Humanitarian Aid in Less Secure Regions:
An Analysis of World Food Programme Operations in the Somali Region of Ethiopia

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ABSTRACT

The World Food Programme (WFP), the United Nations food agency, has recently acquired the difficult task of transporting aid into the Somali region of Ethiopia. The political instability, rebel activity, ethnic tensions, and poor infrastructure in the area endanger and delay the flow of commodities through the WFP's supply chain. In this thesis, we explore and analyze the role that these threats play in the WFP's aid distribution in the Somali region. Specifically, we measure the impact of insecurity in the WFP's distribution system, study the current methods that the WFP employs to mitigate risks, and investigate possible precautionary technologies to improve security in this resource constrained environment. Our research suggests that while many tools can enhance security, the organizational measures aiming to increase responsibility and trust between all involved supply chain stakeholders ultimately prove to have a stronger impact on the overall safety of aid-distribution. Finally, though our research has focused mainly on the WFP, we believe that all similarly situated humanitarian organizations will find our analysis applicable.

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1 INTRODUCTION

Both commercial and humanitarian organizations require the secure distribution of goods, as both depend on the safe arrival and consumption of goods for success. However, while the commercial sector has the funding, manpower, and technology to more securely distribute their products, the humanitarian sector often does not. Many humanitarian organizations cannot justify the cost of implementing high security measures for the distribution of their aid, often commodity foods.

The World Food Programme and other humanitarian organizations often face these problems to a heightened degree while delivering food-aid to insecure areas. A long history of conflict between the governments and various factions in the less secure regions of their countries creates an environment of political instability and has left these regions neglected from government sponsored development and growth. The high value of this aid in areas of humanitarian operation makes it target for theft, hijacking, and looting. In less secure areas, inadequate infrastructure, a lack of reliable road data, and rebel activity all impede the successful, secure delivery of aid.

In our thesis, we will explore and analyze the role that security plays in the World Food Programme's aid distribution[1] in the Somali region of Ethiopia. We will analyze the impact of risk in the WFP's distribution system, study the current methods that the WFP employs to mitigate these risks, and investigate possible precautionary tools to improve security in this resource constrained environment. We will also examine the distribution methods of other non-commercial organizations in less-secure

[1] The WFP uses the term "distribution" to refer to the dispersion of food to beneficiaries at the actual Final Delivery Points (FDP). In our thesis, we use it in a broader supply chain sense.

areas to make comparisons and further recommendations for the WFP. We hope that our research and analysis will be applicable to not only the WFP, but also to other humanitarian organizations in similar situations.

This introductory section will provide background information on the Somali region and the World Food Programme (WFP), describe the WFP's current aid transportation methods both into and within the Somali region, and discuss the approach we took to conduct our research.

1.1 BACKGROUND

Understanding the security concerns which motivate this thesis requires knowledge of both the Somali geographic and political context and knowledge of the WFP's current operations in the region. Here we provide a brief summary of the region and current operations and difficulties.

1.1.1 THE SOMALI REGION OF ETHIOPIA

The Somali region is the eastern most of nine regional states of the Federal Democratic Republic Government of Ethiopia, bordering Djibouti, Kenya, and Somalia. Refer to Figure 1.1.

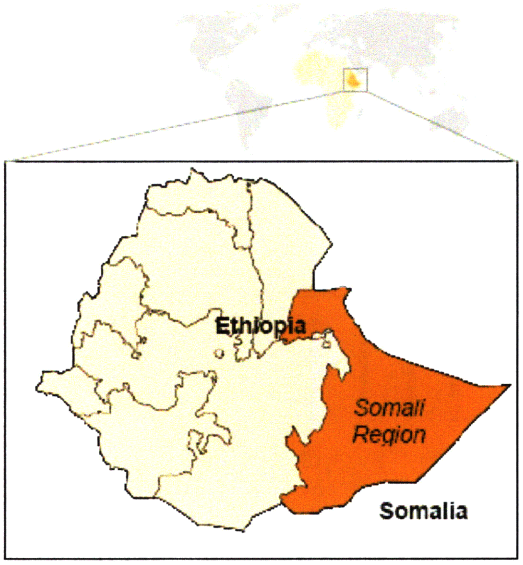


FIGURE 1.1: The location of the Somali region in Ethiopia

Source: CHF International, 2006

Although within Ethiopian boundaries, the Somali region is heavily influenced by its neighboring country, Somalia. According to Ethiopia's Central Statistics Agency (2007), and as seen in Figure 1.2, 4,314,657 out of 4,439,147 total inhabitants of the Somali region (97.2%) are of Somali ethnicity. Because of this overwhelming majority, the culture, forms of subsistence, and environment of the Somali region more closely reflects the characteristics of Somalia than Ethiopia.

FIGURE 1.2: Ethnic Somali dispersion in the Horn of Africa

Source: University of Texas, 2009

1.1.1.1 History of the Ethio-Somali Conflict

Political instability has plagued the ethnically Somali region for many years. Since the late 19th century, the Somali region has passed back and forth through the hands of Ethiopia, Great Britain, and Italy. After a century's worth of European colonial history, Britain returned control of the Somali region to Ethiopia in the 1950s. However, because of Ethio-Somali ethnic tensions and a shortage of resources, political

insurgency began to break out heavily in the 1970s. Ethnic and governmental relations have not improved much since then.

In the Somali region, insurgents and extremists threaten individuals' and communities' safety and security. Armed insurgent rebel groups such as the Ogaden National Liberation Front (ONLF) and the United Western Somali Liberation Front (UWSLF) as well as the prevalence of clans provide these organized risks. For more information on these groups, look at Appendix A. These risks cause the Somali region to remain unpredictable and volatile.

1.1.1.2 Food Insecurity in the Somali Region

The Somali region is poor and largely without access to electricity, potable drinking water, or successful agriculture. The effect of unpredictable weather patterns, harvesting cycles, increased food costs, and lifestyle factors contribute to the high level of food insecurity present in the region. Additionally, the region's lack of government sponsored development and growth has increased its susceptibility to food insecurity. These risks seriously hinder the ability for people to survive without food-aid from humanitarian organizations such as the World Food Programme (WFP).

The Somali region is arid and typically gets affected harder than the rest of Ethiopia when a drought occurs. Without much rain, livelihoods are lost, animals die, and watering holes dry up. Alternatively, too much rain can also adversely affect the Somali region and floods do occur rarely. Not only are floods

dangerous for citizens, livestock, and crops, but floods can also wash away gravel and dirt roads, making it difficult for aid to reach the affected areas.

The Somali region has multiple crop cycles and thus a few different harvest periods. However, they do not overlap, creating a 3 month period between June and September that is considered to be a "hunger period". Unfortunately, the increasing cost of food makes it difficult to supplement harvested food during such hunger periods. Finally, the Somali region, primarily a pastoral region (Mohamed, 2001), consists of many inhabitants who shift around to accommodate the changing seasons. This creates challenges in the dynamics between different groups of people as well as with the ownership of land. Further, aid organizations do find it difficult to reach moving populations.

1.1.1.3 Governance Indicators

The WorldBank (2008) defines Rule of Law as "the extent to which agents have confidence in and abide by the rules of society, in particular the quality of contract enforcement, the police, and the courts, as well as the likelihood of crime and violence". Although the perceived Rule of Law in Ethiopia has increased throughout the last decade, it still remains better than only 38% of the world's countries. Comparatively, Somalia has the world's worst ranking for Rule of Law (refer to Figure 1.3). As discussed earlier, the Somali region more closely resembles Somalia than Ethiopia. Therefore, it should come as no surprise that inhabitants of the Somali region, much like Somalia, have little confidence in the effectiveness of state law enforcement within the region.

FIGURE 1.3: Comparison of the Rule of Law in Ethiopia and Somalia
Source: Adapted from WGI Project, 2008

An additional challenge in the Somali region involves controlling corruption (refer to Figure 1.4). Defined as "the extent to which public power is exercised for private gain" (WorldBank, 2008), corruption and insider involvement can include: drivers keeping rations for themselves or selling them for a profit, drivers using aid or gasoline as a bribe to ward off threats such as the Ogaden National Liberation Front (ONLF), or drivers working in conjunction with threats such as the ONLF. Although Ethiopia is ranked better than 27.5% of countries analyzed, Somalia is again ranked the lowest in the world, clarifying why the Somali region is susceptible to risky behavior.

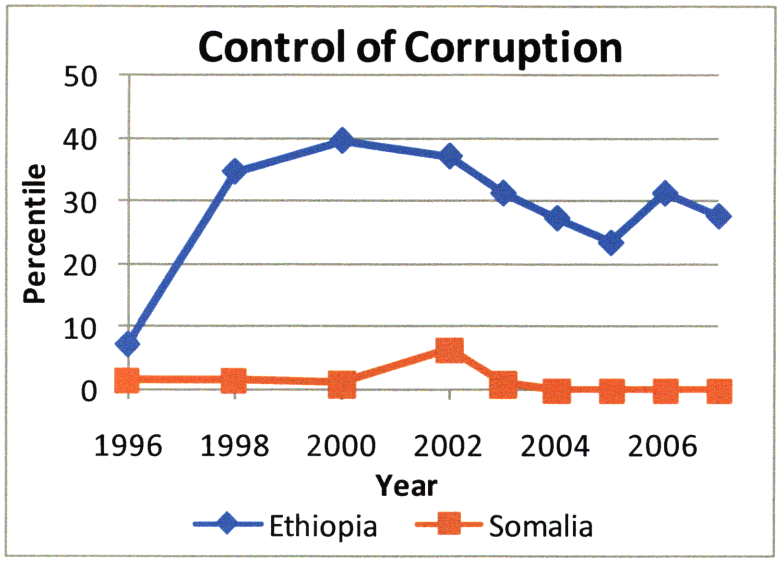


FIGURE 1.4: Comparison of the Control of Corruption in Ethiopia and Somalia
Source: Adapted from WGI Project, 2008

1.1.1.4 Somali Region Road Conditions

The poor infrastructure of the area reflects the impoverished economic and political state of Ethiopia and its Somali region. This complicates organizations' efforts to provide aid in the region. According to the World Health Organization (WHO), the roads in Ethiopia are "poorly maintained, inadequately marked, and poorly lighted" (US State Department, 2008). While the WHO claims that daytime travel on roads is generally safe, it also suggests that various historical and ongoing conflicts have left landmines and other devices on remote dirt paths. Reuters (2007) describes the Somali region as less developed than the rest of Ethiopia. Until 2006 the Somali region only had about 30 kilometers of tarmac road – all of which was around Jijiga, the regional capital of the Somali region.[2]

[2] In recent years, the government increased infrastructure development and the percentage of paved road has gone up. Though development is slow, an exact figure is unknown.

1.1.2 The World Food Programme (WFP) in Ethiopia

The United Nations started the World Food Programme (WFP), its food-aid agency, in 1960. Currently, the organization distributes aid to about 90 million people per year in more than 80 countries.

The WFP's operations vary by country. The WFP in Ethiopia is responsible for information management, food movement, and aid distribution. In Ethiopia, the WFP supports four types of operations: emergency, relief/rehabilitation, development, and special operations. As identified in Figure 1.5, we will focus primarily on the Relief Component within the Protracted Relief and Rehabilitation Operation (PRRO).

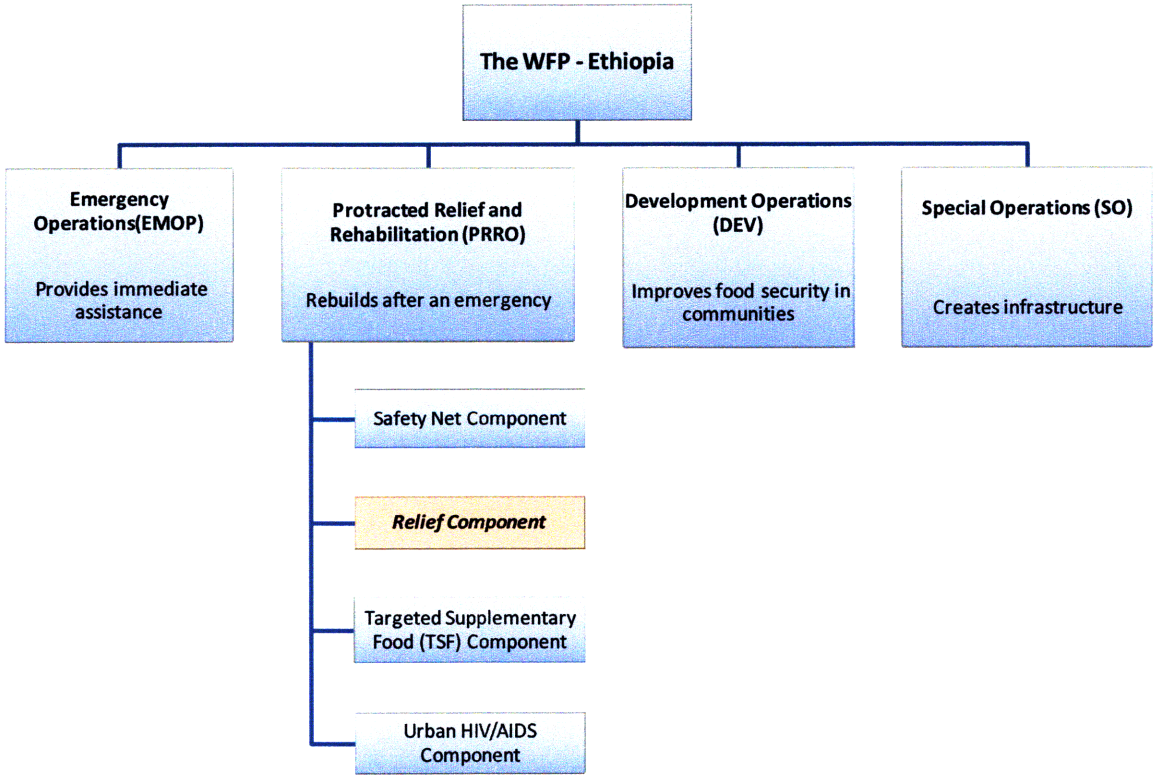


FIGURE 1.5: The Organizational Structure of the World Food Programme's Operations in Ethiopia
Source: Adapted from wfp.org, 2009

The WFP distributes four particular bulk commodity items in the PRRO: cereals, pulses (leguminous plants or their seeds), vegetable oil, and blended foods. The WFP distributes these through a series of "hub and spoke" models.

1.1.2.1 Transportation of Aid in the Somali Region

The WFP aid process begins with the delivery of packaged and unpackaged bulk food to the port city of Djibouti in the country of Djibouti. The WFP bags the unpackaged bulk products into consumer sized rations in Djibouti and transports all the food to five Extended Delivery Points (EDPs) in Ethiopia. EDPs are intermediary warehouses for the food-aid, strategically spread across the country to most efficiently deliver aid to the beneficiaries at the hundreds of Final Destination Points (FDPs).

Previously, for the Somali region, the WFP would only deliver to the EDP at Dire Dawa. From here, the Ethiopian Government, through its Disaster Management and Food Security Sector (DMFSS), took responsibility for the delivery of aid to the FDPs, as seen below in Figure 1.6.

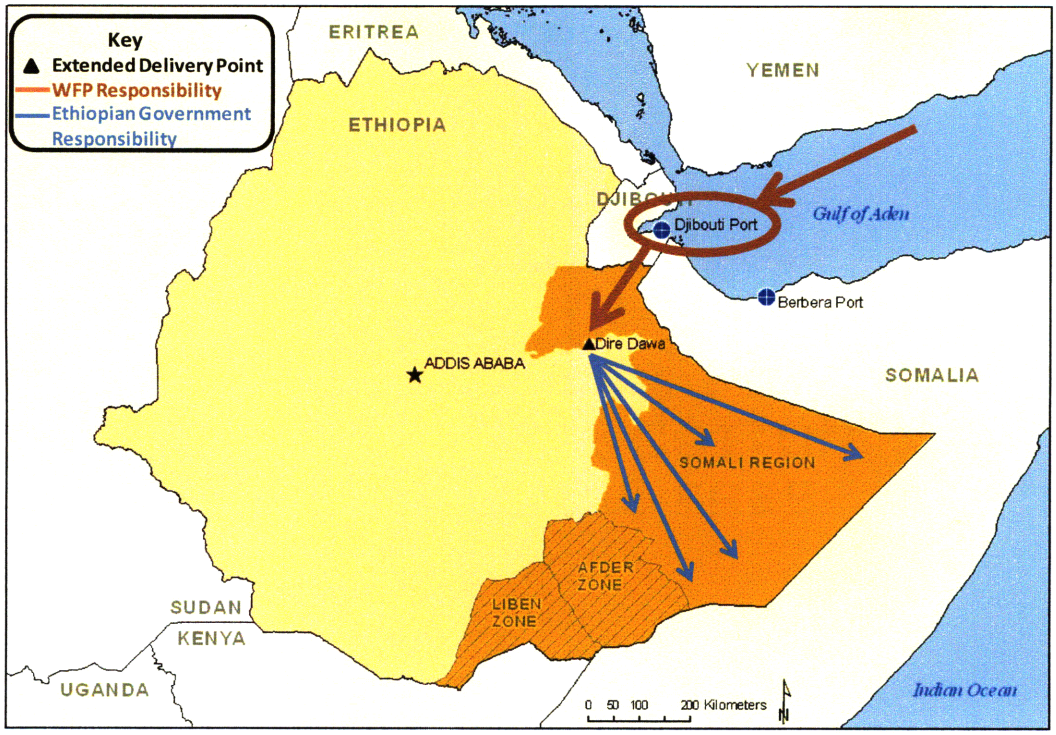


FIGURE 1.6: Previous distribution model for the Somali region

Source: WFP Ethiopia, 2009

When the Ethiopian government took control of the final delivery in the process, however, the WFP could not determine what aid got delivered and to where. The government tracking of aid from this point on did not always come back to the WFP properly, especially since the DMFSS would hand the aid over to the Kebele, the smallest administrative unit in Ethiopia, and other 3rd parties to distribute. This aid would be delivered in 10 to 15-ton trucks, 4x4s, donkeys, or anything else available.

1.1.2.2 New Responsibilities for the WFP

In 2008, a reassessment of hunger needs by the Ethiopian government showed that demand had risen from 4.6 million people to 6.4 million people. The demands in the Somali region alone had risen from

1.5 million to 1.9 million people. Because the DMFSS was no longer able to cope with Somali region food demands and accompanying security concerns by the fall of 2008, the Ethiopian Government handed to the WFP the responsibility of aid delivery to the FDPs. Specifically, the Ethiopian government further granted WFP the responsibility to deliver aid from the EDPs to the FDPs in the Somali region for all relief efforts. In order to accommodate its newly expanded responsibilities, the WFP created additional Extended Delivery Points (EDPs) to enter the Somali region. As seen in Figures 1.7 and 1.8, these EDP locations now include Gode, Degehabur, Dire Dawa, Kebridehar, Nazreth, and Jijiga.

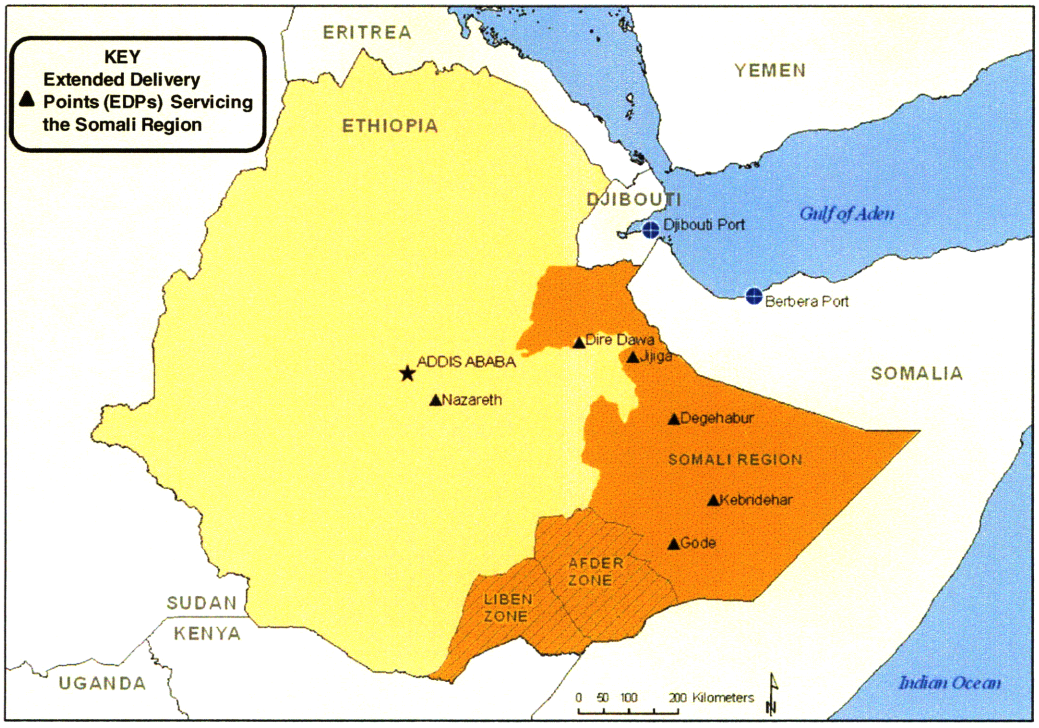


FIGURE 1.7: Extended Delivery Points used for distribution into the Somali Region
Source: WFP Ethiopia, 2009

The WFP plans to contract with local carriers to transport food aid from these new EDPs to the FDPs. However, because of Somali region security concerns, there are a number of considerations the WFP must address in order to successfully distribute food-aid within the region.

