



Increasing Combat Power through Smarter Logistics Support to Remote Areas

The College of William and Mary
The Mason School of Business

MGJW Fellowship



**INCREASED
COMBAT POWER**

Smaller Footprint

Greater Asset
Utilization

Cost Savings

Reduced Strain on
Logistics Network

Reduction of Inventory

Less Casualties

Increase Operational
Flexibility



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Authors listed alphabetically:

CPT Adam Bradford

CPT Timothy Gibbons

CPT Nathan Platz

MAJ Linda Wade

Major General James Wright Fellowship

The College of William and Mary

The Mason School of Business

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Abstract

A comprehensive study of current commercial supply chain innovations reveals many best practices that should be adopted by the US Army. The US Army can better support combat operations in the most remote areas on earth by adopting six proposed recommendations. The six recommendations include: reduce packaging waste, increase use of local and renewable resources, employ regional logistics experts, increase the prevalence of commonality of parts, improve logistics communications systems, and the efficient generation of operational power. The research conducted reveals how all six recommendations lead to an increase in combat power, benefiting US Soldiers and forward commanders. Combat Power will be generated by way of a smaller footprint, greater asset utilization, reduction of inventory, simplified logistics, and increased operational flexibility. Ultimately, combat forces will be more agile. While this report will not focus on cost savings, it is important to note that all six recommendations have proven to reduce costs for commercial companies. In addition to generating combat power, cost savings creates a win-win scenario for the US Army.

Increasing Combat Power through Smarter Logistics Support to Remote Areas

The focus of this report is on sustainment in areas with minimal or no local infrastructure or supply sources in environments similar to inland central Africa and isolated Pacific Islands. For the purposes of this study, remote is defined as:

1. Small base camp (e.g. Combat Outpost, Special Forces team camp): less than 100 personnel in a high threat environment (frequent contact with insurgents, non-contiguous front)
2. Medium base camp (e.g. Forward Operating Base): approximately 2000 to 6000 personnel, up to a BCT-sized unit (with LOGCAP and other support), and in a low to medium threat environment (occasional attacks by insurgents, non-contiguous front)
3. It is assumed that there is a major regional support base within 1,000 miles from which to receive shipments from CONUS or regional suppliers.

This is a Lean/Six-Sigma research project in which seven tools were utilized to develop the findings and recommendations. The ultimate customer for this report is the US Soldier. The definition of value, which can only be defined by the customer, is **combat power**. Combat Power is defined in FM1-02 as “the total means of destructive and/or disruptive force which a military unit/formation can apply against the opponent at a given time” (Army). The definition of waste for this report is “any human activity which absorbs resources but creates no value” (Womack & Jones, 2003). Waste translates into supply chain inefficiencies for the US Army and negatively impacts combat power. This research was focused on reducing waste in the US Army supply chain, leading to improved value (combat power) to the US Soldier.

Method

The U.S. Army Logistics Innovation Agency/DA-G4 chartered the William & Mary Mason School of Business Major General James Wright Program to research Supply Chain Optimization for Remote Locations. The intent is to garner insights from civilian organizations with the objective of improving US Army sustainment for remote locations.

This research project began by conducting a detailed literature review of current Army practices, lessons learned for remote area support, and prior recommendations for improvement. (Appendix G) Following the literature review, 42 current Army leaders (Captains and Majors) performing in logistic capacities were surveyed for their insights into what they experienced as their biggest challenges supporting remote areas. In addition, an Australian Army Officer was interviewed to gain insights from the Australian operation in East Timor from 1999 through 2000. This information collection included face-to-face interviews at Fort Bragg, North Carolina, Fort Lee, Virginia, and Williamsburg, Virginia. All surveys and interviews were open ended. Finally, a tailored survey was given to multinational corporations with experience in remote area logistics to identify best practices that can be applied to the Army. The following civilian companies were surveyed in person or via telephone conference call:

Artemis Global Logistics and Solutions - Specializes in remote area logistics. Artemis manages supply chain and logistics services for the government and civilian companies in Afghanistan and Central Africa.

Caterpillar Inc. - Caterpillar manufactures construction and mining equipment, diesel and natural gas engines, industrial gas turbines and diesel-electric locomotives.

Deloitte Consulting - Deloitte conducts supply chain management consulting worldwide. The company has advised thousands of clients from mid-sized companies to multinational corporations.

Fluor Inc. - One of the world's largest publicly traded engineering, procurement, construction, maintenance, and project management companies. Fluor operates in remote areas around the world.

Freeport-McMoRan Inc. - The largest US publicly traded copper producing mining company in the world. Freeport-McMoRan operates a mine in the Democratic Republic of the Congo.

Walmart Inc. - Walmart is the largest private corporation in the world. Walmart's supply chain initiatives are an integral part of their business strategy and their efforts in this area have resulted in their dominant position in the marketplace. The research team visited two Walmart distribution centers in person.

In addition to surveys, best practices were also identified through researching current civilian company and government agency supply chain initiatives. Additional companies and agencies cited in this report include Ford Motor Company, Subaru, and USAID.

Executive Summary

The people of the United States have charged the US Army to build a globally responsive and regionally engaged force. In a time of fiscal constraint, the Army must focus on maximizing scarce resources in order to achieve this charge. Today, logistics requires half of all Department of Defense (DOD) personnel and consumes approximately \$166 billion of the \$500 billion DOD budget (Lovins, 2010). The ultimate customer for all sustainment is the US Soldier. Colonel John C. Waller stated "It has been said that logistics alone cannot guarantee victory on the battlefield, but lack of logistics can all but guarantee failure. Inability to overcome supply chain shortfalls in business may result in lost profits, decreased market share, or at worst, bankruptcy. Military supply chain failure may lead to battlefield failure and, by extension, the loss of life" (Waller, 2011). The Army must ensure Soldiers have everything they require to fight and win, and the Army must accomplish this logistical feat efficiently in order to ensure victory despite scarce resources. Every resource the Army saves through improved efficiency will translate into an increase in combat power. Resources saved by identifying and eliminating waste in the Army's logistics network can be reallocated to training or Soldiers. In addition to the reallocation of funds, reducing the size of the Army's distribution network will allow security assets to focus on the operational mission.

The Department of the Army Logistics Innovation Agency has charged the Major General James Wright (MGJW) Program with the mission to gain insight into how the Army can better support remote locations from organizations outside of the Department of Defense. The MGJW team found that the US Army logistics network can improve in six areas: reduce packaging waste, increase use of local and renewable resources, employ

regional logistics experts, increase the prevalence of commonality of parts, improve logistics communication systems, and the efficient generation of operational power.

Recommended initiatives must present a tactical advantage to military units and demonstrate how increased efficiency can free scarce resources that will feed combat power. The only way to implement fundamental changes in the logistics network is to highlight that improved efficiency can maintain superior levels of service and free scarce resources to improve the “teeth” of the force.

