and 519) given to foreign nations versus EDA sales to alliances from 1992.

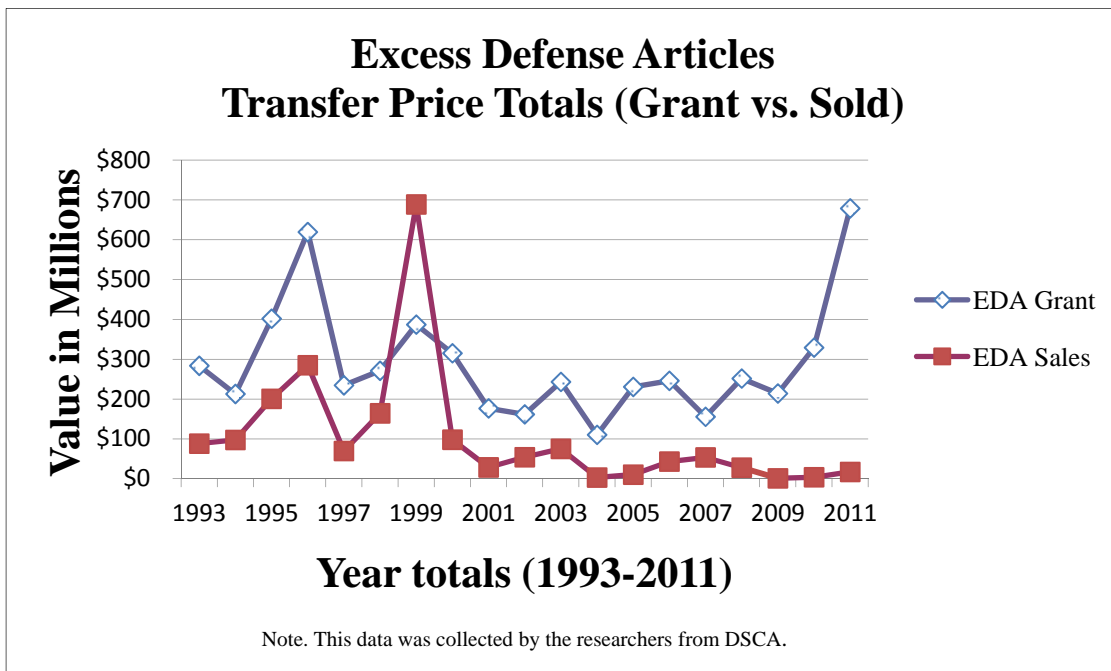


Figure 5. Total Price of Total EDA Transfers

The total original acquisition price of defense articles is a much larger percentage of what the transfer price ends up being regardless of whether an EDA grant or EDA sale takes place. As reliability of equipment depreciates and items therefore become less serviceable, the condition code designated by the service is lower, resulting in a further downward spiral in transfer price. From data collected from DSCA, Figure 6 illustrates the percentage of original acquisition price of ground combat vehicles is predominately priced greater for EDA grants to foreign nations than it is for EDA transfers sold for a return on investment.



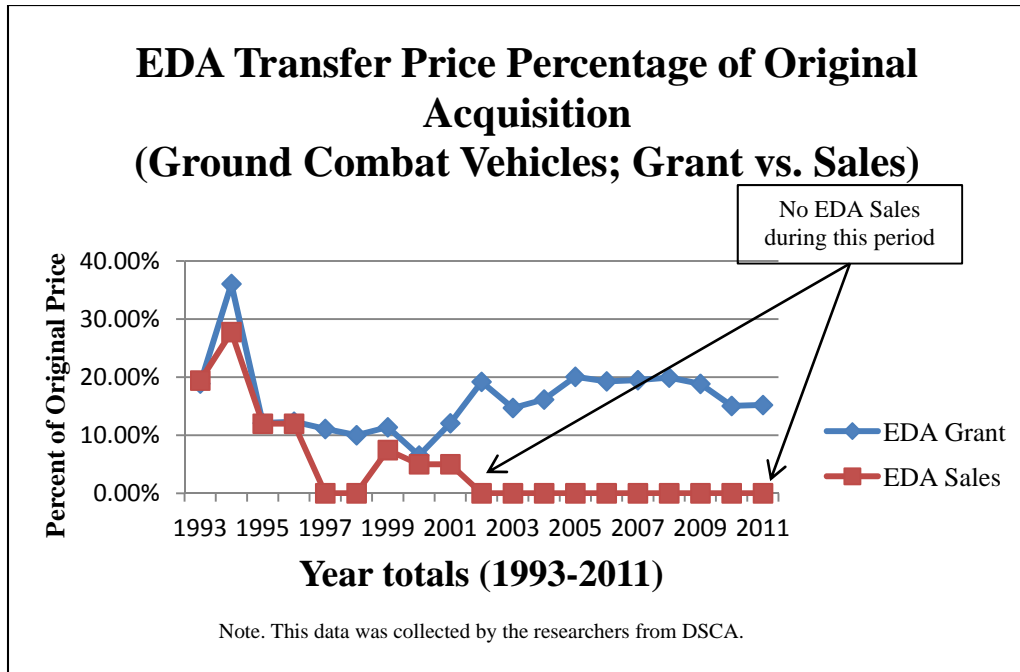


Figure 6. Percent Price of Vehicle EDA From Original Acquisition Price

1. Excess Defense Article Transfer Process

The EDA transfer process is dynamic, and no public lists exist of what is excess from all the different Services. Therefore each country may exploit these excess resources on a first come, first served basis once a request is submitted to DLA. The flow chart in Figure 7 displays the relationship between DLA and DSCA in regard to EDA transfers, referred to as “special programs” in this example, and further distinguishes DLA transfers from EDA transfers. Figure 7 also illustrates the transfer process of the Service identifying an item that is in excess of their AAO and transferring final authority to the foreign nation.



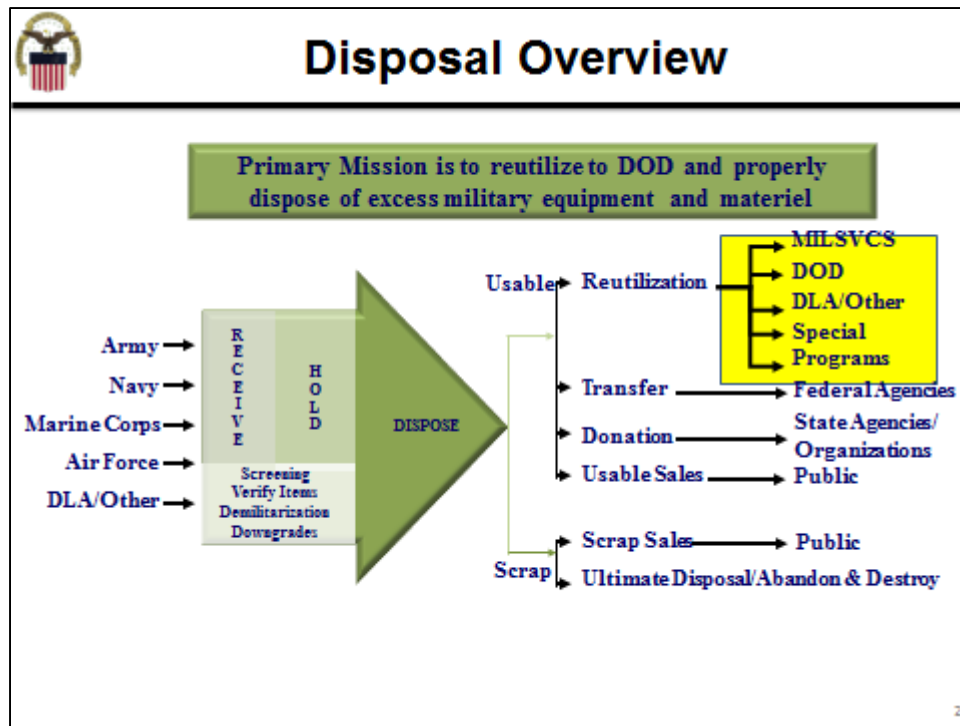


Figure 7. DLA Disposal Overview Flow Chart, March 2011
(DLA, 2011c)

Once equipment is identified as being beyond the needs of the service, the request is turned over to DLA. DLA Disposition Services will place the equipment in one of four categories: transfer, reutilization, donation, and disposal (DLA, 2011c). Examples of DLA transfers, also identified as FEPP in Chapter II, Section IIIB of this report, refer to scenarios when equipment is given to organizations such as the United States Department of Agriculture Forest Service. Such a transfer could occur with something like excess DoD equipment for fire and emergency services (DLA, 2010b, p. 1). When equipment is in the reutilization category, it is transferred to DSCA for further EDA processes, as illustrated in Appendix D of the previously mentioned 1994 GAO report (p. 13) and also is displayed in chapter 11 of the *SAMM* (DSCA, 2003). Equipment in the category for donation would possibly go to organizations such as the Department or the National Association of State Agencies for Surplus Property (NASASP; 2010, p. 1), and equipment prepared for disposal would be demilitarized by DLA.

2. Restrictions

As seen with most retrogrades in U.S. history, once the presidential exit strategy guidance is given, time is a critical factor due to the numerous steps involved. To get authorization for the transference of EDA, Congress must be notified between 15 and 30 days prior to execution, depending on the level of the transfer (GAO, 1994, pp. 10–11). At any rate, the detailed coordination between layers of agencies takes time as requests for U.S. excess equipment go through the requesting country, Department of Commerce, Department of State, DSCA, and the Services.

The EDA transfer process time begins with the military Service identifying equipment that is in excess, not with the customer agent making a request for excess equipment. Supply chain management has, in recent years, changed in the private sector from utilizing push logistics to now primarily providing pull logistics in an effort to reduce customer wait time. Joint Publication (JP) 4-0 (Chairman of the Joint Chiefs of Staff [CJCS], 2008) points out the clear benefits of push and pull methods: “a combination of push and pull resupply will reduce unused or wasted space by adding predictability as well as combining compatible loads, thus resulting in a more effective as well as more efficient use of transportation assets and the logistic footprint in-theater” (p. 13). Nevertheless, a push supply system is required in order to supply the customer base with excess materiel.

Despite the type of logistical support, the poor economic stability of many foreign allies limits what is feasible with regard to EDA. Foreign allies seeking excess equipment have to provide financial support for the transportation of any equipment (Navy International Program Office [NIPO], 2012). This is a limiting factor that deters some foreign allies from obtaining the required assets to defend their national security with less expensive defense articles. A second constraint is the foreign country’s lack of an industrial base sufficient to maintain sustainable technical knowledge for future repairs.

The defense industrial base is a complex system that has grown over the years, capitalizing on directly equipping requirements for our warfighters. In order for the



industrial base to remain active, foreign countries must procure lethal defense articles or maintenance contracts in order to sustain demand within the United States for Services, especially to “offset declining business at home” (Defense Institute of Security Assistance Management [DISAM], 1991, p. 56). On the other side, the DoD requires all project managers to install anti-tamper measures on sensitive defense articles to protect reverse engineering and to maintain integrity, originality, and future demand for the defense industrial base (DoD, 2012, p. 77).

D. UNITED STATES TRANSPORTATION COMMAND

Challenges to U.S. transportation requirements are nothing new to the military, as battles have been exclusively fought offshore ever since the Civil War. Operations in Korea and later Vietnam demonstrated a need for rapid and reliable support requirements that prove challenging to orchestrate. On October 1, 1986, the Goldwater-Nichols Act established that all common-user DoD air, land, and sea transportation would be consolidated (1986, § 212(a) (3)). The consolidation created United States Transportation Command (USTRANSCOM), the largest single authority for U.S. military transportation.

The mission and responsibilities of USTRANSCOM are dynamic and supported through three component commands: Air Mobility Command, Military Sealift Command, and Military Surface Deployment and Distribution Command. As one of nine Combatant Commands, USTRANSCOM has a general support role (defined as “functional”) rather than a regional geographic responsibility. There are two other functional combatant commands: U.S. Strategic Command and U.S. Special Operations Command. The mission of USTRANSCOM is as follows:

Develop and direct the Joint Deployment and Distribution Enterprise to globally project strategic national security capabilities; accurately sense the operating environment; provide end-to-end distribution process visibility; and responsive support of joint, U.S. government and Secretary of Defense-approved multinational and non-governmental logistical requirements. (USTRANSCOM, 2012a, para. 2)

Despite having no physical equipment under its direct responsibility, USTRANSCOM is charged with orchestrating the movement of the service components in and out of all



theaters of operation. To illustrate the complexities of this strategic function, we provide the following statistics: During Operation Desert Storm, USTRANSCOM was responsible for the movement of “nearly 504,000 passengers, 3.7 million tons of dry cargo, and 6.1 million tons of petroleum products in approximately seven months” (USTRANSCOM, 2012a, para. 6). This is just the beginning of the colossal transportation demands subsequently seen in Operations Iraqi Freedom and Enduring Freedom.

Today, USTRANSCOM has not only coordinated logistics for the two major wars in Iraq and Afghanistan, but also delivered 26.2 million pounds of supplies during the unfortunate Pakistani flooding and 3,431 short tons of cargo during the horrific tsunami in Japan in 2011 (USTRANSCOM, 2012c). In addition to humanitarian assistance, a multitude of other missions take place, such as the aerial delivery missions into Afghanistan totaling 80 million pounds of cargo (Fraser, 2012, p. 7). Now USTRANSCOM coordination is becoming just as critical with the demands on transportation for the withdrawal from Afghanistan.

USTRANSCOM maintains responsive support for logistical requirements partly due to the Civil Reserve Air Fleet (CRAF) that supplements military air support requirements when necessary. As stated in a 2006 Congressional Research Service report,

The airlines contractually pledge aircraft to the various segments of CRAF, ready for activation when needed. To provide incentives for civil carriers to commit aircraft to the CRAF program and to assure the United States of adequate airlift reserves, the government makes peacetime airlift business available to civilian airlines that obligate aircraft to the CRAF. (Bolkcom, 2006, p. CRS-2)

In most instances, the cost of buying a new plane will be much higher than using assets from the civilian air fleet by paying an as-required charter fee. As seen during Operation Desert Storm, “AMC [Air Mobility Command] paid carriers about \$1.5 billion for using their aircraft during the operation. Purchasing additional aircraft to provide similar capability would cost [the DoD] from \$15 to \$50 billion, according to Air Force



officials, depending on assumptions used for aircraft replacement cost” (Bolkcom, 2006, p. 4).

The maritime contingency program called Voluntary Intermodal Sealift Agreement (VISA) is similar to the CRAF arrangement for emergency strategic air support. In regard to VISA, a 2009 Department of Defense Inspector General (DoDIG) report stated, “It commits carriers to provide shipping capacity and allows shippers to carry military cargo alongside commercial cargo” (p. 3). Speed is sacrificed when choosing to embark equipment by military sealift; nonetheless, the cost savings are significant compared to airlift when time is not a major constraint in planning. Since the development of the shipping container, an increase in private- and public-sector container shipping has emerged. The extent to which USTRANSCOM’s mission has increased with containers at sea is described by the DoDIG’s (2009) report: “more than 90 percent of all the equipment, fuel, and supplies needed to sustain the United States Military are carried by sea” (p. 1).

General Fraser, the commander of USTRANSCOM told the Senate Armed Services Committee that “[Military] Surface Deployment and Distribution Command (SDDC) expanded into multimodal operations by moving over 3,500 pieces of mission essential cargo by commercial liner sealift with follow-on airlift into Afghanistan” (Fraser, 2012, p.3). Multimodal operations are complex and require detailed coordination with the various combinations of air, sea, and/or land transportation to reach the final destination. During 2010 and 2011, when requirements developed for M-ATVs in Operation Enduring Freedom, approximately 4,200 were delivered by various methods of multi-modal operations (USTRANSCOM, 2012c, p. 7).

1. Transportation Working Capital Fund

According to the DoD *Financial Management Regulation* (OUSD[C], 2008), all “Defense Working Capital Fund[s] consists of activity groups that are managed by DoD Components for providing goods and services, on a reimbursable basis, to other activities within the DoD and to non-DoD activities when authorized” (p. 1-5). The purpose of a working capital fund is to maintain funds from current operations that will be available to



finance funding requirements for future operations without the end-of-year fiscal restrictions. With respect to USTRANSCOM, the Transportation Working Capital Fund (TWCF) is executed within the confines of the working capital fund as regulated by the DoD.

In order to meet financial obligations and future demands, funds can be managed through a working capital fund rather than through appropriations. The working capital fund will break with time due to the “revolving fund” concept that will produce sufficient cash to balance expenditure costs. DoD *Financial Management Regulation 7000.14-R* (OUSD[C], 2008) states, “The revenue collected from these ‘customers’ is used to pay for the acquisition of resources needed to ensure the continuous operation of the various working capital fund activities” (p. 19-3). U.S. military operational requirements have been complex when managing finances for the TWCF. USTRANSCOM’s Director of Program Analysis and Financial Management illustrates the challenges of the TWCF by stating:

Working Capital Fund policy is to maintain 7 to 10 days of cash, or \$400 million to \$600 million, for TWCF. Maintaining this level of cash has been very difficult to manage for the past several years because of volatile fuel prices and past congressional budget marks. Fortunately, the Air Force has helped by raising the cash management level to the Air Force WCF level—TWCF is a subset of the Air Force WCF. (Bentley, 2009, p. 3)

USTRANSCOM must meet all support requirements in order to meet operational demand. This business model creates revenue, but nonetheless serves only as a cushion for the next requirement.

To balance the TWCF over time, the charged transportation rates may increase or decrease as each general contract is signed. The two main categories of funding requirements come from contractual (variable) costs and billing (fixed) costs. The contract used for cost estimates is the Universal Service Contract-06 and it is updated as contractual rates change (USTRANSCOM, 2011). As for billing rates, various situations will determine major differences in what the Service will be charged:



USTRANSCOM sets billing rates annually for three SDDC [(Military) Surface Deployment and Distribution Command] Fee for Service programs – Port Handling, Liner Ocean Transportation (container and break-bulk), and Global Privately Owned Vehicle (POV) Contract (GPC). Billing rates for these programs vary depending on the regional area and commodity or shipment type (import or export). (USTRANSCOM, 2012b)

For the movement of equipment in and out of theaters of operation, transportation costs are major components in calculating total costs. This requires a complex model for computing projected cost estimates for land, air, and sea transportation.

2. Universal Service Contract

The Universal Services Contract (USC) governs the relationship between USTRANSCOM and the global transportation industry. The contract is updated approximately once a year and defines costs for the movement of goods via all modes of transportation, including air, sea, and rail, as well as port operations. Given that shipping transportation has been divided into bulk and break-bulk, these remain the two broad categories through which USTRANSCOM analyzes the array of charges for movement of military equipment (Levinson, 2006, p. 13).

A few examples of the charges can be, but are not limited to, a drayage charge, line-haul charge, and liner-in or liner-out charges. The drayage charge is the cost of moving equipment from an aerial or sea port to another destination ten or fewer miles away. The current USC is USC-06, which defines drayage as “the movement ... within a ten-mile radius of the city limits of that foreign port city, by means other than the Contractor’s principal vessels, such as by highway or railway” (USTRANSCOM, 2011, p. 49). When using multiple modes of transportation, it is common to see a drayage charge included in transportation cost (or added to it). It is challenging to ensure smooth and efficient transitions to the next mode of transportation when dealing with multimodal operations.

The line-haul charge is the transportation of items from one location to another that requires more than ten miles in total distance. The USC-06 defines line-haul as:

The movement between the Contractor’s terminal at the port where the container is loaded to, or discharged from, the vessel and another place



outside of the Commercial Zone or modified zone of that United States port city or beyond a 10-mile radius of the city limits of that foreign port city by means other than the Contractor's principal vessels, such as by highway, railway, canal or river, or in specific instances by feeder vessels, ferry or barge ship system. (USTRANSCOM, 2011, p. 50)

Sea transportation costs utilize line-haul fees in the contract with commercial carriers and USTRANSCOM. The liner in and liner out is expressed as loading or unloading vehicles from the aerial or sea port. The USC-06 states the "Contractor is responsible for the loading and/or discharging of cargo at port of origin and/or destination and all costs associated thereto" (USTRANSCOM, 2011, p. 51).

Many additional charges could apply depending on the need for port handling, cargo cleaning, security, enhanced in-transit visibility, and so forth. In understanding transportation cost, the USC serves as a foundation to build total cost estimates for R4 operations. The challenge in giving accurate calculations versus estimates is that, as mentioned before, many different scenarios exist for multimodal movement, and there are various commercial carriers available for each service provided.

E. MARINE CORPS LOGISTICS COMMAND

The first supply depot in Marine Corps history, also known as the Quartermaster's Depot, was established in 1880 at the Navy Yard, Philadelphia, PA. With decreased need for supplies during post-war efforts, the Philadelphia depot closed, as did others such as Marine Corps Depots in San Francisco, CA; Norfolk, VA; San Diego, CA; and Pearl Harbor, HI (Rottman, 2002, p. 66). Logistics and supply depots in the Marine Corps have seen an assortment of changes—like reductions in depots—but have also seen a number of organizational structure modifications (Morrison, 1994, p. 72). Nevertheless, the flexibility on both east and west coasts is a critical element of logistical activities for maintenance, storage, and supply in the Marine Corps.