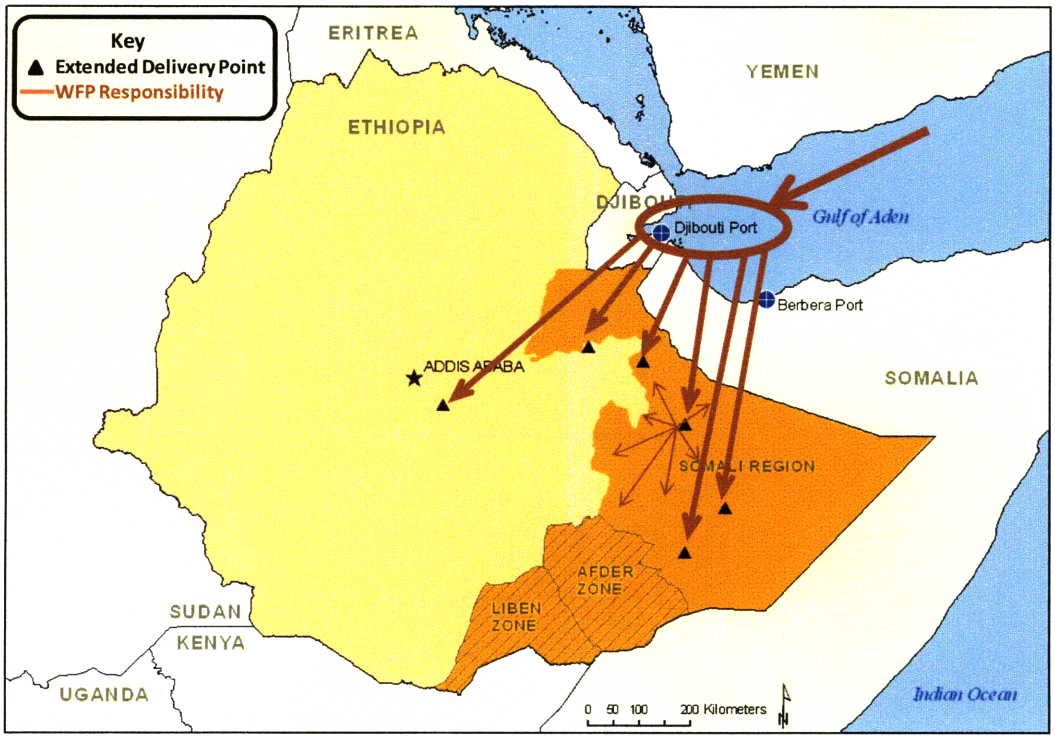


FIGURE 1.8: The current distribution model for the Somali region

Source: WFP Ethiopia, 2009

Unfortunately, rebel forces in the Somali region have a history of taking over DMFSS-sponsored aid vehicles. Therefore, most vehicles traveling in the region require military escort. Traveling with escorts can significantly slow down the delivery process. The military will often wait for a certain number of escort-requiring trucks before proceeding as a convoy, which take as long as a few weeks. Additionally, the nature of a convoy restricts all vehicles from traveling any faster than the slowest truck in the group, resulting in further delays.

1.1.2.3 Ensuring the Delivery of Aid in the Somali Region

Potential rebel take over, the escort process, poor road infrastructure and a lack of good quality trucks slow down the aid process considerably. To most effectively deliver food to the FDPs, the WFP would like to hire a dedicated fleet, a group of trucks owned by a third party but used only for WFP commodities, and deliver aid in frequent and regular intervals. In order to accomplish this, the WFP must improve and maintain excellent relations with the Ethiopian government and travel without convoys. The WFP should further try to hire local Somali carriers to transport aid, as Somali region inhabitants trust and will not target other ethnically Somali workers. Also, the WFP could potentially implement tracking technologies, such as Global Positioning Systems (GPS), to convince the government of the security of food-aid distribution. The WFP hopes that the data collected from these tracking devices will increase knowledge of the road system and driving conditions. Further, the WFP hopes that if the GPS devices can properly track these vehicles' progressions, then the government will allow these WFP dedicated trucks to move through the Somali region without military escort, resulting in faster delivery times.

1.2 APPROACH

In order to research the role of security in the WFP's operations, we closely studied three subjects:

1. Security-related issues that currently impact the WFP distribution environment

2. Current WFP risk mitigation methods

3. Potential technologies and tools to improve the security of distribution.

For each of these three categories, we employed both quantitative and qualitative methods, case studies, interviews, and secondary literature research. By speaking with the WFP team on weekly conference calls, we not only received data about their activities, but perfected our understanding of their distribution system. In order to compare security measures across different organizations, we also conducted several interviews with public, social, and humanitarian sector organizations, and discussions with tracking technology gurus. Overall, however, data on and at humanitarian organizations is difficult to find and procure. The organizations do not always have the resources to keep track or disseminate this information. Therefore, our analysis is based on limited data.

To really understand the environment that the WFP operates in, we studied the impact of security on its distribution system. In particular, we found that the impact of security on the escort system, on carrier rates and relations, and on the aid losses that the WFP incurs to be unique to the humanitarian environment. In order to accomplish this study, we interviewed the WFP extensively regarding all three topics and also analyzed reports produced by the WFP's data collection tools. We analyzed maps, route conditions, carrier rates, and loss data to quantify the atmosphere of the Somali region and also create models and methods for further analysis.

In order to describe and analyze the WFP's current methods used to mitigate security risks, we studied the organization's carrier contracting and engagement process, the Joint-Committee dispatch, and Food Monitoring systems. We interviewed WFP Ethiopia thoroughly for all three subjects, but also analyzed all carrier related documents in comparison with commercial sector documents.

Finally, in researching new, potential security methods and creating our recommendations for the WFP and all humanitarian organizations, we conducted several interviews with different organizations and researched literature on different technologies. This included interviews of many public, social, and humanitarian sector organizations, discussions with tracking technology gurus, and research of articles and cases about security implementation. We then used all of this research to analyze WFP-Ethiopia's specific situation and recommend tools to enhance the security of aid distribution.

1.3 LITERATURE REVIEW

Supply chains worldwide are susceptible to security risks. Our thesis discusses some of the risks that affect the Somali region and proposes some methods to mitigate those risks. Unfortunately, literature regarding security risks in the humanitarian sector is sparse. Our thesis attempts to bridge the gap between tactics and methods used in the private sector and those used in the humanitarian sector.

Our thesis is focused on security risks facing the World Food Programme (WFP) in the Somali region of Ethiopia. Unfortunately, literature about the risk of distribution within the humanitarian sector is limited. Therefore, we broadened our scope to include supply chain security from all sectors in order to extract valuable lessons learned for the World Food Programme in Ethiopia and other humanitarian organizations.

Falit and Fenton (2009) discussed the logistics of fleet management within Non-Governmental Organizations (NGOs). Corruption within fleet management is fairly common within the humanitarian sector but as Falit and Fenton (2009) point out, the amount of money spent wastefully on fleet

management is significantly higher than that lost to corruption. Falit and Fenton (2009) believe that more adequate fleet management in NGOs will allow for better allocation of funds and cost savings that can ultimately be passed along to its beneficiaries. In our thesis, we discuss how the WFP is currently working towards improving fleet management through more effective carrier contracting and a better understanding of carrier rates.

Anderson (2007) and Paul (2005) focused on the private sector; however, many of the consequences from cargo theft are prevalent in the humanitarian sector as well. Paul (2005) reviewed seven best practices to consider employing to enhance the security of a supply chain. The general premise of the article was based on the old saying that "freight at rest is freight at risk". This article summarized several of the most common and general security risks facing supply chains and the measures to take against them. One of these risks, cargo theft, is a legitimate threat to any organization's supply chain. Anderson (2007) examines the practice of cargo theft in today's economy where it is commonly seen in the transportation of high-value products such as tobacco and electronics. Anderson (2007) discussed the motives behind cargo theft as well as the process for the various ways in which theft can take place. Additionally, he discussed Global Positioning Systems (GPS) as a preventative measure but made it clear that "technology alone is not the magic bullet against cargo theft". Our thesis extends this literature into the humanitarian sector as we discuss current risks facing the WFP as well as methods in which to mitigate security risk, both technology-related and non-technology related.

2 Impact of Security Risks on WFP Distribution[3]

As identified in the introduction, travel into the Somali region can be a risky venture. Political, ethnic, and financial tensions all play their part in making the Somali region a potentially dangerous area for transportation and the real and perceived risks of the Somali region severely affect the WFP's distribution. For example, with rebel activity and other security issues dotting the map of the Somali region, the Ethiopian government insists that military escorts accompany many WFP-sponsored vehicles in that area. However, this simple requirement by the government drastically affects the ways in which the WFP distributes aid. The presence and need for escorts changes the frequency of deliveries, the costs of transportation, and the perception of risk associated with the supply chain in the Somali region.

In this section, we will identify and quantify the unique characteristics of the environment that the WFP and its partners operate in within the Somali region. First we will define and explore the role of the military escorts in the WFP's distribution system. Next, we will briefly overview escorts' impact on the frequency of deliveries and the need for unofficial storage at Final Delivery Points (FDPs). Third, we will then analyze the affects of both security escorts and road conditions on the rates contracted carriers charge the WFP. Finally, we will look at specific losses to understand the real threat facing WFP. By doing this analysis, we can gain insight into how the WFP's environment affects the organization and, more generally, how insecure environments affect distribution in humanitarian organizations.

[3] As previously mentioned, the WFP uses the term "distribution" to refer to the dispersion of food to beneficiaries at the actual Final Delivery Points (FDP). In our thesis, we use it in a broader supply chain sense.

2.1 THE ROLE OF ESCORTS IN WFP DISTRIBUTION

The Ethiopian government insists that military escorts accompany all vehicles traveling on specific routes south of Dire Dawa (Refer to Figure 1.6 to see the location of Dire Dawa). Each truck traveling on these routes must wait at specified checkpoints until a military vehicle can escort it further. The government requires this process not only to ensure the safety of vehicles and aid traveling into the Somali region, but also to prevent potential undetected travel by insurgents and political rebels. Because of this dual role of escorts, the government keeps the escort and convoy assignment process rather private. Subsequently, the WFP, other organizations, and passenger vehicles have no true understanding of how long they will need to wait once they have reached a checkpoint. The wait can take several weeks and drivers are instructed to just wait in their trucks. Even after an escort does arrive, it may wait for a convoy of WFP and other aid vehicles, which could be anywhere from 3 to 50 more trucks. Once the convoy departs, escorts will ride at the front and/or the back of the convoy. If a truck breaks down in an unsecure area, the whole convoy will stop until it is fixed or until the commodities are evenly distributed amongst the other vehicles. Additionally, the convoy's speed depends wholly on the speed of the slowest vehicle in the group, often slowing down the trip two or three times.

Because of these slowed travel times adversely affect WFP distribution (as seen in the subsequent sections), the organization hopes to eventually convince the government to allow WFP-sponsored vehicles to travel without escort into the Somali region. However, before doing so, the WFP must assess the real risks that it ensues throughout the distribution process. While escorts restrict the ability for organizations to move freely, it may eliminate threats that outweigh the costly adverse affects.

2.2 INADEQUATE STORAGE AND THE FREQUENCY OF DELIVERIES

The WFP delivers approximately 80 Metric Tons (MT) of food-aid per month to each of 212 FDPs in the Somali region. However, instead of delivering as often as necessary, the organization's vehicles must wait lengthy, unspecified times for escorts and/or convoys to arrive. This slowed traveling limits the WFP to servicing an FDP once every month or two and therefore, it must send enough rations to fulfill an FDP's entire monthly (or bi-monthly) needs. Such infrequent deliveries create an excess of inventory that is not only difficult to store, but also might be diverted before reaching the beneficiaries.

In a perfect world, beneficiaries would receive their rations immediately. However, in reality, infrequent deliveries cause difficulties in distribution since an entire month's worth of rations is often too difficult to distribute right away. Consequently, beneficiaries must leave some food-aid behind in storage for later pick up. In other words, infrequent deliveries result in larger lot sizes and thus, increase the cycle stock. Unfortunately, because the WFP hands responsibility for the food back to the government once it reaches the FDP, it does not have the control or resources to ensure proper storage or warehousing of the food at the FDPs. Therefore, limited storage at the FDPs often results in unofficial town distributors, who store and distribute the unpicked-up food from their homes. As "payment" for this position, the town distributors may take a portion of the food aid, resulting in smaller rations or stockouts for beneficiaries.

We have created a basic model to elaborate on the issue of frequency of delivery and unofficial distributors, as seen in the table below. We know that WFP distributes to 212 FDPs in the Somali region

and that none of those locations have official storage areas. We also know that the WFP plans to transport an average of 80 MT monthly to each FDP. Based on the examples of metric ton food volume that we have seen, we assume that the community will distribute 30 MT immediately and store the other 50 MT for ongoing pick up. We also assume that, on average, 25% of the aid stored in a distributor's house might be kept as payment or sold for profit.

Step			
A	**Frequency of deliveries in one month**	1	
			Calculation
	Per Final Delivery Point (FDP)		
B	Monthly allocation of food-aid (MT)	80	
C	Food-aid distributed per delivery (MT)	80	= B /A
D	Food-aid distributed immediately per delivery	30	
E	Inventory requiring storage per delivery	50	= C - D
F	Inventory requiring storage per month	50	= E * A
G	% of inventory kept as "payment" for storage	25%	
H	Amount of inventory kept as payment per month (MT)	13	= G * F
	Per Entire Somali Region		
I	Number of Distribution Points in the Somali Region	212	
J	Total food-aid distributed per month (MT)	16960	= I *B
K	Total food-aid used as storage "payment" per month (MT)	2650	= H * I
	Total % of food-aid used as "payment" per month	**16%**	= K / J

TABLE 2.1: The total percentage of food aid used as payment for unofficial storage – monthly distribution

As seen in Table 2.1, this would result in an overall 16% loss of food. Of course, behavior in taking this "payment" will change depending on location, amount of food, environment, etc. But for the purpose of this model, we will assume the amount of "payment" taken as a constant percentage. Replenishing food-aid more frequently would result in fewer storage requirements, if any, at the FDPs. In return, the FDPs' unofficial storage needs would also decrease if the frequency of deliveries increased from the current frequency of one per month. For instance, as seen in Table 2.2 below, the frequency of delivery has been increased to two and four times a month. Since we assume that the same amount can always

be distributed to the beneficiaries immediately (30MT per delivery), we can see that an increased frequency of delivery would decrease or zero out the amount an unofficial town distributor might retain.

Step					
A	Frequency of deliveries in one month	1	2	4	
					Calculation
	Per Final Delivery Point (FDP)				
B	Monthly allocation of food-aid (MT)	80	80	80	
C	Food-aid distributed per delivery (MT)	80	40	20	= B / A
D	Food-aid distributed immediately per delivery	30	30	30	
E	Inventory requiring storage per delivery	50	10	0	= C - D
F	Inventory requiring storage per month	50	20	0	= E * A
G	% of inventory kept as "payment" for storage	25%	25%	25%	
H	Amount of inventory kept as payment per month (MT)	13	5	0	= G * F
	Per Entire Somali Region				
I	Number of Distribution Points in the Somali Region	212	212	212	
J	Total food-aid distributed per month (MT)	16960	16960	16960	= I *B
K	Total food-aid used as storage "payment" per month (MT)	2650	1060	0	= H * I
	% of Food Aid Used as Payment / Month	**16%**	**6%**	**0%**	= K / J

TABLE 2.2: The percentage of food aid used as payment for unofficial storage – Variable frequency of distribution

Although the overall coordination of escorts and the WFP has improved recently (as specified in the next chapter), the improvement comes only with more consistent monthly deliveries. If the WFP could deliver rations more frequently in biweekly or weekly shipments, additional flexibility would be built into current operations by allowing shipments to be dispatched as needed rather than in one bulk shipment. Although weekly shipments sound more frequent than necessary, they may not impact transportation costs as one might expect. The WFP currently uses various sized trucks, one of the largest of which is 20MT. There is no cost difference in transporting 80MT to an FDP through one truck delivering aid four times per month or four trucks delivering food-aid all at once.

As mentioned, the WFP is not responsible for distribution at FDPs or tracking demand and service level. However, on a more general level, with more frequent deliveries, humanitarian organizations could better understand true consumption. More frequent deliveries would not only allow an organization to gather data and react accordingly regularly, but would also decrease the necessity for informal storage sites, helping to improve the overall efficiency of the aid distribution process.

2.3 SECURITY IMPACT ON CARRIER RATES

The frequency at which distribution takes place not only impacts the beneficiaries, but also the carriers transporting the aid. The WFP contracts with local carriers to physically transport food-aid into the Somali area. We can assume that the carrier rates charged reflect both the high risks that these contracted carriers face in transporting goods into the region and the slowed travel time that those risks cause. Unfortunately, the financial cost of this security impact is unknown.

We would like to understand the risk that WFP contracted carriers take on and how that risk affects WFP operations and cost. In this section, we would like to quantify and understand the risk that WFP and its contracted carriers face while traveling into the Somali region. To do this, we will identify the least secure routes and how road conditions and security are tied together.

2.3.1 Methodology Used to Analyze Carrier Rates

In order to learn more about the circumstances in which the WFP operates, we acquired and analyzed three data sets from the WFP. We then drew conclusions on WFP's environment and its affect on distribution by measuring the road and security conditions and their impacts on cost. Finally, to determine the extent to which variables affected carrier rates, we performed a multiple regression to identify the variables with the greatest impact on cost.

2.3.2 Data Sets

The WFP provided us with three distinct sets of data to understand individual routes' rates, road conditions, and security levels. The first two data sets listed characteristics for a specific route (a warehouse origin and Final Destination Point pair). Each data set is explained below.

- ***Roads data:*** This data set provides us with routes between warehouse origins to the final destination point and the corresponding distance, travel time, and road type. The road type information provides us with the number of meters of each route that is paved, the number of meters that is gravel, and the number of meters of dirt/other.
- ***Rates data:*** This data set provides us with the rates charged by different carriers for routes between warehouses origins and final destination points. A route may have several carrier rate entries if that route has rate quotes from multiple carriers. These rates are in the units of $/Metric Ton[4].

[4] We did not receive data for the EDP of Kebridehar and have therefore left it out of our analysis.

- ***Security data:*** The WFP provided us with a map that indicated military escort requirements for different main routes through a color-coding scheme. A red colored path indicated a path that required escort, green color indicated a secure path (no escort necessary), and yellow color indicated that the route requires observation. Refer to Figure 3.1 for a sample map.

We first merged the Roads data with the Rates data according to route. With this new, consolidated data set, we could view the rates charged by different carriers, drive times, distances, and road conditions for every route.

Using this data, we created a road conditions scoring system from zero to two based on the route's percentage of pavement, gravel, or dirt/other. Generally speaking, gravel and dirt roads slow the speed at which vehicles can travel. Additionally, gravel and dirt roads, often found in more rural areas with less traffic, expose vehicles to greater security risks more than crowded, paved roads. A higher score reflected a larger proportion of gravel and dirt driving surfaces, and thus a higher security risk. We awarded points proportionally to the amount of each surface type along a certain route then compared the scores for each route to understand the road condition of that route. Points were awarded as follows:

Road risk score = (% pavement * 0 points) + (% gravel * 1 point) + (% dirt/other * 2 points)

For example, according to Table 2.3 below, the route between Degehabur and FDP C received a road risk score of 2.00 whereas the route from Degehabur to FDP F received a score of .23. The route between Degehabur and FDP C consisted of 100% dirt or other surfaces and therefore received a score of 2 points:

100% * 2 = 2 points

The path between Degehabur and FDP F consisted of 78% paved, 20% gravel, and 2% dirt or gravel and received a score of .23 points:

(78% * 0 points) + (20% * 1 point) + (2% * 2 points) = .23 Points

Warehouse	FDP	Paved Surface (m)	Gravel Surface (m)	Dirt/Other Surface (m)	Paved Score (0 pts)	Gravel Score (1 pt)	Dirt/Other Score (2 pts)	Road Risk
Degehabur	FDP C	0.00	0.00	75723.00	0.00	0.00	2.00	2.00
Degehabur	FDP F	221766.01	57974.95	4355.67	0.00	0.20	0.03	0.23

TABLE 2.3: Sample data used to calculate road risk

Finally, we calculated the escort risk for each route. We merged the Security data set into the data set containing both the Roads data and Rates data. Since the map only identified major routes, we identified the escort risk level through the main routes only. To quantify the security threat level as it related to escorts, we proportionally assigned roads marked in red with a score of 2, yellow with a score of 1, and green with a score of 0. Similarly to the method used to calculate road risk, overall security risk ranged from zero to two as well.

Escort risk score = (% green * 0 points) + (% yellow * 1 point) + (% red * 2 points)

Figure 2.1 is an *example* of the map the WFP provided us with. It is important to note that these routes and FDPs are completely fictitious and simply demonstrate the method with which we calculated the escort risk for the more sensitive WFP data.