The US Army must approach procurement of supplies as a strategic partnership rather than merely selecting the lowest bid. The Army procures many supplies by laying out the specifications and selecting the lowest bid. There is little consideration in the specifications for distribution expenses throughout the supply chain. There is a strategic advantage to partnering with suppliers to reduce packaging. Small changes in packaging obtained through partnerships with suppliers will lead to significant savings obtained through efficient transportation and storage. A tactical advantage can be gained by partnering with suppliers to modify packaging materials, because packaging materials can be designed to serve a dual purpose. Packaging refuse can be designed to burn cleanly in waste-to-energy systems or incinerators built to provide operational power. This would result in reduced fuel requirements, and it would reduce the strain on the distribution network as a result. Reduced strain on the distribution network provides a tactical advantage by freeing up combat troops to perform operational tasks other than logistics security.

Procurement of resources and materials must follow a progression that reduces strain on distribution networks. The progression should be locally procured resources followed by domestic production and distribution, and natural resources should be utilized to augment reliable supply chains where possible. Criteria should be set to ensure quality, reliability, and security on natural and locally procured resources. Counter insurgency considerations regarding local economic stimulation should be taken into account. Tactical and logistical advantages can be gained by building local capability.

Logistical challenges vary greatly from region to region, and the best way to prepare is to staff combatant commands with a permanent cohort of regional logistical experts. The team would be responsible for planning and arranging main supply routes, navigating cultural boundaries, and exploring the feasibility of procuring strategic resources locally. The team’s success would depend upon learning from partnerships with organizations outside of the Department of Defense.

Equipment design should consider commonality of parts across platforms. The US Army has done well in procuring families of vehicles and varying a common platform to meet specific mission requirements. However, commonality of parts should exist across families of vehicles wherever possible. Tires, oil filters, mud flaps, light bulbs, belts, fans, and batteries can and should be shared across vehicle platforms and in between different vehicle families. Every common part reduces inventory, transportation requirements, and simplifies maintenance. All future vehicular designs should have commonality of parts as a criterion for approval.

The US Army’s logistics communications systems are falling behind the civilian industry with regard to analysis of historical data for forecasting, inventory management, and information systems for in-transit visibility. Walmart’s logistics systems provide real

time visibility of every retail location's need and is capable of pinpointing when a critical shipment leaves the seaport of embarkation. They also have the ability to increase the speed of the vessel when and if needed, and frontload critical cargo throughout their distribution system. Walmart is able to forecast need through analysis of historical data, predict in-transit times, and reduce inventory. Efficiencies gained through better communication and analysis will translate into a further increase in combat power.

Reducing fuel consumption through waste-to-power initiatives and efficient generator utilization will reduce the strain on the distribution network. Fuel shipments required to generate operational power comprised 25% of all resupply convoys in Afghanistan and Iraq (Strategic Environmental Research and Development Program, 2011). Freeport-McMoRan implemented a waste to power initiative that reduces distribution requirements, creates clean power, and saves money. If the Army implemented the same initiative, they would reduce strain on the distribution network, free assets for operational missions, and could reallocate funds for additional training. Inefficient generator utilization has become a driver of increased fuel requirements. The Army must make a concerted effort to design bases and educate tenants on power generation and distribution. Proper generator use must be a command driven initiative, and if it is done properly, it will save lives.

Recommendations that improve the Army's ability to support remote locations can be applied to the Army as a whole. Significant savings gained through efficient packaging and procurement will increase combat power through additional funding for training and troops. In addition to funding, the Army gains the advantage of providing goodwill and trade with the local populace when local resources are utilized. The old adage "don't bite the hand that feeds you" rings true. Establishing a consistent and dedicated team of regional experts would improve consistency and reliability of main supply routes. Improving the Army's logistics communications systems to give us accurate and timely inventory and consumption levels would improve forecasting and efficiency. Waste to power initiatives and efficient generator utilization will reduce fuel requirements without any additional risk. These recommendations will reduce the strain on the distribution network, improve reliability and consistency, free assets for combat operations, and provide the opportunity to reallocate funds to sharpen the "teeth" of the US Army.

Recommendations

Smarter Packaging Design

Walmart finds the punt (or dimple dent) at the bottom of a bottle of wine to be wasteful. Walmart worked closely with their supplier to redesign the Oak Leaf brand wine bottles to reduce that punt resulting in a shorter and lighter bottle. This small change reaped big cost savings in glass consumption, packaging materials, and transportation which created a win-win scenario for both Walmart and their supplier (Lasky, 2011) and reduced Walmart's annual shipping requirement by 280 trucks (Kalkowski, 2012).

Freeport-McMoRan, one of the top mining companies in the world, worked closely with a supplier to completely redesign their packaging for cobalt hydroxide. The new design resulted in a larger, square shaped product bag that was more rigid. The new design cubed out the exact dimensions of their cargo trucks and doubled the amount of

material that could be shipped in one truck. The company paid two dollars more for the rigid bag, but the new design doubled the efficiency of their transportation network. The new design also made their packing process at the mine more efficient. Freeport-McMoRan gains a competitive advantage through their supplier relationships because they view their suppliers as strategic partners. Freeport-McMoRan works together with their suppliers to increase supply chain efficiency and reduce costs (Freeport-McMoRan, 2014).

What can the Army learn from these initiatives to reduce packaging waste? An initiative to reduce or re-design packaging would have a radical effect on combat operations. Inefficient packaging results in trucks being on the road unnecessarily, poor utilization of air delivery assets, and inefficient use of storage space. Improved packaging would decrease the exposure of vulnerable assets along the supply chain, increase air and ground asset utilization, and reduce transportation requirements. Careful analysis of packaging would eliminate waste thereby increasing combat power.

Most of the current packing material used for food, water, ammunition, and repair parts become a solid waste burden during combat operations. Solid waste must be disposed of for tactical, political, and sanitary reasons in a combat zone. In remote areas the common method for disposing of solid waste is by burning it. Burning packaging materials can lead to future health problems for Soldiers (Strategic Environmental Research and Development Program, 2011). The more remote the greater the challenge of waste disposal; removing unnecessary packing material does not go far enough. Packaging materials should be designed to burn cleanly with zero health impacts in a power generating incinerator.

A single case of meals-ready-to-eat (MREs) is a great example of poor packaging. Not only does the cardboard case create solid waste, but the individual MRE packaging design results in much unused space within a case. This creates waste in the cost of packaging and printing, and it creates waste along the supply chain as these cases move on ships, vehicles, and air assets. Smaller and lighter packaging offers significant benefits to Soldiers who receive resupply by CDS delivery on air-only COPs. Of note, US Army Natick has developed improved packaging for the MRE that is smaller and lighter, but it has yet to be approved by the Department of Defense (US Army Natick Soldier Systems Center, 2014). Another example of poor packaging is a dry erase marker and eraser kit. The packaging used to ship the kit that consists of twelve dry erase markers and one eraser, is almost as large as a shoebox. The markers and eraser take up less than one half of the total packaging space.

The US Army should also design dual purpose packaging to create more value for Soldiers. After a short brainstorming session, several ideas were generated when it comes to dual purpose MRE packaging: MRE Sandbag, MRE Biodegradable Wagbag (field-expedient latrine), or MRE Camouflage Net Case (the packaging from one pallet of MREs could provide enough material to create camouflage netting, which could be used for concealment). There is no current initiative to design dual purpose MRE packaging (US Army Natick Soldier Systems Center, 2014).