Today, the Marine Corps Logistics Command (MCLC) headquarters is located in Albany, GA, and its mission serves as a critical component in our analysis of repair and rebuild costs for the vehicles returning from Afghanistan. The MCLC mission and responsibilities reach much further than just depot maintenance, which include strategic



supply and prepositioning efforts around the world. As seen in Figure 8, MCLC controls two subordinate commands and one forward command element: Blount Island Command in Jacksonville, FL, Marine Depot Maintenance Command in Albany, GA, and MCLC Forward (Fwd) in Afghanistan.



Figure 8. Marine Corps Logistics Command Organizational Chart (MCLC, 2012b)

The MCLC was created to streamline all major logistical processes in support of the operational needs of the warfighters. The mission of MCLC is stated as follows:

To provide worldwide, integrated logistics/supply chain and distributed management; depot level maintenance management; and strategic prepositioning capability in support of the operating forces and other supported units to maximize their readiness and sustainability and support enterprise and program level total life cycle management. (USMC, 2005, p. 1)

The challenge with the last chapters in today's wars resides in having sufficient capacity for equipment repairs and navigating the uncertainty of total repair cost for each piece of equipment.

Today, the presence of MCLC (Fwd) provides logistical services to units in Afghanistan while also supporting the Marine Corps's Reset Strategy as the war comes to a close. As highlighted in the *Operation Enduring Freedom Ground Equipment Reset Strategy*, the cost of repairs for equipment returning to depots will be 40–65 percent of the replacement cost (USMC, 2012, p. 14). Adding to the challenge is the fact that because most of the vehicles returning from Afghanistan are predominantly new procurements, such as the M-ATV or other MRAP vehicle variations, the cost estimations could be drastically different than what is expected. In understanding total cost, the cost to repair equipment and the efforts of MCLC are a major part of the complex equation.

F. BRIEF HISTORY OF FRANCE RETROGRADE

Now we transition from the R4 stakeholder background information to the historical background on recent retrograde operations beginning in France. The North Atlantic Treaty Organization (NATO) charter was signed in the late 1940s and France, the United States, and 10 other European nations took part in this accord. American military presence in Europe still existed after 1945 until 1990 primarily to deter Soviet invasion (i.e., the Cold War), which explained Air Force and Army presences in France and Germany. However, in 1966 General Charles de Gaulle, who at the time was the president of France, had retracted the country's military obligations from NATO, which forced the United States to rapidly retrograde equipment and redeploy forces out of France. This situation resulted in Operation Fast Relocation (Operation FRELOC).

Upon Presidential guidance from the United States, a report was conducted in 1968 discussing the shortfalls of moving all equipment out of France in a one-year time span. The report indicated that the major redeployment and retrograde details encompassed “moving 70,000 personnel, disposing 800,000 short tons of supplies, relocating [Supreme Headquarters Allied Powers Europe] to Belgium, evacuating 190 installations, and constructing new storage outside France” (GAO, 1968, p. 5). Of those approximately 800,000 tons of materiel, the cost was \$1.2 billion, and Congress reported its redistribution as follows: 320,000 tons to Germany, 145,000 to the United



Kingdom, 90,000 to the United States, and 170,000 to disposal (Subcommittee on International Finance and Resources, 1975, p. 5).

Operation FRELOC was a general success in terms of logistical requirements; nevertheless, due to the time constraints, problems arose with regard to EDA. In 1967, equipment valued at \$57.6 million was excess to the U.S. Army in France and not reported at the national level, making it unavailable for use to fill other gaps to other U.S. services and/or foreign allies (GAO, 1968, p. 15). The GAO (1968) report indicated that “during Operation FRELOC, the Air Force shipped many items to Germany that were subsequently sold as scrap” (p. 16), highlighting the potential problems that arise with constrained timeframes.

The result of the constrained timeframes created a ripple effect in Congress. The Subcommittee on International Finance and Resources reported that none of the excess equipment granted had been used as leverage to pay off debt (1975, p. 1). Paying off debt and leveraging financial obligations seemed difficult to manage as such a withdrawal effort was taking place. The State Department reported in 1974 that equipment valued at \$1.5 billion was given to the French as an EDA grant free of charge. Figure 9 shows a breakdown of this grant by Service (Subcommittee on International Finance and Resources, 1975, p. 17).

Embassy Paris reports that as of 30 June 1974, of the \$1.5 million grant equipment, the inventory by Service by dollar amount was :		<i>Millions</i>
Army		\$261.6
Navy		307.6
Air Force		95.7
Total		664.9

Figure 9. Breakdown of the Service’s Portion of the Grant
(Subcommittee on International Finance and Resources, 1975, p. 17)

The U.S. efforts in France illustrate challenges created when a small window of time is given for retrograde. What resulted from these time constraints was an enormous amount of EDA (\$1.5 billion in total cost) given to the French; if more time had been allowed, better financial decisions could have been made, such as selling the items at a



discount to our European allies. Examination of Operation FRELOC is significant in order to analyze inadequate cost decisions during R4.

G. BRIEF HISTORY OF VIETNAM RETROGRADE

Operation FRELOC posed significant challenges in a short amount of time and serves as an interesting retrograde case study. Unlike post-1966 in France, the Vietnam conflict required executing a drawdown while U.S. forces were still engaged in combat operations. As stated in a 1973 *Army Logistician* article, “This is the first time that excess materiel has been identified, screened, and removed from a combat area while the fighting was still in progress” (Buswell, p. 29). Vietnam is also relevant to today’s Afghanistan conflict and the eventual retrograde from there under similar difficulties and constraints.

The inevitable drawdown and reduction of U.S. forces in Vietnam was hastened due to vehement politics and waning public support at home. However, the retrograde process necessitated pragmatic, detailed planning, especially due to the sheer amount of personnel and equipment requiring removal. President Richard Nixon established that any troop reductions were incremental and predicated on “continued improvements within Republic of Vietnam Armed Forces (RVNAF),” or in other words, South Vietnam becoming governmentally and militarily self-reliant (GAO, 1973, p. 144). In three years and 13 carefully staged drawdown increments, the following was accomplished: “the reduction of U.S. forces from 544,000 in June 1969 to 27,000 in December 1972 [that] included the withdrawal not [only] of U.S. personnel but [also] their equipment; concurrently, U.S. forces were improving RVNAF capabilities to minimize the impact of the U.S. redeployments” (GAO, 1973, p. 144).

Logisticians faced the monumental tasks of categorizing the condition of equipment, arranging transport, reselling, and scrapping materiel. An early list of retrograde and capacity issues were identified by a 1971 Comptroller General of the United States (1971a) “phasedown” progress report that assessed the first three withdrawal increments that totaled “a reduction of approximately 21% of the force”



(p. 1). Summarized below are a few of the constraints and bottlenecks documented in this report:

- lack of uniform procedures among the Services,
- equipment backlog at cleaning stations due to strict U.S. Department of Agriculture (USDA) standards,
- “reporting and accounting system did not provide management with accurate, complete, or timely logistical data,”
- “backlog of materiel awaiting shipment to the United States because of the lack of people qualified in packing and crating of materiel,”
- failure to cancel requisitions for unnecessary equipment and supplies,
- “significant backlog of reparable equipment in Vietnam mainly because of limited maintenance capabilities” (Comptroller General of the United States, 1971a, p. 2).

Although these were significant challenges at the time, military personnel were able to move large amounts of equipment out of Vietnam in a relatively short period of time. The U.S. Comptroller General calculated that “during the first 8 months of fiscal year 1970, Army depots in Vietnam were directed to ship excess serviceable secondary items and supplies valued at \$297 million out of Vietnam” (1971a, p. 2).

However, not all equipment left Vietnam, and what was left required further classification for disposition, either as scrap or redistribution to allies. During Vietnam, the Army’s Property Disposal Branch (PDB) was the lead agency for handling excess equipment; the PDB was essentially the predecessor of the current DLA’s Disposition Services. In March of 1973, the PDB became subordinate to the Army Division within the American Embassy’s Defense Attaché Office (DAO), highlighting the importance of supporting foreign militaries through U.S. excess equipment (Comptroller General of the United States, 1974, p. 9).

The PDB operated “five property disposal holding activities strategically located throughout Vietnam at Saigon Island, Ho Nai, Nha Trang, Qui Nhon, and Da Nang” and in fiscal year (FY) 1973 “redistributed property having an original acquisition cost of



\$122 million and received \$27 million in proceeds from the sale of property” (i.e., 22 percent return; Comptroller General of the United States, 1974, p. 9). Excess military equipment or defense article (EDA) sales generally went to the highest bidder and were based on a priority list published by the Secretary of Defense (Comptroller General of the United States, 1974, pp. 6–7). For example, the August 1972 message had inter-service transfers to “U.S. Military Pacific Command” as the highest priority, second were sales to the “Cambodia Military Assistance Program (MAP),” and last priority was sales to other federal agencies (Comptroller General of the United States, 1974, p. 7).

In the early stages of deciding equipment disposition, an incidental constraint and noteworthy issue surfaced that restricted excess equipment sales to the RVNAF. For any vehicle transfer, having a very low mileage was established as a strict requirement due to the limited maintenance capabilities of the RVNAF. The thought was that higher mileage significantly increased the logistics and maintenance burden (Comptroller General of the United States, 1971b, p. 13). Although a reasonable concern, a Comptroller General review elaborated that only “about 10 percent of the vehicles turned in by departing units were transferred to the RVNAF, even though the Vietnamese could have used many more” (1971b, p. 13). For example, after the restriction of a 10,000-mile maximum for Jeeps was lifted to 20,000 miles, eligible vehicles quadrupled from 49 to 196, which provided more flexibility in leveraging equipment transfers and sells (Comptroller General of the United States, 1971b, pp. 13–14).

After the attempted transfer or sale of EDA, anything that “could not be sold [was] then disposed of as scrap” (Comptroller General of the United States, 1974, p. 6). Figure 10 illustrates the types of military equipment disposed and the scale of scrapping operations by the Army’s PDB. Most equipment going to scrap was considered damaged beyond repair or obsolete without being resold or transferred as excess, but equipment from large bore howitzers to helicopters were reduced while in Vietnam.



<u>Description</u>	<u>Number</u>
Small arms	10,350
Gun tubes	1,698
Guns over 50mm (howitzers)	677
Armored vehicles	109
M-151 jeeps	1,724
Communication and elec- tronic items	128
Helicopters	10
Other (note a)	11,048

^aIncludes such items as armor vests, gas masks, steel helmets, and life rafts.

Figure 10. Scope of Demilitarization, January 1972 to March 1973
(Comptroller General of the United States, 1974, p. 20)

Additionally, scrap metal and other byproducts can be sold on the open market as raw materiel, giving the DoD an alternative option to finding returns on the original acquisition costs. In the process of reducing the scrap inventory in 1973, the PDB sought out buyers in the “lucrative offshore markets,” and “a gross return of over 20 percent was realized and further sales were conducted in Singapore and in the Philippines” (Buswell, 1973, p. 31).

The process of retrograding forces out of Vietnam was multifaceted and complex. It required significant logistical expertise, differing approaches to equipment disposition, and a team effort across the many departments of the U.S. government. Although militarily unique in geography, politics, and operations, Vietnam was not a hasty withdraw or unanticipated logistical quagmire; it was a comprehensive case study with numerous lessons learned for future retrograde dilemmas and operations.

H. BRIEF HISTORY OF THAILAND RETROGRADE

Less than 100 miles from Vietnam, American forces were deployed to Thailand in 1961 to “preserve independence of South Vietnam,” facilitating responsive air support and strategic B-52 bomber strikes (Darling, 1967, p. 213). In 1975, the number of Service members stationed in Thailand was approximately 27,000. To put this number in context, it is the same amount of service members stationed in Okinawa during 2012.



With such a large U.S. military presence possibly straining U.S.–Thai relations, the United States eventually negotiated an agreement with the Royal Thai Government in 1969 that began the withdrawal of U.S. troops and then agreed to further assess logistical requirements as needed for retrograde and redeployment (R2). The final retrograde process began in March 1976 when the Royal Thai Government requested that the U.S. forces withdraw permanently from the six remaining U.S. bases in Thailand: Ubon, Nakhon, Phanom, Udorn, Korat, U-Tapao, and Ko Kha (GAO, 1977, p. 34).

According to the GAO (1977), the R2 effort was enormous and experienced many difficulties despite no combat operations concurrently taking place, unlike the withdrawal from Vietnam (p. 17). Maintaining long-term relations with the Thai government by transferring equipment was a critical factor for R2 decisions (GAO, 1977, p. i). Stockpiles of ammunition were left behind to avoid large transportation costs, but the understanding was clear that Thailand had a valid requirement for the EDAs. Additionally, large volumes of communication equipment were also left behind with a three-year agreement with the United States for free usage of communication assets (GAO, 1977, p. 15). Figure 11 displays equipment retrograded from Thailand specific to each base.

PACAF ASSETS RETROGRADED FROM THAILAND						
	<u>Nakhon Phanom</u>	<u>Korat</u>	<u>Udorn</u>	<u>Korat Ko Kha</u>	<u>U-Tapao</u>	<u>Total (note a)</u>
General cargo (short tons):						
Air	785	2,123	2,381	257	473	
Surface	<u>4,108</u>	<u>3,232</u>	<u>6,669</u>	<u>739</u>	<u>4,962</u>	
Total	<u>4,893</u>	<u>5,355</u>	<u>9,050</u>	<u>996</u>	<u>5,435</u>	<u>25,729</u>
Munitions (short tons)	137	12,091	7,654	8	37,108	57,193
Vehicles:						
Number	207	211	200	11	224	853
Short tons	948	1,304	1,064	30	1,460	4,806
Relocatable structures (number)	37	46	88	2	55	228
Real property installed equipment (short tons)	-	-	-	b/461	1,211	1,672
Fuel (gallons):						
JP-4	-	-	-	-	2,907,282	2,907,282
JP7E	-	-	-	-	68,586	68,586
Baggage (short tons)	388	581	368	15	431	1,803

a/Similar data for Ubon is not included because it was not available at the time of our review.
b/None of this is 1,250-kilowatt generators.

Figure 11. Retrograded Equipment from Thailand
(GAO, 1977, p. 33)



The Pacific Air Force was given authority by the State Department and the DoD for disposal operations. However, disposal operations of excess equipment were not feasible because the Royal Thai Government controlled facets such as the transportation nodes, agriculture inspections for equipment departing the country, and contractors working, which proved difficult for U.S. logisticians conducting R2 operations (GAO, 1977, p. 7).

A key to understanding the eventual success Thailand retrograde operations out of Thailand was that each Service was given the autonomy to make judgment calls on whether equipment was deemed to be in excess. The FMS transfers of EDAs to the Royal Thailand Government included vehicles, construction materiel, and repair parts that were estimated to be \$235 million (GAO, 1977, p. 10). These transfers of EDA sales were of financial gain to the United States, which stands in contrast with the nonexistent revenue gained in granting EDAs.

The Thailand example illustrates an understanding of the Thai government's valid military defense requirements that the United States exploited as R4 efforts took place. Even today, the United States maintains a positive rapport with Thailand, as exemplified by the III Marine Expeditionary Force annual exercise Cobra Gold. The reason to study the Thailand withdrawal effort is to better grasp achieving the target of financial opportunity and assessing when to transfer EDAs and avoid large transportation costs.

I. BRIEF HISTORY OF THE FIRST GULF WAR RETROGRADE

Operation Desert Storm (ODS) in 1991 was a very swift military operation that resulted in immediate logistical retrograde and redeployment requirements. Major General William Pagonis, who was the senior logistician of retrograde operations for ODS (later named Operation Desert Farewell [ODF]), suggested lessons learned in his book *Moving Mountains: Lessons in Leadership and Logistics from the Gulf War*. After the first four months of ODF, General Pagonis' team had "cleaned and shipped more than 117,000 wheeled and 12,000 tracked vehicles, 2,000 helicopters, and 41,000 containers of supplies" (Pagonis & Cruikshank, 1992, pp. 157–158).



The R2 after swift military operations required well-orchestrated reverse logistics. The GAO (1992a) reported that the U.S. military utilized “576 ships and 10,002 aircraft containing equipment and supplies” (p. 8). It also reported that the “U.S. military personnel at the airport [of embarkation] processed 354,900 service members” (p. 8). With such a large military buildup of resources, excess materiel was a costly challenge. As stated in the GAO (1992a) report: “In December 1991, DoD estimated that units returning from Southwest Asia had about \$3.4 billion of excess materiel that should eventually be returned to the components supply system” (p. 16).

Disposal and reutilization facilities were set up by DLA in Saudi Arabia to facilitate the R2 operations, as mentioned in Chapter II, Section A of this report. The Services turned over to DLA excess equipment, such as 980 vehicles that were either “sold to Bahrain under Foreign Military Sales or were transferred to Greece under the Southern Region Amendment” (GAO, 1992b, p. 5). Most the vehicles were donations made by Germany, but a number of them were unserviceable vehicles from the U.S. military. Additionally, such equipment was made available to foreign states such as Germany, who faced these issues with the transferred equipment (GAO, 1992b, p. 7):

- the cost of shipping, including shipping from the port and transportation to the port;
- the understanding that most of the equipment was not operational;
- the problems of repairing foreign-made equipment in the United States; and
- the customs laws that prohibited or made difficult the import of such items to the United States and agricultural standards that dictated that the equipment be cleaned.

Even though these were specific barriers for transferring EDAs to foreign nations, the problems also directly impacted the United States, limiting options for R2. What the ODS retrograde exemplifies is that even with swift military operations, the logistical trail to retrograde will still be challenging. Efforts such as Operation Desert Auction can be helpful in transferring items that are deemed economically unsuitable when large transportation costs are considered.



J. HISTORY OF THE SECOND GULF WAR RETROGRADE

Shortly after the Obama administration entered office in 2009, OIF was renamed Operation New Dawn, later resulting in an epic logistical challenge and the beginning of a massive retrograde, redeployment, in support of reset, and reconstitution (R4) effort in early 2009. While visiting Camp Lejeune, NC, in February 2009, President Obama told Marines that the end of the war in Iraq would take place by the end of 2011; nonetheless, strategic and complex planning was necessary well before this announcement (White House, 2009). The reasons for such extensive planning with Iraq were nine years of episodic conflict, the size of the logistical footprint—which was far greater than that of any conflict since Vietnam—and the hybrid use of contractor and military forces. The total costs of R4 have been consistently reported in the billions, with many unknowns in the coming years, such as maintenance capacities, capabilities, and actual time for complete reset.

There is debate on what the complete financial burden has been and will be for OIF, due in part to the unknown actual retrograde costs. Some analysts, such as Nobel Prize-winning economist Joseph Stiglitz, state that the true cost is between \$1–3 trillion (Trotta, 2008). Putting the retrograde in context, according to the Congressional Budget Office (CBO), “the equipment associated with forces in Iraq as of the fall of 2009 could weigh 750,000 tons and fill between 37 and 74 large sealift ships” (Tierney, 2009, p. 7). As convoys, lowboy trailers, and flatbed trucks made the journey toward Camp Arifjan in Kuwait, the final retrograde of MRAP vehicles continued several months after the official end of the war (Hansen, 2012, para. 1).

1. Complexities

As of July 2008, nearly 75 percent of all combat operation casualties were due to IEDs (GAO, 2009, p. 1). As a result of IEDs, the defense industrial base developed armor-enhanced equipment and V-shaped hull for U.S. Service members to use during vehicular convoys. The impetus to acquire the MRAP vehicle was one of the most needed requirements in Iraq and one of the most urgent acquisition procurements made in recent U.S. history.



The Defense Priorities and Allocation System (DPAS) is used by the DoD when filling demand for acquisition requirements of different priority thresholds. The highest priority rating is DX-rating, which requires Presidential approval and is given to those items deemed necessary for national security. Presidential approval was required for MRAP vehicles for the Global War on Terror in Iraq and Afghanistan. Further acquisition restrictions were put in place on partnering nations wanting to procure MRAP vehicles because of the demand to first outfit American units in Iraq and Afghanistan.

Due to this complex situation, the DoD requested that the RAND Corporation analyze the alternatives, feasibilities, and courses of actions for different timelines on the exit of Iraq (Perry, 2009, p. xv). The resulting report, authored by W. L. Perry, simplified the logistical drawdown into two main categories: military vehicles and all other items (predominantly containerized; Perry, 2009, p. 29). With regard to military vehicles, logistical constraints and bottlenecks existed for returning equipment from Iraq to the United States during the war drawdown (Perry, 2009, p. 29). The overriding reasons Perry gave to support the claim that withdrawal from Iraq would be a logistical burden can be summed up in two areas: wash racks and agricultural inspections, which were flashbacks from Vietnam. First, the report indicated that throughput capacity would be overwhelmed at the wash racks prior to embarking equipment on ships in Kuwait (Perry, 2009, p. 40). Second, customs inspections at the border of Kuwait and Iraq would be weighed down by an overload of vehicles and tactical trailers.

Another issue is the service life remaining in equipment returning from Iraq is uncertain. General Michael Hagee, former Commandant of the Marine Corps, testified to Congress on the service life of ground combat vehicles as seen in Figure 12 (Korb, Bergmann, & Thompson, 2006, p. 7). Figure 12 shows a comparison of the service life of vehicles not deployed to Iraq and those that have been in the combat theater of Iraq.