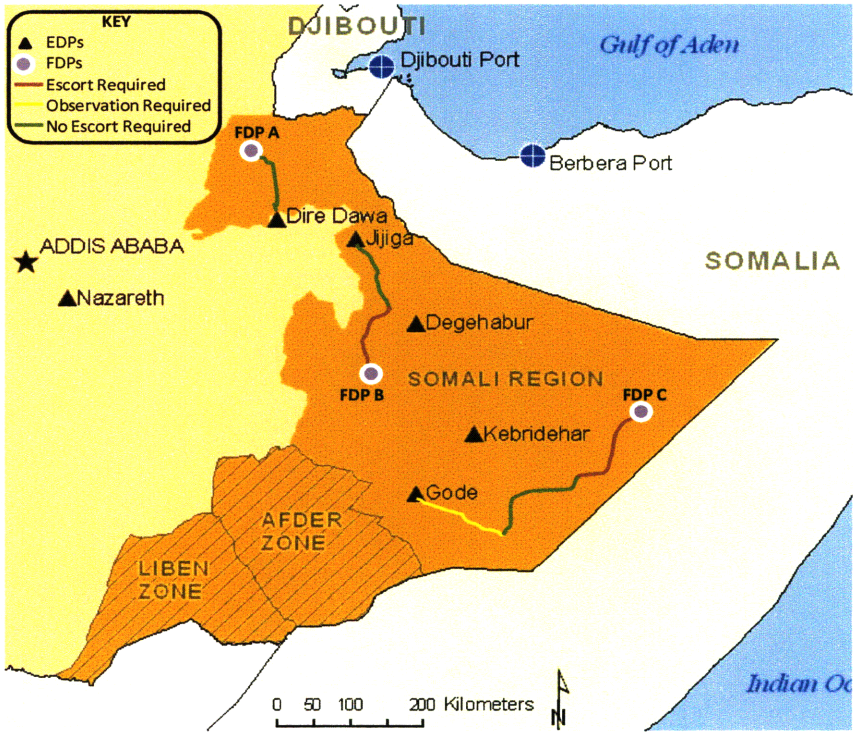


FIGURE 2.1: Sample map used to determine escort risk level for each route in the Somali region[5]
Source: Adapted from WFP Ethiopia, 2009

According to Table 2.4, the route between Dire Dawa and FDP A received a security risk score of 0:

(100% green * 0 points) + (0% yellow * 1 point) + (0% red * 2 points) = 0 points

In comparison, the path between Jijiga and FDP B consisted of 50% green paths and 50% red paths, resulting in an escort risk of 1 point:

(50% green * 0 points) + (0% yellow * 1 point) + (50% red * 2 points) = 1 point

[5] We have falsified the routes indicated on the map to disguise the data provided by the WFP.

Finally, despite the fact that the route between Gode and FDP C consisted equally of green, yellow, and red paths, the resulting escort risk was also 1; the same score received by the route between Jijiga and FDP B:

(33.3% green * 0 points) + (33.3% yellow * 1 point) + (33.3% red * 2 points) = 1 point

Warehouse	FDP	Green (0 pt)	Yellow (1 pt)	Red (2 pts)	Escort Risk
Dire Dawa	FDP A	1	0	0	**0**
Jijiga	FDP B	0.5	0	0.5	**1**
Gode	FDP C	0.33	0.33	0.33	**1**

TABLE 2.4: Sample data used to calculate escort risk

From the two basic calculations of road risk and escort risk, we could now see the rates, distances, time, road quality, and security data for each individual route in the Somali region. To view data tables see Appendix C.

2.3.3 Analysis of Road Risk and Escort Risk on Cost

After compiling all data onto one spreadsheet, we began the process of analyzing individual characteristics' affect on carrier rates. This analysis simply tested our hypothesis that unfavorable route characteristics (poor road condition or the need for an escort) increase the rate that a carrier charges for that route.

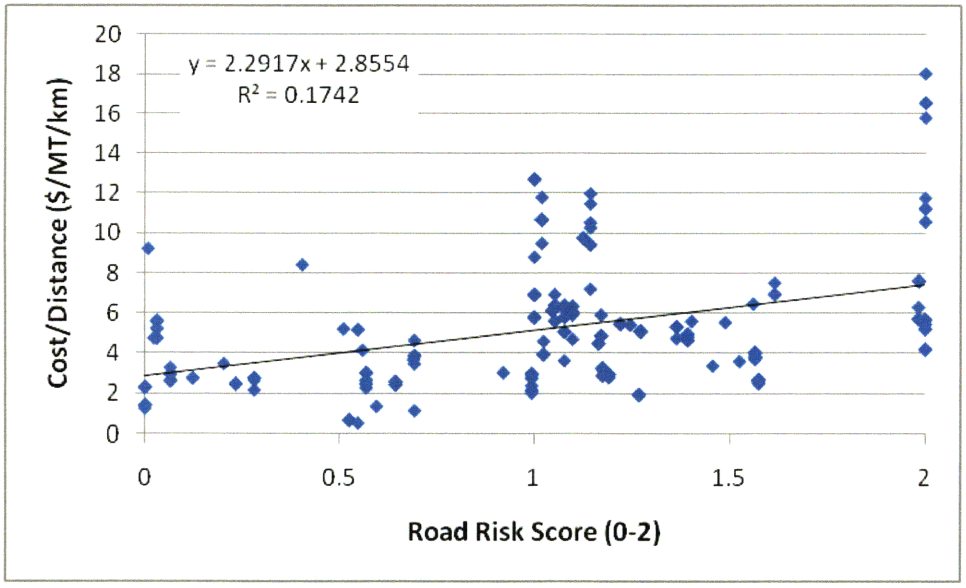


FIGURE 2.2: The effect of road risk on the cost of distribution

Carrier rates do not just reflect road risk but also the road conditions themselves. Poor road conditions can increase cost through the need for additional maintenance and longer travel times. As expected, we noticed that as the road risk score increases, the rate charged by the carrier increases as well. Figure 2.2 displays the positive trend seen in the relationship between road risk score and cost per kilometer.

Similarly, a positive trend appears when comparing escort risk to the cost per kilometer. As seen in Figure 2.3, a large number of routes received extreme scores of 0 (no escort risk) and 2 (maximum escort risk). Although the ranges for cost vary widely, a positive trend shows that overall, the cost increases as the escort risk increases.

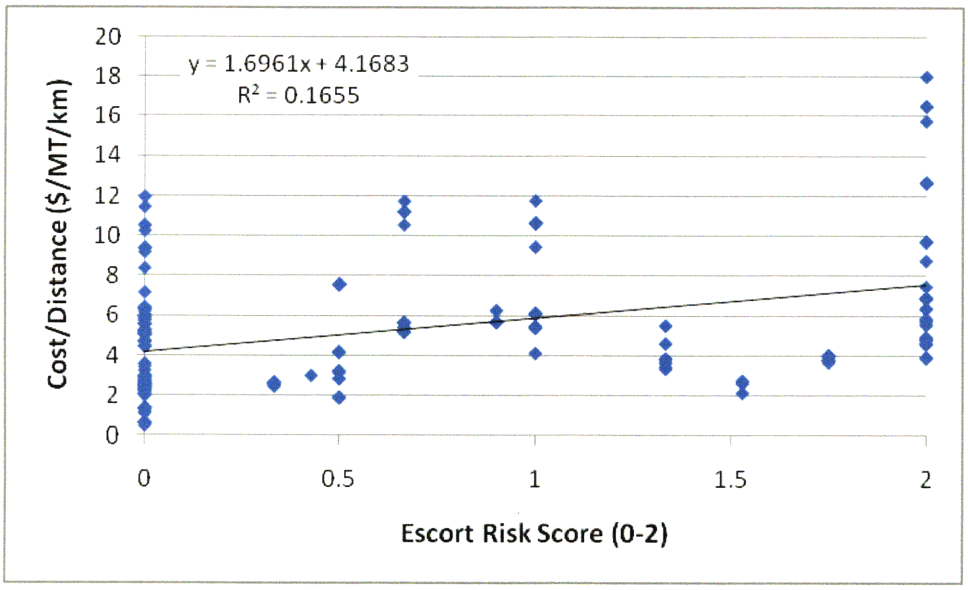


FIGURE 2.3: The effect of escort risk on the cost of transportation

Additionally, as expected, the rate per is lowest when road conditions are best – when more than one third of the route is paved – and highest when road conditions are worst – when more than one third of the route is dirt or other undesirable materials. Refer to Figure 2.4 below.

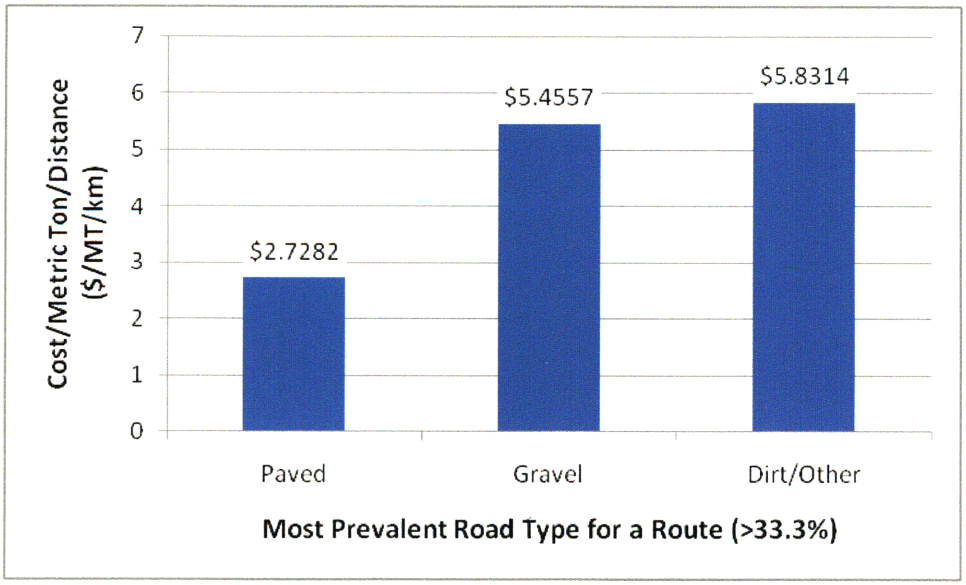


FIGURE 2.4: The effect of road type on cost

Accordingly, Figure 2.5 demonstrates that the data also shows that for the most part, the highest rates are for the slowest routes, and that the rates decrease as the driving speed of the routes increase. In performing this analysis, we identified two paved, fast moving anomalies that threw off the trend towards the 55 km/hr and 60 km/hr marks. The WFP is further investigating these anomalies.

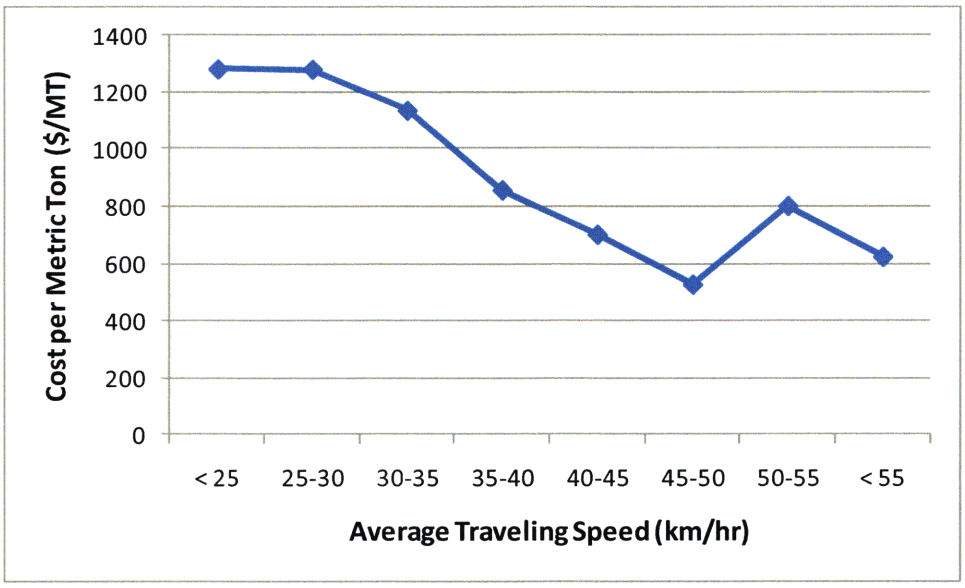


FIGURE 2.5: The effect of average traveling speed on cost

Finally, the average rate per km increases by almost 50% for routes that require an escort. Figure 2.6 reflects the indication that security risks do indeed have a heavy impact on the price of transportation. This is contrary to what one might expect since many carriers would charge a premium for routes *without* an escort, since risk is inherently higher. However, with such lengthy and unpredictable wait times for escorts in the Somali region, carriers try to hedge against periods of wasted time by charging higher rates for routes requiring escorts.

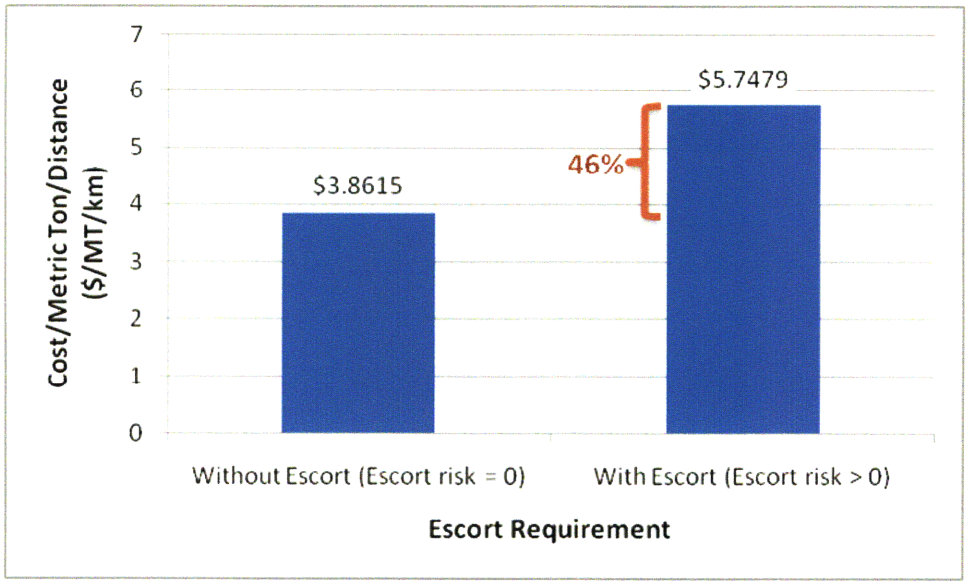


FIGURE 2.6: The effect of escort requirements on cost

As mentioned, security risks create the need for escorts, which in turn affects the speed at which vehicles can travel. The longer the vehicle is en route, whether due to travel speed or distance, the higher the vehicle becomes susceptible to security risks. Figure 2.7 compares road risk to escort risk. From this, we can see that a correlation does exist between the need for escorts and the road condition. As the escort risk increases, the road risk increases. In fact, each route requiring an escort (escort risk >0), has some degree of road risk. Contrarily, routes with road risk do not necessarily require an escort. This is due to the fact that the Ethiopian Government deems many roads to be secure, regardless of road condition. However, for the most part, as road conditions worsen, escort needs increase. This tells us that poor road conditions may pose a security risk. This makes sense, of course, given not only the argument above, but also the mentioned possibility of landmines on rural paths, and general vehicular damage on poor quality roads.

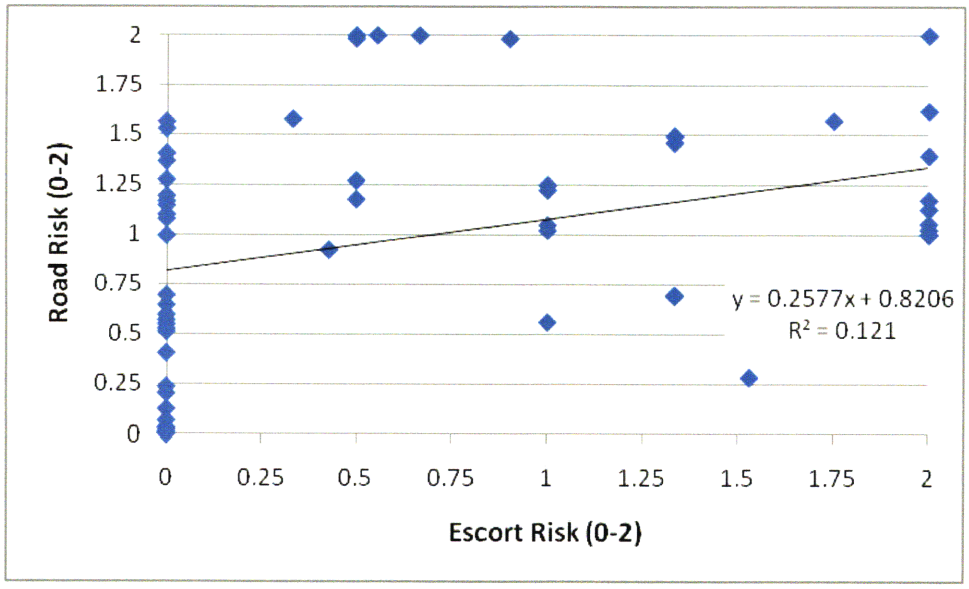


FIGURE 2.7: Comparison of road risk to escort risk

In order to assess the full security threat, we added the two point road risk score and the two point escort risk score together and created an overall security threat score, based on a zero to four scale, with zero being a non-security risk route and four being a full security risk route. (Refer to Figure 2.8). This method assumes that the need for escorts weighs as heavily as road conditions in a carrier's assessment of a route's security risk.

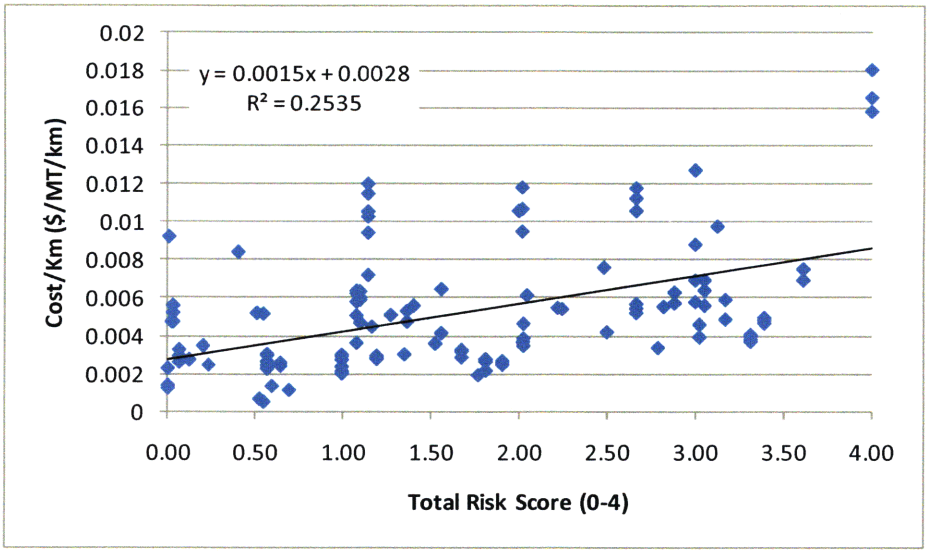


FIGURE 2.8: The effect of overall security risk on cost of distribution

Figure 2.8 shows that the coefficient of determination increases when both escort risk and road risks are taken into consideration (0.2535) and suggests that looking at both type of risk creates a better approach to categorize risk as a predictor of carrier rates.

2.3.4 VARIANCE IN THE COST OF TRANSPORTATION – MULTIPLE REGRESSION

From previous sections, we have seen how security risks affect the cost of transportation in the Somali region. To understand the relationship between the price of transportation for a specific route and the security of that route, we used a multiple regression technique. The purpose of a regression is to model and predict a dependent variable based on a number of independent variables. In this case, the dependent variable is the price of transportation and the model will help us predict the behavior of the price based on observations of independent variables including road risk, escort risk, and driving time. After several iterations, the final form of our regression is:

Price = f (road risk, escort risk, driving time)

$$y_1 = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \varepsilon$$

Where:

y_1 = the cost of transportation

β_0 = the baseline

β_1 =coefficient for road risk

β_2 = coefficient for escort risk

β_3 = coefficient for driving time

ε = noise

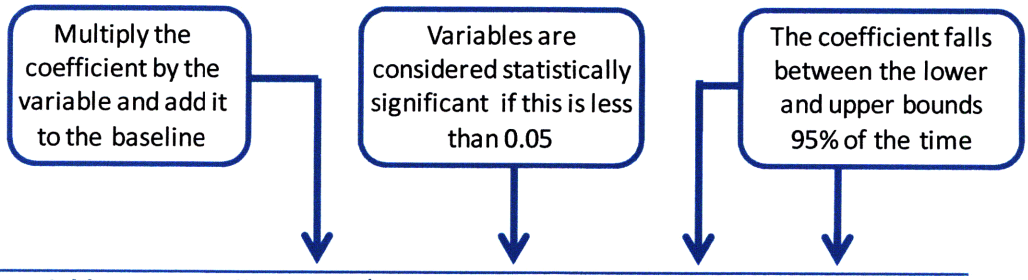
x_1 = road risk score (0-2)

x_2 = escort risk score (0-2)

x_3 = driving time (hrs)

The y-intercept (β_0) serves as the baseline for the model. This means that all routes have an initial cost of β_0 and then increase or decrease depending upon the other variables ($\beta_{1\text{-}3}x_{1\text{-}3}$). Each variable must also have a baseline, or default, value. For continuous variables such as road risk, escort risk, and driving time, the baseline is 0. A route with a road risk of 2 will therefore alter the baseline price of transportation.

The regression model produced a coefficient of determination of .646, meaning that 64.6% of the variation in price can be explained by the road risk, escort risk, and driving time. The higher the coefficient of determination, the more accurately the model can be used to predict future outcomes. Table 2.5 shows some selected results from the regression model.