The improved packaging initiative should also extend to how the Army awards contracts to suppliers who are key partners in the supply chain value stream. Contracts should only be awarded to suppliers who comply with efficient packaging standards to include minimum required packaging, lighter packaging, dual purpose packaging, and

clean burn packaging. Strict contracting requirements would no doubt put American ingenuity to work in developing smart solutions to packaging challenges. The Army must recognize that suppliers are a critical part of the value stream in the supply chain.

Every bit of space available to resupply Soldiers in combat should be utilized. Soldiers should be able to utilize almost every piece of material the Army sends them, to include packaging materials. All material should be lightweight, and they should burn cleanly in order to reduce health risks and even generate power. A smaller physical footprint, lighter rucksacks, increased asset utilization, and dual purpose packaging offer a clear tactical advantage to forward units. This initiative would also reduce troop requirements for protection, which enables maneuver commanders to utilize this combat power in support of their mission. What is evident in the case of Walmart and Freeport-McMoRan is that improved packaging would also reduce supply chain costs for the US Army.

Increased use of Local and Renewable Resources

Freeport-McMoRan operates mines in remote areas of Central Africa. They have adopted methods of maximizing local¹ and renewable² resources in order to reduce their logistical resupply requirement, increase their operational effect, and maximize their profits. Methods employed by Freeport-McMoRan include digging wells, partnering to refurbish a hydroelectric plant, and providing equipment and training to create local sourcing options. Each of these methods reduces the distribution resources required to sustain operations at these remote sites, freeing up assets and money to support core operations.

What can the Army learn from these methods to utilize local and renewable resources? The Army can drastically increase combat power while reducing the support requirement by utilizing local and renewable resources. The Army would sharpen the proverbial tooth and shorten the tail becoming more efficient and tactically capable in the process. By adopting these methods, the Army would save dollars in the supply chain, and every dollar saved in logistics is another dollar that can be spent towards combat power.

When Freeport-McMoRan moves into a remote area, their water requirements are similar to that of an Army forward operating base (FOB) in Afghanistan. Instead of solely relying on shipping bottled water into the remote site, Freeport-McMoRan constructs a freshwater well which supplies their remote site and the local village with fresh water (Freeport-McMoRan, 2014). As a result they reduce their requirement to import water and also use this opportunity to provide water to the local village. Freeport-McMoRan realizes that goodwill towards the local populace is critical to their success and well construction is one way the company builds a sustainable and lasting relationship while also reducing their logistical requirements.

Many remote Army bases rely heavily on bottled water with very low emphasis on digging freshwater wells. The tactical benefits to the Army of building a freshwater well are four fold: a reduction in the number of resupply convoys, a freeing up of assets

¹ Local Resources are defined as anything that can be produced or procured locally

² Renewable resources are defined as anything that can be replenished with the passage of time and occurs naturally.

for combat missions, the strengthening of relationships with local community, and an increase in funding available for combat power.

A reduction in the number of resupply convoys: In 2008, 20% of all material sent by convoy in Iraq and Afghanistan was for water (Army Environmental Policy Institute, 2009). Implementing a freshwater well to support a remote Army FOB would result in eliminating a significant number of resupply convoys.

Freeing up assets for combat missions: Resupply convoys operating in Iraq and Afghanistan often require air support consisting of Kiowa or Apache Helicopters. In 2007, the number of water convoys required was 3,725 (3,287 in Iraq and 438 in Afghanistan), which computes to a little more than 10 convoys per day solely for water (Army Environmental Policy Institute, 2009). Assuming two helicopters are required to escort one convoy, adequate air support requirements would be 20 attack helicopters per day. Reducing resupply convoy requirements by 20% would free up these valuable air assets for combat missions. Even reducing resupply convoy requirements by 10% would free up critical assets for combat operations.

The strengthening of relationships with the local community: building a freshwater well provides a water source for the Army base and water for the local village. Establishing good relationships with the local population are critical to long term security in any operation. Building a freshwater well that supplies water to the local village as well as the Army FOB would establish an enduring relationship. Funding could be established to pay the locals for the water provided at far less than the cost of transporting bottled water. This would strengthen the local economy, support counterinsurgency operations, and reduce logistical support requirements.

An increase in combat power: The most telling benefit of this method is the increase in combat power. Combat power is increased through a number of ways, most predominantly through freeing up assets. Additionally, the utilization of local resources to provide water would lessen the requirement for support personnel on the FOB. The reduction in support personnel equates to an increase in combat personnel and increases combat power. The effect is more noticeable when operating under the restrictions of a Force Management Level as in Afghanistan.

Freeport-McMoRan also requires bricks to construct essential buildings for their mines in central Africa. Bricks are heavy and expensive to move. Instead of transporting bricks into Africa, Freeport-McMoRan transported the equipment required to make bricks into the remote area and trained the locals how to make the bricks. Freeport-McMoRan purchases these bricks from the local village freeing up essential logistics assets to be dedicated toward moving other critical supplies or product. This local sourcing initiative also created goodwill with the local community, as Freeport-McMoRan helped bring an economic benefit to local villagers.

An example of where the Army has utilized this method was in 2007 during Operation Iraqi Freedom. Cement barriers were needed in mass quantities to cordon off areas for the presidential election. Transporting cement barriers into Iraq was not practical so they were produced locally in Iraq and procured by the Army (Officers W. V., 2014). This same mindset can be applied to other building material such as wood, nails, and wire. A 2011 report by the Government Accountability Office stated that “[The] DOD has not always met delivery standards and timelines for shipments to major logistics bases in Afghanistan [...] due in large part to the various difficulties in

transporting cargo on surface routes through neighboring countries and inside Afghanistan [...] [f]or example, from December 2009 through March 2011, surface shipments of requisitioned supplies did not once meet the time-definite delivery standard that calls for 85 percent of shipments to arrive within 97 days of being ordered” (Office G. A., 2011). This fact is illustrated in Appendix F. This represents a tremendous amount of waste in the Army supply chain that negatively affects combat power by making Soldiers wait for needed supplies, go without, or causes a crippling buildup of inventory. Locally sourcing supplies, as Freeport-McMoRan does, would lessen the requirements of the Army supply system and improve the delivery time of supplies to the front line, increasing combat power. The effects of this would reduce the money spent on the supply chain, reduce lead time, and support the local populace.

When moving into a remote location one of the first requirements is CL IV. Soldiers need this to improve fighting positions, establish areas to operate out of and improve their ‘foxhole’. CL IV is bulky, heavy, and requires several logistic assets to move. The Army’s current solution when deploying to a remote area is to procure CL IV at home station in America and transport the supplies to the forward location, moving it through every node along the way. This is expensive, time consuming, and takes up valuable logistics assets that are needed to move other critical items. Much of the CL IV required initially in remote areas, such as wood, can be procured locally freeing up logistic assets while also establishing a relationship with the local populace. Local procurement of building materials would alleviate the requirement to ship from CONUS, increase the timeliness of arrival, and establish a relationship with a local merchant.

Employ Regional Logistics Experts

The US Army must provide a globally responsive and regionally engaged force, ready to face the national security challenges of tomorrow. US Army logisticians face significant challenges navigating cultural boundaries and bureaucratic process when resupplying troops in the field. Civilian corporations face these challenges every day and they have logistics experts working with government officials learning the bureaucracy and adjusting their system to provide seamless support. Combatant commands are charged with contingency planning, but commands often lack the continuity and resources required for a deep understanding of regional challenges. The US Army requires a team of professionals dedicated to making contacts with local support options, navigating bureaucracy, and learning from partnerships.