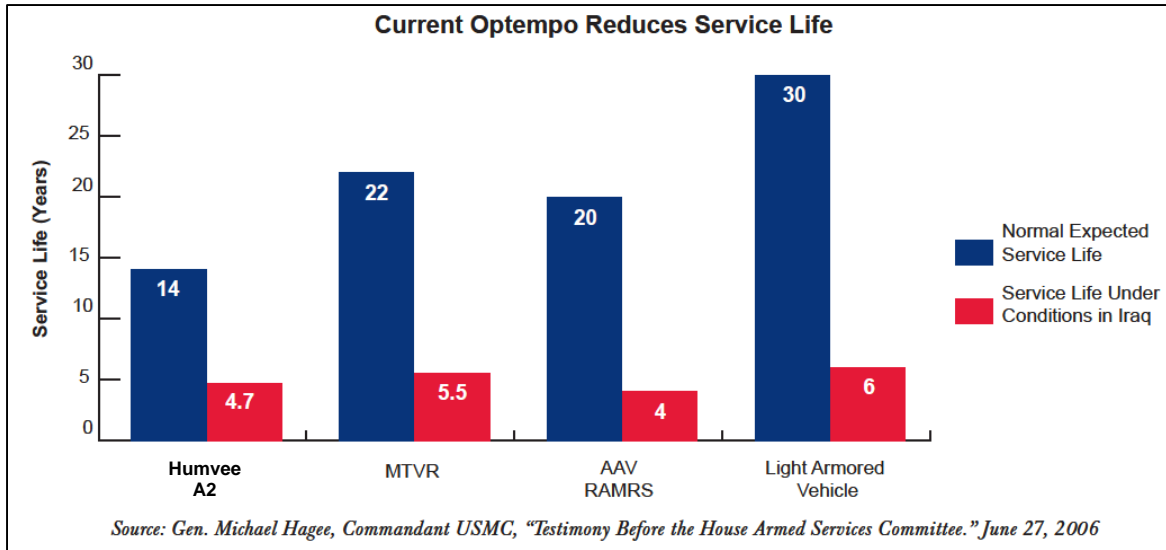


Figure 12. Representation of Ground Combat Vehicle Service Life
(Korb et al., 2006, p. 7)

2. Courses of Action

After examining the courses of action taken, the Marine Corps' overall approach was similar to the approach of other Services: to smooth out unforeseen obstacles in the system by using the concept of reverse supply chain logistics (Marine Corps Center for Lessons Learned [MCCLL], 2010, p. 2). Through a methodical and successful process, the flow of equipment in the early stages allowed for decision-makers and data analysts to reduce equipment size, redistribute equipment, and utilize the DLA as a primary source during retrograde operations. In order to identify potential challenges, Headquarters, Marine Corps mandated a "prime the pump" (i.e., perform a system test) standard that required 10 percent of ground tactical vehicles be sent to their home station regardless of whether the equipment was deemed in excess or required maintenance repairs. The categories of decisions on retrograde were based on sending gear to CONUS or redistributing to fill needed equipment gaps for OEF.

Because combat and training operational commitments in Iraq took place continuously with retrograde operations, the feasibility of screening equipment identified as EDA or authorized for disposition via the DLA was a challenge. Major end-item review boards were conducted by members in the Marine Expeditionary Force



operational planning staff along with a multitude of stakeholders, sometimes on as many as 22 different occasions (MCCLL, 2010, p. 15). Additionally, while retrograde operations took place, the training and transitioning of forces required the Iraqi army and police to use U.S. vehicles that were simultaneously being considered excess equipment.

Once the Marine Corps completed this retrograde screening process in Iraq, the approval to take equipment off the records and label it “excess” flowed through various organizations. An example of the approval authorization required were the using unit, the battalion, the regiment, the division, the Marine Expeditionary Force forward element headquarters, Multi-national Forces West, Marine Forces Central Command, Plans Policies and Operations, Installation and Logistics, Multi-National Security Transition Command Iraq, Defense Logistics Agency, Defense Security Cooperation Agency, Navy International Programs Office, and then Marine Corps Systems Command (USMC, 2009, p. 22). After screening equipment for future action by the Marine Corps, DLA would ultimately decide if equipment labeled “excess” could then be sold or granted to foreign allies.

A systematic retrograde began in early 2009. MCCLL reported the equipment flow over the period 2009–2010 was about 15,000 items per week, or approximately four battalion-sized Marine Corps elements (MCCLL, 2010, p. 14). Using lessons learned from ODS, USTRANSCOM had a variety of pilot programs to improve supply-chain visibility. For example, the Military Surface Deployment and Distribution Command maintained a Lean Six Sigma organization to improve throughput once all containers and vehicles arrived and processed through Kuwait (Johnson, 2010, p. 18). Despite completing the retrograde, the MCCLL (2010) made the following statement: “As a MAGTF [Marine Air-Ground Task Force], we’re supposed to be expeditionary and when we have a MEF [Marine Expeditionary Force] with 11,000 containers, we’re really not expeditionary anymore” (p. 18). Much like the container situation, this statement further stresses the issue of a reduced expeditionary capability for the bulky Marine Corps ground tactical vehicles.



3. Cost Estimates

The Reset Cost Model was used by the Marine Corps to develop cost estimates to assist planners with analyzing thresholds for determining whether equipment from Iraq was to be retrograded (USMC, 2009, p. 25). Four broad categories were used, based on the condition of the equipment:

- No Reset: The condition of the equipment is stable enough to return to the home station.
- Depot: The maintenance cost will be 65% of procurement costs.
- Field: The maintenance cost will be 20% of procurement costs.
- Procure: Equipment is needed via the acquisition process (if AAO is deficient).

Planners used these categories to make retrograde decisions that justified the use of resources and extended equipment usage for OEF if requirements for certain items existed in Afghanistan (USMC, 2009, p. 25).

Reporting the total cost of retrograde was dependent on what phase of the operation was being analyzed. For example, the cost to retrograde a single MRAP vehicle—to get it from Kuwait to the U.S. East Coast by sealift—using 2012 pricing based on the USC-06 is approximately \$18,000. Additionally, there is a billing rate issued to the Service being supported, which for this example is approximately \$22,000 in 2012 dollars. This billing rate total is slightly larger than the contract cost; nonetheless, the aforementioned estimate captures only the (coast to coast) transportation cost excluding first destination transportation costs (OCONUS), costs in CONUS, and those costs required to reset as deemed necessary by the Reset Cost Model. Additionally, this transportation was computed only for sea transportation. If air transportation requirements were needed, as in Afghanistan, an additional \$11,386 per flight (variable costs) and air billing rates (fixed costs) per hour would be factored in when using strategic airlift (Gertler, 2010, p. 2).

As the focus has shifted from Iraq to Afghanistan, HQMC began collecting data and conducting simulations for the eventual return of equipment. An example is the



Ground Equipment Management Simulation-Marine Corps (GEMS-MC) process map for R2, which is a current initiative at HQMC, Installation and Logistics (I&L), Logistics Operations Analysis Division (LX) for cost estimation. GEMS-MC has the capability to forecast resource decisions over time. The model also estimates the average time it takes equipment to reach final reconstitution, transportation cost, utilization rate at depots, and major bottlenecks.

K. CURRENT INITIATIVES IN AFGHANISTAN

Every war the United States enters eventually concludes with the gradual or immediate withdrawal of combat troops and equipment. Many factors weigh on the urgency and expediency of a retrograde, including geopolitical dynamics, public opinion, and events on the ground in the area of operations. Numerous historical examples illustrate these issues, such as the 1967 NATO/France fallout and sudden withdrawal of the U.S. military (Chapter I, Section IIA of this report), the extensive retrograde of Vietnam from 1970 to 1974 during continuous combat operations, and the early U.S. pullout of Iraq in 2011 due to a conflict in the Status of Forces Agreement.



Figure 13. Photo of Last American Combat Unit Leaving Iraq
(Morones, 2011)



The trend of retrograding under unpredictable constraints and conditions is not likely to change for any military, and the withdrawal from Afghanistan, ending OEF, will be no exception. The anticipated constraints for that end game could very well be the most difficult experienced in U.S. history due to the previously stated factors and major geographical limitation of Afghanistan—a landlocked country with the closest port of Karachi, Pakistan, 1,000 miles away. Another constraint the U.S. will face in withdrawing from Afghanistan is that the surged violence in 2008 and 2009 increased the presence of U.S. troops (and gear), requiring more logistics to return home.

1. Complexities and the Northern Distribution Network

The route to Karachi is called the Pakistan Ground Lines of Communication (PAKGLOC), and it presents more problems for U.S. withdrawal from Afghanistan than just distance. Since November 26, 2011, the PAKGLOC has been closed due to a cross-border incident between U.S. and Pakistani forces that killed 24 of the latter’s troops (“Pakistan,” 2011). This resulted in the PAKGLOC being shut off to U.S. resupply missions and left the DoD and military logisticians scrambling for a new route. Currently, various routes through the Central Asia region, or through the “Stans,” are available, but each of these routes means traveling through countries with unique governments and sometimes unpredictable decision-making by their leaders. Figure 14 shows a simplified version of these extensive routes. The green lines represent rail transportation through various countries and the red line highlights the roundabout long-haul route for trucks. This entire transportation network is called the Northern Distribution Network (NDN), and the U.S. military now heavily relies on it. It is also multimodal, meaning cargo has to switch between different types of transportation (e.g., rail to ship to truck). As reported on by the deputy chief of staff, logistics, Army G-4, the NDN “route is long and is three to four times more expensive than the PAKGLOC” and the use of “multiple modes of transportation ... increases the costs” (Lopez, 2012).



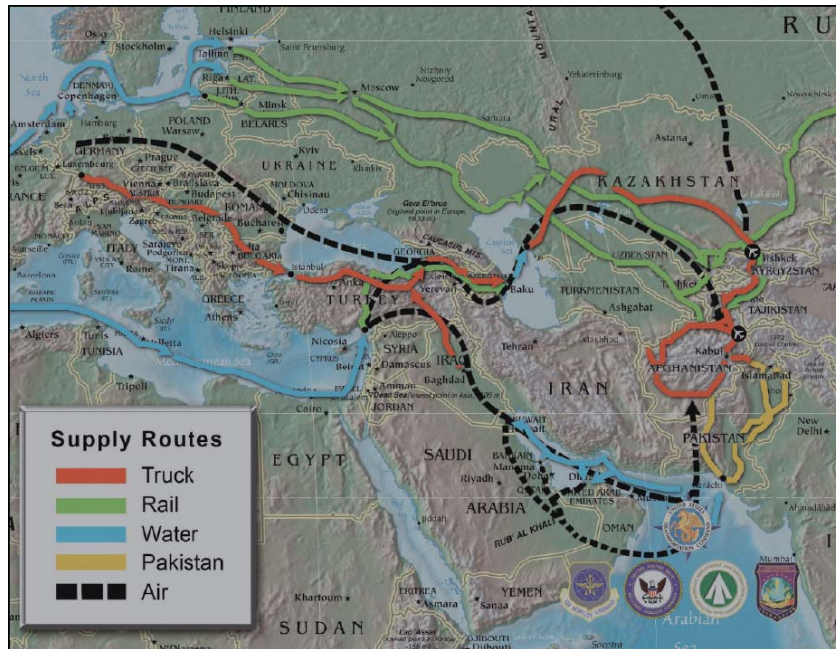


Figure 14. Map of Northern Distribution Network (USTRANSCOM, 2012c)

This new position that the U.S. faces in resupplying troops is obviously precarious and underscores the political sensitivity of keeping viable routes open. As Kuchins and Sanderson (2010) conveyed in their Center for Strategic and International Studies report, “understanding the dimensions of and knowing how to manage the geopolitical challenges and opportunities associated with NDN transit states and other key players is critical for the United States” (p. 1). The growing conflict in Syria, which has been evolving over the past months (April–June 2012), is a testament to this conundrum. Why does Syria matter to the NDN? As media reports have shown, the Syrian regime has intentionally killed hundreds of civilians. Although the international community and the U.S. Department of State (DoS) have condemned these actions, Russia has essentially sided with Syria by vetoing any U.N. Security Council resolution on the Syrian issue. Further accusations have been made by the DoS that Russia recently supplied military attack helicopters to assist Syria in suppressing the anti-Assad rebellion. As Figure 14 illustrates, cooperation with Russia is essential if the U.S. is to have access to multiple lines of communication critical to OEF resupplies. Russian cooperation is so essential that the DoD has contradicted previous statements or toned down any unfavorable messages with respect to Russian support of the Syrian regime.



2. Major Decisions and United States Marine Corps Policy

Recognizing the challenges ahead, the USMC has already initiated guidance on retrograding from Afghanistan in *Operation Enduring Freedom Ground Equipment Reset Strategy* (USMC, 2012), signed by the Commandant. The policy reiterates the previous reset strategy from OIF as well as the immediacy, expected simultaneous stresses, and importance of correctly conducting an OEF retrograde. It explicitly states,

It is imperative the Marine Corps promotes simplicity and unity of effort throughout all aspects of the reset process. The complexities involved with transitioning the force in stride are great. Executing reset actions until completed will be complicated by geography, limited distribution and deployment options, potential acceleration of redeployment timelines and tightening of OCO funding. (USMC, 2012, p. 6)

As this quote makes clear, the concern and urgency for a feasible retrograde strategy is increasing; all variables and options must be considered, including transportation costs, future refurbishment and maintenance costs, disposing of equipment through FMS or scrapping, required AAOs or item allowances, achievable timelines, and route capacity. The approaching OEF retrograde is truly a politically susceptible and complex strategic problem that will require a consolidated effort by multiple sectors of government (e.g., the DoD, DoS, Congress, etc.).

In summary, every step in the retrograde phase of OEF will have to be methodical to ensure combat equipment returns to the U.S. or is properly disposed of. Safely bringing back every American troop and civilian is equally important, and calculated options and insightful politics are a necessity for the retrograde plan. It is still unclear whether the U.S. military will leave Afghanistan orderly and peaceably as it did in OIF, or whether it will confront a full carrier deck as it did in evacuating Saigon in 1975, only this time surrounded by borders of uncertain allies and lines of communication.



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II. DATA COLLECTION, CONCEPTS, AND MODEL

In this chapter, we illustrate the data collected, reintroduce the conceptual FBCR4 & AoA model, and present the FBCR4 & AoA model strategic view along with details of inputs and outputs from the cost model. We do this by describing the sources of data collection, laying out the cost elements in the FBCR4 & AoA model, and then discussing the tie-in from the conceptual view to the strategic view of the model.

A. DATA COLLECTION

In this section, we identify and describe the data we utilized and the sources. To exemplify the complexities of estimating the cost for R4 with vehicles, data was required from seven different stakeholders with significantly different missions in order for us to piece together the cost estimate. There are three challenges in developing R4 cost estimates: (1) some activities are not being properly measured or tracked; (2) there are many possible scenarios for transportation; and (3) it is undetermined which cost drivers are most relevant.

1. Transportation Costs from USTRANSCOM

We collected the transportation cost data from USTRANSCOM and its component commands, such as Surface Deployment Distribution Command (SDDC) and Air Mobility Command (AMC). We dissected each of the costs in order to determine what the Marine Corps is charged, as well as to understand if there are any other costs that are not included. We used the USC-06 general contract (as of March 2011) to collect ocean break-bulk rates, line-haul rates, and all accessorial fees such as washing, security, and tarping. We also received an update to data from SDDC, which further allowed us to estimate transportation costs by air, ground, and sea by the most current contract.

We used data calculations from AMC (2011), the *Air Mobility Planning Factors*, which provide the capacities used for military air lift, to further compute the number of vehicles permissible to load on an aircraft. The FY2012 Transportation Working Capital



Fund (TWCF) Planning Factors data set was used to estimate the cost per flight hour of military air lift.

2. OEF Equipment Density List from HQMC, I&L, LX

The GEMS-MC data provided from HQMC, I&L, LX established a baseline quantity for equipment currently on hand in Afghanistan and in inventory within the Marine Corps. The same data set had been utilized for the GEMS-MC simulation tool by HQMC and other government data analysts in order to provide time and cost estimations. Our data from HQMC, I&L, LX's equipment density list displays table authorized materiel control number (TAMCN), nomenclature, dimensional data, equipment totals, and each associated owning Marine Corps unit. Not every equipment type was used; nevertheless, with the use of our model, other vehicular equipment TAMCNs can be examined instead of the specific combat vehicle we used for the model.

3. Reset Percentages from HQMC, I&L, LX

HQMC, I&L, LX also provided reset data from the Ground Equipment Reset Playbook (I&L, 2012) that was provided from HQMC, I&L, LX. This data consisted of TAMCNs, nomenclatures, national stock numbers, percentage totals of equipment that will go to the depot, require field maintenance, or need new acquisitions as it was determined by HQMC. The data was consistent with the equipment density list mentioned earlier and was also provided by HQMC, I&L, LX. Repair costs are estimated as a percentage of replacement cost as follows: (1) if no depot maintenance is required, then costs range from 0–25%; (2) if depot maintenance is required, then costs range from 40–65%; and (3) if cost estimates are more than 65% to repair, then full replacement is projected. The determined percentages of equipment requiring reset have potential for being a significant cost element when 65% is used in the FBCR4 & AoA model.

4. OCONUS Activity Times from MCLC (Fwd)

The data for time-intensive activities was sourced from MCLC (Fwd). This data consists of averages and estimates of the current ongoing retrograde situation with each



of the processes involved with R4 operations for Marine Corps vehicles. A labor cost estimate is derived for the OCONUS R4 tasks military Service members and civilian contractors while deployed in theater.

5. Contractor Labor Estimates from Marine Corps Logistics Command, Blount Island Command

MCLC, Blount Island Command has responsibility for overseeing the current contract for civilian employees conducting R4 operations. The cost estimates include the average labor cost for both Camp Leatherneck and Forward Operating Base (FOB) Dwyer and add in other direct and indirect burdened costs to illustrate an hourly cost of the contractor work. Differences exist when analyzing military and civilian contractor pay rates for services in a warzone, so it is relevant to differentiate this labor cost data into the model when evaluating cost estimates for the various processes in OCONUS.

6. EDA Transfer Data from DSCA

The DSCA provided data that enabled us to analyze the trends of equipment transfers from 1993 to 2011. The data comprised of every line item either sold or given to various allied countries. We needed this to analyze data specific to vehicles over this 20-year period and provide analysis for alternative solutions to the issues discussed in this report.

7. Revenue and Scrap Quantity from DLA

The DLA provided data on scrap metal quantities for Afghanistan and Iraq from 2005–2011, broken down by area of operations and particular DLA disposition site. We received a twelve-month data set that displayed scrap metal quantities and actual funds exchanged with local vendors in Afghanistan. The DLA also provided a graphical depiction that illustrated the average labor and time required to completely scrap one MRAP vehicle. We were able to analyze the costs associated from disposal of vehicles and compare with other methods.



B. FULLY BURDENED COST OF RETROGRADE, REDEPLOYMENT, RESET, AND RECONSTITUTION AND ANALYSIS OF ALTERNATIVES

We propose a new paradigm to measure, the FBCR4 & AoA, as a way to help commanders more accurately gauge costs with R4 and therefore make better forecasts. The FBCR4 & AoA estimates labor and materiel for OCONUS costs, transportation costs, CONUS costs, and depot costs, and the model further provides cost estimations of the alternatives. The purpose of FBCR4 & AoA is to equip logistical planners and Marine Corps officials with the tools they need to make sound financial and management decisions for retrograde and reset. The theoretical idea of FBCR4 & AoA is to provide an estimate of the cost of returning equipment from OCONUS to the owning unit's military installation. We have configured the FBCR4 & AoA into a strategic process that is comprised of two cost paths and four major areas of expenditures in labor and materiel, as shown in Figure 15, and we further describe the purpose and method behind each step.