Variable	Coefficient in ($)	P-Value	95% Lower	95% Upper
Y-intercept	4.376	1.01E-52	3.9098	4.8431
Road Risk	2.889	1.51E-37	2.4994	3.2786
Escort Risk	1.037	3.99E-12	0.7541	1.3207
Driving Time	-0.3884	8.02E-56	-0.4281	-0.3487

TABLE 2.5: Results from the multiple regression

Recall the equation seen earlier:

Price = f (road risk, escort risk, driving time)

$$y_1 = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \varepsilon$$

Given the results from the regression, we can use this equation to predict future prices as long as we know the road risk, escort risk, expected driving time, origin, and destination. Let's assume we have a route with the following parameters:

road risk	escort risk	driving time
2	1	3 hrs

Y_1=4.376 + 2.889(2) + 1.037(1) -0.3884(3) → **Y_1= 10.03($/MT/km)**

Using the model we can predict that a route with those parameters would have a rate of $10.03 per Metric ton per kilometer. Although this model may prove useful in predicting or verifying proposed costs for transportation, it has much room for improvement. Ideally, we would have added origin and destination into the equation. We did, in fact, attempt to add variables into the equation for origin and

destination, and in doing so, received a much higher coefficient of determination (.875). However, Microsoft Excel limited us to a maximum of 16 variables and in order to account for each of the origins (warehouses) and destinations (FDPs), we would have required a system capable of incorporating 55 additional binary variables. Additionally, we only had 333 observations; more data would be necessary to perform such a robust regression from which to draw strong conclusions. Therefore, we chose to base the variation in carrier costs on the three variables (road risk, escort risk, and driving time) from our original regression.

The individual variable which impacted the coefficient of determination the most significantly was the driving time. The driving time was presented to us as an independent variable based upon data from past trips. However, realistically, both escort risk and road risk contribute to variation in driving time and may in fact correlate to driving time. Any correlation amongst independent variables such as driving time, road risk, and escort risk can lead to multi co-linearity, a condition in which independent variables are dependent on other independent variables, much like a circular reference. To ensure the greatest level of accuracy, further statistical tests should be conducted to avoid multi co-linearity. However, given the depth of data available, we were unable to conduct further statistical tests.

2.3.5 Remarks on Security's Effect on Carrier Rates

The results of this data show us a few important things. Firstly, as we have seen, escorts bring serious cost impacts on route rates, likely as less secure paths require escorts and escorts cause longer waiting times. These wait times create an uncertainty for carrier drivers. Secondly, road conditions are correlated with security. Not only do poor road conditions cause high prices, but these conditions exist

on routes with security and escort threats. Thirdly, understanding route characteristics about security such as road risk, escort risk, driving time, origin, and destination explain 87.5% of the variation on the price of transportation. Although it is likely that additional variables affect the cost as well, it is clear that the variables most closely related to security have the greatest impact on cost.

2.4 LOSS DATA

So far, we have defined WFP operations in an environment where serious security threats occur consistently. Unfortunately, we have little data to explore the actual incidents creating this environment of risk. During 2008, the WFP made 5,136 deliveries and only reported nine incidents of hijackings and thefts to the authorities, resulting in only a 211.5 MT food-aid loss. However, while the number of incidents does not seem to indicate much, we can learn much about the background in which the WFP operates.

2.4.1 LOSS DATA ANALYSIS

The WFP data provided us with the details of 9 incidents of loss. This data contains the name of the destination district, the amount of food lost, and a description of the event. We merged this data with the analysis from the previous section, allowing us to see the road and security scores for each incident. We had to eliminate two of the data points since we did not have enough information about the route traveled during distribution. We have placed the data below in Table 2.6 with changed destination names.

EDP	FDP	Allocation Month	Losses in MT	Remarks	Escort Risk (0-2)	Road Risk (0-2)	Overall security risk (0-4)
2	W	May	60	Railway wagons that were left behind due to technical issues were looted by locals despite being guarded by 3 railway Policemen. This is linked to food shortage as the local population is not considered to be banditry.	0	0.525	0.525
2	MM	June	40.5	Dispatched from EDP outside of Somali Region.	1.333	1.46	2.79
2	FF	June	24.304	District officials complained that town FDP rations were not delivered despite the fact that other food deliveries were completed as scheduled. District officials reportedly saw a broken down vehicle around the FDP that was not seen again later.	1.33	0.693	2.026
2	W	July	60	Railway wagons that were left behind due to technical issues were looted by locals despite being guarded by 4 railway Policemen. This is linked to food shortage as the local population is not considered to be banditry.	0.525	0	0.525
1	FF	August	2.1	Reported by officials. Food was retrieved, legal action was taken & food was distributed to beneficiaries.	0	0.235	0.235
2	W	October	20.2	The truck was stuck in a mud when it was looted by a local community.	0	0.525	0.525
2	HH	October	1.9748	The driver was misguided by members of local community.	0	0.065	0.065
2	U	October	2.4528	Looted by a local community	0	1.077	1.077
4	BB	December	?	Two trucks were looted by armed villagers while 11 trucks were trying to cross the river near their village. Then the armed-men instructed the remaining 9 trucks to park in the village. The 9 trucks were later released with no casualty. The incident is linked to shortage of food in the area.	1.33	0.69	2.024

TABLE 2.6: Masked loss data from 2008 for the Somali region

Source: WFP Ethiopia, 2008

2.4.2 LOOTING CHARACTERISTICS

At first glance, the amount of food lost last year (211.5 MT) seems inconsequential compared to the total amount of aid that the WFP distributes to the Somali region (an average of 80 MT/month for 212 FDPs is 203,520 MT per year); less than 0.1% of the goods are lost per year.

As most of these incidents occur in "secure areas", we might assume that the data correlates poorly to the perceived threat of the region. However, because the military requires escort services on roads considered medium and high security risks, this could mean that hijackings and lootings can now only occur in the absence of military protection. Without military escort, the looting parties might feel more powerful against guards and truck drivers. Though escorts create significantly slower traveling times, perhaps their presence does defend the WFP's food aid in a considerable manner. Figure 3.9 displays each of the nine incidents' overall security risks.

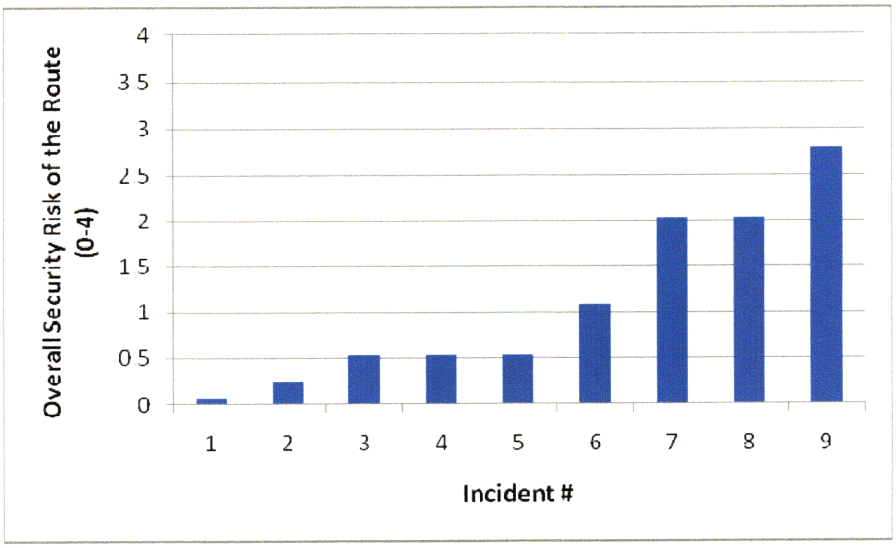


FIGURE 2.9: 2008 incidents of Loss and their overall security risks

According to the commentaries accompanying each entry, two-thirds of the incidents occurred in the presence of truck drivers or railway guards. The other incidents may have also transpired similarly, but their entries simply did not specify the circumstances around the looting. This information leads us to believe that these events, though few in number, do indeed signify an environment full of danger.

As mentioned previously, we assume that vehicles that travel on dirt and gravel roads might have a higher theft frequency, as they travel at slower susceptible paces. However, from this data, we cannot tell on which part of the road that this event occurred and therefore, we cannot see if that pattern persists.

2.4.3 Incident Reporting

Due to the nature of the political instability, food insecurity, and overall tension in the region, one might assume that the Somali region would have more than nine instances of aid lost in 2008. A low number of incidents could also mean that the WFP sponsored truck drivers, beneficiary communities, or warehousing workers fail to report incidents to authorities. This could be for any number of reasons including lack of trust in law enforcement, bribery, or insider involvement. As previously mentioned in Chapter 1.1.1.3, the Somali region has low Rule of Law and corruption measures. In that case, of course, insider involvement will not be reported to the authorities and there may also be additional backlash on communities if they do report any unusual behavior. Additionally, those responsible for theft may bribe witnesses with some of the stolen goods to remain quiet. Therefore it is plausible that drivers might keep rations for themselves or selling them for a profit, use aid or gasoline as a bribe to ward off threats

from rebel groups, or even drivers working in conjunction with those groups – all without fear of consequences.

Finally, lootings in these particular regions may occur so rarely that when they happen, people report them. It is possible that theft, robbery, and hijacking are so common in other districts that they are no longer reported each time they happen, as per low Rule of Law.

2.5 CONCLUSION

Political, ethnic, agricultural, and financial tensions define the security of the Somali region. Unfortunately, the perceived risk that accompanies these tensions severely limits the distribution supply chain of the WFP in the Somali area. That perceived risk translates into the need for escorts, heavily slowed transit times, food storage issues, and increased carrier rates. As seen in the last section, sometimes the security threat directly impinges on the safety and health of WFP-sponsored truck drivers and beneficiaries.

While the WFP understood that the stability of the region takes a toll on their operations, the organization had not previously quantified it or assessed it in depth. However, with this data analysis, it may reassess the value of escorts for protection, try to re-negotiate the frequency with which it delivers food, or bargain with carriers to lower rates.

Humanitarian organizations should work to understand the affect of security on their distributions and operations. It is with this quantification that they may be able to collaborate with the parties around them to enhance their quality of work.

3 WORLD FOOD PROGRAMME SECURITY ACTIVITIES

The aid distributed by the WFP passes through the hands of several parties and individuals before reaching the actual beneficiaries. The government, private carriers, and beneficiary community leaders all have a profound influence on the success of the WFP's distribution system. Their actions determine the amount, frequency, and consumption of aid that reaches the people of the Somali region. By involving these parties in the planning and assessment process, the WFP takes an active role in ensuring the security of its aid and beneficiaries. In this section, we will examine the activities in which the WFP engages to secure its aid distribution in the insecure Somali region. Specifically, we will look at how the WFP engages with carriers through a contracting process, with the government through Joint Committees, and with beneficiaries through Food Monitors. All three of these processes not only set strict guidelines meant to secure goods, but also create relationships of trust and responsibility within the WFP communities.

3.1 CARRIER CONTRACTING

Generally, organizations contract with carriers to transport their products. In the case of the WFP and some other humanitarian organizations, this product is food-aid. While the carrier and the consignor almost always engage in some contract process to ensure the safe transport of goods, the WFP's specialized process takes into account the perceived risk of its environment. By engaging and contracting carefully and uniquely with carriers, the WFP takes the first step in securing its distribution system in the Somali region.

To analyze WFP's carrier engagement process, we compared the carrier documentation of the WFP and a commercial sector organization in a stable environment. The WFP Requests for Quotation (RFQ) can be found in Appendix B. In this section we will first review the steps that the WFP takes to mitigate risk in the overall carrier engagement process. Next we will identify the contractual clauses that the WFP uses to account for unique security threats.

3.1.1 Engagement Process

Generally, the WFP and the commercial sector engage local carriers similarly. The WFP first sends out questionnaires asking for carrier companies' profiles, bank accounts, and financial statements. Second, the WFP sends out RFQs to carriers whose questionnaire profiles match their standards. Unlike the commercial sector, the WFP does not use an actual contract, but relies solely on an RFQ. After this step, carriers receive Loading Orders and carriers and beneficiary community representatives sign paper Waybills to track aid shipments. In the case that carriers do not perform up to the standards stipulated by the RFQ, the WFP will blacklist them.

Private carriers, however, hesitate to sign on for the WFP job. The instability of the area as well as the long, empty backhauls means lost efficiencies, wages, and security for the company. This hesitation causes the WFP, unlike commercial organizations, to engage with local carriers in a more informal manner, allowing carriers the option to leave the mutual contract.

However, at the same time, because the food-aid that the WFP distributes fuels the lives of those in the Somali region, the WFP must take great care in choosing carriers. Especially while looking for a dedicated fleet or a permanent relationship, the WFP must look for carriers with good reputations and financial backings. Further, the WFP finds few carrier companies that both match their standards and are willing to dedicate fleet to travel within the Somali region. Because of this, the WFP does not pay as much attention to cost as organizations in the commercial sector might. The WFP cannot concern itself with finding the cheapest carriers, as it must concentrate on finding the few qualified, dedicated, and willing carriers.

3.1.2 Contractual Clauses

Once the WFP does find qualified, dedicated, and willing carriers, it must communicate emphatically the importance of the security of its goods and beneficiaries. The RFQ in Appendix B, written by the WFP, has many stipulations with high security implications, much like a contract. To assess the clauses driven by the WFP's unique security situation, we compared the WFP documents with commercial sector contract for dedicated fleets. We find that, unlike commercial contracts, the WFP RFQ urges carriers to take full responsibility, insists on full communication during a security breakdown, and sets guidelines for beneficiary interaction.

Firstly, the RFQ specifies several times that the carrier assumes full responsibility for the safety of the cargo. Accordingly, the WFP has a no tolerance policy for leakage or spillage of goods, defined as any "shortage in weight" of goods at destination.

> *The contractor shall assume full responsibility for the cargo (quantity, condition and integrity) whilst in his custody or that of his employees, agents or subcontractors* (RFQ 8.1, 2008)

> *Leakage and / or spillage shall not be tolerated and shall be considered as losses (missing quantities). For the purpose of this RfQ, leakage or spillage is defined as a shortage in weight of units at destination compared with the weight of units as declared on the waybill and signed at the point of origin where the contractor took over the responsibility over the commodities.* (RFQ 8.2, 2008)

Unlike the commercial contracts that we analyzed, this RFQ anticipates the possibility of fraud, theft, and corruption at a heightened level. In the WFP RFQ, legal measures written to secure distribution may also propel a heightened sense of responsibility upon the driver. However, this sense of responsibility might be an attitude that the WFP intentionally tries to spread. If the attitude reflected in the contract trickles down to individual drivers, it may instill in them the responsibility to defend the cargo that they carry. It may deter drivers from taking part in insider scams, assisting rebel groups, or leaving their trucks un-manned.

Secondly, the WFP demands full communication in the case of a security issue. In Section 7.3, the RFQ specifies that the carriers must adhere to *Prompt and comprehensive reporting* and *Continuous feedback in case of breakdown, accident or security incident*. Further, the RFQ stipulates:

> *In addition, the Contractor shall assume full responsibility for any fraudulent and/or illegal acts it commits knowingly or unknowingly and WFP shall be exempt from any liability whatsoever in this respect.* (RFQ 11, 2008)

In comparison to commercial contracts, the WFP RFQ exhibits not only an awareness of a looming security threat, but also an expectation. Because of this, the WFP sets up performance guidelines for

those security related situations. In this case, the WFP, unlike a commercial organization, demands that the carrier ensures ongoing communication even during a threatening situation.

Thirdly, and most importantly, the WFP RFQ demands respect and security for its beneficiaries in addition to its food-aid cargo. The RFQ specifies not only the responsibility of the carrier to abstain from fraudulent and illegal activities, but also the protection agreement of the UN to the people that the WFP serves. The RFQ demands that all carriers and contractors act according to the highest standards of protection. Further, to avoid the sexual abuse and exploitation of beneficiaries, the document prohibits carriers from spending the night at beneficiary camps.

> *The United Nations and WFP are committed to the protection of vulnerable populations in humanitarian crisis, including from sexual exploitation or abuse. By entering into an agreement with WFP, the Contractor undertakes to adhere to the standard of conduct established to this effect by the United Nations and to ensure that its personnel conforms to the highest standards of moral and ethical conduct. Any failure by the Contractor to take preventive measures against sexual exploitation or abuse, to investigate allegations thereof or to take corrective action, shall constitute grounds for termination of the agreement.*

> *Contractor employees are prohibited from staying overnight at a beneficiary camp.* (RFQ 16, 2008)

Commercial contracts may demand that cargo reach the end-customer in satisfactory condition. However, while commercial organizations hope for the satisfaction of their customers, they do not stipulate this satisfaction within the bounds of a carrier contract. For the WFP and other humanitarian organizations, beneficiaries are the end-user. The organizations' businesses focus solely on maintaining the lives of those living in instability.

3.2 JOINT COMMITTEES

In the fall of 2008, the World Food Programme (WFP) began to lead the secondary transport of food-aid within Ethiopia to the Somali region. In order to increase collaborative efforts, the World Food Programme and the Ethiopian government have set up two Joint Committee groups. The first group, composed of WFP and the Disaster Management and Food Security Sector (DMFSS) members and located in Addis Ababa, oversees the entirety of the food intervention in the Somali region. The second, more unique group, composed of the WFP, the military, and government workers, decentralizes the dispatch and escort decisions and increases cooperation at local levels on the ground. Now, instead of solely making decisions for transportation throughout Ethiopia from the capital city of Addis Ababa, the committee members will jointly decide dispatches from Gode, Dire Dawa, Jijiga, Kebridehar, and Degehabor, the EDPs serving the Somali region. (Refer to Map 1.7).

This second, localized Joint Committee meets in each of the ground locations once a week. Each weekly meeting, co-chaired by DMFSS and WFP, requires representation from the three member groups stated above. A head of a sub-office or head of logistics from the WFP must also attend. Additionally, mayors or zonal administrators are also invited to join the meetings and, in some areas, play a very critical role within the committee. Together, the committee will make decisions regarding the routes, the food-aid content, and whether moving is plausible at all. Each decision requires buy-in from each of the three represented arms.

This Joint Committee has two tangible benefits. Because of their now local, joint dispatching efforts, the military is more aware of the WFP's escort needs and therefore can more accurately predict WFP

deliveries. Further, because the WFP and the military work together to schedule these deliveries from the ground, the military can send WFP sponsored vehicles just with escorts instead of waiting for full convoys at Dire Dawa. Subsequently, they can deliver aid more frequently. For instance, in the past, only 20% of delivery points were being reached each month. However, due to the increased frequency of military escorts, 70%-80% of distribution points are now successfully receiving deliveries. Since the dispatches are local, the drivers are also locals, instead of Ethio-ethnic highlanders. Highlanders are often mistrusted in the politically rebellious Somali region, and therefore, transportation security increases with the addition of local drivers.

3.3 FOOD MONITORING

In order to secure distribution at the FDP, the WFP sends official Food Monitors into the field. These Food Monitors verify the distribution of beneficiary aid as often as possible in selected locations , given the limited resources. The FDP selection process is semi-random but prioritizes problematic FDPs. Each EDP office dispatches food monitors and decides on the prioritization of its food monitoring programs. For example, if the WFP recognizes an FDP as especially inefficient or corrupt, it will send a Monitor there instead of a smoothly running FDP. Food Monitors report back to the country office weekly and the country office compiles those reports and sends them back to headquarters.

Like any WFP staff member, these Food Monitors must receive security clearance from the United Nations Department of Safety and Security in Addis Ababa. However, unlike most of the WFP staff members, Food Monitors are locals and therefore have more flexibility in terms of movement. The Food

Monitors can go anywhere in the country, whereas the WFP restricts international staff members from traveling to areas without a significant military presence. Further, by hiring local staff for this position, the WFP has enhanced its ability to communicate directly with beneficiaries. These Food Monitors, often ethnically Somali, can communicate with beneficiaries and often interview beneficiaries to find the quality and reliability of the aid service. This practice further secures the distribution of aid but now at the beneficiary level.

The WFP hires Food Monitors to ensure the safety of its aid. However, the WFP has also created policies to ensure the safety of its Food Monitors. The WFP has a policy to not deliver food if a Food Monitor cannot access the area. However, in practice, because security restrictions can change rapidly, food will sometimes continue to travel into an area that a Food Monitor can no longer go. This inhibits the WFP's ability to monitor an area and may prevent that area from receiving aid until it is deemed safe.

3.4 CONCLUSION

The WFP and all humanitarian organizations operating in insecure areas rely on other parties and individuals to safely distribute aid. In this particular case, the WFP relies on the government and its military escorts, private carriers and their drivers, and its own Food Monitors and the beneficiaries that they interact with. Escort drivers, carrier drivers, and food monitors are not just simple contracted employees, but significant security guarantors. For this reason, to best ensure the safety of its aid, the WFP must treat each individual in its aid supply chain of its aid with respect and trust.

Further, the WFP must engage all participating parties and individuals in the planning and monitoring process. With closer ties to government, the organization raised its delivery efficiency by 60%. By specifying risks and security clauses, the WFP truthfully outlines the environment and expectations to contracted carriers. These actions create unions in which both parties have vested interest in the best security for the aid and the beneficiaries.

More generally speaking, to ensure the safety of aid, the WFP and other humanitarian organizations must reach out to all stakeholders to create the relationships that foster trust. With trust between organizations and the home government, carriers, beneficiaries, and ethnic groups, different parties and individuals will be less likely to blatantly disrupt the distribution process. Further, the relationship between humanitarian organizations and the government is crucial. The relationship should be synergistic so that the organization can not only receive assistance from the government, but can lift up and champion the methods of the government when appropriate.