Local support options can free logistics and combat assets by reducing transportation requirements. Contracting local support can provide a tactical advantage to maneuver commanders through the good will garnered from conducting business with the local populace. Regional experts can provide insight for military commanders into the feasibility of procuring any and all manner of supplies from the local populace. As mentioned, Freeport-McMoRan’s initiatives provide an excellent example of how local resourcing can be more efficient and create goodwill (Freeport-McMoRan, 2014). Regional experts can focus on, or expand, initiatives similar to civilian counterparts in the area. They can serve “on the ground” to develop partnerships that will reduce the strain on the distribution network and free scarce resources for combat power.

Cultural boundaries in the form of regulations, policy, and hostility provide great challenges to supporting remote locations. The reliability and consistency of shipments decreases with every border crossing. Freeport-McMoRan learned the lessons first hand

when trucking metal exports out of their mining operations located deep in the Democratic Republic of the Congo. Freeport-McMoRan ensured all trucks were properly registered in the countries through which they will be traveling in order to minimize border crossing delays (Freeport-McMoRan, 2014). National borders provide the most obvious challenges, but tribal and cultural boundaries must also be known. The regional experts can gain first-hand knowledge of each nations' requirements. They can understand the cultural landscape and calculate the impact on distribution networks throughout the region. The most efficient main supply route will often depend on the cultural landscape rather than distance and infrastructure. Regional experts would be indispensable if they gain a working knowledge of cultural boundaries and how best to navigate them.

Major corporations and government agencies have logistics operations in every corner of the globe, and regional experts can partner with them in order refine planning and glean lessons learned. A thorough plan is not enough to be successful. Practical lessons from real world situations bring challenges to light, and knowledge comes more from experience than from study. It is not practical for the US Army to conduct mock operations in remote locations to learn these lessons, but it is entirely feasible that a team of regional experts can partner with civilian corporations and agencies in order to gain invaluable insight before any operation. USAID funds an economic development project across Africa with the intent of reducing barriers to trade. The Trade Hub program understands how to move across borders, and they are actively campaigning to reduce border delays. The East African Trade Hub program has successfully reduced border crossing documentation by 10%, established main trade routes, and has an intimate knowledge of the requirements (USAID, 2014). The US Army should seek to benefit from USAID's effort, and the regional experts would be the catalyst to ensure the information is shared.

Develop a Robust Common Platform and Common Parts Initiative

In 2011 Ford Motor Company released news about their global initiative to reduce the amount of platforms used in their vehicles from fifteen to five. This economies of scale initiative led to cost savings in engineering time, parts and service, and tooling and machinery (Ramsey, 2011). In 2014 Subaru announced the implementation of a new Subaru Global Platform for their vehicles. The initiative promises to cut unit costs by 20% by 2020 through "more efficient vehicle designs, standardized platforms and leaner manufacturing processes" that are all in the works (Greimel, 2014).

Freeport-McMoRan purchased 150 of their own cargo trucks to move supplies on a portion of their supply route where they experienced the most challenges and incurred the highest freight cost. They wanted to handle "the hard part of logistics," or the last tactical mile, themselves to reduce lead time, pilferage, and decrease freight costs (Freeport-McMoRan, 2014). This situation is similar to the scope of this project which assumes that contractor support is unavailable. When purchasing these vehicles their vendors wanted to sell the company three different brands of trucks. Freeport-McMoRan insisted on only purchasing one brand, and they procured of 150 of the exact same trucks and 200 of the exact same trailers. The advantages of purchasing the exact same trucks were six-fold: the supply chain required for parts was reduced, inventory storage of parts and lubricants reduced, operator training requirements reduced, mechanic training requirements reduced, and communication with manufacturer for maintenance expertise

or warranty claims simplified. The common platform resulted in large costs savings over the alternative course of action.

Recent history shows that the Army is moving in a different direction than civilian industries. Mine Resistant Ambush Protected (MRAP) vehicles fielded in Iraq and Afghanistan consisted of different platforms with parts that were not interchangeable (Vergun, 2013). While the MRAP was procured as a stopgap measure to combat the improved explosive device threat, the challenges placed on the Army supply system as a result of the low commonality of parts between variants of MRAPs should serve as a lesson for future vehicle procurement. As the Army moves forward in procuring the newly designed Joint Light Tactical Vehicle (JLTV), increasing common platforms and common parts should be of high priority in vendor designs. The Army has wisely insisted on high commonality of parts for the JLTV family of vehicles, up to 90% commonality (General Dynamics, 2010). This is a tremendous step in the right direction for the Army, unfortunately it is only half of the step. To go the whole way the Army needs to source vehicles with commonality of parts in between families of vehicles; 90% commonality within the JLTV family is not the goal, the goal should be commonality of parts within the entire fleet of Army vehicles. The road toward that level of commonality is long, but the benefits would be astronomical.

Common platforms, viewed from both the manufacturer and end user perspective, offer tremendous advantages. By embracing a more robust common platform initiative in the design and purchase of vehicles the Army can reduce the logistics burden of parts, storage, transportation, operator training, mechanical expertise, and manufacturer support. All of these advantages lead to a smaller physical footprint, a lighter supply chain, and greater simplicity in the maintenance and distribution of repair parts. The simplicity that comes with commonality of parts will inevitably increase operational readiness rates by reducing average lead time for parts. This creates a clear tactical advantage for forward units, especially those in remote areas with poor infrastructure and harsh weather conditions.

Equipment design should consider commonality of parts across both platforms and vehicle families. The US Army has done well in procuring families of vehicles and varying the platform to meet specific mission requirements. However, commonality of parts should exist across families of vehicles whenever possible. Tires, oil filters, mud flaps, light bulbs, belts, fans, and batteries can be shared across vehicle platforms. Picture a Light Cargo Truck, Gun Truck, and Forklift that all share the same parts. Every vehicle has the same exact tires, same brake system, same lights, same battery, same seat belt clips. This vehicle fleet is ready for the most austere and logistically challenging locations on earth. Every common part reduces Prescribed Load List (PLL) requirements, transportation requirements, and simplifies maintenance. The fleet described above would provide a clear tactical advantage due to the inherent simplicity and a decreased logistics burden.

Improve Logistics Communication Systems

George Bernard Shaw once stated that “The biggest problem with communication is the illusion that it has taken place”. In surveys conducted for this project, both Army professionals and civilian agencies listed communication as the leading cause of logistical problems when resupplying remote locations and operations in general. The Army is often inefficient in supply distribution due to a lack of simple and effective

communication platforms that can forecast accurately the needs of those on the front lines. These platforms encompass more than face-to-face dialogue and include in-transit visibility (ITV), inventory management, and collection of historical data.

In-Transit Visibility is designed to provide the maximum outlook and near real-time status on movement of materials from supplier to user. The Department of Defense (DOD) defines ITV as “the ability to track the identity, status, and location of DOD units, and nonunit cargo (excluding bulk petroleum, oils, and lubricants) and passengers; patients; and personal property from origin to consignee or destination across the range of military operations” (US Army, 2008). The Army uses this capability poorly; as a result it is difficult to adequately track distribution of all classes of supply to remote locations. Though AR 700-80 confirms “in-transit visibility begins at the point of origin and ends at the point of use,” (US Army, 2008) it is often difficult to track a shipment through the Army supply chain with the same accuracy and visibility enjoyed by leading civilian corporations. There is a need to revamp the Army’s ITV scope and platform in order to become more efficient in resupply operations.