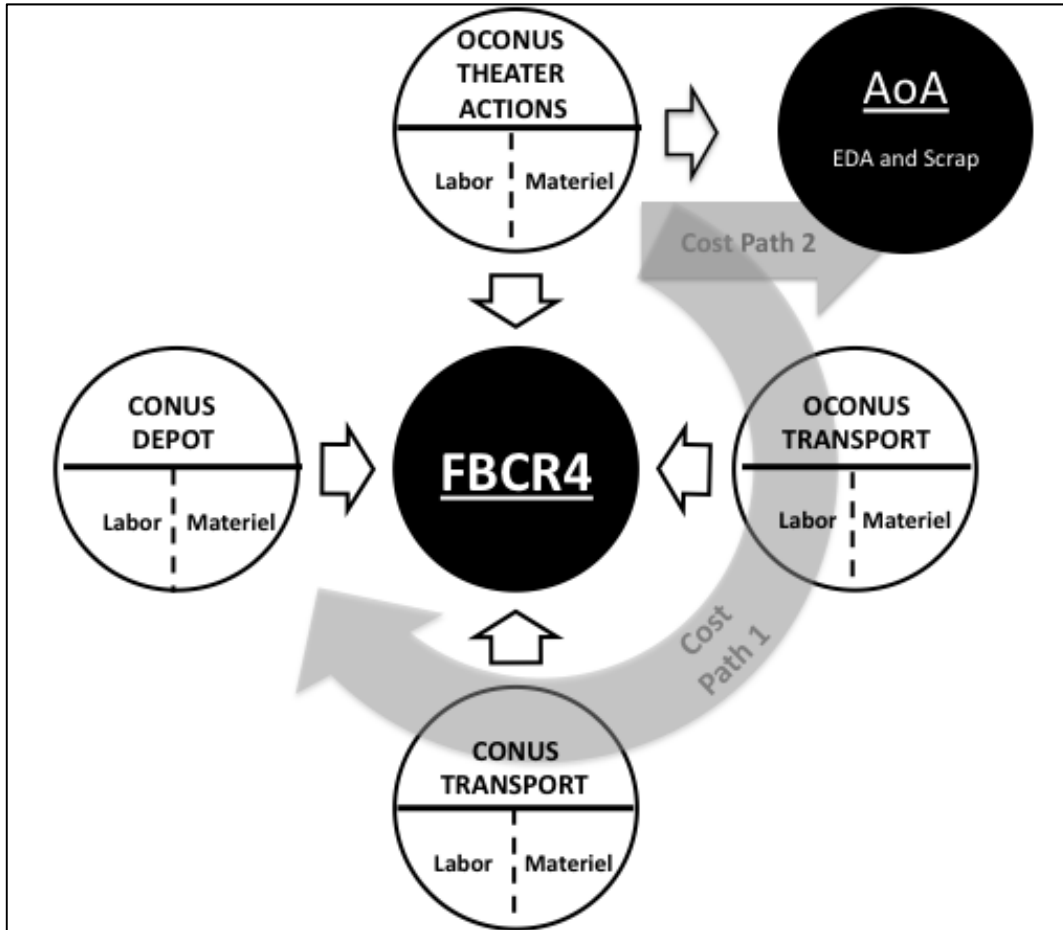


Figure 15. The FBCR4 & AoA Conceptual View

1. OCONUS Theater Activities Labor Cost

The purpose of the OCONUS theater activities labor cost step is to quantify the labor time required for the various activities and labor preparations required to prepare a particular piece of equipment for its first stage of transportation after combat operational requirements have ceased for it. The activities include all preparation processes needed to retrograde the equipment: washing the vehicles, dispatching, conducting limited technical inspections (LTI), completing agricultural inspections, and embarking the equipment. The labor time for activities such as contractor and military pay is identified and then summed with all other labor activities.

2. OCONUS Theater Activities Materiel Cost

The OCONUS theater activities materiel cost's purpose is to calculate the cost of all materiel that requires further preparation to get to the first stage of transportation once combat operational requirements have ceased. The manner in which this is done is to sum the average gallons of water utilized for vehicle cleaning, gallons of fuel utilized and/or purged, batteries, and radio frequency identification tags.

3. OCONUS Transportation Labor Cost

The purpose of the OCONUS transportation labor cost is to calculate all labor utilized after the start of the first stage of transportation until the arrival of the equipment to the first CONUS aerial or sea port. The labor includes not only military labor, but also the cost of civilian pay associated with air, sea, or ground transportation. However, this step is separate from the activities as mentioned next in Step 4, which is associated with the USC-06 contract. Therefore, the method for this step is to sum labor for various activities involved in the transportation activities that are specifically handled by military personnel.

4. OCONUS Transportation Materiel Cost

In OCONUS transportation materiel cost, we sum all materiel utilized after the initial stage of transportation until the arrival of the equipment to the first CONUS aerial or sea port. We obtain cost estimates from the commercial carriers as in USC-06. We assume that labor for these activities is built into the contract and add all accessorial charges to the transportation mode cost. The labor cost discussed in the aforementioned step is distinguishable from OCONUS transportation materiel cost. In situations with air transportation, the cost per flying hour to the government is included in this cost rather than the cost to the Service. For sea, rail, or line-haul charges, the rates will be followed in accordance with USTRANSCOM.



5. CONUS Transportation Labor Cost

The purpose of CONUS transportation labor cost is to calculate all labor associated with processes once equipment arrives at the first aerial port of debarkation (APOD) or sea port of debarkation (SPOD) through the travel to either the depot or military installation. The approach is to include labor cost for all port operations, transportation to depot, and travel from depot to the unit's installation.

6. CONUS Transportation Materiel Cost

The CONUS transportation materiel cost's purpose is to sum all the materiel cost in CONUS upon arrival at the first APOD or SPOD through the travel to either the depot or military installation. The method is to summate the fuel, drayage charges, line-haul charges, and any additional service rendered, such as cargo cleaning at the CONUS port.

7. CONUS Depot Labor Cost

The purpose of the CONUS depot labor cost is to calculate all labor utilized to reset and reconstitute the equipment either at the assigned depot or at the military unit's installation. The approach we utilize calculates all labor directly involved in maintenance activities to restore the equipment.

8. CONUS Depot Materiel Cost

The purpose of CONUS depot materiel cost is to calculate all materiel associated to reset and reconstitute equipment either at the assigned depot or at the military unit's installation. The method is to calculate costs for all the supply parts and resources needed to complete the reset and reconstitution effort. This is the last step to comprise Cost Path 1.

9. Alternative of Analysis for Cost Path 2

The AoA for Cost Path 2 calculates potential cost savings/loses in the case of EDA vehicle sales or scrapping. The method used assumes all costs in Steps 1 and 2 at the OCONUS theater activities will be incurred. In the case of EDA, this step replicates historical revenue from EDA grants/sales and transfers to foreign alliances via DoS. The



other alternative summates labor and materiel to conduct scrapping and calculates potential funds exchanged from local scrap sales.

C. STRATEGIC VIEW OF THE MODEL

These cost factors are at the core of the FBCR4 & AoA estimating tool, which is comprised of all OCONUS and CONUS activities. The conceptual view (Figure 15) of our model transitions directly into our strategic view (Figure 16) by illustrating the key decision points and a work breakdown structure of the phases from the beginning to the end of the retrograde process. Appendix H illustrates in detail the FBCR4 & AoA strategic model flow chart, as seen in Figure 16, and provides the cost line items utilized for our calculations. The following chapter will further explain the results of our model and analysis.



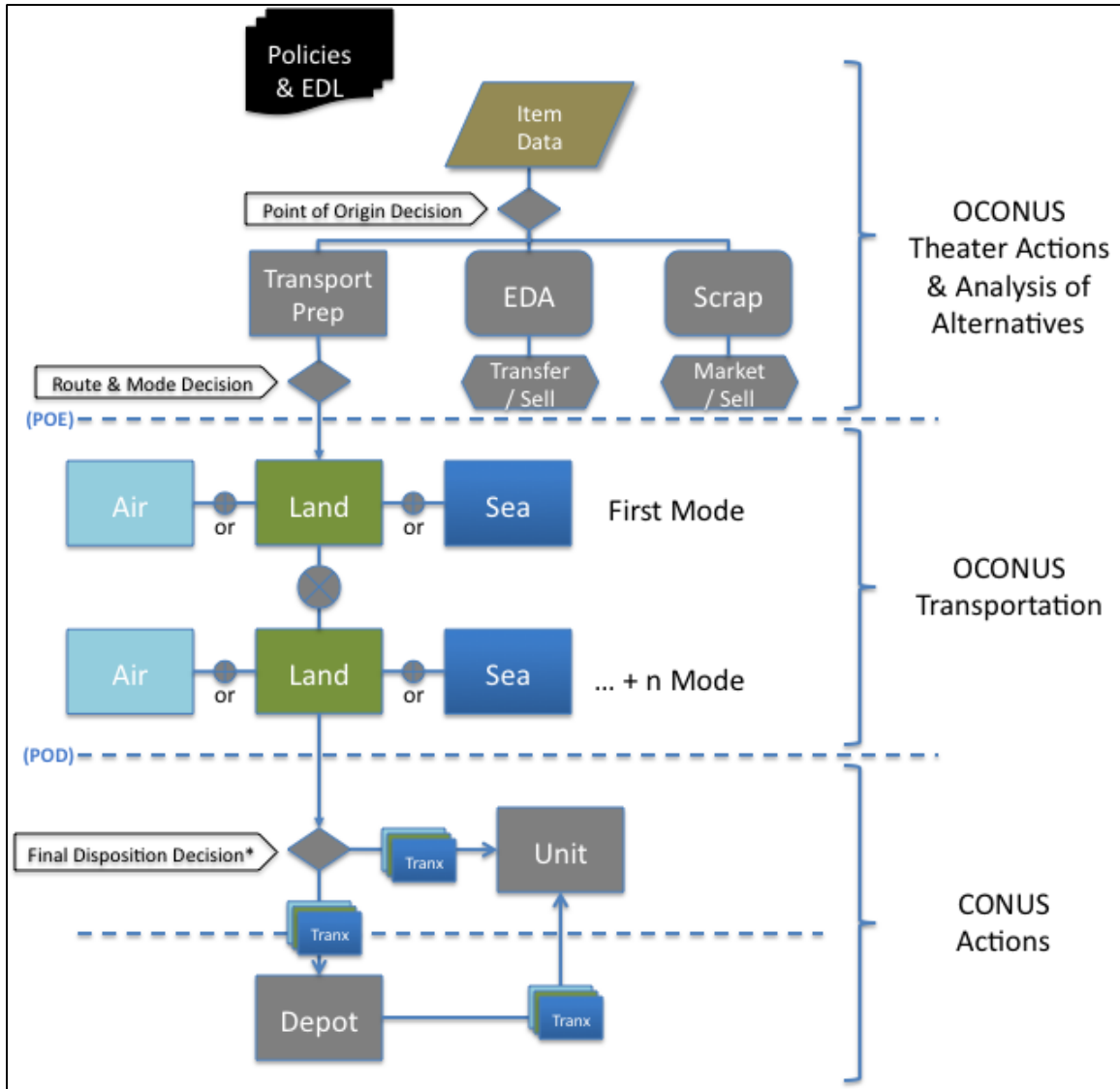


Figure 16. The FBCR4 & AoA Model Strategic View

Note. The final disposition decision is potentially preplanned at the point of origin.

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IV. MODEL ANALYSIS

A. FBCR4 COST ESTIMATIONS

In this section we describe the layout of the base case model and a breakout of specific details in estimating the cost for scenarios in which an M-ATV is transported back to CONUS.

1. M-ATV Base Case Model Layout

We used a single vehicle to demonstrate the function of the cost model. Other equipment types can be used to construct similar cost analyses. The inputs we utilized are from a single M-ATV for the three base case models (i.e., transportation cost model, transfer cost model, and scrap cost model), consisting of a TAMCN, national stock number (NSN), dimensional data (length, width, and height), weight, original procurement cost, and service life. The cost model determine 100 percent of the cost for each scenario of the base case.

2. Transportation Cost Model

The FBCR4 & AoA strategic model flow chart is constructed in order to understand the cost of R4 and potential alternatives. The strategic model exhibits the sum of transportation costs and starts with the input of one M-ATV and continues until the vehicle reaches the home installation, as seen in Appendix H. Multiple retrograde scenarios can be utilized depending on the sequence and chosen modes of transportation, as well as different options for commercial carriers that provide services by means of the USC-06.

The cost estimation for the OCONUS theater activities labor is, on average, approximately \$2,336.48 in FY12 dollars per M-ATV, which is larger than that of materiel cost due to insufficient data. When the data such as wash rack construction materiel, purged fuel, gallons of water, and other supplies becomes available, the correct costs can be inserted, as seen in Appendix H. The assumptions used for the total number



individuals involved in OCONUS theater activities for the retrograde of one vehicle are broken down and further illustrated in Table 1.

Table 1. OCONUS Theater Activity Labor Cost Estimates

Wash rack – Labor	Personnel / Unit	Hrs / Unit	\$ / Person (Hr)			Total Cost		
			Min	Ave	Max	Min	Ave	Max
(1) Supervisor (Military)	1	1	\$19	\$25	\$31	(\$19)	(\$25)	(\$31)
(2) Washer (Military)	3	6	\$17	\$18	\$19	(\$300)	(\$321)	(\$342)
(3) Driver (Military)	2	1	\$17	\$19	\$23	(\$33)	(\$39)	(\$45)
(4) Mechanic (Military)	1	1	\$17	\$19	\$23	(\$17)	(\$19)	(\$23)
(5) Dispatch (Military)	1	1	\$17	\$19	\$23	(\$17)	(\$19)	(\$23)
(6) R4 Ops (Contractor)	4	4	\$62	\$70	\$78	(\$959)	(\$1,114)	(\$1,243)
LTI – Labor								
(1) Supervisor (Military)	1	1	\$19	\$25	\$31	(\$19)	(\$25)	(\$31)
(2) Inspector (Military)	2	2	\$17	\$19	\$23	(\$67)	(\$78)	(\$90)
(3) Supervisor (Military)	1	1	\$62	\$70	\$78	(\$62)	(\$70)	(\$78)
(4) Inspector (Military)	2	2	\$62	\$70	\$78	(\$246)	(\$279)	(\$311)
Agriculture Inspection - Labor								
(1) Supervisor (Contractor)	1	1	\$62	\$70	\$78	(\$62)	(\$70)	(\$78)
(2) Inspector (Contractor)	2	2	\$62	\$70	\$78	(\$246)	(\$279)	(\$311)

The labor cost per hour calculations for military members reference the labor cost estimates in Appendix F. Furthermore, the labor cost per hour for contractors were utilized from the average cost estimates of contractors involved with R4 operations at MCLC (Fwd) in Afghanistan during 2012. These contractor costs were provided by BIC and can be seen in Table 2. The labor estimate is based on the average labor for 22 and 26 different contractors working on R4 operations at FOB Dwyer and Camp Leatherneck, respectively, and includes other costs such as the labor burden, fringe benefits, general and administration expense, and fixed fees.



Table 2. Contractor Labor Cost Estimates for R4 Operations

Contractor Location	Ave Labor Cost (A)	Ave Other Direct & Indirect Costs (B)	Ave Yearly Cost 10-month contract (A) + (B)	Ave Monthly Cost 10-month contract	Ave Daily Cost 26-working days a month	Ave Hourly Cost 12 working hours a day
FOB Dwyer	\$104,424	\$137,770	\$242,194	\$24,219	\$932	\$78
Camp Leatherneck	\$65,519	\$127,107	\$192,626	\$19,263	\$741	\$62
Ave	\$84,972	\$132,438	\$217,410	\$21,741	\$837	\$70

The next step of this model begins with deciding what the first mode of transportation will be for the vehicles departing the theater of operation. For retrograde scenarios dictating air transportation as the first mode, calculating costs start at the aerial port of embarkation (APOE) and conclude at the APOD. The labor costs for air transportation consist of two categories: flight crew and ground crew. The assumption of the breakdown for individuals involved with this phase is shown in Table 3.

Table 3. Air Transportation Labor Cost Estimations

Flight Crew – Labor	Personnel / Unit	Ave Hrs / Flight	Min	Ave	Max
(1) Pilot	2	7.91	(\$596)	(\$667)	(\$737)
(2) Flight Engineer	1	7.91	(\$211)	(\$244)	(\$277)
(3) Crew Chief	1	7.91	(\$211)	(\$229)	(\$246)
(4) Load Master	1	7.91	(\$182)	(\$229)	(\$277)
Ground Crew – Labor					
(1) Embarker	2	2	(\$90)	(\$107)	(\$124)
(2) Refueler	1	1	(\$19)	(\$25)	(\$31)
(3) Maintainer	4	15.82	(\$1,203)	(\$1,447)	(\$1,691)

A breakdown of (C-17) aircraft rates is in this section of the model, and the model assumes that three M-ATVs will load onto a C-17 (as illustrated in Appendix I). This breakdown identifies the flying cost per hour for total government costs (TGC), as seen in Table 4, for the eight APOD destinations from the two current APOEs in Afghanistan. The total flight cost estimate used for the analysis was the overall route average



(\$56,915), a more conservative approach, as opposed to the three most likely APODs (see Table 4).

Table 4. Cost Per C-17 Flight Hour Estimates

Operational APOD locations	Flt Hrs	Round Trip Flt Hrs	TGC per Flt Hr (\$21,586) x # Hrs / (3) M-ATV
APOD 1 **	2.8	5.6	(\$40,294)
APOD 2	2.26	4.52	(\$32,523)
APOD 3 **	6.2	12.4	(\$89,222)
APOD 4	4.8	9.6	(\$69,075)
APOD 5 **	3.28	6.56	(\$47,201)
APOD 6	2.9	5.8	(\$41,733)
APOD 7	3.7	7.4	(\$53,245)
APOD 8	5.7	11.4	(\$82,027)
Ave	3.96	7.91	(\$56,915)
** Ave of 3 most likely utilized APODs	4.09	8.19	(\$58,906)

The next possible mode of transportation is sealift. When doing calculations for sea cost, we use measurement tons (M/T), which in the case of one M-ATV is 42 M/Ts. The costs begin to incur once the vehicle is delivered from the drayage service via the APOD or from the ground transportation network, such as the NDN routes or PAKGLOC. The factors for this model consist of (1) the distance traveled from sea port of embarkation (SPOE) to the SPOD; (2) the vessel fee; and (3) the port fees. The factors for the vessel fee and port fees are illustrated in Table 5.



Table 5. Vessel and Port Fee Cost Estimates

Fee Name				Formula	Total Cost		
	Min	Ave	Max		Min	Ave	Max
Vessel Fee	\$95	\$135	\$179	M/T x Rate	(\$3,990)	(\$5,670)	(\$7,518)
Port Fees							
Liner-In Handling	\$8	\$23	\$30	M/T x Rate	(\$336)	(\$966)	(\$1,260)
Liner-Out Handling	\$8	\$23	\$30	M/T x Rate	(\$480)	(\$1,380)	(\$1,260)
Washing	\$110	\$399	\$770	Per Vehicle	(\$110)	(\$399)	(\$770)
Port Arbitrary	\$17	\$54	\$95	M/T x Rate	(\$1,020)	(\$3,240)	(\$5,700)
Daily ITV	\$8	\$10	\$12	Per Vehicle	(\$8)	(\$10)	(\$12)
Port Handling Cargo	\$10	\$18	\$34	M/T x Rate	(\$420)	(\$756)	(\$1,428)

All sea shipping fees are referenced from the current USC-06 rates and include the cost of labor and materiel in the general contract.

The calculations for ground transportation in this model are available. Nevertheless, the current utilization of ground transportation for R4 is minimal due to the unauthorized passage of combat vehicles or lethal cargo sent through the NDN or PAKGLOC. The model distinguished two major categories: the distance traveled and the ground transportation route fees (in accordance with the current USC-06). The ground transportation route fees can be seen in Table 6; they estimate movement from either Camp Bastion or FOB Dwyer in Afghanistan to the port of Karachi or the NDN route. As part of the model, we calculated a high, average, and low estimate due to the variety of commercial carriers available in the general contract.



Table 6. Ground Transportation Route Fee Estimates

Fee Name				Formula	Total Cost		
	Min	Ave	Max		Min	Ave	Max
Flatbed (PAKGLOC)	\$8,338	\$9,135	\$18,183	Per Vehicle	(\$8,338)	(\$9,135)	(\$18,183)
Flatbed (NDN)	\$10,868	\$29,724	\$64,095	Per Vehicle	(\$10,868)	(\$29,724)	(\$64,095)
Tarping	\$10	\$22	\$25	M/T x Rate	(\$420)	(\$924)	(\$1,050)
Crating	\$25	\$57	\$75	M/T x Rate	(\$1,050)	(\$2,394)	(\$3,150)
Enhanced ITV	\$450	\$746	\$1,350	Per Vehicle	(\$450)	(\$746)	(\$1,350)
Enhanced Physical Security	\$798	\$1,062	\$1,500	Per Vehicle	(\$798)	(\$1,062)	(\$1,500)
Port Arbitrary	\$17	\$54	\$95	M/T x Rate	(\$1,020)	(\$3,240)	(\$5,700)
Outer Routing KKT	\$2,375	\$6,821	\$8,550	Per Vehicle	(\$2,375)	(\$6,821)	(\$8,550)
Outer Routing Chapman	\$3,750	\$4,468	\$4,950	Per Vehicle	(\$3,750)	(\$4,468)	(\$4,950)

The rail network is available through the NDN, but it is not part of the model because the possibility of shipping heavy vehicles on freight railways is unlikely due to the lethal cargo limitations for each country. The sea, air, and/or ground transportation can be combined or used in various retrograde situations to determine the total R4 cost.

The calculations for CONUS activity costs include all labor and materiel once the equipment arrives at the SPOD, as seen in Table 7 and further explained in Appendix H.

In addition, depreciation cost is applied by factoring in the service life of 16 years with the conservative assumption that the M-ATV has aged two years, which equates to \$81,250 reduction per M-ATV.