4 POTENTIAL AND RECOMMENDED SECURITY MEASURES

Recently, the WFP- Ethiopia has decided to follow the lead of several other commercial and humanitarian organizations and look into the use of Global Positioning System (GPS) technologies to enhance its distribution security. Technology is becoming a popular method through which organizations monitor their supply chains. In this section we will analyze the features, benefits, and risks of this and other tracking technologies for humanitarian organizations using literature, interviews, and case-based research. Further, we will analyze non-technology methods and approaches that enhance and ensure secure and successful aid delivery. Finally, we will make recommendations about security measures that we believe the WFP-Ethiopia and other humanitarian organizations should consider implementing to enhance the distribution of aid.

4.1 TRACKING TECHNOLOGY

Security technology allows the WFP both to actively manage its trips in real time and gather reliable data from which to plan future trips. Devices such as Global Positioning Systems (GPS), Radio Frequency Identification (RFID), and accelerometers increase the visibility of assets throughout the supply chain and provide valuable information about road conditions. In this section we will introduce these tracking technologies and discuss the beneficial features and risks of implementing them in humanitarian organizations such as the World Food Programme (WFP). Given the importance and relevance of GPS to the WFP, we will place special emphasis on that particular technology.

4.1.1 Global Positioning System (GPS)

Global Positioning System (GPS) is a satellite navigation system originally developed by the Department of Defense for military use around the globe. Although originally restricted for the military, GPS became publicly available in the 1990s and has since proven itself in the commercial sector. GPS technology consists of three separate segments: the space segment (satellite), the control segment, (control stations at home offices), and the user segment (GPS receiver units). (Garmin Ltd., 2008). Not only is the system capital heavy, but the implementation of the GPS receiver units into individual vehicles can be a laborious process.

Organizations implement GPS units either as part of a covert system or an overt system. Vehicles with overt systems have GPS units out in the open whereas vehicles with covert systems have GPS units hidden within the vehicle. Both overt and covert tracking have benefits and drawbacks. In overt tracking, the driver knows that he/she is being tracked. The GPS device is not hidden from the driver and may even be easily identifiable from outside of the truck. Although this may make the GPS unit a target for theft, it will also act as a psychological deterrent for drivers and other insurgents interested in stealing cargo. In areas with prevalent theft, hijacking, corruption, and robbery, a driver's temptation to stray from doing his/her job decreases as accountability increases from the GPS tracking capability.

In covert tracking, the organization embeds a GPS unit within the cargo without the driver's knowledge. Covert tracking focuses on recovering stolen goods and has no effect as a deterrent since the driver remains unaware that he/she is being tracked. Covert tracking is more effective in countries where law

enforcement security firms respond quickly (within 20 minutes) since, with a prompt response, law enforcers can recover lost goods more successfully. However, without a prompt response, the goods will be lost along with the GPS unit itself.

4.1.1.1 Benefits of Implementing GPS

GPS can have a profound effect on the security of a fleet. Accurate information about characteristics such as speed, idle time, time of movement, and location provides visibility beneficial to effective monitoring and route security. Further, GPS technologies can psychologically deter corrupt or risky behavior. In the case of overt units, potentially corrupt individuals note that having a GPS unit on board means that stealing cargo is risky. Additionally, in less secure areas, fuel is often used as a means of bribery. Monitoring its consumption can identify inappropriate drivers and fuel usage.

Many public sector organizations have implemented GPS units. The United States Army and the Army and Air Force Exchange Service (AAFES) both rely heavily on GPS to monitor and secure vehicles during transportation through their current operations in Iraq and Afghanistan – two areas widely considered insecure. The United States Army system created a Movement Tracking System (MTS) to accurately monitor the movement of vehicles during operations. Figures 4.1 and 4.2 show examples of the computer based system installed inside vehicles as well as the satellite communication device installed on vehicles. For more information on the US Army and AAFES operations, refer to Appendices E and H.

FIGURE 4.1*:* A mobile Army MTS computer system installed in a vehicle
(Source: Tapp, 2004)

FIGURE 4.2: The satellite communications device (the white box) used to transmit data for MTS
(Source: Tapp, 2004)

Also, several New York school districts recently integrated GPS into school bus fleets. Unlike the Army and AAFES which focus on securing and tracking goods, the New York Public School Systems focus on securing and tracking students. The September 11 attacks catapulted security into an extreme priority for the citizens of New York City. Implementing GPS provided a peace of mind about the location of school children during their commute to and from school. (GeoPhys.com, 2006).

GPS systems have several add-on beneficial features that can alert organizations in real time if an unexpected event occurs. As humanitarian organizations are often located in insecure areas, these features are particularly relevant. In the case of WFP, a quick reaction to an alert can help re-route the vehicle or determine an appropriate course of action. Over the next few paragraphs, we introduce both established GPS features, such as geo-fencing and time-fencing, and newer features, such as geo-tagging, that have yet to be fully incorporated into transportation-related GPS devices.

Geo-fencing

A geo-fence notifies the control system when a vehicle exits the perimeter of an administrator-placed virtual boundary and sends along with the coordinates of the boundary breach. Refer to Figure 4.3 for an example of a virtual boundary set by an organization.

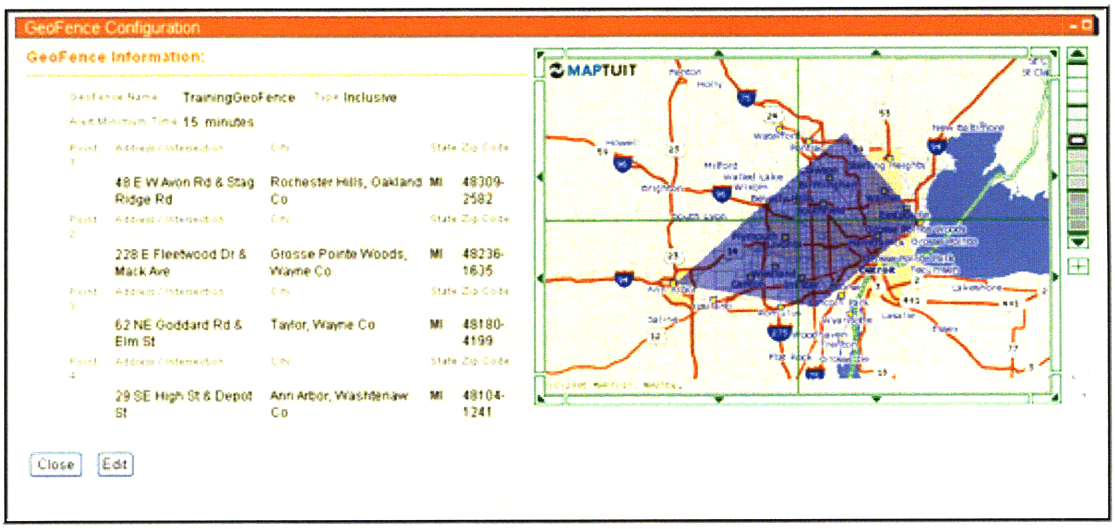


FIGURE 4.3: An example of a virtual boundary set up for the purposes of geo-fencing
(Source: International® Aware™ Vehicle Intelligence)

Organizations with regular routes in insecure areas may benefit from this type of alert as it may signify a potential hijacking or robbery. Though humanitarian organizations do not want or need to locate rebel groups, this feature can help these organizations to avoid dangerous locations.

The American Red Cross has hundreds of Emergency Response Vehicles responsible for transporting aid in disaster and emergency situations. Unfortunately, because the Red Cross has had trouble monitoring their vehicles in these frantic situations, especially during Hurricane Katrina, it implemented GPS units with geo-fencing. (Refer to Appendix F). The New York Public School System's implementation of GPS also includes geo-fencing capabilities, specifically to identify potential hijacking situations. When a school bus breaches a boundary, officials immediately receive a message through modes of communication including email, mobile phone, text messages, and pagers. (GeoPhys.com, 2006).

Geo-tagging

Geo-tagging, also known as geo-coding, notifies a system of a landmark by attaching geographical information (such as names or geographic coordinates), to data as requested by the GPS unit user. (NationMaster Encyclopedia). Popularly used in photography, organizations can implement this feature into the vehicle by using something as simple as a button which, when pressed, can record the exact coordinates where the specified landmark was seen. For humanitarian organizations, this function could mark specific locations or landmarks of interest during transportation such as checkpoints, recent locations of rebel activity, or areas on which road conditions are too poor to drive.

Time-fencing

A time-fence, similar to a geo-fence, sets boundaries which, if exceeded, will activate an alarm or an alert. Time-related actions such as unexpected stops will send a notification that an unscheduled event has taken place. If a vehicle scheduled to rest on an overnight trip suddenly starts to move, an alert will notify the organization.

Deactivation locks

A deactivating lock in the back of the trailer can be linked to a GPS unit, only allowing the trailer to open after the truck has arrived at its destination. Upon arrival at the destination, the driver can call into the monitoring center to have it released. If someone cuts the door open en route or without authorization, an alarm will send a notification of a possible theft. For humanitarian organizations, this would restrict the times at which doors could open, deterring those who seek to steal the aid en route.

4.1.1.2 Risks of Implementing GPS

Despite the increased visibility provided by GPS, various disadvantages still exist. Carrier hesitation, high operating costs, and inaccuracies of data might cause several difficulties in implementing this technology. More importantly, GPS tools, though useful for monitoring, do not guarantee the security of the goods during transportation.

Carrier Hesitation

First and foremost, carriers may resist the idea of having their vehicles tracked at all times. Drivers may also question the purpose of an overt GPS unit. Particularly in less technologically advanced regions, drivers may become suspect the GPS unit to be bomb with remote detonation or something more dangerous. Currently, the WFP hopes to contract with a dedicated fleet. However, this resistance and hesitation may drastically reduce the pool of eligible carriers, indirectly increasing carrier rates for humanitarian organizations.

Cost

Organizations must consider a number of costs associated with implementing GPS prior to implementation. An organization will encounter high capital costs while establishing satellite coverage and a control center and implementing individual GPS devices. Hiring and familiarizing employees with the technology will also contribute to the cost. However, because the value of aid security and beneficiary safety is unquantifiable, it is difficult to perform a cost-benefit analysis of GPS technologies to humanitarian organizations.

Interference

Of course, technical errors that accidentally or intentionally obstruct the transmission of signals do accompany these technology systems. The low power signal used in GPS technology is susceptible to noise and interference from improperly designed or maintained systems as well as commercially designed GPS jammers. Organizations must take sufficient security measures to

prevent interference with the signal while still allowing for the necessary transmission of data. (Simonsen, et al, 2002)

Distribution of Aid is Not Guaranteed

Finally, the purpose of GPS implementation in the humanitarian sector is to help ensure the proper distribution of food-aid. The WFP would likely attach the GPS unit to the vehicle instead of to the aid itself. Subsequently, a tracked vehicle may properly arrive at its destination without its aid, because, although overt GPS units may act as deterrents, they cannot actually stop a robbery or hijacking from occurring. If thieves steal or destroy the unit, it will no longer provide accurate information to the control center. Further, if rebels, or even potentially corrupt drivers, learn to interfere with the transmitted signal, they will not get caught acting dishonestly.

4.1.2 Radio Frequency Identification (RFID)

Radio Frequency Identification (RFID) technologies transmit and identify information about an object through wireless radio waves. An RFID system has two main components: a tag and a reader. An RFID tag, typically a microchip, is attached to an object and holds information about the object such as the date of manufacture and the destination. An RFID reader communicates with the tag and then passes the digital information about the object on to a computer system. Although similar to a bar code, RFID has significantly greater capabilities. Bar codes and bar code scanners communicate through line-of-sight communications. Therefore, a scanner can only read information off of bar codes positioned

directly towards the scanner. In comparison, RFID interrogators can read information from RFID tags from any direction since RFID is based off of radio waves. The commercial sector uses RFID quite extensively as the financial benefits generated by an RFID system outweigh the cost of the tags. (RFID Journal, 2009)

RFID tags come with varying levels of components, capabilities, read-ranges, disposal, and cost. An appropriate RFID system gets implemented depending on the value of the goods. Tags can be attached to an entire shipment, a single pallet, or an individual item. Companies tend to track high value goods using a more active and costly system with a long range for transmitting data. While simple and disposable tags are more appropriate for commodity items, they remain quite expensive to implement on a reasonable scale. These systems can cost anywhere from $290,000 to $5,000,000. (Robarti, 2006 and SCDigest Editorial Staff, 2009). Although companies justify the cost for high-valued goods, it is difficult to justify the use of these tags on inexpensive commodities.

However, RFID increases visibility throughout the distribution process and provides the capability to actively and directly monitor goods through various checkpoints. Further, because RFID tracks goods on a more detailed level, it also tracks goods more accurately than GPS. Organizations such as the US Army and AAFES place RFID tags directly on individual units to monitor the security each item, rather than just a shipment or truckload.

4.1.3 ACCELEROMETERS

As seen in chapter 3, road conditions do correlate with road security. As such, an in-depth understanding of the road conditions may help to significantly increase security. Accelerometers, which measure various forces of acceleration including static forces (such as gravity) and dynamic forces (such as moving) (Dimension Engineering), allow us to understand the road conditions on which the vehicle travels. For instance, the Massachusetts Institute of Technology's Pothole Patrol (See Appendix G) uses accelerometers to monitor infrastructure on and along roadways. The Pothole Patrol embedded accelerometers in taxis to measure the dynamic velocity and vibration of vehicles in Boston and Cambridge, Massachusetts. By coupling GPS systems with accelerometers, the project successfully identified potholes locations, sizes, and depths on roads.

Since natural and human disasters may suddenly change road conditions in less secure areas, the ability to gather data about road quality on a regular basis would help organizations plan accordingly for future trips. For example, the Somali region's common floods and droughts change road conditions consistently. Accelerometers could provide the WFP with the capability to measure and compare roads in order to efficiently plan future routes – and potentially secure goods. Additionally, an accelerometer could help the WFP and the government prioritize critical infrastructure improvement projects.

4.2 NON-TECHNOLOGY SECURITY MEASURES

As we have seen, technology can enhance supply chain security. However, given the capital cost and infrastructure necessary to implement such tools, we will also introduce some non-technology

measures. In this section we will discuss two groups of supplemental security measures. The first group consists of tools that humanitarian organizations can utilize to monitor security – check points and weighing stations. The second group consists of two slightly larger scale changes humanitarian organizations may take to take to develop the security of their distributions – expanding driver responsibilities and relying on airdrops.

4.2.1 Monitoring Methods

The depth with which an organization monitors the distribution of goods varies with resources. As seen in chapter 4, the WFP monitors food distribution primarily through the usage of waybills and Food Monitors. These manual processes compare the amount allocated for a Final Destination Point (FDP) with the amount delivered. However, while the WFP uses these processes to compare the initial and final amounts of aid, the organization incorporates few monitoring efforts elsewhere in the distribution process.

By creating checkpoints along distribution routes, organizations such as AAFES, who also uses private carriers, create intermediate monitoring opportunities throughout the distribution process. An organization will designate certain locations along routes and appoint a representative to man each location, ensuring that the vehicles passing through contain the correct amount of aid. Organizations should disperse checkpoints along different routes and should rotate locations periodically so that they remain unpredictable and effective. This will allow for closer monitoring of distribution and will help organizations identify particular areas that may present a higher risk for theft.

An organization can also employ weigh stations along distribution routes. These stations weigh vehicles and identify any unexpected discrepancies between the amounts of aid it should and actually does have. AAFES uses this method while transporting food to both Iraq and Afghanistan. Though weigh stations can be less labor intensive for an organization than checkpoints, they can also require fewer people. However, weigh stations require a slightly higher cost of capital to construct and implement.

4.2.2 Other Security Measures

While monitoring tools and methods will help enhance distribution security, we have identified a few overall larger scale approaches to increase security. These approaches may be improbable for WFP's current status, but nevertheless, would make or maintain significant safety changes.

Ideally, a truck should continue moving at all times – otherwise, the vehicle is at higher risk for a hijacking or looting incident. Assigning two or three drivers to a vehicle could eliminate the need for a vehicle to stop and park during overnight trips, in turn reducing the risk that trucks face. Further, having multiple drivers could also create a self-policing method, as drivers will be less likely to engage in corrupt activities while someone present.

Finally, humanitarian organizations with access to resources may want to look into aerial monitoring and distribution. As discussed in Appendix E the Army has turned to air distribution in large part to monitor and avoid the dangers of ground transportation in Afghanistan. This method of transportation is very costly. However, it is useful in extreme cases. The WFP already has experience using aerial delivery to

deliver aid during times of extreme need, such as a recent 2008 fall flood in Gode. Currently, however, the WFP only uses aerial delivery in the Somali region when roads are completely inaccessible.

4.3 PROPOSED ACTION FOR THE WFP – ETHIOPIA AND OTHER SIMILAR ORGANIZATIONS

In this chapter, we have introduced several technologies and measures that can enhance the security of an organization's distribution and transportation process. However, in order to decide whether or not to really implement a specific tool into an organization, the organization must evaluate that tool against its operating environment. The WFP-Ethiopia's Somali regions have two separate operating environments – the Somali region itself and the WFP's internal environment. The Somali region is an area of perceived and real risk as well as an area lacking much infrastructure (technological or otherwise). The WFP is an organization with few resources (capital and human) as well as an organization sometimes too large to quickly adapt to change. The technologies and tools that the WFP does adopt in this region should, then, address security risk, work with existing infrastructure, be cost-effective, and be easily implementable.

However, the WFP should remember that while supply chain security technologies can deter illicit activities, technologies cannot prevent them. Therefore, the WFP cannot evaluate a technology as a standalone provider of security. Also, while the WFP has limited capital resources, the need to ensure beneficiary aid and safety will always outweigh the raw cost of a tool that really enhances security. If

two similar technologies have very different costs, then the WFP should choose to use the less expensive one. However, the cost of the general technology may not always be prohibitive.

Given this analysis, we propose that the WFP implement Global Positioning Systems (GPS) onto its dedicated fleet of vehicles. GPS has several technical and psychological benefits that will help secure an organization's supply chain. By implementing GPS, the WFP will have a chance to not only track the progression of its contracted carriers, but also speculate upon potential hazards. The WFP should also enlist the geo-fencing and deactivation lock add-ons if possible. The geo-fencing capability will send a real-time alert in the case of a hijacking that takes the vehicle outside the bounds of its route, while a deactivation lock will prevent rebels from obtaining the food-aid. Depending on the additional cost of geo-tagging and time-fencing, the WFP may consider purchasing these features as well. However, we consider those technologies to be less necessary as they may present the WFP with several false alarms. Since the expected travel time for a route varies greatly depending on the need for escorts and current road condition and also since drivers may manually mark the location of an incident or security breach, those add-ons may cost more than their worth to the WFP.

As mentioned, the WFP should also implement GPS overtly within its vehicles. In areas with low regulatory quality, control of corruption, political stability, and rule of law, such as the Somali region, a deterrent such as an overt system has more potential to enhance security than a covert system. An insurgent group may back off when it comes upon an aid truck armed with a covert GPS unit. If they know the purpose of the unit, the insurgents may fear tracking by the government. Otherwise, they

may assume that the unit has some more dangerous purpose. Further, drivers themselves will resist assisting insurgent groups if they know that the WFP will monitor their behavior.

The system requires little infrastructure outside of the WFP's vehicles and home office. However, implementation of GPS may not be trouble-free. Although the implementation of individual units is technically simple, each and every vehicle in the WFP's dedicated fleet will need a unit. This implies, of course, that drivers will need to attach the units to their trucks. However, if truck drivers fear the GPS unit (fearing either monitoring or that the unit is actually something more dangerous), they may not place the units within their vehicles in a timely manner. Further, the control system of the GPS will need some technological infrastructure at the country home office in Addis Ababa. While the WFP office in Addis is equipped with internet technology, the service is intermittent and may mean a slower system. However, if the WFP can temper expectations of the system with its employees, then the office will tolerate a slower GPS monitoring tool and change along with the system.

GPS infrastructure and units come at a high price. However, for the security service it provides the WFP's distribution system and the timely nourishment it may help to provide beneficiaries with, the cost may be negligible. Further, in comparison to RFID technologies that have high infrastructure needs, difficult implementation, as well as extravagant costs, GPS's costs are attractive.

Finally, the WFP should use GPS devices *in coordination with* other security measures. Firstly, we believe that escorts play an extremely important role in the safety the WFP's distribution system.

Though traveling with an escort can double the driving time of a route, these escorts also prevent rebel activity, hijackings, lootings and other security issues. However, to continue increasing the efficiencies of the escort system, the WFP should also maintain its Joint Committees with the government and military. With this simple committee, the WFP has already tripled its efficiency.

5 CONCLUSION

The Ethiopian government has handed over to the WFP the difficult task of delivering food-aid into the insecure Somali region. However, though the instability of the Somali environment directly and indirectly increases the theft and loss of food as well as the prices of carriers, the WFP has made incredible strides in actively and efficiently securing its distribution process. Through the creative use of Joint Committees and carrier contracts along with the insightful use of Food Monitors, the WFP has involved each of the distribution stakeholders in the planning of its supply chain.

While the WFP can add technological capabilities to its repertoire of security measures, the technology itself will not prevent rebellion, insurgency, theft, or hijacking. Like many organizations', the key to WFP's supply chain success lies in its communication strategy.

The WFP's strategy of strong local communication and decentralized decision-making enhances their relationship building efforts. At each level of duty, the WFP has built strong relationships – either with the government, with escorts, or with the beneficiaries. For instance, at the EDP level, the WFP communicates expansively with the government and military through the Joint Committee, performing overall decision-making for that area. This further allows the WFP to contract with local carriers, mitigating risk of en route hijackings. Similarly, by hiring local staff to monitor food activities at FDPs, the WFP can directly work with beneficiaries to gain their knowledge without losing their trust. This strategy of strong local communication and decentralized decision-making generates a sense of responsibility and importance for each person involved in the supply chain. It is through this sense of

ownership that individuals will resist temptation of illicit activities and commit to distributing food-aid in an efficient and honest manner.