Providing decision makers with effective ITV systems will allow for improved inventory management. The Army’s current inventory management system is not synchronized in a manner that allows leaders at higher echelons to see the total logistical picture; instead the Army utilizes systems that are piecemealed by unit, location, etc. According to a congressional report from the Government Accountability Office in 2012, the Army has \$8.4 billion worth of excess inventory (Office, 2012). Walmart and Caterpillar use advanced scanning mechanisms to track items from supplier to point of sale in real time. Walmart cashiers update the company’s elaborate tracking system simply by scanning items customers purchase when they check out (Traub, 2014). In order to better manage resupply missions and ultimately resupply to remote locations, the Army should conduct research and make efforts to embrace technology that supports superior in-transit visibility and inventory management. Scanning capabilities that allowed all classes of supply to be tracked to the point of consumption would significantly improve the Army’s ability to manage inventory.

Deloitte found that in addition to ITV usage, companies that used collaborative forecasting and fostered relationships with their suppliers were successful (Deloitte, 2014). Companies within the supply industry use vendors to manage inventory; sharing demand data with suppliers to enable better forecasting projections (Deloitte, 2014). As mentioned earlier in this report, the Army often partners with the lowest bidder. This practice is not strategic in nature and does not add value to inventory management. Wherever possible (not tactically, operationally, or strategically detrimental), the Army should look to have suppliers manage and maintain inventory; this will simplify the supply chain and shorten lead time on deliveries.

The lack of a simple, dependable and accurate ITV platform combined with inadequate inventory management results in historical data being lost and underutilized in forecasting supply operations. With respect to logistics, the Army collects data, uses the information momentarily, and then dumps it. The Army’s scanning systems do not have the capability to archive historical data that can be easily assessed by leaders and logistics professionals several years in the future. For example, it would be extremely difficult if the logistics officer in the 2nd Brigade Combat Team of the 101st Airborne Division wanted to retrieve the number of tires or the amount of fuel distributed to one of their

maneuver battalions while serving in Mahmadia, Iraq in 2005. The Army needs a simple, web based, and customizable system that collects historical data by location, unit, and class of supply. This data would be invaluable to forecasting the requirements of units in all locations, especially in remote locations, and would also allow units to simulate demands in the supply chain based on a variety of situations. These simulations would further add to increased accuracy in forecasting and result in more efficient supply chains and ultimately an increase in combat power.

The Army has logistics reporting tools in place that are underutilized because they are not user-friendly and not used consistently across the Army. With units using their individualized supply tracking mechanisms, the Army cannot capture historical data, track items in transit, nor easily manage inventory on a macro level. Civilian companies like Caterpillar used a combination of these methods to forecast. This global leader in mining equipment cited forecasting as its biggest competitive advantage (Caterpillar, 2014). The Army needs to move in the direction of civilian agencies and improve communication systems that allow it to capture and use data to improve the logistics network. Implementation of this type of system would increase combat power by allowing leaders to more accurately identify what remote areas need and when. This will lead to a lean and accurate distribution network and keep unneeded Soldiers and vehicles off the road conducting resupply missions that are not required.

Efficient Generation of Operational Power

Freeport-McMoRan has instituted systems at its remote mining sites to turn waste into energy. This reduces the fuel requirement for base operations, saves money, and reduces the strain on the distribution network. Additionally, this provides Freeport-McMoRan with a responsible and safe manner in which to dispose of waste. Freeport-McMoRan achieves this through the use of an incinerator, which burns used oil cleanly to produce energy. The Army can adopt this method to reduce the resource requirements at remote locations and improve combat power. In 2007, 50% of all convoys were dedicated to the transportation of fuel (Army Environmental Policy Institute, 2009). Reducing the amount of fuel required to sustain operations would result in cost savings, a more efficient supply chain, increased asset utilization, increased operational flexibility, and increased combat power.

The Army has operated numerous Combat Outposts (COPs) in Iraq and Afghanistan over the past decade-plus of war. These COPs are located in remote areas next to small villages or town centers. Ensuring ample fuel is on hand to sustain operations is imperative to mission success. Likewise, given the small quarters of the COP, efficient waste management is critical to both the health of the Soldiers on the COPs and the relationship with the local population. Generators for operational power are mission essential and are responsible for approximately 40% of remote base fuel consumption (Strategic Environmental Research and Development Program, 2011). Waste is collected into one location at these sites and is burned to keep the amount of waste under control, often times with serious and lasting negative health consequences (Jacobs, 2013).

Implementing a modular waste to energy system or incinerator would offer the Army a solution to both of these issues. With this piece of equipment, the Army could provide energy to remote locations through the burning of trash, reducing the support requirement and increasing the operational flexibility of the remote location. Also,

incinerators have been shown to reduce air particulates when compared to open burn pits (Schogol, 2012). Implementing waste to energy systems at remote locations would not only reduce the logistical requirement and increase the operational flexibility of the site, it would be safer for the Soldiers in the COPs.

Currently the Army relies on generators to supply energy for base operations on remote locations. However, the Army is extremely inefficient in how it employs and operates these generators, and the consequences greatly hinder combat power. At Camp Leatherneck, a remote base in Southern Afghanistan, “the 5 MW of demand is met by 19 MW of capacity, with 196 generators running at 30% capacity and consuming 15,431 gallons of fuel per day” (Strategic Environmental Research and Development Program, 2011). Operating generators at 30% capacity results in the generators ‘wet stacking.’ Wet stacking occurs when a generator is ran with a minimal load which causes the generator to burn fuel quicker, burn oil, and results in unnecessary wear and tear on the equipment, leading to higher maintenance requirements. Operating the generators at Camp Leatherneck at 30% represents not only tremendous waste, but it also increases the maintenance burden. Fluor, a major defense contractor, highlighted the wet stacking of generators as a major focus for how they are striving to improve remote logistics support. According to research conducted by Fluor, running the required number of generators at an 80% load factor would save 2,000 fuel tankers per year to one FOB (Fluor, 2014). Simply by running generators as they are designed reduces the amount of fuel required, which reduces the number of convoys required, which improves combat power and saves lives.

If reducing the fuel requirements to a FOB is truly this simple and has drastic benefits toward improving combat power, why is it not practiced more Army wide? The Army lacks the appropriate command emphasis and does not properly deploy knowledgeable Soldiers to enforce how generators are properly operated. The consequences of poorly operated generators are a higher fuel requirement which leads to a higher casualty rate (3% of all fuel convoys resulted in a casualty) (Army Environmental Policy Institute, 2009).