Table 7. CONUS Activity Estimates

Transportation – Materiel & Labor (Contracted)	% of TAMCN / Activity	Ave Miles	Activity Cost (\$ per mile)			Total Cost		
			Min	Ave	Max	Min	Ave	Max
(1) SPOD to Depot	75%	286	\$4.04	\$8.20	\$11.11	(\$865)	(\$1,757)	(\$2,380)
(2) Depot to Home Station	75%	273	\$4.04	\$8.20	\$11.11	(\$826)	(\$1,678)	(\$2,273)
Or								
(3) Straight to Home Station from SPOD	25%	333	\$3.89	\$7.56	\$10.22	(\$324)	(\$630)	(\$851)
Depot – Materiel & Labor (Contracted)	% of TAMCN / Activity	Original Procure Cost	Depot Reset Cost Factor			Total Cost		
			Min	Ave	Max	Min	Ave	Max
	75%	\$650K	0.4	0.525	0.65	(\$195,000)	(\$255,938)	(\$316,875)



The output of the total costs for FBCR4 is displayed in Figure 17. The analysis displayed shows a larger percentage of the costs in all CONUS activities that include transportation and repairs.

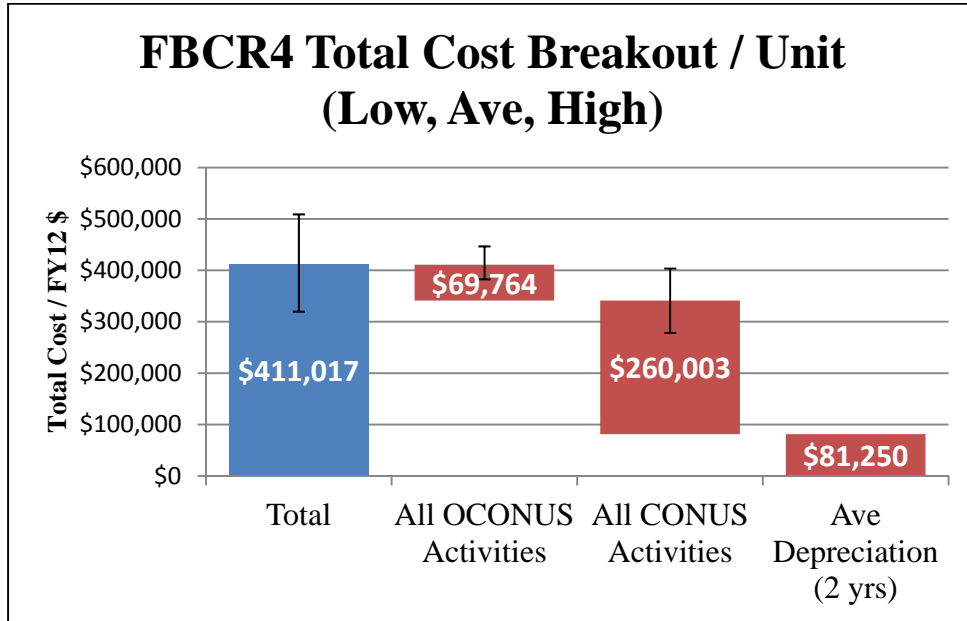


Figure 17. FBCR4 Total Cost Estimate Breakout per M-ATV

The depreciation cost for each M-ATV is highly variable depending on each vehicle’s actual service life. Table 8 illustrates scenarios in which the models assumption of a two-year average service life for each M-ATV is changed in calculating the total FBCR4 cost. As displayed, an average 6 percent increase in total FBCR4 cost per year will occur as vehicles are identified with the accurate service life.

Table 8. Depreciation Cost per M-ATV

# of Years Depreciation	Total Depreciation Ave Cost	Total Cost			% of Procurement Cost		
		Min	Ave	Max	Min	Ave	Max
2 years	(\$81,250)	(\$319,668)	(\$411,017)	(\$509,075)	49%	63%	78%
3 years	(\$121,875))	(\$360,293)	(\$451,642)	(\$549,700)	55%	69%	85%
4 years	(\$161,500)	(\$400,918)	(\$492,267)	(\$590,325)	62%	76%	91%
5 years	(\$203,125)	(\$441,543)	(\$532,892)	(\$630,950)	68%	82%	97%
6 years	(\$243,750)	(\$482,168)	(\$573,517)	(\$671,575)	74%	88%	103%



B. ANALYSIS OF ALTERNATIVES COST ESTIMATIONS

The following analysis shifts focus to the AoA cost estimations. We do this by laying out the transfer and scrap costs and comparing the results with FBCR4.

1. Transfer Cost Model

The transfer portion illustrates required costs and it further considers associated revenue by selling the vehicle to allies via the FMS process. The FBCR4 & AoA model assumes that OCONUS theater activities, as seen in Appendix H, will still take place regardless of the decision made to transfer the vehicle.

When calculating the OCONUS labor activities for the transfer model, the activities are consistent with OCONUS labor in the transportation cost model. The only difference is there is no requirement for an agriculture inspection laborer, which is \$349 less labor on average (see Table 1).

In calculating OCONUS materiel, the model also assumes that transportation cost for transferring is incurred by the receiving nation. Additionally, the model generates an average unit price for vehicles transferred from historical EDA data (1993 to 2011); the average unit price for EDA grants and EDA sales are 16.08 and 4.43 percent, respectively. The historical percentage is utilized to calculate possible cost savings by using a minimum, average, and high of 5, 20, and 50 percent, respectively. The revenue potential at a 20 percent transfer price for each M-ATV is approximately \$128K as reflected in Table 9



Table 9. Revenue Potential Estimates for EDA Transference

	% of Acquisition Cost		\$ / Unit
(1) Full Price from stock	100%		\$650,000
(2) Price from Federal Condition Codes			
(a) A-1	50%		\$325,000
(b) A-4	40%		\$260,000
(c) A-2, A-5, B-1, C-1, D-1, B-4, C-4 ,D-4	30%		\$195,000
(d) B-2, C2, D-2, B-5, C-5, D-5, D-7, E-7, F-7, G-7	20%		\$130,000
(e) A-3, B-3,C-3,D-3,A-6,B-6,C-6,H-7,F-8	10%		\$65,000
(f) D-8,H-8,D-9,H-9,F-9,F-X,G-X,H-X	5%		\$32,500
	Min	Ave	Max
Total Materiel / Unit:	\$0.00	\$0.00	\$0.00
Total Labor / Unit	(\$1,764.72)	(\$1,988)	(\$2,216)
Total Cost / Unit	(\$1,764.72)	(\$1,988)	(\$2,216)
Revenue / Unit	\$32,500.00	\$130,000	\$325,000
Net Cost / Unit	\$30,735.28	\$128,012	\$322,784

2. Disposal Cost Model

The disposal cost model constructs cost estimates of the labor and materiel that are required to scrap one M-ATV and sell it to the local scrap market. The model assumes that the similar initial OCONUS theater activities needed in the prior two models will be required for the disposal cost model. The additional labor cost estimates can be seen in Table 10.

Table 10. Scrapping Labor Cost Estimations

Scrap – Labor	Personnel / Unit	Hrs / Unit	\$ / Person (Hr)			Total Cost		
			Min	Ave	Max	Min	Ave	Max
(1) Demil Coordinator	2	6.25	\$61	\$70	\$78	(\$770)	(\$870)	(\$971)
(2) Cutters	3	8.5	\$61	\$70	\$78	(\$1,571)	(\$1,776)	(\$1,980)
(3) Laborers	3	8.5	\$61	\$70	\$78	(\$1,571)	(\$1,776)	(\$1,980)
(4) Forklift Operator	1	8.5	\$61	\$70	\$78	(\$524)	(\$592)	(\$660)
(5) Contracting Officer	1	8.5	\$61	\$70	\$78	(\$524)	(\$592)	(\$660)
Total labor / unit						(\$6,724)	(\$8,042)	(\$8,468)



We applied a 75 percent usable weight factor for the average revenue potential with the assumption that not 100 percent of the vehicle will be reutilized and saleable as scrap materiel (i.e., tires, engine parts, seating, etc.) and then we further multiplied the given weight of each vehicle. The scrap materiel cost is currently inchoate and requires further refinement from DLA and real-time data from in country disposition sites. Nevertheless, even though a small revenue can be made, the net cost results in zero savings due to a low dollar/pound of scrap sales (\$0.0453), as seen in Table 11.

Table 11. Revenue Potential for Scrapping an M-ATV

Scrap Revenue Potential w/ Labor & Materiel Costs			
(1) Unit Weight (lbs)		24,500	
(2) Useable Weight Factor (%)	50%	75%	100%
(3) Useable Weight (lbs)	12,250	18,375	24,500
(4) \$ / lb	\$0.045	\$0.045	\$0.045
(5) Revenue	\$555	\$832	\$1,110
	Min	Ave	Max
Total Materiel / Unit:	\$0.00	\$0.00	\$0.00
Total Labor / Unit	(\$6,724)	(\$8,042)	(\$8,468)
Total Cost / Unit	(\$6,724)	(\$8,042)	(\$8,468)
Revenue / Unit	(\$555)	(\$832)	(\$1,110)
Net Cost / Unit	(\$6,169)	(\$7,209)	(\$7,358)

3. What If Analysis

In Figure 18, we look at analyses for two additional TAMCNs: DD0025, an MRAP vehicle, and D0033, an up-armored HMMWV. On average, the MRAP vehicle will have a FBCR4 of approximately \$22,000 greater than that of the M-ATV. No dollar value is gained when selling the scrap metal to local scrap vendors; nevertheless, the two largest areas for cost savings are illustrated in the EDA transfers of M-ATV and MRAP vehicles.



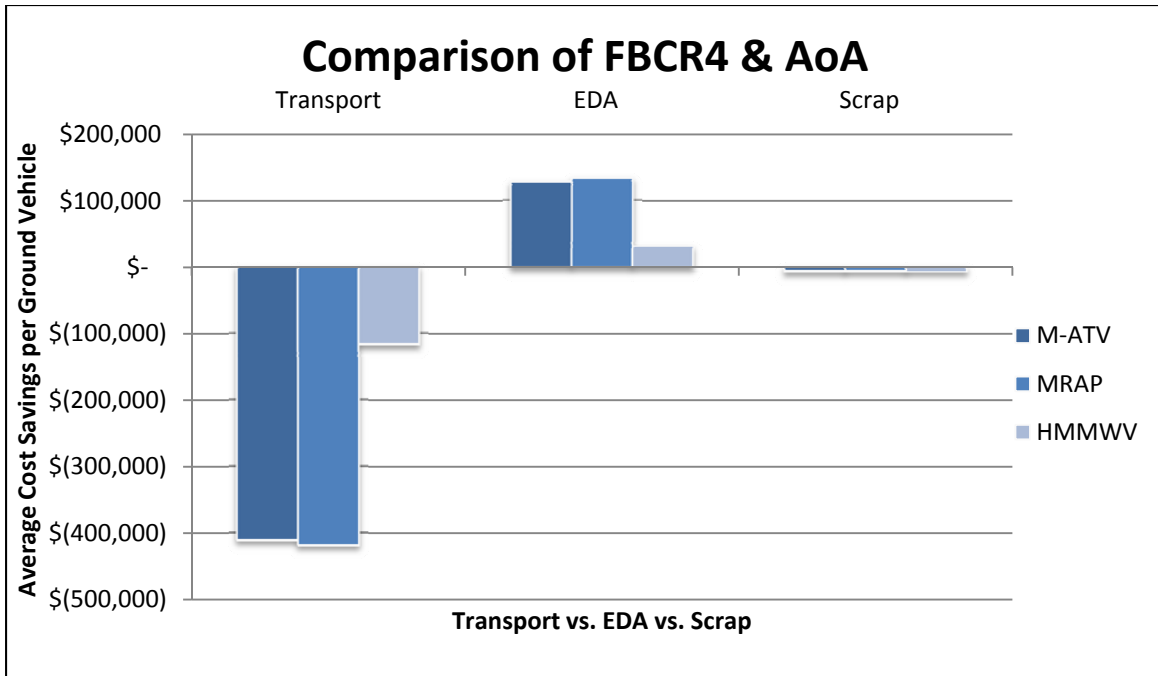


Figure 18. Ground Combat Vehicle Cost Savings Comparison for FBCR4 & AoA

The cost data for FBCR4 & AoA for the three different TAMCNs illustrates a considerably lower amount of revenue for the D0033, HMMWV; however, conservative cost estimates in all three options (transport, EDA, scrap) are similar when looking at the percentage of procurement cost for all three vehicles combined, which are -65, 19, and -2, respectively.



V. CONCLUSION AND RECOMMENDATIONS

A. CONCLUSION

The war on terrorism in Afghanistan has unfolded a prodigious effort by support personnel. They are tasked with sustaining supplies, logistics, and firepower for allied forces in a landlocked country surrounded by geopolitically unstable neighbors one thousand miles from the nearest port—all during concurrent combat operations. The same effort will be required to leave. The intricacies of the conflict in Afghanistan illustrate the critical importance of in-depth logistics capabilities, strategic partnering to secure lines of communication, and having an array of supportable and flexible retrograde solutions.

The FBCR4 & AoA model provides quantitative analysis and a strategic insight of the cost totality associated with military vehicular equipment returning from a combat theater, and it presents operational and logistics planners with alternative solutions for the disposition of that materiel.

The primary objective of this thesis is to aggregate the numerous variables, fees, and constraints of R4 for any combat theater in order to contemporaneously assist in executing the Commandant's OEF Ground Equipment Reset Strategy (USMC, 2012) and informing key leadership of critical R4 cost analysis. This objective is accomplished through illustrating historical trends from past conflicts and evaluating a broad range of data. Although our model is limited in precision, it captures and stitches together dozens of inputs, variables, and references associated with the current R4 processes of OIF and OEF, and it provides general illumination to total costs. As a secondary objective, we see the FBCR4 & AoA model as the framework for a permanent planning tool not only for today's complex logistical issues, but also for solving retrograde dilemmas in future conflicts.

During the thesis research and analysis, we identified major cost drivers in the model as contract labor, required airlift as the first mode of transportation, and the significant percentage of depot-level maintenance for TAMCN items. Contract support,



though important, is double or triple the cost of similarly skilled military personnel. Secondly, air transportation from the point of origin to the nearest seaport costs the government \$21,000 to \$37,000 per hour just to operate a C-17 or C-5. Due to political constraints and road limitations out of Afghanistan, the so-called “air bridge” is critical for R4 and extricating equipment, but airlift is also the most costly mode of transport. When considering heavy equipment, limited aircraft capacities result in moving very few vehicles at a high cost, unlike sealift economies of scale in which ocean liner fees spread over hundreds of vehicles carried on one vessel. On average, eight hours of air transport for one M-ATV is five times higher than sealift from the Persian Gulf region to CONUS. Lastly, after years of sustained combat and usage, it will take many years of maintenance to reset and refurbish equipment. The forecasted percentage of TAMCN quantities requiring depot-level maintenance and the severity of maintenance percentage are the major factors in determining costs. In our model, the maintenance percentage to return an M-ATV to its original condition is as high as 65 percent of the acquisition cost (or \$422,500), and it is predicted by HQMC, I&L, LX that 75 percent of the M-ATV fleet will require depot-level repairs. This might rival some insurance companies’ standard definitions of total loss and acceptable repairs when adding in all the costs of transportation prior to acceptance at maintenance facilities.

In evaluating Cost Path 2 and the two alternatives to R4/transporting, our model provides insight into the process costs of excess defense articles (EDA) and disposing of items through scrapping. Both alternatives show the same initial labor requirements as transporting, but continue in itemizing other materiel and labor costs and presenting potential revenue. Scrapping requires substantially more man-hours in labor to completely reduce large items such as an MRAP or M-ATV to scrap metal, and the revenues are minimal and only offset costs by a small percentage. Scrapping on a large scale is probably infeasible and not recommended because it would likely challenge the logistics system in materiel and personnel, consume more time than it warrants, and inefficiently return investment dollars. Conversely, EDAs present the lowest costs and highest revenue if the sales of certain items are authorized, sensitive components are



simultaneously stripped, and acceptable buyers are found and willing to accept the equipment's current condition and associated transaction costs.

Although these alternatives might not be acceptable in full, they do offer options for commanders and planners to decrease surplus inventories at determined percentages without incurring the high costs of transportation, maintenance, and long-term support. There are numerous historical examples as presented in which these alternatives were applied. Additionally, EDA and scrapping are viable options to consider, as uncertainty surrounds the MRAP, M-ATV, and older generation HMMWVs in regard to Service and mission integration, maintenance support, and future strategic and tactical requirements.

Our research and model also illustrate a demand for obligatory coordination across multiple agencies to ensure success in the immediate actions necessary for an OEF drawdown and also in the long-term inventory, maintenance, and acquisition strategies of DoD Services. Organizations instrumental in the FBCR4 & AoA are the component headquarters, DLA, DSCA, the State Department, and U.S. Transportation Command.

Again, we reiterate the FBCR4 & AoA model as a foundational tool for R4 analysis, and with refinement we hope that it will become a fundamental tool for the DoD in future planning and contingency operations.

B. RECOMMENDATIONS

Provided below are bulleted lists of our final recommendations to the DoD and suggested research areas in order to assist with improving the R4 process and related issues.

- Adopt the FBCR4 & AoA model in making equipment disposition decisions for the OEF drawdown.
- Institutionalize the FBCR4 & AoA model by establishing a Joint Equipment Disposition Strategy (JEDS) board to support the drawdown of OEF and future conflicts. This board should include representatives from the Joint Staff, Military Services, USTRANSCOM, DLA, and DSCA to make fully burdened cost informed decisions on major equipment disposition. The JEDS board could be modeled after the Army's Equipment Distribution Review Board (EDRB).



- Develop a FBCR4 & AoA Joint Staff planning publication.
- Consider the EDA sales option for combat vehicles whose total R4 costs exceed 50-65 percent of their original procurement costs.
- Redirect R4 dollars saved by executing EDA sales of tactical wheeled vehicles to the JLTV or other programs. This will have the added benefit of contributing to sustaining the U.S. industrial base for tactical wheeled vehicles.
- Realign equipment authorized acquisition objectives (AAO) with current and forthcoming strategic, military, and service strategies, missions, and requirements.
- Reevaluate labor contracts and requirements for all activities to decrease costs.
- Thoroughly analyze the major cost drivers in the OEF R4 process to determine more accurate costs, forecasts, and potential savings. Run simulations and sensitivity analysis on the updated data.
- Evaluate (using Doctrine, Organization, Training, Materiel, Leadership, Personnel, and Facilities) the support requirements for excess equipment returning from OIF and OEF, specifically the mission suitability, AAO quantities, and long-term maintenance requirements for the MRAP vehicles, M-ATVs, and HMMWVs.

C. SUGGESTED FURTHER RESEARCH

- Improve the FBCR4 & AoA model by analyzing variables through optimization studies and Monte Carlo simulations.
- Refine all labor costs and data in the model.
- Analyze the “transactional cost economics” in the FBCR4 & AoA model.
- Build into the model time constraints, capacities, and inventory costs.
- Conduct regression analysis to quantify the significant cost variables.
- Build an accurate R4 timeline for the withdrawal of U.S. forces from Afghanistan based off this research and other cumulative information.



- Build a metric or model that assists commanders in future conflicts by determining the time and logistics effort for retrograding forces from a given geographical point, even in offensive operations. This could act as a strategic situational planning tool.
- Determine if the JLTV program negates keeping, maintaining, and storing thousands of MRAPs and M-ATVs.



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APPENDIX A. SUPPLY CONDITION CODES

Code	Title	Definition
A	Serviceable (Issuable without Qualification)	New, used, repaired, or reconditioned material which is serviceable and issuable to all customers without limitation or restriction. Includes material with more than 6 months of shelf life remaining.
B	Serviceable (Issuable with Qualification)	New, used, repaired, or reconditioned material which is serviceable and issuable for its intended purpose but which is restricted from issue to specific units, activities, or geographical areas by reason of its limited usefulness or short service life expectancy. Includes material with 3 through 6 months' shelf life remaining.
C	Serviceable (Priority Issue)	Items which are serviceable and issuable to selected customers, but which must be issued before Condition A and B material to avoid loss or as a usable asset, Includes material with less than 3 months shelf life remaining,
D	Serviceable (Test/ Modification)	Serviceable material which requires test, alteration, modification, conversion, or disassembly. (This does not include items which must be inspected or tested immediately prior to issue.)
E	Unserviceable (Limited Restoration)	Material which involves only limited expense or effort to restore to serviceable condition and which is accomplished in the storage activity where the stock is located.