Though the WFP's individual country organizations operate as separate entities, they would all benefit greatly from coming together to trade "industry" secrets. The different WFP country offices do not necessarily know what one another accomplishes. Each country office, especially in similar geographic areas, could conference the other organizations in their responsibilities, duties, relationships, and progress. Operations facing similar distribution disturbances could explore successful solutions and allow collaboration that could increase efficiencies and shorten implementation processes. Ultimately, each unit would benefit from increased transparency among the entire organization and sector in general.

The WFP should also continue to quantify and analyze the environment of risk that it operates within. It is through such analysis that the WFP can understand the rates charged by carriers, the amount of loss it actually incurs, and affect of mandated processes such as escort. With this knowledge, it can re-negotiate with authorities, private carriers, and other supply-chain stakeholders to receive the most efficient service. More importantly, with this knowledge, the WFP can begin to disperse lessons learned to other humanitarian organizations.

In conclusion, the lessons we have learned from this project are applicable to all humanitarian organizations in less secure areas. By using local resources, decentralizing decision-making, and

maintaining superior relations with the government, humanitarian organizations can secure their supply chains. Further, with a few simple technologies, these organizations can enhance security and claim peace of mind.

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APPENDIX A: BACKGROUND INFORMATION ON INSURGENCY IN THE SOMALI REGION

According to the US Department of State's travel information for Ethiopia (2008), "domestic insurgent groups, extremists from Somalia, and the heavy military buildup along the northern border pose risks to safety and security, particularly along Ethiopia's border areas and in the Somali region." A few of these risks are organized armed insurgent groups such as the Ogaden National Liberation Front (ONLF) and the United Western Somali Liberation Front (UWSLF) as well as the prevalence of clans and poor road conditions. These risks cause the Somali region to remain unpredictable and volatile.

Ogaden National Liberation Front (ONLF)

The ONLF has been battling the Ethiopian Defense Force (EDF) for years in an attempt to gain greater autonomy for the Somali region (Reuters ALertNet, 2007). In 2007, the "ONLF killed 74 people in an attack on a Chinese run oil exploration field" (Reuters AlertNet 2007) and since then, the government has attempted to concentrate on controlling the insurgency. However, according to the US State Department, a "hotel in the town of Jijiga was bombed and two hotels in the town of Negele Borena were bombed" in 2008 and as recently as February 2009, fierce battles between the ONLF, EDF and militia have taken place with numerous casualties. During a five day battle from February 2009, 140 Ethiopian soldiers and 29 ONLF members were killed. Although the numbers of casualties is disputed by the government, the fact that fighting took place was not. (McLure, 2009).

United Western Somali Liberation Front (UWSLF)

According to a press release published in the Sudan Tribute (2006), "the United Western Somali Liberation Front (UWSLF) ... is political and armed organization dedicated for the right and freedom of Western Somali (Ogaden)". A military communiqué from the UWSLF Information Office in 2006 announced an attack that took place in the Somali region in which 39 soldiers were killed. In September of 2006, 2 International Committee of the Red Cross and Red Crescent (ICRC) members were kidnapped and subsequently released (ICRC, 2006).

Clan Fighting

The Somali region is home to a significant number of nomadic clans and sub clans. However, these clans often fight with each other over basic needs such as land and water sources. In 2006, two sub-clans who belonged to the same parent clan, had a disagreement about "the construction of a water reservoir" which resulted in 39 deaths (IRIN-Africa, 2006). More recently, 300 people were killed and thousands were forced to flee their homes as a result of clan fighting between the Borana or Oromo and the Garre of Somali. "Violent clashes often occur between the Borana Oromo and Garre Somali, mostly over territorial disagreements and over scarce resources for the two pastoralist communities. The recent drought in southern Ethiopia has escalated the conflict over water wells." (Jimma Times, 2009).

APPENDIX B: SAMPLE WFP REQUEST FOR QUOTATION (RFQ)

Request for Quotations (RfQ)

Our Reference: # [redacted]

March 3, 2009

The above reference number must be indicated on all replies

Offers are invited for a period of six (6) months for the *purpose of transportation service* of the below described commodities under the terms and conditions contained herein.

Only offers received by WFP Ethiopia under following fax number will be accepted: Fax # [redacted] **(Confidential Fax Line or directly into the Tender box as per below address.**

1. Cargo:

1.1 Various Commodities:

Cargo packed in Bags at a unit weight between 50Kg – 25 Kg: **Cereals, Pulse, Blended Food (CSB/Famix) and Vegetable Oil.**

Cargo Packed in Cartons, Boxes, Tins, and Jerycans at a unit weight between 18Kg – 24Kg: **Vegetable Oil.**

2. Origin:

2.1 WFP [redacted] **Warehouse**

2.2 Loaded on mode of transport / trucks:

- *Free on Trucks at WFP and or counter parts warehouses (See attached table)..*

3. Destination(s)

3.1. **Location(s):**

Flat rate per Woreda is applicable to the below listed destinations upto FDP level, and for any new FDP that may come out due to the Emergency operation. Unless stated otherwise in writing from WFP, the attached list of destinations are considered operational sites. (Table deleted upon request from WFP)

Total of minimum 3,500 MT of Mixed Commodities per month for all destinations up to FDP.

3.2 Allocation (quantity per commodity and destination will be communicated to carriers by means of a loading order (LTI)

WFP also reserves the right to change the quantities to the various specific destinations as necessary to react to changing circumstances.

4. Offer

4.1 Your offer should be **Flat Rate per Woreda in *Eth Birr* per MT Gross, and transportation has to be up To FDP Level under the Woreda. Flate rate should be applicable for any new FDP that can arise under its Woreda.** Flat rates are all inclusive of the services listed below.

Rates, which will remain valid for 6 months period regardless of the tonnage/quantity to be transported as advised by WFP.

4.2. Offers will not be valid unless clearly indicated in the attached Quotation.

4.3 Transporters who are not interested to quote for this RFQ are requested to send their regret on the tender fax or deliver the same to the tender box.

5. Services required

5.1. The selected transporter(s) will be requested to confirm the available transport capacity prior the issuance of Landside transport instruction hereinafter referred to as LTI (loading order).

5.2. Upon receipt of the LTI (Loading order), the transporter must position the trucks at the loading point within 24 hours. The transporter must ensure the loaded tonnage does not exceed the axle load limitation in the country where the transport will take place.

5.3. The transporter must also ensure the driver and trucks have all the necessary permits and documentation to carry out the requested transport.

5.4. The Transport Company ensures that the relief commodities are lifted within the time frame specified on the LTI and each consignment (truckload) delivered within the maximum delivery time given in the LTI.

6. Costs

6.1 All costs to be incurred, envisaged by the Contractor and considered to be for the account of WFP must be included at this stage. No other costs other than those included in the offer will be accepted.

6.2. Said costs are to be applied to the distance covered under load to the destinations, return distance being always excluded

Handling cost is paid by WFP.

6.3. For bagged commodities, the payment will be made based on **Gross** weight as per WFP waybill.

Vegetable Oil will be paid on actual truck pay load (as certified by Ethiopian Road Transport Authority) and with maximum carton stacking of 6 layers. Trucks with high sideboard ('sponda') are preferred for Oil loads.

6.4. All costs arising from Transporter non-performance or poor performance of the Contractor shall be for Transporter account.

The rates quoted will remain valid for a period of one year from the date of the award.

6.5. WFP reserves the right to extend the validity of the rate quoted for a further period of time to be notified later and agreed by all parties.

7. Commencement, execution and Completion of transport / and other services required:

7.1. Date of Commencement: Upon award

Completion Date: After 6 months

7.2 WFP shall inform the Contractor in advance of the commencement date of the operation and inform the Contractor through the Loading Order (specifying quantity and destination). Under all circumstances, the Contractor will co-ordinate closely with WFP.

7.3 The overall performance of the Contractor will influence future evaluation of offers. The following criteria are considered by WFP while assessing the Transport Company performance:

- Promptness in placing trucks at loading point
- Completion of uplift within period specified in the LTI (Loading order)
- Completion of delivery within agreed delivery time
- Nil or minimum transit losses
- Prompt and comprehensive reporting
- Continuous feedback in case of breakdown, accident or security incident
- Failure to perform as per your submitted offer will lead to a temporary suspension of at least 6 months or even an exclusion from the WFP short-list.
- Accurate presentation of transporter invoice to WFP.

7.4 Should the Contractor fail to provide required transport capacity in the agreed period of time WFP reserves the right to charge to the Contractor the penalty of ETB 20 (Twenty Ethiopian Birr) per MT for each day of delay until the agreed tonnage is uplifted or the LTI/Transport Instruction or Award terminated.

7.5 All transport must be carried out safely and expeditiously; The contractor will be responsible for providing the required amount of transport units (e.g. number of trucks) to complete the delivery within the agreed period and take all necessary steps to ensure that all transport units are in good operational condition at all times.

8. Missing / Damaged commodities:

8.1 The cargo shall be delivered at the destination in good condition and the contractor shall take all necessary precautions for the care of the cargo whilst under his responsibility. The contractor shall assume full responsibility for the cargo (quantity, condition and integrity) whilst in his custody or that of his employees, agents or subcontractors.

8.2 Leakage and / or spillage shall not be tolerated and shall be considered as losses (missing quantities). For the purpose of this RfQ, leakage or spillage is defined as a shortage in weight of units at destination compared with the weight of units as declared on the waybill and signed at the point of origin where the contractor took over the responsibility over the commodities.

8.3 All missing or damaged commodities and any excess spillage or leakage during the period under your responsibility will be debited against transport invoices based on the arrived commodity value or the market value at final destination, whichever is greater. The arrived value at destination is calculated by adding all transport and related costs to the value of commodity at source.

8.4 Damaged/missing items shall be identified by WFP and /or its superintendents or/and designated consignee and recorded on transport waybill, which has to be signed by both, the contractor and consignee/receiving party.

8.5 The Contractor shall not be obliged to load damaged cargo at the point of cargo receipt, unless expressly requested by WFP, in writing, and agreed to by the contractor

9. Awarding

WFP reserves the right to award the agreement to one or more contractors. WFP reserves the right to withdraw the award in whole or in part should the successful contractor be unable to provide uptake capacity necessary or the delivery within the specific period and/or is unable to provide in full the agreed services.

10. Payments

10.1 Payment shall be made within 30 working days only upon the receipt of a query free invoice in line with the Loading Order and quantities specified there in.

10.2 The invoice(s) must be accompanied by originally signed transport waybills for the entire movement duly signed and stamped (indicating number of units received) by official recipient of WFP official/consignee and the WFP Loading Order.

10.3 Payment by WFP will be effected directly into a Bank account or check in the country wherein the movement is taking place, or where the trucks as well as contractor are registered.

11. Liability

WFP, the United Nations, its agencies and organizations, its employees and agents shall be exempt from any liability in respect of any direct, indirect or consequential loss and/or damage and/or injury sustained by the contractor, its employees, agents or any third party arising from this agreement or the performance thereof which is undertaken entirely at the risk of the contractor, its agents, or employees. Should any claim arise, the contractor will indemnify WFP and hold harmless WFP, United Nations, its agencies and organizations, its employees and agents from any liability.

In addition, the Contractor shall assume full responsibility for any fraudulent and/or illegal acts it commits knowingly or unknowingly and WFP shall be exempt from any liability whatsoever in this respect.

12. Reporting

The Contractor shall fulfil reporting obligations regularly to WFP Ethiopia as agreed during transport operations, through electronic mail (see below addresses) or by fax (WFP Logistics Office Fax # 00251-115-503799)or via mobile phone

13. Law and Arbitration Clause

This Agreement, and any dispute arising there from, shall be governed by general principles of law, to the exclusion of any single national system of law. Any dispute between the parties concerning the interpretation and the execution of the Contract that is unresolved after conciliation shall, at the request of either party be settled by arbitration in accordance with the Arbitration Rules of the United Nations Commission on International Trade Law (UNCITRAL), as at present in force. Any arbitration award rendered in accordance with the provisions of this article shall be final and binding on the Parties.

14. UN Immunity Clause

Nothing in this agreement shall imply a waiver by United Nations World Food Programme, the United Nations or any of its Agencies or Organizations of any privileges or immunity enjoyed by them or by their acceptance of the jurisdiction of the courts of any country over disputes arising out of this agreement.

15. Termination

15.1 Any non-performance related to the terms and conditions of this RFQ by the Contractor shall be deemed as a breach of the agreement and the agreement may be terminated immediately by WFP

15.2 In the event that Carrier commits an act of bankruptcy or has a receiving order made against him or makes any arrangement with his creditors or if distress or execution is levied or threatened upon any of Carrier's property, this Agreement shall automatically and without notice terminate.

15.3 If relief operations to Ethiopia are suspended or if WFP for any reason whatsoever ceases to operate an emergency relief Programme in the Ethiopia, this Agreement shall terminate without notice.

15.4 In the event of termination of this Agreement Carrier will deliver all cargos in transit to their destinations and return any equipment belong to WFP within a reasonable period of time.

15.5 If at any time during the course of the Award it shall become impossible for any of the parties hereto to perform any of its obligations for reason of force majeure, that party shall promptly notify the other in writing of the existence of such force majeure whereupon the party giving notice shall be relieved from such obligations as long as force majeure persists.

16. Sexual Exploitation and Abuse:

The United Nations and WFP are committed to the protection of vulnerable populations in humanitarian crisis, including from sexual exploitation or abuse. By entering into an agreement with WFP, the Contractor undertakes to adhere to the standard of conduct established to this effect by the United Nations and to ensure that its personnel conforms to the highest standards of moral and ethical conduct. Any failure by the Contractor to take preventive measures against sexual exploitation or abuse, to investigate allegations thereof or to take corrective action, shall constitute grounds for termination of the agreement.

Contractor employees are prohibited from staying overnight at a beneficiary camp.

17. <u>Replies</u>

(Deleted for disclosure purposes)

APPENDIX C: RAW DATA FROM CARRIER ANALYSIS

EDP	FDP	Cost($) / km	Driving Time (hrs)	% Paved	% Gravel	% Dirt/ Other	Road Risk	% Green	% Yellow	% Red	Escort Risk	Total Risk
1	C	0.01123	3.786	0%	0%	100%	2.000	67%	0%	33%	0.667	2.667
1	C	0.01056	3.786	0%	0%	100%	2.000	67%	0%	33%	0.667	2.667
1	C	0.01175	3.786	0%	0%	100%	2.000	67%	0%	33%	0.667	2.667
1	C	0.01123	3.786	0%	0%	100%	2.000	67%	0%	33%	0.667	2.667
1	C	0.01123	3.786	0%	0%	100%	2.000	67%	0%	33%	0.667	2.667
1	C	0.01056	3.786	0%	0%	100%	2.000	100%	0%	0%	0.000	2.000
1	D	0.00246	6.394	60%	24%	17%	0.569	100%	0%	0%	0.000	0.569
1	D	0.00227	6.394	60%	24%	17%	0.569	100%	0%	0%	0.000	0.569
1	D	0.00302	6.394	60%	24%	17%	0.569	100%	0%	0%	0.000	0.569
1	D	0.00265	6.394	60%	24%	17%	0.569	100%	0%	0%	0.000	0.569
1	D	0.00302	6.394	60%	24%	17%	0.569	100%	0%	0%	0.000	0.569
1	D	0.00299	6.394	60%	24%	17%	0.569	100%	0%	0%	0.000	0.569
1	D	0.00265	6.394	60%	24%	17%	0.569	100%	0%	0%	0.000	0.569
1	D	0.00246	6.394	60%	24%	17%	0.569	100%	0%	0%	0.000	0.569
1	F	0.00246	5.363	78%	20%	2%	0.235	100%	0%	0%	0.000	0.235
1	F	0.00246	5.363	78%	20%	2%	0.235	100%	0%	0%	0.000	0.235
1	F	0.00246	5.363	78%	20%	2%	0.235	100%	0%	0%	0.000	0.235
1	F	0.00246	5.363	78%	20%	2%	0.235	100%	0%	0%	0.000	0.235
1	F	0.00246	5.363	78%	20%	2%	0.235	100%	0%	0%	0.000	0.235
1	F	0.00246	5.363	78%	20%	2%	0.235	100%	0%	0%	0.000	0.235
1	H	0.00257	20.620	0%	43%	57%	1.573	83%	0%	17%	0.333	1.907
1	H	0.00267	20.620	0%	43%	57%	1.573	83%	0%	17%	0.333	1.907
1	H	0.00267	20.620	0%	43%	57%	1.573	83%	0%	17%	0.333	1.907
1	H	0.00267	20.620	0%	43%	57%	1.573	83%	0%	17%	0.333	1.907
1	H	0.00267	20.620	0%	43%	57%	1.573	83%	0%	17%	0.333	1.907
1	H	0.00267	20.620	0%	43%	57%	1.573	83%	0%	17%	0.333	1.907
1	H	0.00267	20.620	0%	43%	57%	1.573	83%	0%	17%	0.333	1.907
1	H	0.00267	20.620	0%	43%	57%	1.573	83%	0%	17%	0.333	1.907
1	H	0.00267	20.620	0%	43%	57%	1.573	83%	0%	17%	0.333	1.907
1	H	0.00248	20.620	0%	43%	57%	1.573	83%	0%	17%	0.333	1.907
1	H	0.00267	20.620	0%	43%	57%	1.573	83%	0%	17%	0.333	1.907
1	J	0.00419	11.935	0%	0%	100%	2.000	75%	0%	25%	0.500	2.500
1	J	0.00419	11.935	0%	0%	100%	2.000	75%	0%	25%	0.500	2.500
1	J	0.00419	11.935	0%	0%	100%	2.000	75%	0%	25%	0.500	2.500
1	J	0.00419	11.935	0%	0%	100%	2.000	75%	0%	25%	0.500	2.500
1	J	0.00419	11.935	0%	0%	100%	2.000	75%	0%	25%	0.500	2.500
1	P	0.00559	4.946	0%	95%	5%	1.053	0%	0%	100%	2.000	3.053
1	P	0.00559	4.946	0%	95%	5%	1.053	0%	0%	100%	2.000	3.053
1	P	0.00638	4.946	0%	95%	5%	1.053	0%	0%	100%	2.000	3.053
1	P	0.00638	4.946	0%	95%	5%	1.053	0%	0%	100%	2.000	3.053
1	P	0.00692	4.946	0%	95%	5%	1.053	0%	0%	100%	2.000	3.053
1	P	0.00638	4.946	0%	95%	5%	1.053	0%	0%	100%	2.000	3.053
1	Z	0.00567	10.580	0%	0%	100%	2.000	67%	0%	33%	0.667	2.667
1	Z	0.0052	10.580	0%	0%	100%	2.000	67%	0%	33%	0.667	2.667
1	Z	0.00567	10.580	0%	0%	100%	2.000	67%	0%	33%	0.667	2.667
1	Z	0.00567	10.580	0%	0%	100%	2.000	67%	0%	33%	0.667	2.667
1	Z	0.00567	10.580	0%	0%	100%	2.000	67%	0%	33%	0.667	2.667
1	Z	0.00567	10.580	0%	0%	100%	2.000	67%	0%	33%	0.667	2.667
1	Z	0.0052	10.580	0%	0%	100%	2.000	67%	0%	33%	0.667	2.667