Recommendations for Future Research

Improve Water Delivery Options for the US Soldier

Deloitte Consulting identified water management as the number one challenge that civilian companies face when operating in remote areas (Deloitte, 2014). US Army logistics officers also identified water delivery as the number one class of supply challenge faced when deployed to remote areas (Appendix B). The Army is efficient at producing and storing water, however, it lacks an efficient delivery system for remote locations. The current containers for delivering water are inadequate for remote locations. Poor delivery containers are the root cause for the Army’s dependence on bottled water. The Army currently had five distribution options in which water can be delivered to the US Soldier for consumption at remote areas:

1. Water Hippo (too large, incapable of CDS/LCLA)
2. Water Buffalo (awkward to sling, backhaul required, no CDS/LCLA)
3. Water Blivet (Cumbersome, typically moved with MHE, backhaul required)
4. 5 Gallon Jugs (difficult to palletize, backhaul required)

5. Bottled Water Pallets (break apart during CDS/LCLA, solid waste build-up, consume transportation assets)

The US Army can improve water distribution by exploring the following opportunities: Five Gallon Flexible Bag, Mini Hippo, Palletized Container or Rain Catchment and Filtration System. Deloitte consulting recommended two companies to help design an improved distribution system, Ecolab or Pentair.

In addition, to promote well use and reduce dependence on bottled water, the Army may consider adding a well digging capability to the Sustainment Brigade. The equipment and personnel would service FOBs and COPs within the Sustainment Brigade AO. This team would drill primary and alternate wells during FOB or COP construction. The wells could serve a dual purpose as they create good will with the local populace.

Create a Lighter Vehicle

The current fleet of trucks in the Army is comprised of vehicles whose massive size and weight limit maneuverability to austere locations. Light/Medium Truck Companies house the smallest fleet of vehicles in the Army. Normally, under the command of a Combat Sustainment Support Battalion (CSSB) or a Motor Transportation Battalion, the Light/Medium Truck Company has 50 FMTV cargo trucks with 25 trailers capable of moving both materiel and personnel. The cargo trucks are used for small bulk shipments, personnel movements, and unit relocations. Additionally, the unit has 10 FMTV tractors with 20 semi-trailers capable of line haul cargo transport. The Light/Medium Truck Company's fleet provides transportation for the movement of bulk cargo, containers, and personnel (CASCOR Force Development Directorate, 2014). The design of this equipment is not consistent with the support needed for remote locations that lack adequate infrastructure to support the weight of these vehicles.

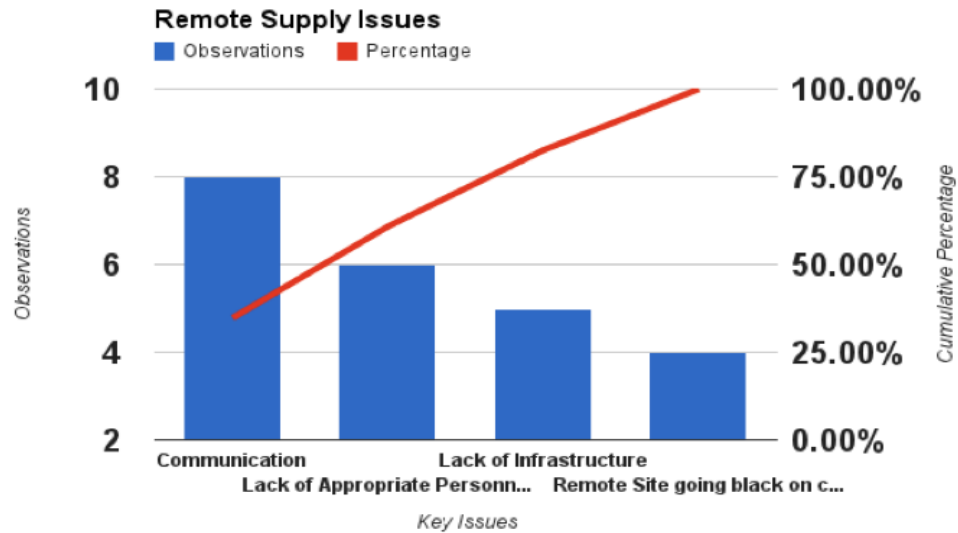
Sustainment Brigades are allocated Light/Medium Companies; however, in order to efficiently support austere locations the design of the FMTVs within these companies must be altered into an even lighter platform. The family of medium tactical vehicles weigh between 11 and 14 tons, sometimes surpassing weight restrictions in many areas of undeveloped countries. Many of the Army's larger vehicles are too heavy for some American bridges and roads. When considering redesigning transportation assets to create a modern lightweight vehicle it is most practical to use the FMTV as a foundation because the vehicles, "performs over 55% of the U.S. Army's local, line haul, and unit supply missions" (FMTV - MTV & LMTV, 2014).

Conclusion

Chairman of the Joint Chiefs of Staff, General Martin Dempsey, recently stated that "[o]ur force will be smaller, so it must be more agile, more lethal, and postured to project power wherever needed" (Dempsey, 2014). The path to achieve a more agile and lethal force capable of projecting power anywhere and anytime lies in creating logistics efficiencies. The research conducted outlines six solutions to gain efficiencies in the supply chain. Through these gained efficiencies in the supply chain, the Army will be able to decrease waste, decrease delivery times, increase accuracy, increase asset utilization, and free up valuable funding to be applied toward increasing combat power. The feasibility impact of these six solutions is illustrated in an impact map (Appendix D).