(ODUSD[L], 1997, p. 3.3-1)



F	Unserviceable (Reparable)	Economically reparable material which requires repair, overhaul, or reconditioning (includes reparable items which are radioactively contaminated).
G	Unserviceable (Incomplete To Issue)	Material requiring additional parts or components to complete the end item prior to issue.
H	Unserviceable (Condemned)	Material which has been determined to be unserviceable and does not meet repair criteria (includes condemned items which are radioactively contaminated).
S	Unserviceable (Scrap)	Material that has no value except for its basic material content. No stock will be recorded as on hand in Condition Code S. This code is used only on transactions involving shipments to DRMOs. Material may not be transferred to Condition Code S prior to turn-in to DRMOs if material is recorded in Condition Code A through H at the time material is determined excess, Material identified by NSN

(ODUSD[L], 1997, p. 3.3-2)



APPENDIX B. DISPOSAL CONDITION CODES

Code	Title	Definition
1	Unused-good	Unused property that is usable without repairs and identical or interchangeable with new items from normal supply source.
2	Unused-fair	Unused property that is usable without repairs, but is deteriorated or damaged to the extent that utility is somewhat impaired.
	Unused-poor	Unused property that is usable without repairs, but is considerably deteriorated or damaged. Enough utility remains to classify the property better than salvage.
4	Used-good	Used property that is usable without repairs and most of its useful life remains,
5	Used-fair	Used property that is usable without repairs, but is somewhat worn or deteriorated and may soon require repairs,
6	Used-poor	Used property that may be used without repairs, but is considerably worn or deteriorated to the degree that remaining utility is limited or major repairs will soon be required.
7	Repairs Required-good	Required repairs are minor and should not exceed 15 percent of original acquisition cost.
8	Repairs Required-fair	Required repairs are considerable and are estimated to range from 16 percent to 40 percent of original acquisition cost.
	Repairs Required-poor	Required repairs are major because the property is badly damaged, worn, or deteriorated, and are

(ODUSD[L], 1997, p. 3.4-1)



		estimated to range from 41 percent to 65 percent of original acquisition cost.
X	Salvage	Property has some value in excess of its basic material content, but repair or rehabilitation to use for the originally intended purpose is clearly impractical. Repair for any use would exceed 65 percent of the original acquisition cost.
S	Scrap	Material that has no value except for its basic material content.

(ODUSD[L], 1997, p. 3.4-2)



APPENDIX C. FEDERAL CONDITION CODES

Federal Condition Code	Percent of Inventory Price of Materiel
(See DoD 4160.21-M [reference (p)] for specific definitions)	
A-1 (serviceable, unused - good)	50
A-4 (serviceable, used - good)	40
A-2, A-5, B-1, C-1, D-1, B-4, C-4, D-4 (serviceable with qualification, materiel is either unused in fair condition; if used, in good condition).	30
B-2, C-2, D-2, B-5, C-5, D-5, D-7, E-7, F-7, G-7 (serviceable with qualification, if unused in fair condition; if used, in good condition). (Also includes unservice- able items that are in good condition but require minor repairs.)	20

A-3, B-3, C-3, D-3, A-6, B-6, C-6, H-7, F-8 (serviceable, in poor condition; unserviceable, in poor condition; or unserviceable because item requires minor repairs).	10
D-8, H-8, D-9, H-9, F-9, F-X, G-X, H-X (unserviceable, requiring major repairs).	5

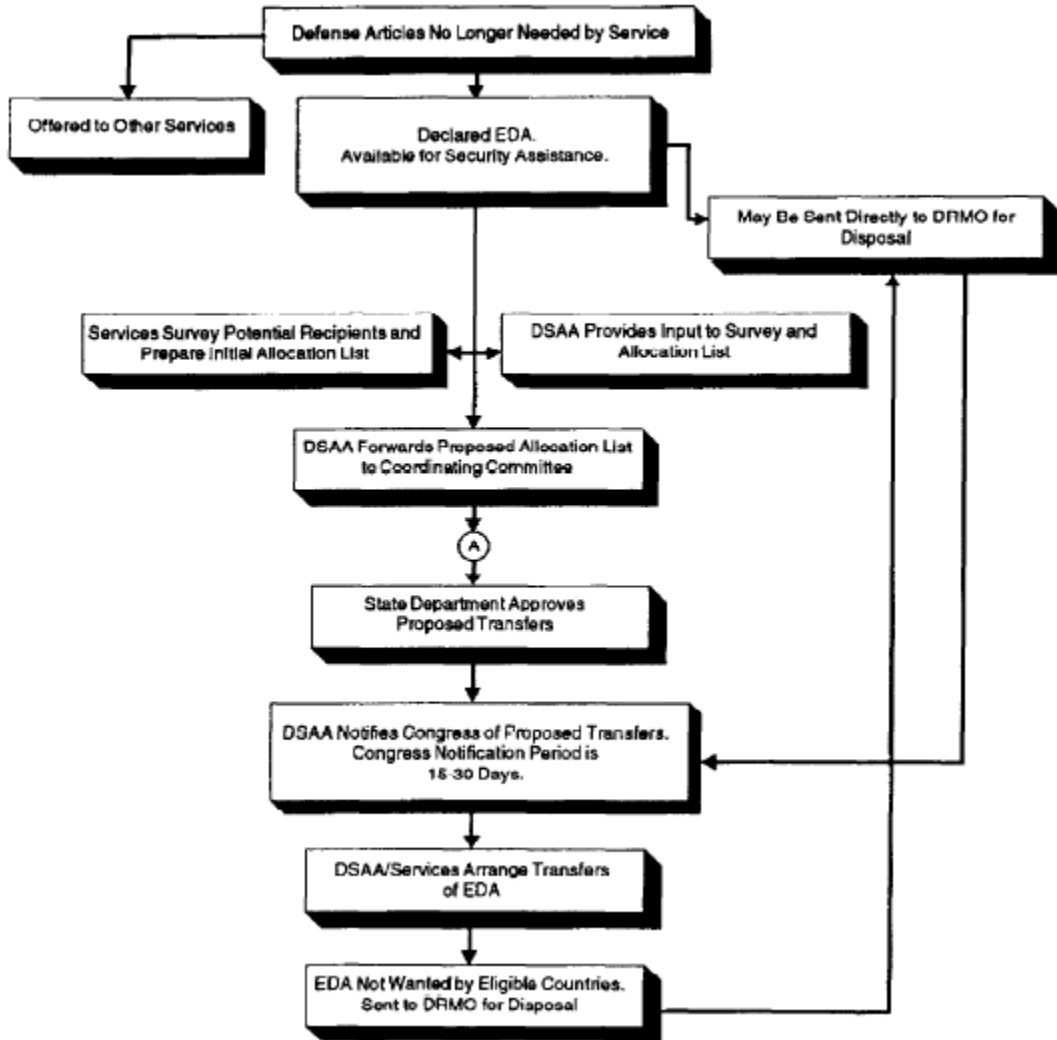
(ODUSD[L], 1997, p. 7-22)



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APPENDIX D. EDA TRANSFER PROCESS



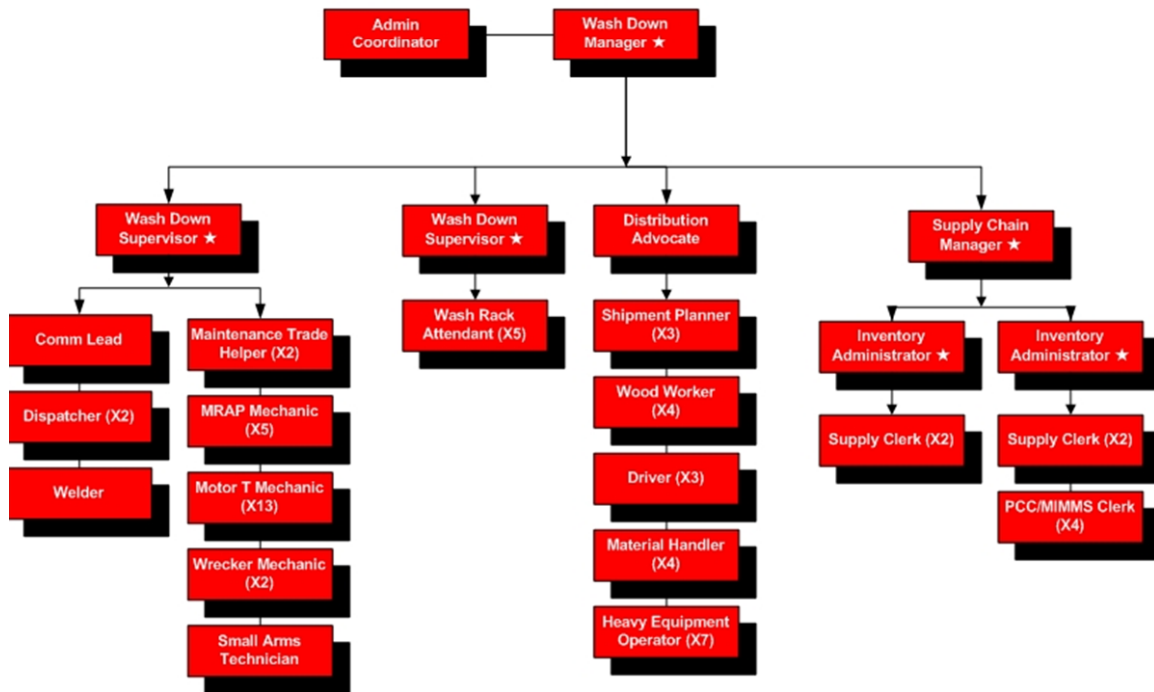
(GAO, 1994, p. 13)



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APPENDIX E. ORGANIZATION FOR WASH RACK OPERATIONS



(MCLC, 2012a)



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APPENDIX F. MILITARY DEPLOYED PAY CHART

Grade	Annually	Monthly	Combat Pay	Total Ave Monthly Combat Pay	Total Ave Daily Combat Pay	Total Ave Hourly Combat Pay
O-10	\$295,240	\$24,603	\$ 680	\$25,283	\$ 972	\$ 81
O-9	\$298,409	\$24,867	\$ 680	\$25,547	\$ 983	\$ 82
O-8	\$275,574	\$22,965	\$ 680	\$23,645	\$ 909	\$ 76
O-7	\$245,980	\$20,498	\$ 680	\$21,178	\$ 815	\$ 68
O-6	\$232,064	\$19,339	\$ 680	\$20,019	\$ 770	\$ 64
O-5	\$193,920	\$16,160	\$ 680	\$16,840	\$ 648	\$ 54
O-4	\$166,273	\$13,856	\$ 680	\$14,536	\$ 559	\$ 47
O-3	\$132,959	\$11,080	\$ 680	\$11,760	\$ 452	\$ 38
O-2	\$106,997	\$ 8,916	\$ 680	\$ 9,596	\$ 369	\$ 31
O-1	\$ 85,616	\$ 7,135	\$ 680	\$ 7,815	\$ 301	\$ 25
WO-5	\$191,550	\$15,963	\$ 680	\$16,643	\$ 640	\$ 53
WO-4	\$162,748	\$13,562	\$ 680	\$14,242	\$ 548	\$ 46
WO-3	\$139,175	\$11,598	\$ 680	\$12,278	\$ 472	\$ 39
WO-2	\$117,717	\$ 9,810	\$ 680	\$10,490	\$ 403	\$ 34
WO-1	\$103,267	\$ 8,606	\$ 680	\$ 9,286	\$ 357	\$ 30
E-9	\$148,501	\$12,375	\$ 680	\$13,055	\$ 502	\$ 42
E-8	\$122,739	\$10,228	\$ 680	\$10,908	\$ 420	\$ 35
E-7	\$108,292	\$ 9,024	\$ 680	\$ 9,704	\$ 373	\$ 31
E-6	\$ 91,901	\$ 7,658	\$ 680	\$ 8,338	\$ 321	\$ 27
E-5	\$ 76,381	\$ 6,365	\$ 680	\$ 7,045	\$ 271	\$ 23
E-4	\$ 62,996	\$ 5,250	\$ 680	\$ 5,930	\$ 228	\$ 19
E-3	\$ 54,193	\$ 4,516	\$ 680	\$ 5,196	\$ 200	\$ 17
E-2	\$ 49,812	\$ 4,151	\$ 680	\$ 4,831	\$ 186	\$ 15
E-1	\$ 45,041	\$ 3,753	\$ 680	\$ 4,433	\$ 171	\$ 14

Pay explanations	Cost	Reference
Annual/Monthly Military Composite Standard Rates	In Chart	Defense Comptroller
Hostile Fire & Imminent Danger Pay (HF&IDP)	\$ 225	2011 Military Pay Chart
Hardship Duty Pay (HDP)	\$ 100	2011 Military Pay Chart
Deployed Per Diem (DPD)	\$ 105	2011 Military Pay Chart
Family Separation Allowance (FSA)	\$ 250	2011 Military Pay Chart
Aviation Career Incentive Pay not factored (Ave Difference is \$1 more an hour)		

Formulas
Combat Pay = Sum of (HF&IDP + HDP + DPD + FSA)
Total Ave Monthly Combat Pay = Combat Pay + Monthly Military Composite Standard Rate

Assumptions
1. Rates are daily based on 26 working days in a month (1 off day a week).
2. Rates are hourly based on 12 hour work days.

Note. We created this table using information about combat pay and entitlements from the following websites: (www.militarypay.com) and (www.comptroller.defense.gov).



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APPENDIX G. KEY TERMS AND DEFINITIONS

1. Approved Acquisition Objective. DoD 4140.1-R (Office of the Under Secretary of Defense for Logistics and Materiel Readiness [ODUSD(L&MR)], 2003), also referred to as the DoD Supply Chain Materiel Management Regulation, defines an approved acquisition objective (AAO) as being, “the quantity of an item authorized for peacetime and wartime requirements to equip and sustain U.S. and Allied Forces, according to current DoD policies and plans” (p. 55). The Marine Corps Order 4490.1 follows the same definition; however, it delineates an actual equation in which it sums all the USMC-specific materiel requirements in which Marine Corps Combat Development Command maintains responsibility (USMC, 1997, p. 3).

2. Condition Code. The simplest definition of a condition code is that it is an alphanumeric code “which most accurately describes the materiel’s physical condition” (ODUSD[L], 1997, p. xxii). Condition codes are used for supply accounting purposes and in “reutilization program screening and review” (ODUSD[L], 1997, p. xxii). Further explanation is provided in Chapter II, Section A.4.

3. Disposal. Disposal is “the process of reutilizing, transferring, donating, selling, destroying, or other ultimate disposition of personal property” (ODUSD[L], 1997, p. xix). The concept of disposal is similar to reutilizing, which has a main goal of “maximiz[ing] reutilization of DoD property” (CJCS, 2010b, p. 108).

4. Disposition. *Merriam-Webster* defines *disposition* as “the act or the power of disposing or the state of being disposed” or also the “final arrangement” of an item (“Disposition,” 2012). *Disposition* and *disposal* are sometimes interchangeable and it should not be assumed that an item is automatically destroyed when either term is utilized. The DLA Disposition Services handles the disposal of equipment and materiel through the multiple means listed under *disposal* (2012).

5. Excess Defense Articles. The term *excess defense articles* (EDA) is defined in law, Section 644 of the Foreign Assistance Act (FAA), as follows:



The quantity of defense articles owned by the USG, and not procured in anticipation of military assistance or sales requirements, or pursuant to a military assistance or sales order, which is in excess of the Approved Force Acquisition Objective and Approved Force Retention Stock of all DoD Components at the time such articles are dropped from inventory by the supplying agency for delivery to countries or international organizations under this Act. (FAA, 1961)

Each Service defines what is in excess, and these items are provided “as is, where is,” at no cost to the customer, with the exception of transportation costs. In the case of Iraq and Afghanistan, the foreign state does not pay transportation cost since the equipment is in place. Two categories of EDA are sales EDA and grant EDA. The difference is with sales EDA, funds are exchanged with an eligible country, whereas with grant EDA, items are “free” with the exception of packaging, crating, handling, and transportation.

6. Foreign Excess Personal Property. An expression with a meaning similar to EDA, the term *foreign excess personal property* is defined in DoD 4160.21-M (ODUSD[L], 1997) as follows:

FEPP may be transferred by the Secretary of Defense to foreign countries for foreign currencies or credits, substantial benefits, or the discharge of claims resulting from the compromise or settlement of such claims, in accordance with the law, when the Secretary of Defense determines that the transfer is in the interests of the United States (p. 9-4).

However, the differentiation between EDA and FEPP is FEPP’s equipment maintains eligibility associated with non-standard equipment, as authorized by 22 U.S.C. § 2321j.

7. Foreign Military Sales. As defined by the *SAMM*, Foreign Military Sales (FMS) is the organization within the DSCA that “provides for the sale of defense articles and/or defense services usually from DoD stocks or through purchase under DoD-managed contracts” (DSCA, 2003, p. 95).

8. Measurement Ton. As defined by the Universal Service Contract-06, a measurement ton (M/T) is “40 cubic feet per ton or 2240 lbs. per ton” (USTRANSCOM, 2011, p. 51). All sea transportation costs require M/T as a metric to calculate the



shipping cost, while air shipping requires pounds (lbs.) to be used in cost determination. The traditional view of long ton and short ton have been used within the DoD as 2000 lbs, and for the purpose of this thesis, we use only the M/T for cost estimates.

9. Recapitalization. To *recapitalize* means to rebuild. For the purpose of this report, we use the term in the same way as in JP 4-0: “Rebuild recapitalizes an item to a standard as nearly as possible to its original condition in appearance, performance, and life expectancy to include technology upgrades and capability improvements. Rebuild is the highest degree of materiel maintenance applied to equipment” at the highest level of maintenance, which is the depot level in DoD components (CJCS, 2008, p. II 5).

10. Reconstitution. In most literature, reconstitution is analogous to the term *reset*. However, the Marine Corps Warfighting Publication 4-12, *Operational-Level Logistics*, describes reconstitution as “the regeneration, reorganization, replenishment, and reorientation of a Marine Air-Ground Task Force (MAGTF) for a new mission without having to return to home base” (USMC, 2002, p. 12). In the *OEF Ground Equipment Reset Strategy*, the Marine Corps differentiates reconstitution from reset by stating that reconstitution is defined “as actions beyond reset, taken during or after operational employment, to restore or upgrade combat capability to full-spectrum operational readiness, which includes personnel, equipment, and training” (USMC, 2012, p. 5).

11. Redeployment. JP 1-02 (CJCS, 2010a) categorizes redeployment as “the transfer of forces and materiel to support another joint force commander’s operational requirements, or to return personnel, equipment, and materiel to the home and/or demobilization stations for reintegration and/or out-processing” (p. 261). The Marine Corps definition is the movement of Class VII principal end items (PEIs) from the theater of operation to the Marine Expeditionary Force (MEF) units, which requires no reset. In terms of this thesis, we use *redeployment* in terms of returning personnel and equipment to the home station, requiring no reset.

12. Reset. The *OIF Ground Equipment Reset Plan* (USMC, 2009) defines the reset concept as “actions taken to restore units to a desired level of combat capability



commensurate with the unit's future mission" (p. 5). It further points out the equipment in this category is defined as "destroyed, damaged, stressed, rendered obsolete, or worn out beyond economic repair due to combat operations" (p. 5). Funding requirements are placed in two appropriations: operation and maintenance (O&M) funds and procurement. In a 2010 Congressional Research Service report, the DoD requested \$151 billion for the reset of equipment (Belasco, 2011, p. 50).

13. Retrograde. JP 1-02 (CJCS, 2010a) categorizes retrograde as the "process for the movement of non-unit equipment and materiel from a forward location to a reset (replenishment, repair, or recapitalization) program or to another directed area of operations to replenish unit stocks, or to satisfy stock requirements" (p. 290). Key considerations for the planning of retrograde operation according to JP 4-09, *Distribution Operations* (CJCS, 2010b), include the "type and amount of reparable components used, the maintenance concepts associated, and repair cycles, arrangements for cleaning, and USDA inspection prior to shipment from the theater" (p. 81). It later emphasizes cost as being a result of any postponement of the considerations for planning. The service definition is the movement of Class VII PEIs from the theater of operation to the Marine Corps Logistics Command (MCLC). In terms of this thesis, we use *retrograde* to mean the act of returning equipment from the theater of operations.

14. Reutilization. JP 4-09 (CJCS, 2010b) provides the following explanation of *reutilization*: "Reutilization of DoD excess is a source of supply for combatant forces, reduces the need for retrograde transportation, and minimizes the need for abandonment and destruction of FEPP" (p. 108).

15. Reverse Logistics. Due to growing economic and environmental concerns, interest in reverse logistics has risen and has been carried out within the DoD by the DLA. According to the Reverse Logistics Executive Council (2012), reverse logistics is "the process of planning, implementing, and controlling the efficient, cost effective flow of raw materiel, in-process inventory, finished goods and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper



disposal.” The reverse logistics pipeline has many benefits to the military, including “increased readiness and cost savings” (Diener, Peltz, Lackey, Blake, & Vaidyanathan, 2005, p. 59).

16. R2. R2 is the combination of the retrograde and redeployment processes. The R2 process map developed by HQMC, Installations and Logistics (I&L), Logistics Operations Analysis Division (LX) is an additional simulation tool for cost, time, and processes in Afghanistan.

17. R4. R4 is a Marine Corps acronym that stands for retrograde/redeployment in support of reset/reconstitution and that has emphasized the complete cycle of movement of equipment in Afghanistan to the home theater.

18. Transference. In this thesis, *transference* is used to describe the act of transferring and selling equipment to allies and/or reducing materiel to scrap metal, then selling to the international community.



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APPENDIX H. DETAILED VIEW AND EXPLANATION OF THE MODEL

In this appendix, each section of the FBCR4 & AoA cost model and associated line items are presented in order to provide a closer look at the actual cost factors affecting the retrograde and reset of equipment. These details are placed in an appendix in order to ensure all technical information is afforded to the reader without disrupting the flow of analysis in the main body.