EDP	FDP	Cost($) / km	Driving Time (hrs)	% Paved	% Gravel	% Dirt/ Other	Road Risk	% Green	% Yellow	% Red	Escort Risk	Total Risk
1	Z	0.0052	10.580	0%	0%	100%	2.000	67%	0%	33%	0.667	2.667
1	Z	0.00567	10.580	0%	0%	100%	2.000	67%	0%	33%	0.667	2.667
1	Z	0.0052	10.580	0%	0%	100%	2.000	67%	0%	33%	0.667	2.667
1	Z	0.00543	10.580	0%	0%	100%	2.000	67%	0%	33%	0.667	2.667
1	Z	0.00543	10.580	0%	0%	100%	2.000	67%	0%	33%	0.667	2.667
1	EE	0.00275	4.088	94%	0%	6%	0.123	100%	0%	0%	0.000	0.123
1	EE	0.00275	4.088	94%	0%	6%	0.123	100%	0%	0%	0.000	0.123
1	EE	0.00275	4.088	94%	0%	6%	0.123	100%	0%	0%	0.000	0.123
1	GG	0.00257	6.952	59%	18%	23%	0.644	100%	0%	0%	0.000	0.644
1	GG	0.00257	6.952	59%	18%	23%	0.644	100%	0%	0%	0.000	0.644
1	GG	0.00257	6.952	59%	18%	23%	0.644	100%	0%	0%	0.000	0.644
1	GG	0.00257	6.952	59%	18%	23%	0.644	100%	0%	0%	0.000	0.644
1	GG	0.00242	6.952	59%	18%	23%	0.644	100%	0%	0%	0.000	0.644
1	GG	0.00242	6.952	59%	18%	23%	0.644	100%	0%	0%	0.000	0.644
1	GG	0.00242	6.952	59%	18%	23%	0.644	100%	0%	0%	0.000	0.644
1	GG	0.00257	6.952	59%	18%	23%	0.644	100%	0%	0%	0.000	0.644
1	GG	0.00257	6.952	59%	18%	23%	0.644	100%	0%	0%	0.000	0.644
1	II	0.00474	1.812	98%	0%	2%	0.030	100%	0%	0%	0.000	0.030
1	II	0.00521	1.812	98%	0%	2%	0.030	100%	0%	0%	0.000	0.030
1	II	0.00521	1.812	98%	0%	2%	0.030	100%	0%	0%	0.000	0.030
1	II	0.00474	1.812	98%	0%	2%	0.030	100%	0%	0%	0.000	0.030
1	II	0.00559	1.812	98%	0%	2%	0.030	100%	0%	0%	0.000	0.030
1	II	0.00559	1.812	98%	0%	2%	0.030	100%	0%	0%	0.000	0.030
1	II	0.00559	1.812	98%	0%	2%	0.030	100%	0%	0%	0.000	0.030
1	II	0.00559	1.812	98%	0%	2%	0.030	100%	0%	0%	0.000	0.030
1	II	0.00559	1.812	98%	0%	2%	0.030	100%	0%	0%	0.000	0.030
1	II	0.00521	1.812	98%	0%	2%	0.030	100%	0%	0%	0.000	0.030
1	UU	0.00393	7.816	0%	98%	2%	1.024	0%	0%	100%	2.000	3.024
1	UU	0.00393	7.816	0%	98%	2%	1.024	0%	0%	100%	2.000	3.024
1	UU	0.00458	7.816	0%	98%	2%	1.024	0%	0%	100%	2.000	3.024
1	UU	0.00393	7.816	0%	98%	2%	1.024	0%	0%	100%	2.000	3.024
1	UU	0.00393	7.816	0%	98%	2%	1.024	0%	0%	100%	2.000	3.024
1	CC	0.01652	3.329	0%	0%	100%	2.000	0%	0%	100%	2.000	4.000
1	CC	0.01577	3.329	0%	0%	100%	2.000	0%	0%	100%	2.000	4.000
1	CC	0.01803	3.329	0%	0%	100%	2.000	0%	0%	100%	2.000	4.000
1	CC	0.01652	3.329	0%	0%	100%	2.000	0%	0%	100%	2.000	4.000
1	CC	0.01652	3.329	0%	0%	100%	2.000	0%	0%	100%	2.000	4.000
1	M	0.00975	2.309	0%	87%	13%	1.125	0%	0%	100%	2.000	3.125
1	M	0.00975	2.309	0%	87%	13%	1.125	0%	0%	100%	2.000	3.125
1	M	0.00975	2.309	0%	87%	13%	1.125	0%	0%	100%	2.000	3.125
1	M	0.00975	2.309	0%	87%	13%	1.125	0%	0%	100%	2.000	3.125
1	M	0.00975	2.309	0%	87%	13%	1.125	0%	0%	100%	2.000	3.125
2	B	0.0053	3.618	1%	61%	37%	1.364	100%	0%	0%	0.000	1.364
2	B	0.0053	3.618	1%	61%	37%	1.364	100%	0%	0%	0.000	1.364
2	B	0.0053	3.618	1%	61%	37%	1.364	100%	0%	0%	0.000	1.364
2	B	0.00474	3.618	1%	61%	37%	1.364	100%	0%	0%	0.000	1.364
2	E	0.00275	4.090	1%	99%	0%	0.994	100%	0%	0%	0.000	0.994
2	E	0.00214	4.090	1%	99%	0%	0.994	100%	0%	0%	0.000	0.994
2	E	0.00294	4.090	1%	99%	0%	0.994	100%	0%	0%	0.000	0.994
2	E	0.00294	4.090	1%	99%	0%	0.994	100%	0%	0%	0.000	0.994

EDP	FDP	Cost($) / km	Driving Time (hrs)	% Paved	% Gravel	% Dirt/ Other	Road Risk	% Green	% Yellow	% Red	Escort Risk	Total Risk
2	E	0.00238	4.090	1%	99%	0%	0.994	100%	0%	0%	0.000	0.994
2	E	0.00214	4.090	1%	99%	0%	0.994	100%	0%	0%	0.000	0.994
2	E	0.00201	4.090	1%	99%	0%	0.994	100%	0%	0%	0.000	0.994
2	E	0.00294	4.090	1%	99%	0%	0.994	100%	0%	0%	0.000	0.994
2	E	0.00294	4.090	1%	99%	0%	0.994	100%	0%	0%	0.000	0.994
2	E	0.00294	4.090	1%	99%	0%	0.994	100%	0%	0%	0.000	0.994
2	E	0.00275	4.090	1%	99%	0%	0.994	100%	0%	0%	0.000	0.994
2	E	0.00299	4.090	1%	99%	0%	0.994	100%	0%	0%	0.000	0.994
2	O	0.00633	2.303	1%	88%	11%	1.098	100%	0%	0%	0.000	1.098
2	O	0.00601	2.303	1%	88%	11%	1.098	100%	0%	0%	0.000	1.098
2	O	0.00601	2.303	1%	88%	11%	1.098	100%	0%	0%	0.000	1.098
2	O	0.00589	2.303	1%	88%	11%	1.098	100%	0%	0%	0.000	1.098
2	O	0.00469	2.303	1%	88%	11%	1.098	100%	0%	0%	0.000	1.098
2	O	0.00601	2.303	1%	88%	11%	1.098	100%	0%	0%	0.000	1.098
2	O	0.00601	2.303	1%	88%	11%	1.098	100%	0%	0%	0.000	1.098
2	O	0.00633	2.303	1%	88%	11%	1.098	100%	0%	0%	0.000	1.098
2	O	0.00601	2.303	1%	88%	11%	1.098	100%	0%	0%	0.000	1.098
2	O	0.00601	2.303	1%	88%	11%	1.098	100%	0%	0%	0.000	1.098
2	O	0.00601	2.303	1%	88%	11%	1.098	100%	0%	0%	0.000	1.098
2	O	0.00601	2.303	1%	88%	11%	1.098	100%	0%	0%	0.000	1.098
2	O	0.00601	2.303	1%	88%	11%	1.098	100%	0%	0%	0.000	1.098
2	U	0.00579	1.880	2%	89%	9%	1.077	100%	0%	0%	0.000	1.077
2	U	0.00579	1.880	2%	89%	9%	1.077	100%	0%	0%	0.000	1.077
2	U	0.00506	1.880	2%	89%	9%	1.077	100%	0%	0%	0.000	1.077
2	U	0.00506	1.880	2%	89%	9%	1.077	100%	0%	0%	0.000	1.077
2	U	0.00506	1.880	2%	89%	9%	1.077	100%	0%	0%	0.000	1.077
2	U	0.00362	1.880	2%	89%	9%	1.077	100%	0%	0%	0.000	1.077
2	U	0.00622	1.880	2%	89%	9%	1.077	100%	0%	0%	0.000	1.077
2	U	0.00636	1.880	2%	89%	9%	1.077	100%	0%	0%	0.000	1.077
2	U	0.00636	1.880	2%	89%	9%	1.077	100%	0%	0%	0.000	1.077
2	U	0.00636	1.880	2%	89%	9%	1.077	100%	0%	0%	0.000	1.077
2	U	0.00636	1.880	2%	89%	9%	1.077	100%	0%	0%	0.000	1.077
2	W	0.00325	8.999	30%	22%	48%	1.175	75%	0%	25%	0.500	1.675
2	W	0.00287	8.999	30%	22%	48%	1.175	75%	0%	25%	0.500	1.675
2	W	0.00287	8.999	30%	22%	48%	1.175	75%	0%	25%	0.500	1.675
2	W	0.00317	8.999	30%	22%	48%	1.175	75%	0%	25%	0.500	1.675
2	W	0.00325	8.999	30%	22%	48%	1.175	75%	0%	25%	0.500	1.675
2	W	0.00325	8.999	30%	22%	48%	1.175	75%	0%	25%	0.500	1.675
2	FF	0.00385	5.766	31%	69%	0%	0.693	33%	0%	67%	1.333	2.026
2	FF	0.00385	5.766	31%	69%	0%	0.693	33%	0%	67%	1.333	2.026
2	FF	0.00385	5.766	31%	69%	0%	0.693	33%	0%	67%	1.333	2.026
2	FF	0.00346	5.766	31%	69%	0%	0.693	33%	0%	67%	1.333	2.026
2	FF	0.00385	5.766	31%	69%	0%	0.693	33%	0%	67%	1.333	2.026
2	FF	0.00463	5.766	31%	69%	0%	0.693	33%	0%	67%	1.333	2.026
2	HH	0.00262	2.631	93%	7%	0%	0.065	100%	0%	0%	0.000	0.065
2	HH	0.00262	2.631	93%	7%	0%	0.065	100%	0%	0%	0.000	0.065
2	HH	0.00262	2.631	93%	7%	0%	0.065	100%	0%	0%	0.000	0.065
2	HH	0.00262	2.631	93%	7%	0%	0.065	100%	0%	0%	0.000	0.065
2	HH	0.00262	2.631	93%	7%	0%	0.065	100%	0%	0%	0.000	0.065
2	HH	0.00294	2.631	93%	7%	0%	0.065	100%	0%	0%	0.000	0.065

EDP	FDP	Cost($) / km	Driving Time (hrs)	% Paved	% Gravel	% Dirt/ Other	Road Risk	% Green	% Yellow	% Red	Escort Risk	Total Risk
2	HH	0.00294	2.631	93%	7%	0%	0.065	100%	0%	0%	0.000	0.065
2	HH	0.00327	2.631	93%	7%	0%	0.065	100%	0%	0%	0.000	0.065
2	HH	0.00262	2.631	93%	7%	0%	0.065	100%	0%	0%	0.000	0.065
2	MM	0.00337	11.000	9%	36%	55%	1.456	33%	0%	67%	1.333	2.790
2	OO	0.00229	3.781	100%	0%	0%	0.000	100%	0%	0%	0.000	0.000
2	OO	0.00229	3.781	100%	0%	0%	0.000	100%	0%	0%	0.000	0.000
2	OO	0.00229	3.781	100%	0%	0%	0.000	100%	0%	0%	0.000	0.000
2	OO	0.00229	3.781	100%	0%	0%	0.000	100%	0%	0%	0.000	0.000
2	OO	0.00229	3.781	100%	0%	0%	0.000	100%	0%	0%	0.000	0.000
2	RR	0.00216	7.950	72%	27%	0%	0.282	24%	0%	76%	1.529	1.812
2	RR	0.00276	7.950	72%	27%	0%	0.282	24%	0%	76%	1.529	1.812
2	RR	0.00264	7.950	72%	27%	0%	0.282	24%	0%	76%	1.529	1.812
2	RR	0.00276	7.950	72%	27%	0%	0.282	24%	0%	76%	1.529	1.812
2	RR	0.00276	7.950	72%	27%	0%	0.282	24%	0%	76%	1.529	1.812
2	VV	0.00067	12.903	50%	47%	3%	0.525	100%	0%	0%	0.000	0.525
2	VV	0.00067	12.903	50%	47%	3%	0.525	100%	0%	0%	0.000	0.525
2	VV	0.00067	12.903	50%	47%	3%	0.525	100%	0%	0%	0.000	0.525
2	VV	0.00067	12.903	50%	47%	3%	0.525	100%	0%	0%	0.000	0.525
2	VV	0.00067	12.903	50%	47%	3%	0.525	100%	0%	0%	0.000	0.525
2	VV	0.00067	12.903	50%	47%	3%	0.525	100%	0%	0%	0.000	0.525
2	VV	0.00067	12.903	50%	47%	3%	0.525	100%	0%	0%	0.000	0.525
2	VV	0.00067	12.903	50%	47%	3%	0.525	100%	0%	0%	0.000	0.525
2	VV	0.00067	12.903	50%	47%	3%	0.525	100%	0%	0%	0.000	0.525
2	VV	0.00067	12.903	50%	47%	3%	0.525	100%	0%	0%	0.000	0.525
2	VV	0.00067	12.903	50%	47%	3%	0.525	100%	0%	0%	0.000	0.525
2	VV	0.00067	12.903	50%	47%	3%	0.525	100%	0%	0%	0.000	0.525
2	VV	0.00067	12.903	50%	47%	3%	0.525	100%	0%	0%	0.000	0.525
2	VV	0.00067	12.903	50%	47%	3%	0.525	100%	0%	0%	0.000	0.525
2	SS	0.00553	11.895	9%	33%	58%	1.488	33%	0%	67%	1.333	2.821
2	NN	0.00516	3.706	45%	55%	0%	0.548	100%	0%	0%	0.000	0.548
2	NN	0.00516	3.706	45%	55%	0%	0.548	100%	0%	0%	0.000	0.548
2	NN	0.00052	3.706	45%	55%	0%	0.548	100%	0%	0%	0.000	0.548
3	A	0.00718	1.671	0%	86%	14%	1.144	100%	0%	0%	0.000	1.144
3	A	0.00941	1.671	0%	86%	14%	1.144	100%	0%	0%	0.000	1.144
3	A	0.01052	1.671	0%	86%	14%	1.144	100%	0%	0%	0.000	1.144
3	A	0.00941	1.671	0%	86%	14%	1.144	100%	0%	0%	0.000	1.144
3	A	0.00941	1.671	0%	86%	14%	1.144	100%	0%	0%	0.000	1.144
3	A	0.01026	1.671	0%	86%	14%	1.144	100%	0%	0%	0.000	1.144
3	A	0.01146	1.671	0%	86%	14%	1.144	100%	0%	0%	0.000	1.144
3	A	0.01197	1.671	0%	86%	14%	1.144	100%	0%	0%	0.000	1.144
3	G	0.00508	7.820	0%	73%	27%	1.272	100%	0%	0%	0.000	1.272
3	G	0.00508	7.820	0%	73%	27%	1.272	100%	0%	0%	0.000	1.272
3	G	0.00508	7.820	0%	73%	27%	1.272	100%	0%	0%	0.000	1.272
3	G	0.00508	7.820	0%	73%	27%	1.272	100%	0%	0%	0.000	1.272
3	G	0.00508	7.820	0%	73%	27%	1.272	100%	0%	0%	0.000	1.272
3	G	0.00508	7.820	0%	73%	27%	1.272	100%	0%	0%	0.000	1.272
3	G	0.00508	7.820	0%	73%	27%	1.272	100%	0%	0%	0.000	1.272
3	G	0.00508	7.820	0%	73%	27%	1.272	100%	0%	0%	0.000	1.272
3	G	0.00508	7.820	0%	73%	27%	1.272	100%	0%	0%	0.000	1.272
3	N	0.01269	1.576	0%	100%	0%	1.000	0%	0%	100%	2.000	3.000

EDP	FDP	Cost($) / km	Driving Time (hrs)	% Paved	% Gravel	% Dirt/ Other	Road Risk	% Green	% Yellow	% Red	Escort Risk	Total Risk
3	N	0.01269	1.576	0%	100%	0%	1.000	0%	0%	100%	2.000	3.000
3	N	0.01269	1.576	0%	100%	0%	1.000	0%	0%	100%	2.000	3.000
3	N	0.01269	1.576	0%	100%	0%	1.000	0%	0%	100%	2.000	3.000
3	N	0.01269	1.576	0%	100%	0%	1.000	0%	0%	100%	2.000	3.000
3	S	0.00628	8.685	0%	2%	98%	1.983	30%	50%	20%	0.900	2.883
3	S	0.00571	8.685	0%	2%	98%	1.983	30%	50%	20%	0.900	2.883
3	S	0.00571	8.685	0%	2%	98%	1.983	30%	50%	20%	0.900	2.883
3	S	0.00571	8.685	0%	2%	98%	1.983	30%	50%	20%	0.900	2.883
3	S	0.00571	8.685	0%	2%	98%	1.983	30%	50%	20%	0.900	2.883
3	S	0.00571	8.685	0%	2%	98%	1.983	30%	50%	20%	0.900	2.883
3	V	0.00546	6.706	0%	78%	22%	1.221	0%	100%		1.000	2.221
3	V	0.00546	6.706	0%	78%	22%	1.221	0%	100%		1.000	2.221
3	V	0.00546	6.706	0%	78%	22%	1.221	0%	100%		1.000	2.221
3	V	0.00546	6.706	0%	78%	22%	1.221	0%	100%		1.000	2.221
3	V	0.00546	6.706	0%	78%	22%	1.221	0%	100%		1.000	2.221
3	AA	0.00381	16.439	0%	44%	56%	1.564	0%	25%	75%	1.750	3.314
3	AA	0.00381	16.439	0%	44%	56%	1.564	0%	25%	75%	1.750	3.314
3	AA	0.00381	16.439	0%	44%	56%	1.564	0%	25%	75%	1.750	3.314
3	AA	0.00381	16.439	0%	44%	56%	1.564	0%	25%	75%	1.750	3.314
3	AA	0.00381	16.439	0%	44%	56%	1.564	0%	25%	75%	1.750	3.314
3	AA	0.00381	16.439	0%	44%	56%	1.564	0%	25%	75%	1.750	3.314
3	AA	0.00369	16.439	0%	44%	56%	1.564	0%	25%	75%	1.750	3.314
3	AA	0.00397	16.439	0%	44%	56%	1.564	0%	25%	75%	1.750	3.314
3	AA	0.00404	16.439	0%	44%	56%	1.564	0%	25%	75%	1.750	3.314
3	AA	0.00404	16.439	0%	44%	56%	1.564	0%	25%	75%	1.750	3.314
3	AA	0.00404	16.439	0%	44%	56%	1.564	0%	25%	75%	1.750	3.314
3	AA	0.00404	16.439	0%	44%	56%	1.564	0%	25%	75%	1.750	3.314
3	Y	0.0075	6.997	0%	39%	61%	1.614	0%	0%	100%	2.000	3.614
3	Y	0.00692	6.997	0%	39%	61%	1.614	0%	0%	100%	2.000	3.614
3	Y	0.00692	6.997	0%	39%	61%	1.614	0%	0%	100%	2.000	3.614
3	Y	0.00692	6.997	0%	39%	61%	1.614	0%	0%	100%	2.000	3.614
3	JJ	0.00691	3.980	0%	100%	0%	1.000	0%	0%	100%	2.000	3.000
3	JJ	0.00691	3.980	0%	100%	0%	1.000	0%	0%	100%	2.000	3.000
3	JJ	0.00691	3.980	0%	100%	0%	1.000	0%	0%	100%	2.000	3.000
3	JJ	0.00691	3.980	0%	100%	0%	1.000	0%	0%	100%	2.000	3.000
3	JJ	0.00691	3.980	0%	100%	0%	1.000	0%	0%	100%	2.000	3.000
3	JJ	0.00879	3.980	0%	100%	0%	1.000	0%	0%	100%	2.000	3.000
3	QQ	0.00612	4.698	0%	95%	5%	1.046	0%	100%	0%	1.000	2.046
3	QQ	0.00612	4.698	0%	95%	5%	1.046	0%	100%	0%	1.000	2.046
3	QQ	0.00612	4.698	0%	95%	5%	1.046	0%	100%	0%	1.000	2.046
3	QQ	0.00612	4.698	0%	95%	5%	1.046	0%	100%	0%	1.000	2.046
3	QQ	0.00612	4.698	0%	95%	5%	1.046	0%	100%	0%	1.000	2.046
3	QQ	0.00612	4.698	0%	95%	5%	1.046	0%	100%	0%	1.000	2.046
3	QQ	0.00612	4.698	0%	95%	5%	1.046	0%	100%	0%	1.000	2.046
3	QQ	0.00612	4.698	0%	95%	5%	1.046	0%	100%	0%	1.000	2.046
3	QQ	0.00612	4.698	0%	95%	5%	1.046	0%	100%	0%	1.000	2.046
3	TT	0.00577	6.062	0%	100%	0%	1.000	0%	0%	100%	2.000	3.000
3	TT	0.00577	6.062	0%	100%	0%	1.000	0%	0%	100%	2.000	3.000
3	TT	0.00577	6.062	0%	100%	0%	1.000	0%	0%	100%	2.000	3.000
3	TT	0.00577	6.062	0%	100%	0%	1.000	0%	0%	100%	2.000	3.000