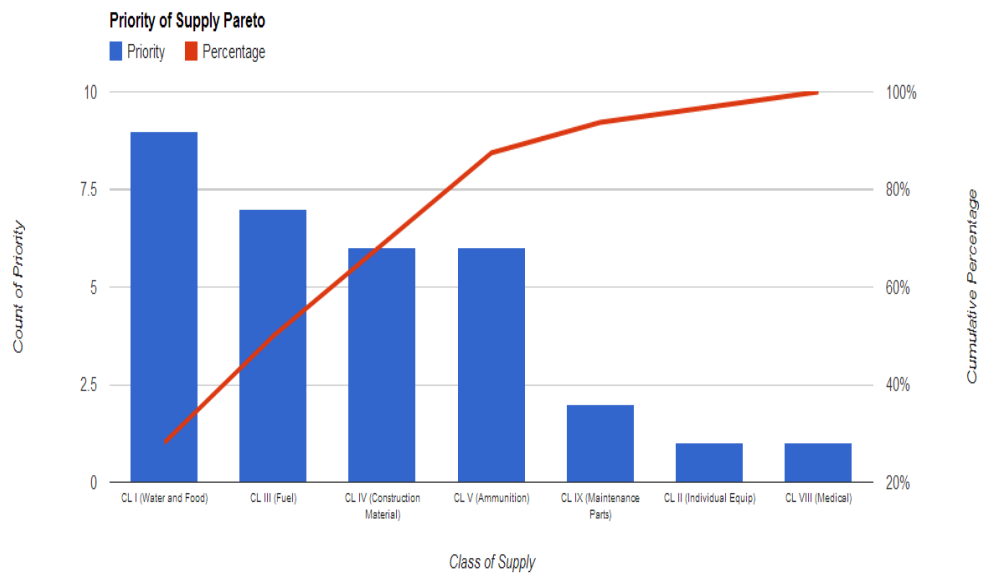
Appendices and Charts

Appendix A: Remote Supply Issues Pareto Chart



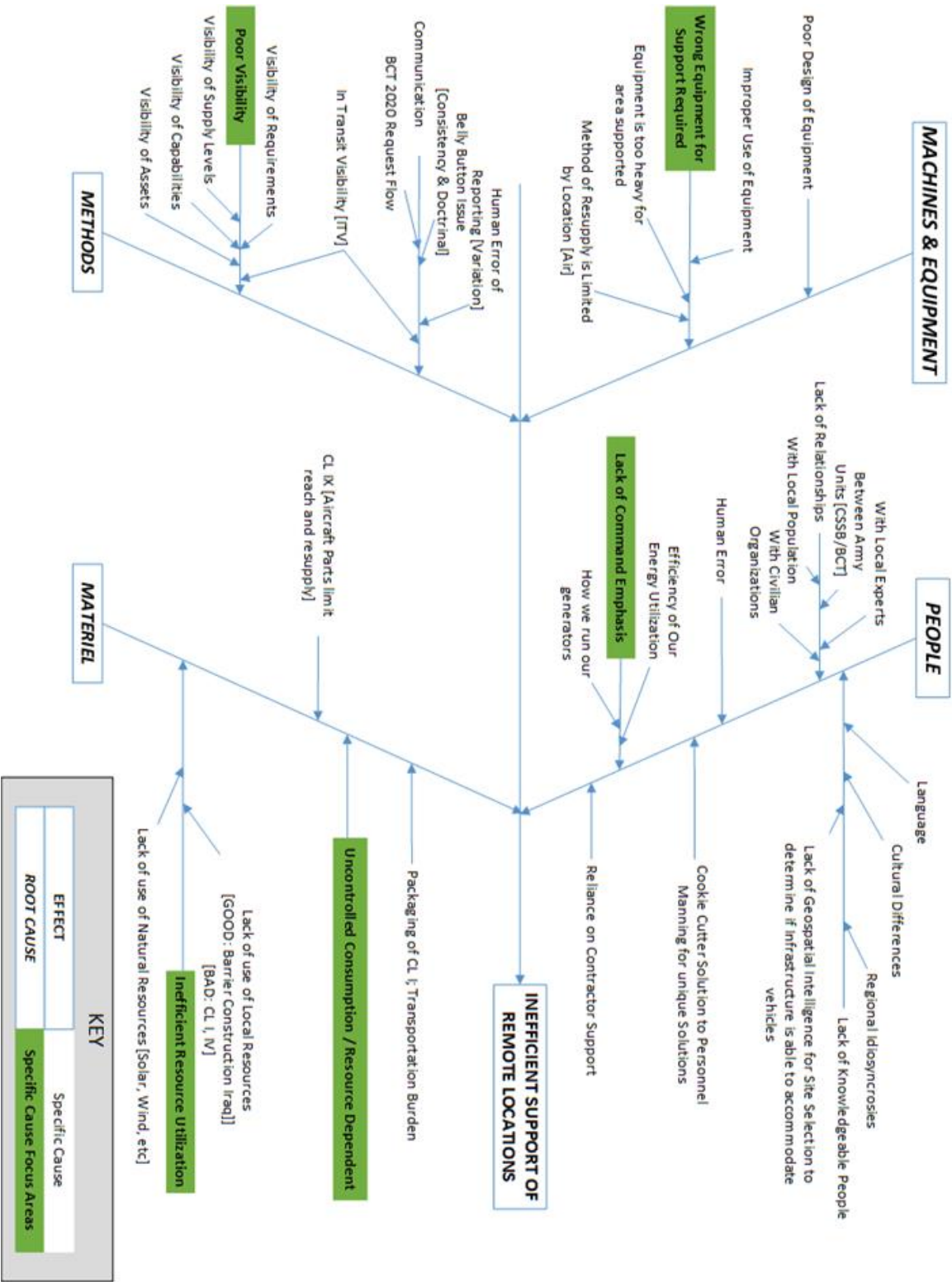
(Officers 8. A., 2014) (Officers 8. S., 2014)

Appendix B: Priority of Supply Pareto Chart



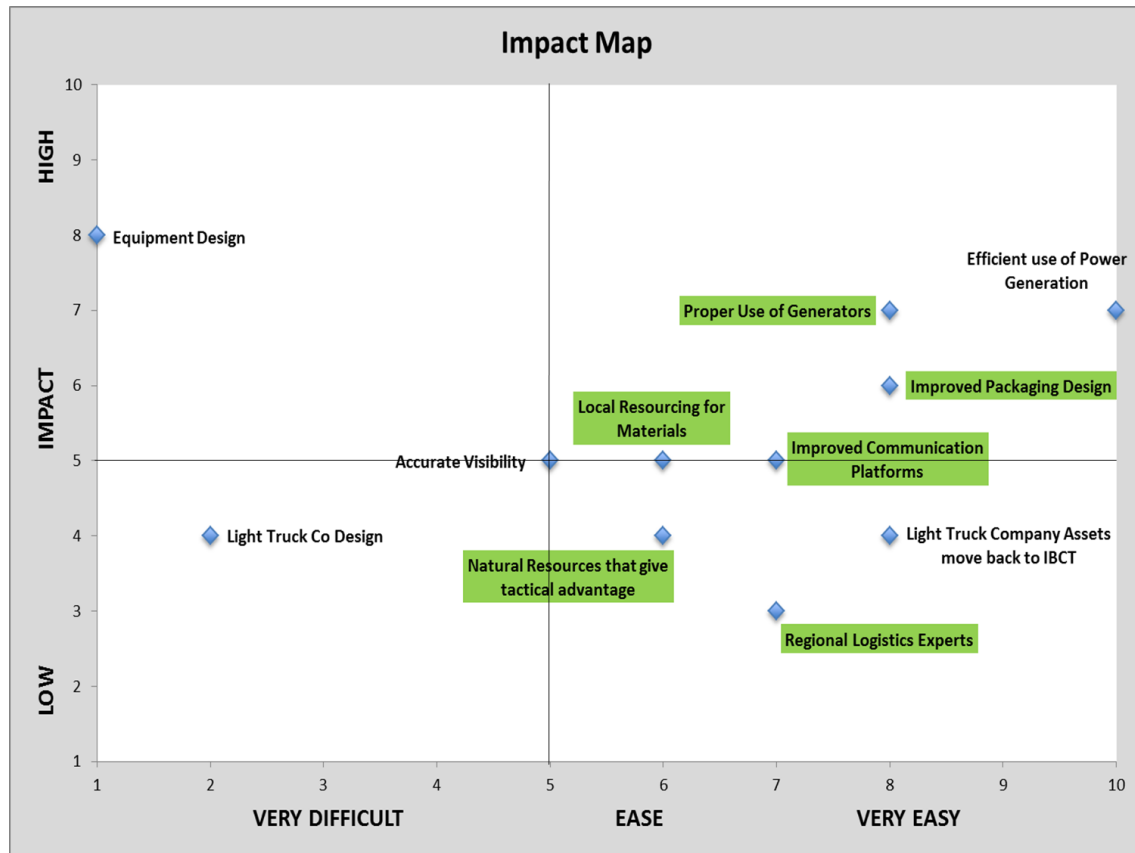
(Officers 8. A., 2014) (Officers 8. S., 2014)