Starting with the big picture, Figure 19 shows the strategic view side-by-side with a macro-level snapshot of the spreadsheet model that is used to analyze the costs of FBCR4 & AoA for an individual TAMCN item. It is immediately apparent that the spreadsheet model is nearly a mirror image of the strategic view, only it has dozens of inputs for each segment. Of note, the spreadsheet model is only useful for deriving cost information for vehicular, rolling stock, or break-bulk type items that are not containerized, as mentioned in Chapter II, Section III, in regard to the two broad categories USTRANSCOM uses to analyze equipment classification.



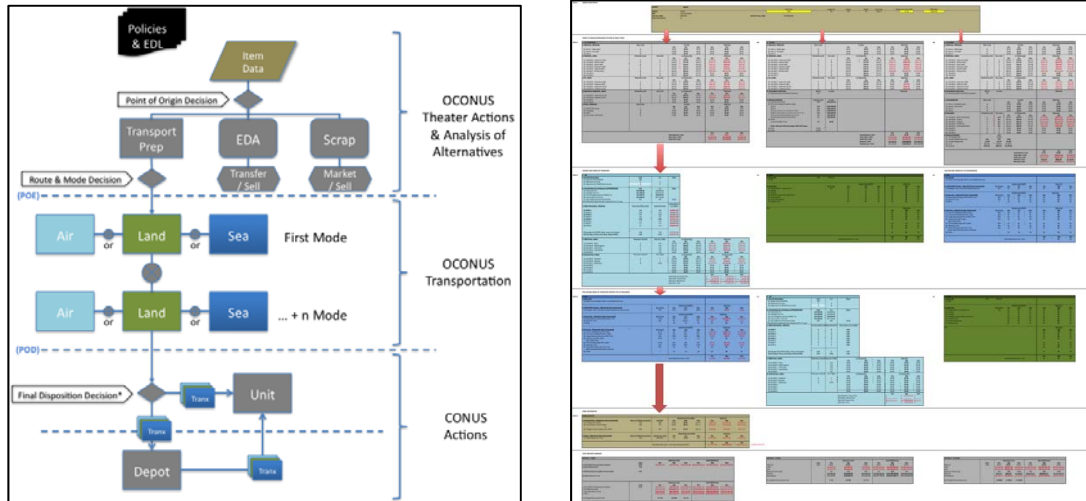


Figure 19. The FBCR4 & AoA Model Strategic View (left) and Itemized Spreadsheet Cost Model (right)

In the following subsections we present and expand the details of the spreadsheet model.

A. TABLE AUTHORIZED MATERIEL CONTROL NUMBERS DATA INPUT

All information associated with an individual piece of equipment is plugged in to this segment of the model and represents Step 1 of calculating costs. The inputs are the TAMCN number, NSN, original unit acquisition value, expected service life, total unit quantity, total unit acquisition value, dimensions, weight in M/T, and gross vehicle weight. Figure 20 illustrates a partial view of the listed inputs that are in the model. A majority of required vehicle TAMCN data is found in the *Ground Equipment Reset Playbook* (I&L, 2012), GEMS-MC data, and *Principal Technical Characteristics of U.S. Marine Corps Motor Transportation Equipment* (USMC, 2010).





Figure 20. Partial Expansion of the TAMCN Data Segment of the Itemized Spreadsheet Cost Model

B. POINT-OF-ORIGIN OPTIONS

This segment of the model is synonymous with OCONUS theater actions & AoA and illustrates the three options of transport, EDA, and scrap at the point of origin, no matter the location. As formerly presented in the conceptual and strategic viewpoints, materiel and labor requirements are broken down separately and factored in the spreadsheet model. The first materiel and labor inputs are represented in light gray (seen in Figures 21–24) because they are required inputs across the board for all three options and their costs should not differ for either course of action. Essentially, an item needs cleaning and a thorough inspection prior to transporting, selling, or scrapping. The actions in light gray are wash-rack materiel and labor and limited technical inspection (LTI) labor. Labor is subcategorized by numerous job skills and further classified as a military



specialty or contractor position. The latter is important due to the significant contractor support in current military operations and disparity between military and contractor wages for like skills. As an itemized cost model, flexibility is inherently built in for the planner's environment or situation. He or she can add or drop materiel and labor as required to realistically portray the processes on the ground.

For simplicity in the model, each line item has only one type of distribution built into its total cost. The triangle distribution (minimum, average, and maximum) for cost is utilized for a majority of materiel and labor in the point-of-origin options (see Figure 21) and other segments. However, different distributions across all variables, such as the line item's unit quantity, labor hours per unit, and cost, could easily be incorporated in further research and more complex models.

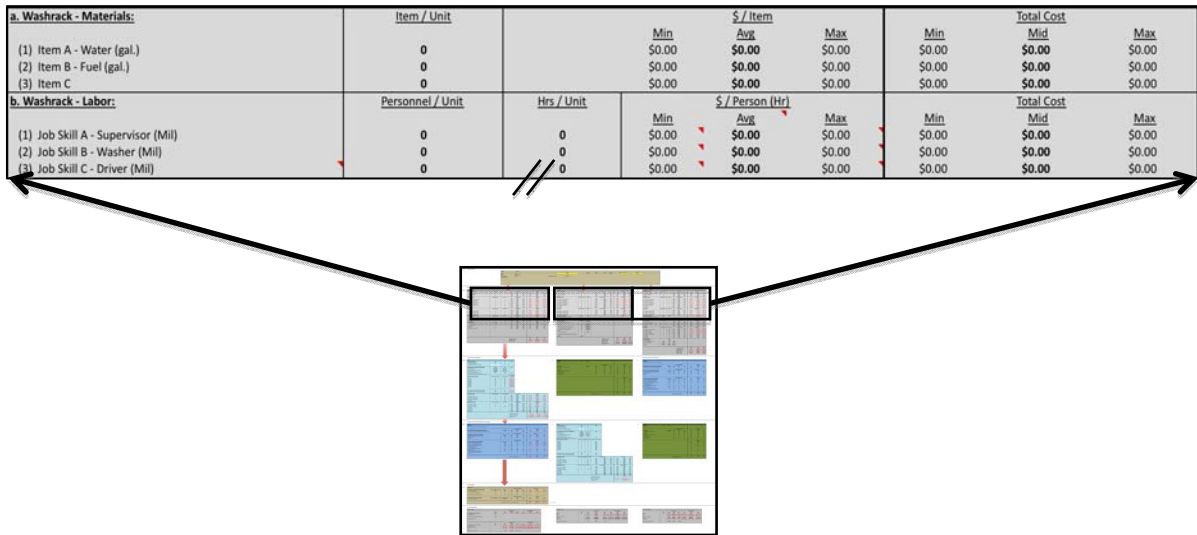


Figure 21. Point-of-Origin Segment of the Itemized Spreadsheet Cost Model showing Line Items and Cost Factors

1. To Transport

Below the double line, the dark-gray portion illustrates actions, labor, or materiel associated with the point-of-origin option. Of particular importance to transportation are an agriculture inspection (which is required by the USDA) and other necessary materiel, such as radio frequency identification (RFID) tags, packaging, and materiel handling equipment (MHE), as shown in Figure 22. It is possible that the agriculture inspection is



not sequenced at the point of origin and occurs later in the transportation process, but still prior to an item’s final embarkation on a ship or airline that directly enters the United States. However, the agriculture inspection is listed as an upfront cost under “To Transport” because it is a known factor for this course of action.

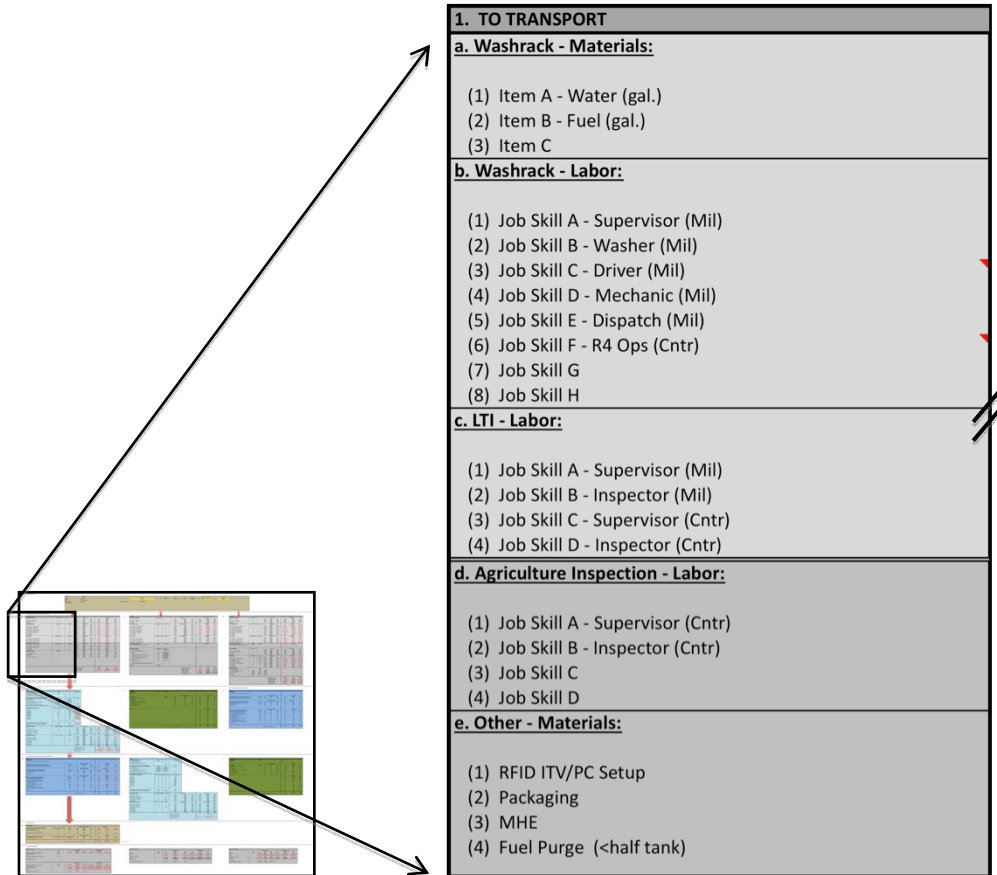


Figure 22. Point-of-Origin Segment for Transport of the Itemized Spreadsheet Cost Model

2. To EDA

As we previously mentioned, the EDA segment has the same materiel and labor costs (in light gray) as transporting and scrapping. These variables and costs automatically populate in the model for EDA. In addition to materiel and labor, there is a potential DSCA surcharge in handling the transaction(s) with a foreign buyer. This charge is also known as the working capital fund overhead cost (Figure 23).



EDA distinguishes itself from transportation in that there is resale and revenue potential on the original investment. Revenue is subject to the current condition and value of an item after a LTI or physical assessment is conducted. The Federal Condition Codes determine the percentage of original acquisition cost at which an item is valued, and these percentages range from 5 to 50 percent (see Appendix C). If a command directly transfers a piece of equipment new from inventory, then up to a 100 percent of the original acquisition cost is realized as revenue, and conversely, no revenue is gained if an item is granted through EDA. This range of revenue potential is show in Figure 23.

Additionally, no transportation costs are represented in the model for EDA because it is typical for the buyer to pay all costs associated with shipping after accepting the item, unless specific arrangements are made between parties.



2. TO EDA	
a. Washrack - Materials:	
(1) Item A - Water (gal.)	
(2) Item B - Fuel (gal.)	
(3) Item C	
b. Washrack - Labor:	
(1) Job Skill A - Supervisor (Mil)	
(2) Job Skill B - Washer (Mil)	
(3) Job Skill C - Driver (Mil)	
(4) Job Skill D - Mechanic (Mil)	
(5) Job Skill E - Dispatch (Mil)	
(6) Job Skill F - R4 Ops (Cntr)	
(7) Job Skill G	
(8) Job Skill H	
c. LTI - Labor:	
(1) Job Skill A - Supervisor (Mil)	
(2) Job Skill B - Inspector (Mil)	
(3) Job Skill C - Supervisor (Cntr)	
(4) Job Skill D - Inspector (Cntr)	
d. Inter-Agency Tranx Cost:	
(1) Working Capital Fund (WCF) overhead	
e. Revenue Potential:	
	% of Acq. Cost
(1) Full Price from Stock	100%
(2) Price from Federal Condition Codes:	
(a) A-1	50%
(b) A-4	40%
(c) A-2, A-5, B-1, C-1, D-1, B-4, C-4, D-4	30%
(d) B-2, C2, D-2, B-5, C-5, D-5, D-7, E-7, F-7, G-7	20%
(e) A-3, B-3, C-3, D-3, A-6, B-6, C-6, H-7, F-8	10%
(f) D-8, H-8, D-9, H-9, F-9, F-X, G-X, H-X	5%
(3) Grant	
(a) Any Condition Code	0%
*Note: Historical EDA percentages 1992-2012 (Avg.)	
(1) Sold	0.00%
(2) Grant	0.00%

Figure 23. Point-of-Origin Segment for EDA of the Itemized Spreadsheet Cost Model

3. To Scrap

Scrapping has the same initial materiel and labor costs as the other two options. These costs may seem counterintuitive, but they are necessary in order to ensure a vehicle or piece of equipment is properly cataloged and clear of debris to avoid interference with the actual scrapping process. Scrapping has a working capital fund surcharge from DLA for the transfer and handling of equipment, similar to DSCA’s overhead cost.



Specific to this segment are the numerous other required materiel, special equipment, and labor for implementing the scrapping processes, as seen in Figure 24. There is also a section to calculate revenue from any potential sales of scrap.

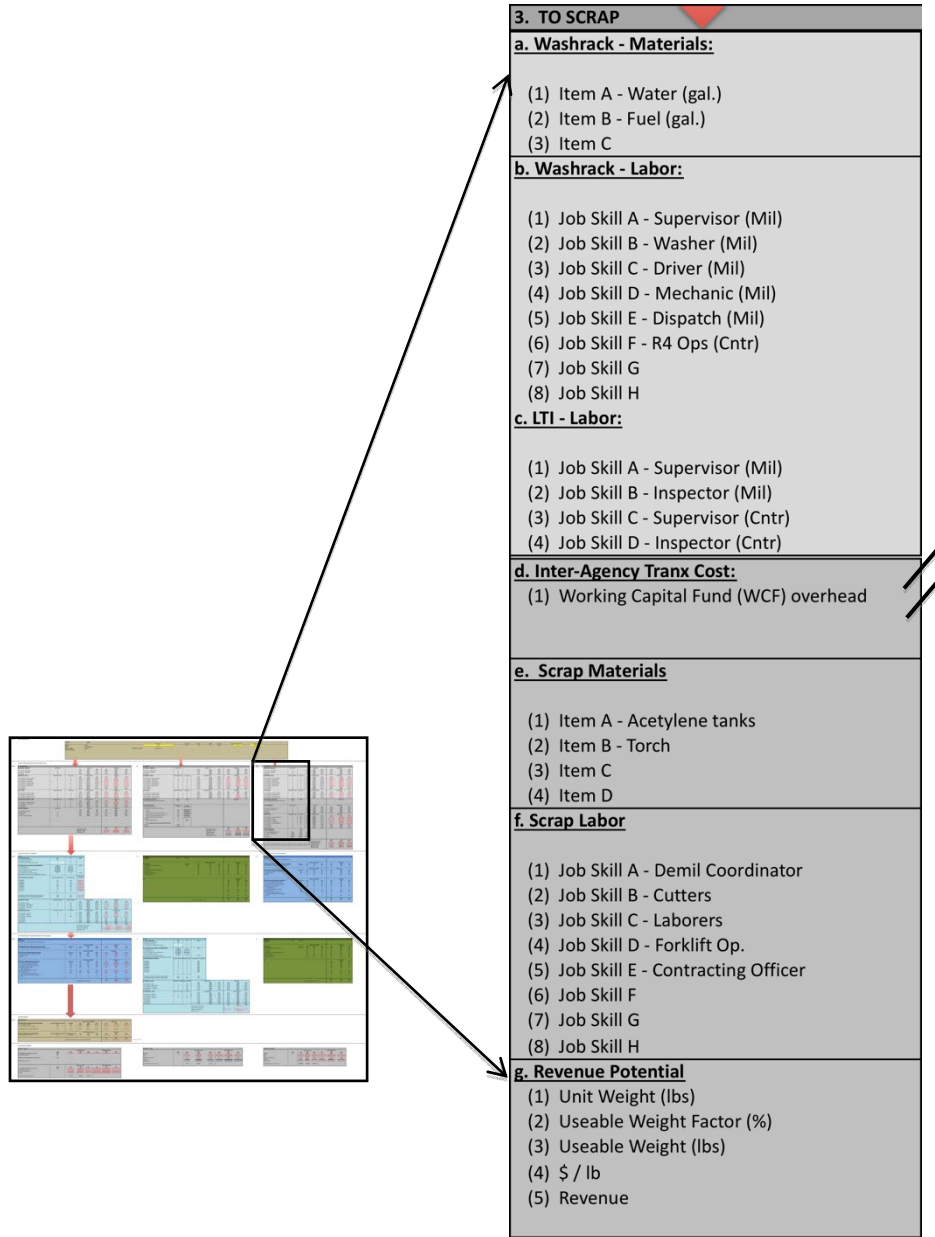


Figure 24. Point-of-Origin Segment for Scrapping of the Itemized Spreadsheet Cost Model



C. OCONUS MODES OF TRANSPORTATION

This segment of the itemized spreadsheet cost model provides three detailed options or modes of transportation in lieu of a point-of-origin decision to transport equipment out of theater. The three options of transport are categorized as air, land, or sea, and each table provides specific variables in materiel and labor that are required for that mode of transportation. This step in the process is repeated as many times as necessary for the exact number of legs (i.e., node-to-node) in the selected route from OCONUS to CONUS.

1. To Transport via Air

The first section of air transport represents the basic inputs of the particular aircraft that are standard for strategic airlift for the expected transportation routes. The aircraft information includes air speed, crew size, and the number of TAMCN units a particular plane is capable of carrying. Air speed is only necessary if an average flight time to an APOD is not provided.

The following aircraft information includes current 2012 USTRANSCOM rates that represent the fixed and variable cost of utilizing an aircraft for contingency operations such as OIF or OEF. There is also a blank line item for a commercial aircraft origination fee if utilizing this type of transport; however, we did not consider it due to its high variability and to the problems it caused in establishing a baseline cost in the model. For this thesis, the C-17 is the primary mover and only the total cost (fixed and variable) to the government is considered in order to derive FBCR4.

Flight information comprises of the flying time between APOE and APOD, and then multiplies that time by two in order to derive a round-trip calculation. Only the round-trip time is used because the USTRANSCOM “air-bridge” during a retrograde is two-way and continuous until the last piece of equipment is moved. The cost to the government per flight is simply the USTRANSCOM rate per hour multiplied by the round trip in hours. This section is also listed as materiel expenditure because fixed and variable costs are highly associated with the actual aircraft, fuel, and asset depreciation.



Labor is similar to the previous point-of-origin segment, but broken down in to the flight and ground crews with space to add or drop job skills. Flight crew labor is multiplied by the sum average of all round-trip times, and this number is more conservative than the sum average of the three most likely traveled APODs. Ground crew labor is multiplied by an estimated time considered for each position, as seen in Figure 25.

1. AIR								
a. Aircraft Information:								
(1) Speed of Aircraft (MPH)	C-17	C-5	Other					
(2) Minimum # of Crew	3	6						
(3) Maximum # of TAMCN item carried	?	?						
b. Aircraft Rates for Contingency (USTRANSCOM):								
(1) Fixed Cost / Hr	C-17	C-5	Other					
(2) Variable Cost / Hr	\$10,200.00	\$18,209.00						
(3) Cost Charged to Service (USMC) / Hr	\$11,386.00	\$19,507.00						
(4) Cost to Gov't / Hr (1+2)	\$13,200.00	\$29,999.00						
(5) Avg. Origin Fee (Commercial Only)	\$21,586.00	\$37,716.00	\$0.00					
*All information below this line is based off of C-17 costs								
c. Flight Information - Materiel:								
	Time from APOE 1 (Hrs)	Round Trip (Hrs)	Cost to Gov't / C-17 Flight					
(1) APOD 1	0	0	0.00					
(2) APOD 2	0	0	0.00					
(3) APOD 3	0	0	0.00					
(4) APOD 4	0	0	0.00					
(5) APOD 5	0	0	0.00					
(6) APOD 6	0	0	0.00					
(7) APOD 7	0	0	0.00					
(8) APOD 8	0	0	0.00					
(9) Average of all APODs (Note: used in calc below)	0.00	0	0.00					
(10) Average of three most likely utilized APODs	0.00	0.00	0.00					
c. Flight Crew - Labor:								
	Personnel / Aircraft	Avg. Hrs / Flight	\$ / Person (Hr)			Total Cost		
			Min	Avg	Max	Min	Avg	Max
(1) Job Skill A - Pilots	0	0	\$37.69	\$42.14	\$46.59	\$0.00	\$0.00	\$0.00
(2) Job Skill B - Flight Engineer	0	0	\$26.72	\$30.84	\$34.96	\$0.00	\$0.00	\$0.00
(3) Job Skill C - Crew Chief	0	0	\$26.72	\$28.91	\$31.10	\$0.00	\$0.00	\$0.00
(4) Job Skill D - Load Master	0	0	\$23.00	\$29.00	\$35.00	\$0.00	\$0.00	\$0.00
(5) Job Skill E	0	0	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
d. Ground Crew - Labor:								
	Personnel / Aircraft	Hrs / Flight	\$ / Person (Hr)			\$ / Person (Hr)		
			Min	Avg	Max	Min	Avg	Max
(1) Job Skill A - Embarker	0	0	\$22.58	\$26.84	\$31.10	\$0.00	\$0.00	\$0.00
(2) Job Skill B - Refueler	0	0	\$19.01	\$22.87	\$26.72	\$0.00	\$0.00	\$0.00
(3) Job Skill C - Maintainer	0	0	\$19.01	\$22.87	\$26.72	\$0.00	\$0.00	\$0.00
(4) Job Skill D			\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
(5) Job Skill E			\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
(6) Job Skill F			\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
(7) Job Skill G			\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
						Min	Avg	Max
Total Materiel / Round Trip:						\$ -	\$ -	\$ -
Total Labor / Round Trip:						\$ -	\$ -	\$ -
Total Cost / Round Trip:						\$ -	\$ -	\$ -
Total Cost / Unit						#VALUE!	#VALUE!	#VALUE!