EDP	FDP	Cost($) / km	Driving Time (hrs)	% Paved	% Gravel	% Dirt/ Other	Road Risk	% Green	% Yellow	% Red	Escort Risk	Total Risk
3	TT	0.00577	6.062	0%	100%	0%	1.000	0%	0%	100%	2.000	3.000
3	WW	0.00465	10.483	0%	61%	39%	1.392	0%	0%	100%	2.000	3.392
3	WW	0.00465	10.483	0%	61%	39%	1.392	0%	0%	100%	2.000	3.392
3	WW	0.00465	10.483	0%	61%	39%	1.392	0%	0%	100%	2.000	3.392
3	WW	0.00495	10.483	0%	61%	39%	1.392	0%	0%	100%	2.000	3.392
3	WW	0.00495	10.483	0%	61%	39%	1.392	0%	0%	100%	2.000	3.392
3	WW	0.00481	10.483	0%	61%	39%	1.392	0%	0%	100%	2.000	3.392
3	WW	0.00481	10.483	0%	61%	39%	1.392	0%	0%	100%	2.000	3.392
3	XX	0.00759	9.144	0%	2%	98%	1.984	50%	50%	0%	0.500	2.484
3	XX	0.00759	9.144	0%	2%	98%	1.984	50%	50%	0%	0.500	2.484
3	XX	0.00759	9.144	0%	2%	98%	1.984	50%	50%	0%	0.500	2.484
3	XX	0.00759	9.144	0%	2%	98%	1.984	50%	50%	0%	0.500	2.484
3	XX	0.00759	9.144	0%	2%	98%	1.984	50%	50%	0%	0.500	2.484
3	XX	0.00759	9.144	0%	2%	98%	1.984	50%	50%	0%	0.500	2.484
3	XX	0.00759	9.144	0%	2%	98%	1.984	50%	50%	0%	0.500	2.484
3	XX	0.00759	9.144	0%	2%	98%	1.984	50%	50%	0%	0.500	2.484
3	XX	0.00759	9.144	0%	2%	98%	1.984	50%	50%	0%	0.500	2.484
3	XX	0.00759	9.144	0%	2%	98%	1.984	50%	50%	0%	0.500	2.484
3	XX	0.00759	9.144	0%	2%	98%	1.984	50%	50%	0%	0.500	2.484
3	XX	0.00759	9.144	0%	2%	98%	1.984	50%	50%	0%	0.500	2.484
3	XX	0.00759	9.144	0%	2%	98%	1.984	50%	50%	0%	0.500	2.484
3	XX	0.00759	9.144	0%	2%	98%	1.984	50%	50%	0%	0.500	2.484
3	XX	0.00759	9.144	0%	2%	98%	1.984	50%	50%	0%	0.500	2.484
3	I	0.00448	7.153	0%	84%	16%	1.165	100%	0%	0%	0.000	1.165
3	I	0.00448	7.153	0%	84%	16%	1.165	100%	0%	0%	0.000	1.165
3	I	0.00448	7.153	0%	84%	16%	1.165	100%	0%	0%	0.000	1.165
3	I	0.00448	7.153	0%	84%	16%	1.165	100%	0%	0%	0.000	1.165
3	K	0.00486	5.966	0%	83%	17%	1.171	0%	0%	100%	2.000	3.171
3	K	0.00486	5.966	0%	83%	17%	1.171	0%	0%	100%	2.000	3.171
3	K	0.00486	5.966	0%	83%	17%	1.171	0%	0%	100%	2.000	3.171
3	K	0.00486	5.966	0%	83%	17%	1.171	0%	0%	100%	2.000	3.171
3	K	0.00486	5.966	0%	83%	17%	1.171	0%	0%	100%	2.000	3.171
3	K	0.00589	5.966	0%	83%	17%	1.171	0%	0%	100%	2.000	3.171
3	T	0.00192	25.726	0%	73%	27%	1.268	50%	50%	0%	0.500	1.768
3	T	0.00192	25.726	0%	73%	27%	1.268	50%	50%	0%	0.500	1.768
3	T	0.00192	25.726	0%	73%	27%	1.268	50%	50%	0%	0.500	1.768
3	T	0.00192	25.726	0%	73%	27%	1.268	50%	50%	0%	0.500	1.768
3	T	0.00192	25.726	0%	73%	27%	1.268	50%	50%	0%	0.500	1.768
3	KK	0.01066	2.150	0%	98%	2%	1.019	0%	100%	0%	1.000	2.019
3	KK	0.01066	2.150	0%	98%	2%	1.019	0%	100%	0%	1.000	2.019
3	KK	0.01066	2.150	0%	98%	2%	1.019	0%	100%	0%	1.000	2.019
3	KK	0.01066	2.150	0%	98%	2%	1.019	0%	100%	0%	1.000	2.019
3	KK	0.01066	2.150	0%	98%	2%	1.019	0%	100%	0%	1.000	2.019
3	KK	0.01066	2.150	0%	98%	2%	1.019	0%	100%	0%	1.000	2.019
3	KK	0.01066	2.150	0%	98%	2%	1.019	0%	100%	0%	1.000	2.019
3	KK	0.01066	2.150	0%	98%	2%	1.019	0%	100%	0%	1.000	2.019
3	KK	0.01066	2.150	0%	98%	2%	1.019	0%	100%	0%	1.000	2.019
3	KK	0.01066	2.150	0%	98%	2%	1.019	0%	100%	0%	1.000	2.019
3	KK	0.01066	2.150	0%	98%	2%	1.019	0%	100%	0%	1.000	2.019
3	KK	0.01066	2.150	0%	98%	2%	1.019	0%	100%	0%	1.000	2.019

APPENDIX D: THE WORLD FOOD PROGRAMME – GUINEA BISSAU

We spoke with Hyoung-Joon Lim a WFP Program Officer currently on leave studying at the Kennedy School of Government. He has worked in Laos, Honduras, and Guinea Bissau. Since Guinea Bissau is located in Africa, we focused on it to make the least variable comparison.

Guinea Bissau has a background of political instability and tensions, including a Coup D'état. Because of this, the WFP works without much government assistance or interference. The lack of government monitoring greatly distinguishes WFP operations in Guinea Bissau from those in Ethiopia.

WFP has two of its own ten ton trucks for use in the distribution of aid. Additionally, the operation employs long-term and short-term contract combinations with external carriers to complete the distributions. Instead of traveling with mandated military escorts, the carriers wait for security clearance from the UN, which tracks the country climate by radio, with two days advance notice and then are on their way. However, other than during the Coup D'état, the UN had routinely given clearance.

The trucks are tracked by radio and the aid-inventory is tracked manually by a "Way Bill". All warehouse managers, carriers, and aid recipient representatives must sign this document and testify to the amount of food-aid received. WFP officials will randomly monitor distribution points to ensure the proper distribution of aid to all beneficiaries.

Finally, the recipient representatives (often school teachers) must also record the number, gender, and age of the beneficiaries so that WFP can track its reach. A Japanese company had donated a satellite basted technology that could be used to send this information directly to WFP home office in Bissau. However, though the technology was very simple, the lack of staff members or government officials available for repeated trainings made it difficult for teachers to use.

The WFP in Guinea Bissau only has two warehouses. Procurement of food normally takes about four months, as the food comes from Asia. However, in the case of a broken pipeline (most often due to resource limitations), the Guinea Bissau operation can apply for emergency funding from WFP headquarters, called IFP funding, or from the UN headquarters, called CRF funding, both for $500,000. This funding will be distributed within 72 hours.

APPENDIX E: US ARMY OPERATIONS AND USE OF TECHNOLOGY IN IRAQ AND AFGHANISTAN

The United States Army operates throughout a spectrum of conflicts ranging from domestic support and relief, to humanitarian operations, peacekeeping efforts, and war. Army operations often take place in regions that are considered to be dangerous or hostile and the Army is therefore forced to address significant risk throughout the entirety of its supply chain. This section will introduce the US Army's operations in Iraq and Afghanistan as well as two tactics that the Army has pursued to mitigate security risk for ground transportation

Operations in Iraq

In Iraq, oil is distributed under heavy surveillance. Convoys are enforced and military escorts are used for deliveries to US Forces. For example, US Army National Guard security forces brigades (SECFOR) are dedicated to securing the ground lines of communication. The Main Supply Route (MSR) coming from Kuwait has been heavily guarded since insurgents destroyed bridges along the route causing it to shut down early on. The route coming from the West is considered to be less dangerous and therefore only requires escorts as the convoys approach the central part of Iraq. The Army has nearly 1000 deliveries of rations per day and has three supporting warehouses in Iraq. Although the Army has attempted to move supplies by railway, they have repeatedly been targets for insurgents and therefore, food is delivered by contractors via ground transportation.

Operations in Afghanistan

Logistics operations in Afghanistan differ greatly from those in Iraq. The operating environment is the key driving force behind the need for alternate operations. In addition to the extremely difficult terrain that blankets Afghanistan, the country also has a limited road network and poor infrastructure. Afghanistan is very susceptible to severe effects from weather, insurgency, and political and economic problems. The Army has four times more troops in Iraq than Afghanistan, contributing to the limited combat logistics patrols in Afghanistan. Although it is a small operation, it is very dangerous and with the limited number of troops and increased risk, the Army opted to contract out the responsibility of distributing oil. Since the distribution of oil is handled entirely by the Army's three prime contractors, military escorts are not used as they are in Iraq. Additionally, local Afghani truck drivers are often used as sensors to gain valuable route intelligence.

Even with contractors handling the distribution of oil, there have still been some instances of disruption of service. 240 contractors have gone missing while delivering goods to the Army in Afghanistan. There is also potential for corruption as contractors are paid upon the delivery of the oil. In response, the Army has begun taking X-rays of the trucks to ensure that they were indeed filled to the appropriate level.

Operations in both Iraq and Afghanistan have also experienced delays in service at the border crossings. The Khyber Pass has been closed several times at the Torkham border between Pakistan and Afghanistan causing re-routing and delays in service. The border between Iraq and Turkey (another supplier of oil) has occasionally been backed up for distances of 23 or 24 miles. This results in wait times of a couple of weeks just to cross the border into Iraq.

Restricted Distribution using Air Transportation

A method being actively pursued is the ability to use aerial resupply methods. During Operation Enduring Freedom (OEF) in Afghanistan, roughly 220-360 containers of supplies were airdropped per day, resulting in a cost of $25 million. This cost of using this Container Delivery System (CDS) was particularly high since the containers and parachutes used were non-recoverable and thus severely depleted the stock of equipment used to perform aerial resupply. (Shopalovich, 2005). The Army is now looking into more efficient methods of airdropping supplies including: the Low Cost Aerial Delivery System (LCADS), the Low Cost Low Altitude (LCLA) aerial resupply, and the Free drop Packaging Concept Project (FPCP).

The Low Cost Aerial Delivery System (LCADS)

The Low Cost Aerial Delivery System (LCADS) program was initiated as a direct result of OEF in Afghanistan. The goal of the program was to develop and field a low cost alternative for the Container Delivery System (CDS). The Army developed new parachutes and containers to reduce costs by 55% while maintaining the same performance, accuracy, and survivability of CDS. LCADS can release cargo weighing between 500-2,200 pounds using low velocity airdrop (500-1,250 feet above ground level) or high velocity airdrop (15,000-25,000 feet above sea level). (Shopalovich, 2005).

Low Cost Low Altitude (LCLA)

Low Cost Low Altitude (LCLA) aerial resupply containers are airdropped at lower altitudes than LCADS when normal resupply methods, such as ground transportation, are not feasible.

Airdropping cargo weighing up to 350 pounds from an altitude of 150-500 feet above ground level increases the accuracy of the delivery and results in less damage to the supplies. Additionally, it minimizes the size of the drop zone, the load dispersion at the drop zone, and the size of the force required to secure the drop zone. One of the goals of LCLA is to reduce the Army's logistics footprint. Dropping supplies less than 50 meters from the designated drop zone with 100% survivability of cargo allows for the easy recovery of loads by two soldiers in under two minutes. This provides a less costly, more rapid, and more accurate delivery of supplies while decreasing the exposure of troops while recovering airdropped supplies. (Zello & Labin, 2008)

Free drop Packaging Concept Project (FPCP)

Despite reduced costs of parachutes using LCADS and LCLA, the parachutes and containers are still typically used only once. Therefore, the Army is developing a method to drop supplies without needing a parachute at all. The Free drop Packaging Concept Project is a facet of LCLA aerial resupply in which 50-150 pounds of cargo are dropped from 50-75 feet above ground level in special energy-absorbing containers that prevent damage to the supplies upon impact. (US Army Logistics Innovation Agency, 2009)

The Army Movement Tracking System (MTS)

The Army has invested in technology measures to enhance security throughout their supply chain. Solutions range from weigh stations to monitor contract carriers, to autonomous guidance units (AGUs) to help guide airdropped supplies, to extensive use of GPS and RFID to monitor vehicles, containers, and individual units. The Movement Tracking System (MTS) was developed to provide greater asset visibility on a battlefield that was becoming increasingly digitized. The two main components of MTS

include a mobile unit that can be installed in vehicles and laptop control stations which remains at headquarters. MTS communicates through satellites and is used primarily to track military logistics convoys and supplies. (Weigner, H.E. & Laudan, J.E., 2005)

MTS provides reliable communication capability, such as pre-formatted text messages, through satellite communication, even when radios or other forms of communications are unavailable. MTS enabled vehicles and control stations can communicate with each other at all times, allowing soldiers and leaders to manage missions more efficiently. Communicating information, potential changes in routes or missions, and other valuable information can be done throughout the duration of the mission itself. (Weigner, H.E. & Laudan, J.E., 2005). In addition to MTS' ability to track vehicles, it has an RFID function which enables in-transit visibility of the supplies being transported by those vehicles. Active RFID tags on cargo or containers are read by an RFID interrogator which is embedded in the MTS unit. This allows control stations to closely monitor the distribution of cargo all the way to its final destination and redirect shipments as necessary. (Weigner, H.E. & Laudan, J.E., 2005).

Although there are numerous benefits from using MTS, there are also several challenges. Satellite systems are reliable for communication purposes; however, procuring satellite coverage is expensive and can be difficult depending on geographic region. Another difficulty is determining an appropriate level of security. MTS abides by security requirements outlined by the Army, but also must ensure that the right information is getting to the right personnel at the right time. A system such as MTS would not be useful if only partial information were communicated while at the same time could be dangerous if too much information were broadcasted and ended up in the wrong hands.

Conclusion

The United States Army has a record of conducting operations in some of the most dangerous parts of the world; however, there is no single solution that can be applied from one region to another. The Army is fortunate to have a number of products, methods, and technologies that can be used to mitigate risk and improve efficiency, safety, and visibility. Monitoring contractor vehicles through weigh stations and x-rays provide basic confidence that goods are being transported properly. Technology such as MTS provides a high level of asset visibility throughout the battlefield and modernized aerial delivery systems provide a means to supply areas difficult to reach via the ground in a cost effective and accurate manner. All of these provide the Army with options which can be implemented in different regions according to mission goals, assets, resources, and risk.

APPENDIX F: THE AMERICAN RED CROSS AND GPS

The American Red Cross (ARC) has hundreds of Emergency Response Vehicles (ERVs) that are responsible for bringing aid in disaster and emergency situations. Previously, ARC had trouble with the accountability of the ERVs in emergency situations. Without technology, ARC had no visibility into where the vehicles were at any moment or how long it would take the vehicles to reach an emergency area. This necessity became more apparent after Hurricane Katrina.

To solve this problem, the ARC team installed Global Positioning System (GPS) units on every vehicle and trailer about 5 years ago. For $350 a unit, ARC installed GPS units the size of a Kleenex box to gather data and transmit it to the Orbit1 web-based system. The system includes geo-fencing. Data from Orbit1 is consolidated into a spreadsheet and distributed to stakeholders. Unfortunately, no cost-benefit analysis was done before installing these units. The security and visibility provided by GPS units was deemed so necessary that a cost-benefit analysis was unnecessary.

There are several challenges to the GPS units. Firstly, many of the truck drivers did not realize that their vehicles were being tracked until much after installation. This, of course, took them by surprise and caused a negative reaction. Also, since the Red Cross distributed the units to the different chapters, it is the chapters that became responsible for the implementation of the units onto the vehicles. Unfortunately, many of these chapters were very busy and did not deploy the GPS units onto each vehicle. Clearly, this decreased the utility of the units and the web system.

Additionally, ARC equipped each ERV with a pink cellular phone. These phones were added at almost zero cost thanks to AT&T. By making these phones pink, ARC has increased their security measures; each phone is immediately recognizable as an ERV phone and because of the stigma attached to the pink color, the phones have low re-sale value.

APPENDIX G: MIT'S POTHOLE PATROL – USING ACCELEROMETERS TO IDENTIFY POTHOLES

CarTel (car telecommunications) is an MIT research project that was initiated in 2004-2005 to monitor infrastructure on or along roadways through the use of sensors. Prior to CarTel, most efforts to monitor infrastructure were based on traffic flow analysis using sensors, such as cameras, along the side of the road. Road conditions have also been monitored using cameras (to take pictures of potholes) or laser sensors (to measure depth of potholes). The CarTel project intended to investigate applications of sensor technology that were not currently being pursued to monitor roads. The Pothole Patrol opted to use accelerometers to measure the dynamic velocity of vehicles in 3 directions: front and back, up and down, and side to side.

The Pothole Patrol installed wireless devices containing 3-axis accelerometers inside the glove compartment of 10 taxis in Boston and Cambridge, Massachusetts. External GPS devices were also mounted on the taxis. GPS data was collected once a second and accelerometer data was collected 600 times per second. This data was then transmitted through a wireless connection for analysis using algorithms to perform statistical analysis to identify events; a method called machine learning.

In order for the algorithm to work properly, the Pothole Patrol drove a car over numerous potholes to gather training data – data that is known to be associated with a specific event. The training data was fed into an algorithm along with characteristics that might be indicative of potholes. The algorithm compared the data collected from the taxis to the training data to identify potential potholes on the

roads. In one week 4,800 bad surface locations were identified in Boston and Cambridge (Pothole Patrol, 2007).

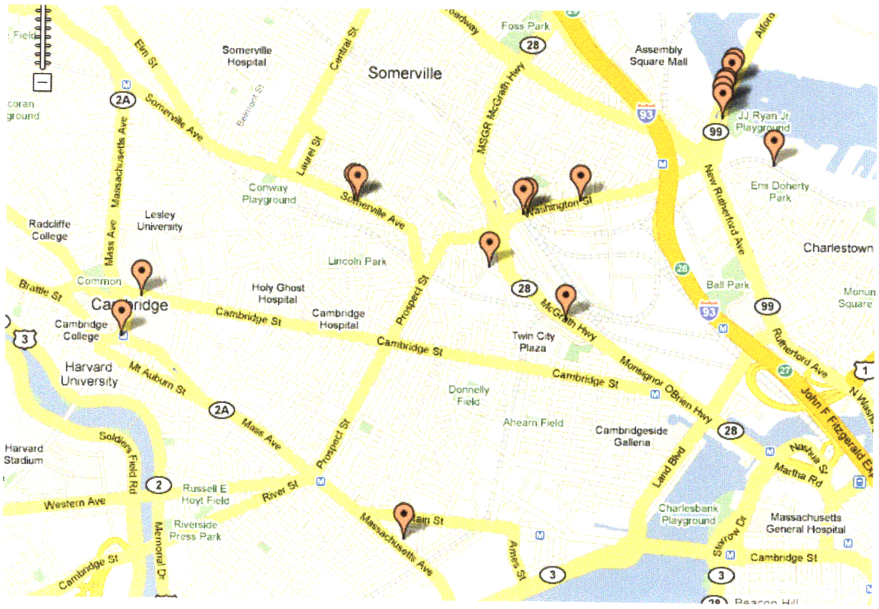

FIGURE A.1: A map showing some of the locations of the Pothole Patrol's identified "potholes"
Source: Pothole Patrol (2007)

FIGURE A.2: Photos of the identified "potholes", including some false positives
Source: Pothole Patrol (2007)

As seen in Figure A.2, one of the challenges the Pothole Patrol incurred was ensuring the accuracy of the data collected. For instance, manholes, drains, speed bumps, and other obstacles caused spikes in waveforms as well. The Pothole Patrol had to determine how to filter false positives out by differentiating potholes from other things on the road. It was determined that potholes have a signature waveform; data looks quite different when a vehicle hits a pothole (which typically happens on one side of the car) rather than an obstruction that crosses the entire street, such as a speed bump. The Pothole Patrol's results included a false positive rate of less than 5%. (Pothole Patrol, 2007).

The use of accelerometers in the Pothole Patrol's experiment produced an effective method in which to measure road conditions through embedding sensors in vehicles. Using accelerometers in conjunction with GPS devices, the Pothole Patrol was able to accurately locate potholes, and other obstructions, that were affecting vehicles in Cambridge and Boston. The application of accelerometers was useful for determining the dynamic velocity and vibration of the vehicles and has proven to be an effective tool for measuring road conditions.

APPENDIX H: THE ARMY AND AIR FORCE EXCHANGE SERVICE

The Army & Air Force Exchange Service (AAFES), the retailing agency for the US Army and Air Force, provides commercial and non-commercial merchandise and services to several military bases around the world.

In particular, AAFES transports goods to Iraq and Afghanistan where security and infrastructure concerns are similar to the World Food Programme's concerns in the Somali region. Like the World Food Programme, AAFES moves perishable goods and food-items into these areas with little transportation infrastructure, unreliable weather, and security issues. Not only are the roads into these areas harsh, but pilfering activities can cost truckloads of merchandise. Also like the World Food Programme, AAFES uses technology to secure its goods. In Iraq and Afghanistan both, the organization is trying out different technologies and methodologies. However, unlike the World Food Programme, AAFES will not rely on technology alone to secure its items on the dangerous journey to the bases.

In Iraq, AAFES employs Global Positioning System (GPS) and Radio Frequency Identification (RFID) technologies to track their goods. GPS equipment for text messaging and sensors that react to light, door, and seal sensitivity of products help specialists know if the transport of the goods has been interrupted in some way. RFID tags on each container and frequent interrogators en route allow specialists to know the recent whereabouts of the goods at all time. However, the organization does not feel that it can depend on these devices solely to provide security information or visibility. Therefore, AAFES also moves with the US Army convoys. Because AAFES is not always considered high priority, their merchandise can wait up to two weeks for military escort. Though disruptive to the lead time, it is through this method that safety and some security of items is guaranteed. High risk items, such as iPods

or cigarettes, are flown into Iraq, but merchandise and food items, as would be similar to the WFP, are delivered in this manner. Otherwise, in order to combat these long lead times, the bases have large quantities of safety stock.

To get merchandise and goods into Afghanistan, AAFES must first ship its items to Pakistan. However, as there is no US Military presence in Pakistan, AAFES must transport its merchandise here without military escort. There is only one road into Afghanistan and it is often held up by traffic, bad weather, and generally poor infrastructure problems. The direction of traffic flow changes everyday – eastward traffic goes one day and westward traffic goes the next. Because of these long transit times, the DCs try to pick the freshest of the perishable products for the long journeys and build the safety stocks at the military bases. While AAFES has tried many different security measures, they have not found the mix that they think will work right in this area. The organization has tried some GPS tracking and periodic weighing stations, where security is maintained by knowing that the weight of goods over the journey has been maintained. However, the pilfering activities in this area are thrifty and quick and have been able to outlast the technologies.