Appendix C: Fishbone Diagram

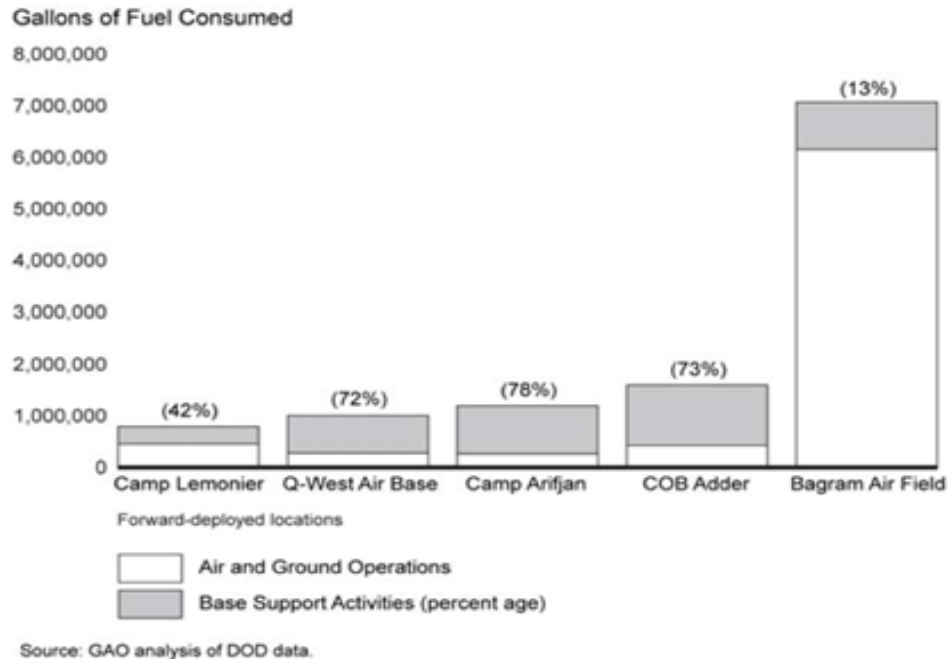


Appendix D: Impact Map

Impact	Recommendations	Ease	Impact
4	Light Truck Company Assets move back to IBCT	8	4
4	Light Truck Co Design	2	4
8	Equipment Design	1	8
5	Accurate Visibility	5	5
5	Improved Communication Platforms	7	5
6	Improved Packaging Design	8	6
7	Efficient use of Power Generation	10	7
7	Proper Use of Generators	8	7
4	Natural Resources that give tactical advantage	6	4
5	Local Resourcing for Materials	6	5
3	Regional Logistics Experts	7	3

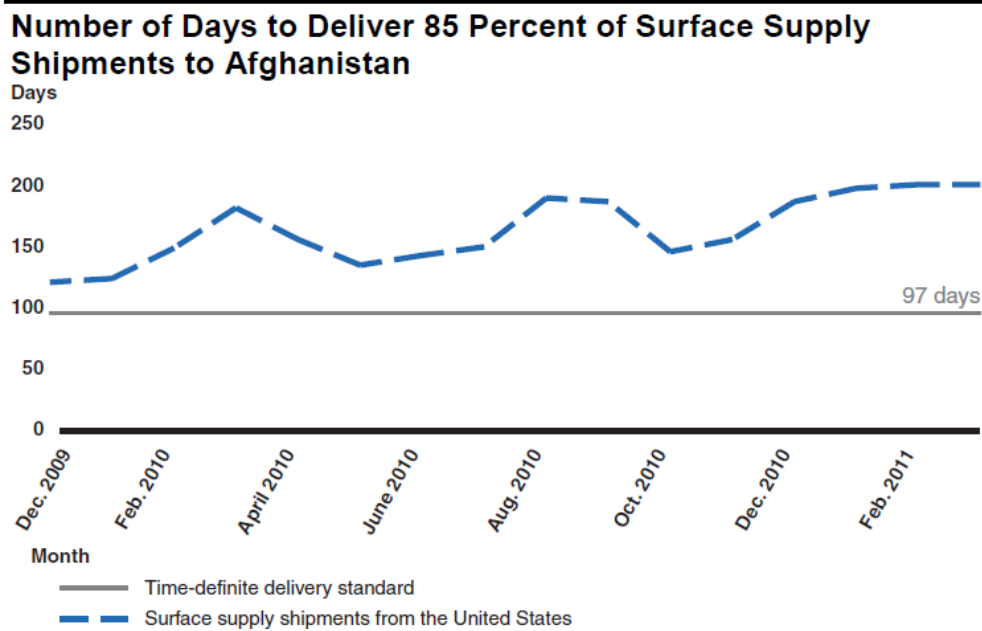


Appendix E: Remote Base Fuel Requirements



(Strategic Environmental Research and Development Program, 2011)

Appendix F: Number of Days to Deliver Chart



(Office G. A., 2011)

Appendix G: Literature Review

The Center for Army Lessons Learned (CALL) collects and analyzes operational records of armistice and combat missions in order to disseminate information for the purpose of knowledge sharing (Center for Army Lessons Learned, 2014). A search and review of lessons learned concerning resupplying remote locations was conducted. Listed below is a summary that captures the most relevant lessons learned:

Kicker Palettes and Speed Bags

Using wooden “kicker pallets” and “speed-bags” as a quick form of aerial resupply for small units operating in remote areas of Afghanistan greatly enhanced re-supply operations. Kicker pallets are one time use form of resupply built on wooden framed pallets sized to fit on CH-47 Chinooks and “speed-bags” made out of duffel bags stuffed with three days of supplies. It proved to be an effective way to supply squad sized units operating without an approved Landing Zone (LZ) (Center for Army Lessons Learned, 2014).

Aerial Resupply

Rotary wing assets are used for many re-supply operations via sling load or internal load, however, the use of Air Force assets are not utilized to their full potential. Through the course of conducting operations in Iraq, units tend to focus aerial re-supply requests to locally available rotary wing assets. The need for using aerial re-supply depends on the location, duration, and the size of the unit conducting the operation. Units that plan for these operations tend to limit themselves to requesting only rotary wing support to replenish supplies. There are several factors that contribute to this limitation. Lesson Learned/TTP: personnel responsible for planning and coordinating re-supply operations need to be trained and understand the procedures for requesting Air Force assets to deliver supplies to troops conducting operations in remote areas. (Center for Army Lessons Learned, 2014)

Resupply using Pack Animals

Units in OEF operating in mountainous terrain and conducting operations in hard to reach areas over extended periods of time found it difficult to resupply needed items. The terrain created unique resupply challenges. One piece of the solution worked well was pack animals. Availability of pack animal services can be problematic. Early identification and introduction to village elders and developing their trust in the contracting system is critical. Local nationals providing this service for the U.S. military have faced reprisals by the enemy. The ability of the Afghan National Army (ANA) or Afghan National Police (ANP) to provide security and the ability to make the risk economically feasible are two of the present challenges. Using local nationals on a contracted basis ensures that Soldiers are reserved for the operational missions. (Center for Army Lessons Learned, 2014)

Horn of Africa Lessons Learned

Joint logistics does not exist as a system or in the Army’s education system. As the DOD moves closer to a joint operating environment, knowledge in joint logistics will become an ever increasing demand (Center for Army Lessons Learned, 2014). A Joint/Coalition/Multi-National environment with sovereign nations requires a highly experienced logistics staff to effectively deal with diverse rules and regulations in a timely manner (Center for Army Lessons Learned, 2014).

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