Figure 25. Air Mode of Transportation of the Itemized Spreadsheet Cost Model

2. To Transport via Land

The second mode of transportation in the model (Figure 26) is delivery of equipment over land. This option predominantly involves the transfer of combat vehicles by flatbed trucks or rail through designated land routes and lines of communications. The land information includes fees for flatbed usage, tarping, crating, washing, enhanced in-transit visibility, enhanced security, and arbitrary surcharges.



3. SEA								
a. Route Info								
(1) Data is from Multiple SPOEs in the Middle East area								
b. APOD-SPOE Transfer - Materiel & Labor (Contracted)				Activity Cost (\$/MT)			Total Cost	
(1) Drayage / Unit (<10 mile transport between :	MT of Unit	Min	Avg	Max	Min	Avg	Max	
	N/A	\$0	\$0	\$0	\$0	\$0	\$0	
c. Ocean Liner - Materiel & Labor (Contracted)				Activity Cost (\$/MT)			Total Cost	
(1) Ocean Rate for Heavy Vehicle (HV) / Unit	MT of Unit	Min	Avg	Max	Min	Avg	Max	
(2) Daily ITV / Unit	N/A	\$0	\$0	\$0	\$0	\$0	\$0	
(3) Other	?	\$0	\$0	\$0	\$0	\$0	\$0	
d. Port Fees - Materiel & Labor (Contracted)				Activity Cost (\$/MT)			Total Cost	
(1) Liner-In Handling Fee (MT x Rate)	MT of Unit	Min	Avg	Max	Min	Avg	Max	
(2) Liner-Out Handling Fee (MT x Rate)	N/A	\$0	\$0	\$0	\$0	\$0	\$0	
(3) Cargo Clearance Service at POE / Unit	N/A	\$0	\$0	\$0	\$0	\$0	\$0	
(4) Arbitrary Fee (MT x Rate) (Note: NDN Only)	N/A	\$0	\$0	\$0	\$0	\$0	\$0	
(5) Port Handling Cargo (MT x Rate)	N/A	\$0	\$0	\$0	\$0	\$0	\$0	
(6) Washing / Unit	N/A	\$0	\$0	\$0	\$0	\$0	\$0	
(7) Enhanced Physical Security / Unit (Note: predominantly Karachi, Pakistan)	N/A	\$0	\$0	\$0	\$0	\$0	\$0	
(8) Other	?	\$0	\$0	\$0	\$0	\$0	\$0	
Total Materiel & Labor / Unit:					Min	Avg	Max	
					\$0	\$0	\$0	

Figure 27. Sea Mode of Transportation of the Itemized Spreadsheet Cost Model

D. CONUS ACTIONS AND FINAL DESTINATION

This segment of the spreadsheet model includes the CONUS transportation and depot-level maintenance costs that are reflected in the conceptual and strategic views. Labor and materiel costs are combined again to accurately reflect the USC-06 contract fees. There are only two options when returning to CONUS: (1) equipment goes directly to a home port or (2) the equipment is inducted at a depot facility. The GEMS-MC data provides the model forecasted percentages of those two options for a certain TAMCN. Additionally, in order to simplify this segment and end analysis, a weighted percentage based off of the GEMS-MC data is factored in to both the transportation and depot costs. Using this calculation method ultimately presents an average cost per unit across the entire TAMCN instead of two separate totals for vehicles going to a home port or depot.

Along with this weighted percentage, transportation factors the average miles to a home port or depot on both coasts and the average cost per mile from the USC-06 contract.

Depot costs multiply the weighted percentage, original acquisition value, and reset cost factor to derive the average cost per unit receiving this level of maintenance (Figure 28). The reset cost factor is found in the *OEF Ground Equipment Reset Strategy* (USMC, 2012, p.14) and ranges from 40 to 65 percent.



CONUS ACTIVITY			Activity Cost (\$ Per Mile)			Total Cost		
	Wgt % of TAMCN per Activity	Avg Miles	Min	Avg	Max	Min	Avg	Max
a. Transportation - Materiel & Labor (Contracted)								
(1) To Depot from SPOD	75%	286	\$4.04	\$8.20	\$11.11	(\$865.44)	(\$1,757.49)	(\$2,379.97)
(2) From Depot to Home Station or	75%	273	\$4.04	\$8.20	\$11.11	(\$826.43)	(\$1,678.26)	(\$2,272.69)
(3) Straight to Home Station from SPOD	25%	333	\$3.89	\$7.56	\$10.22	(\$324.09)	(\$630.00)	(\$851.45)
b. Depot - Materiel & Labor (Contracted)			Depot Reset Cost Factor			Total Cost		
(1) Depot Reset Cost / Unit	75%	Original Acq. Value \$650,000	Min 0.4	Avg 0.525	Max 0.65	Min (\$195,000)	Avg (\$255,938)	Max (\$316,875)
Total Materiel & Labor / Unit requiring Depot Maint.:						Min (\$197,015.96)	Avg (\$260,003.25)	Max (\$322,379.11)

Figure 28. CONUS Actions of the Itemized Spreadsheet Cost Model

E. SUMMARY OF ANALYSIS TABLES

The final segment of the model is the summary of analysis that illustrates the cost result tables for each of the initial point-of-origin options—to transport, EDA, or scrap. By originally selecting to transport equipment out of theater, the resulting costs become the total for FBCR4. In the FBCR4 summary, all OCONUS and CONUS activities are added to provide a per-unit grand total for the entire TAMCN, as well as minimum and maximum cost estimates. The percentage of the vehicle’s original procurement cost is also provided to give a further quantitative perspective on transporting an item back to CONUS.

The EDA and scrap cost result tables mirror each other in layout and both calculate a net value between materiel and labor costs and any realized revenue. In addition, the percentage of the vehicle’s original procurement cost is provided for comparison among options.

We describe and analyze any results in Chapter IV of this thesis.



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APPENDIX I. AIR LOAD PLANS

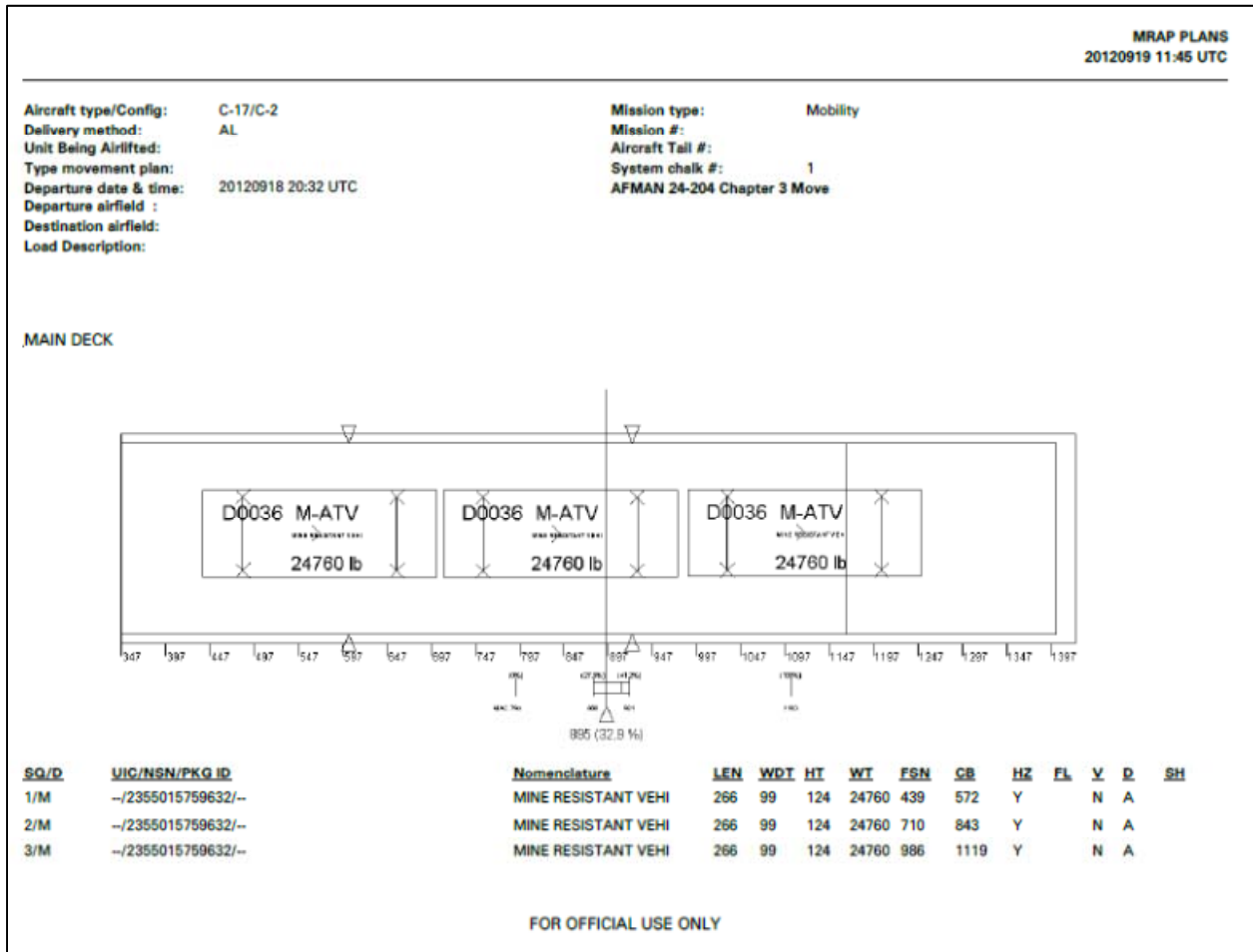


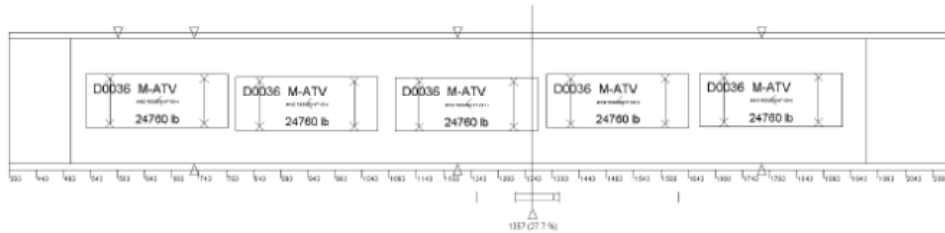
Figure 29. C-17 Air Load Plan for M-ATV
 (Integrated Computerized Deployment System [ICODES], 2012)



Aircraft type/Config: C-5/CP-2
 Delivery method: AL
 Unit Being Airlifted:
 Type movement plan:
 Departure date & time: 20120919 11:36 UTC
 Departure airfield :
 Destination airfield:
 Load Description:

Mission type: Mobility
 Mission #:
 Aircraft Tail #:
 System chalk #: 2
 AFMAN 24-204 Chapter 3 Move

MAIN DFCK



SQ/D	UIC/NSN/PKG ID	Nomenclature	LEN	WDT	HT	WT	FSN	CB	HZ	FL	V	D	SH
1/M	--/2355015759632/--	MINE RESISTANT VEHI	266	99	124	24760	532	665	Y		N	A	
2/M	--/2355015759632/--	MINE RESISTANT VEHI	266	99	124	24760	808	941	Y		N	A	
3/M	--/2355015759632/--	MINE RESISTANT VEHI	266	99	124	24760	1102	1235	Y		N	A	
4/M	--/2355015759632/--	MINE RESISTANT VEHI	266	99	124	24760	1381	1514	Y		N	A	
5/M	--/2355015759632/--	MINE RESISTANT VEHI	266	99	124	24760	1663	1796	Y		N	A	

Total # of Pax: 0 Weight/Pax: 0 Total PAX Weight: 0
 Total # of Subfloors: 0 Weight/Subfloor: 0 Total Subfloor Weight: 0
 Total Cargo Wt: 123800 %ACL: 95 ACL: 130000

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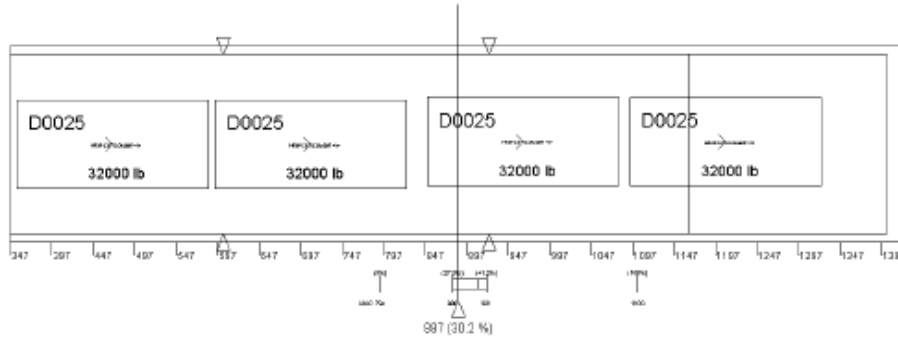
Figure 30. C-5 Air Load Plan for M-ATV (ICODES, 2012)



Aircraft type/Config: C-17/C-2
 Delivery method: AL
 Unit Being Airlifted:
 Type movement plan:
 Departure date & time: 20121015 13:11 UTC
 Departure airfield :
 Destination airfield:
 Load Description:

Mission type: Mobility
 Mission #:
 Aircraft Tail #:
 System chalk #: CHALK 2
 AFMAN 24-204 Chapter 3 Move

MAIN DECK



SQ/D	UIC/NSN/PKG ID	Nomenclature	LEN	WDT	HT	WT	FSN	CB	HZ	FL	V	D	SH
1/M	--/2355015525565/--	MRAP CAT I COUGAR 4X4	233	108	103	32000	354	471	Y		N	A	
2/M	--/2355015525565/--	MRAP CAT I COUGAR 4X4	233	108	103	32000	593	709	Y		N	A	
3/M	--/2355015525565/--	MRAP CAT I COUGAR	233	108	103	32000	849	965	Y		N	A	

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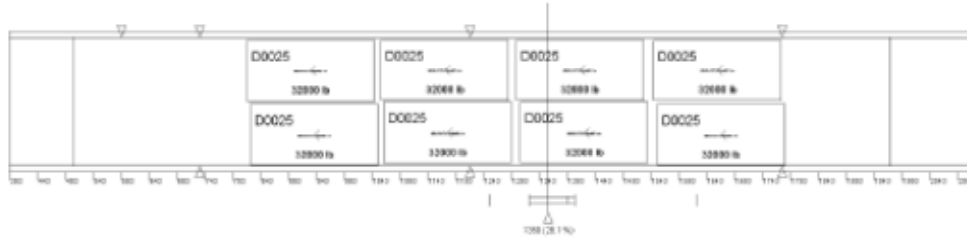
Figure 31. C-17 Air Load Plan for MRAP Vehicles (ICODES, 2012)



Aircraft type/Config: C-5/CP-2
 Delivery method: AL
 Unit Being Airlifted:
 Type movement plan:
 Departure date & time: 20121015 13:12 UTC
 Departure airfield :
 Destination airfield:
 Load Description:

Mission type: Mobility
 Mission #:
 Aircraft Tail #:
 System chalk #: CHALK 4
 AFMAN 24-204 Chapter 3 Move

MAIN DECK



SQ/D	UIC/NSN/PKG ID	Nomenclature	LEN	WDT	HT	WT	FSN	CB	HZ	FL	V	D	SH
1/M	--/2355015525565/--	MRAP CAT I COUGAR 4X4	233	108	103	32000	817	933	Y		N	A	
2/M	--/2355015525565/--	MRAP CAT I COUGAR 4X4	233	108	103	32000	823	939	Y		N	A	
3/M	--/2355015525565/--	MRAP CAT I COUGAR 4X4	233	108	103	32000	1057	1174	Y		N	A	
4/M	--/2355015525565/--	MRAP CAT I COUGAR 4X4	233	108	103	32000	1062	1179	Y		N	A	
5/M	--/2355015525565/--	MRAP CAT I COUGAR 4X4	233	108	103	32000	1299	1416	Y		N	A	

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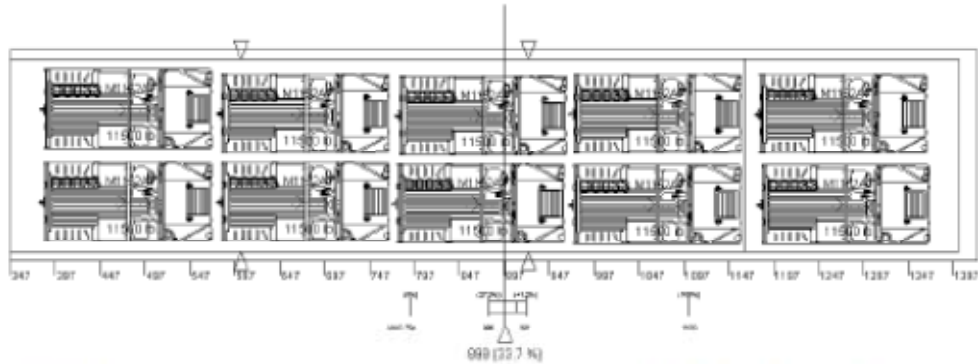
Figure 32. C-5 Air Load Plan for MRAP Vehicles (ICODES, 2012)



Aircraft type/Config: C-17/C-2
 Delivery method: AL
 Unit Being Airlifted:
 Type movement plan:
 Departure date & time: 20121015 13:09 UTC
 Departure airfield :
 Destination airfield:
 Load Description:

Mission type: Mobility
 Mission #:
 Aircraft Tail #:
 System chalk #: CHALK 1
 AFMAN 24-204 Chapter 3 Move

MAIN DECK



SQ/D	UIC/NSN/PKG ID	Nomenclature	LEN	WDT	HT	WT	FSN	CB	HZ	FL	V	D	SH
1/M	--/2320015402007/--	TRUCK, UTILITY; EXPANDED CAPACITY, ENHANCED, IAP/ARMOR READY	194	91	74	11500	378	475	Y		N	A	
2/M	--/2320015402007/--	TRUCK, UTILITY:	194	91	74	11500	379	476	Y		N	A	

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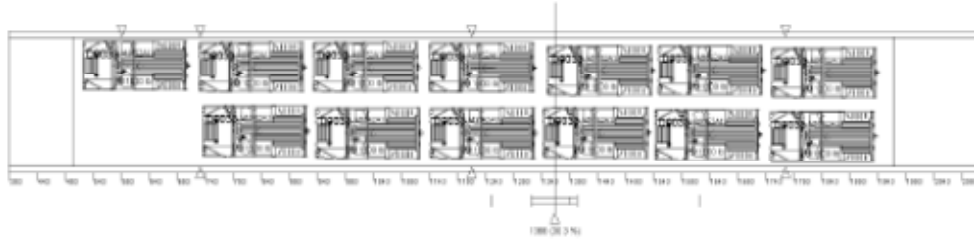
Figure 33. C-17 Air Load Plan for HMMWV (ICODES, 2012)



Aircraft type/Config: C-5/CP-2
 Delivery method: AL
 Unit Being Airlifted:
 Type movement plan:
 Departure date & time: 20121015 13:11 UTC
 Departure airfield :
 Destination airfield:
 Load Description:

Mission type: Mobility
 Mission #:
 Aircraft Tail #:
 System chalk #: CHALK 3
 AFMAN 24-204 Chapter 3 Move

MAIN DFCK



SO/D	UIC/NSN/PKG ID	Manufacturer	LEN	WDT	HT	WT	FSN	CB	HZ	EL	V	D	SH
1/M	--/2320015402007/--	TRUCK, UTILITY: EXPANDED CAPACITY, ENHANCED, IAP/ARMOR READY	194	91	74	11500	523	620	Y		N	A	
2/M	--/2320015402007/--	TRUCK, UTILITY: EXPANDED CAPACITY, ENHANCED, IAP/ARMOR READY	194	91	74	11500	731	828	Y		N	A	
3/M	--/2320015402007/--	TRUCK, UTILITY: EXPANDED CAPACITY, ENHANCED, IAP/ARMOR READY	194	91	74	11500	736	833	Y		N	A	

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Figure 34. C-5 Air Load Plan for HMMWV (ICODES, 2012)



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