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Humanitarian Operations: A Case-
Based Approach**

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(Revised version of 2009/39/TOM/ISIC)

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Abstract

Transportation is the second largest overhead cost to humanitarian organizations after personnel. The international 4x4 Field Vehicle Fleet size is estimated between 70,000 and 80,000 units with a cost above \$1 billion per year. Nevertheless, academic knowledge about fleet management in humanitarian operations is scarce. By using a multiple case research design we study field vehicle fleet management in 4 large international humanitarian organizations (IHO): the International Committee of the Red Cross, the International Federation of Red Cross and Red Crescent Societies, the World Food Program and World Vision International. Our field research includes more than 40 interviews at headquarters, regional and national level in Africa, the Middle East and Europe. We aim to answer three questions: 1) How do IHO manage their field vehicle fleets? 2) What are the critical factors affecting IHO field vehicle fleet management? 3) How does field vehicle fleet management affect in-country program delivery? Finally, we suggest further research areas in transportation and fleet management in humanitarian operations.

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1. Introduction

Global operations, high uncertainty, urgency, lack of local infrastructure (Tomasini and Van Wassenhove, 2009) and rigid funding structures (Edwards and Hulme, 1996) are some of the challenges faced by international humanitarian organizations (IHO) in charge of delivering aid to people in need. IHO relief (life saving) and development (improving quality of life) delivery is performed via in-country programs. Transportation is a key element of delivery and represents the second largest overhead cost to humanitarian operations after personnel. According to the Fleet Forum, an IHO interagency initiative, the cost of IHO 4x4 fleets is above \$1 billion per year and its size is substantial; between 70,000 and 80,000 vehicles. The United Nations Environmental Programme estimates that this number will triple by 2050 (UNEP, 2008).

Most of the previous research related to transportation in humanitarian logistics has taken a central planner perspective without examining transportation implementation. Little is known about current Field Vehicle Fleet Management (Field VFM) in humanitarian operations and how existing managerial structures, strategic interactions and incentives shape fleet management in in-country programs. It is therefore difficult to conclude whether optimization methods could be used to improve in-country program delivery performance or whether unpredictable operating conditions, complex organizational structures, loose objectives, or donor constraints would make the use of decision tools too complex or prohibitively expensive. We study Field VFM within IHO and focus on 4x4 vehicles. These vehicles are used mostly to coordinate but also to execute last mile distribution of in-country program delivery (Balcik, Beamon and Smilowitz, 2008). It includes: 1) transport of relief items in-country and to beneficiaries; 2) transport of staff coordinating or delivering

services to beneficiaries, and 3) transport of staff and materials related to development programs (building schools, hospitals, water sanitation, etc.). This paper aims to answer three research questions regarding Field VFM in humanitarian operations:

- 1) How do IHO manage their field vehicle fleets?
- 2) What are the critical factors affecting IHO Field VFM?
- 3) How does Field VFM affect in-country program delivery?

Following Meredith (1998) and Fisher (2007), due to the lack of previous literature related to our research problem, we use descriptive exploratory research to obtain primary data directly from humanitarian in-country programs. Our research design is case-based with the fleet management model as the unit of analysis (Yin, 2003). We study 4 of the largest IHO: The International Committee of the Red Cross (ICRC), the International Federation of Red Cross and Red Crescent Societies (IFRC), the World Food Program (WFP) and World Vision International (WVI).

Fleet management in the ICRC is carried out using a centralized model. Most of the decisions regarding the fleet are made at the fleet management unit (FMU) at headquarters in Geneva, Switzerland. IFRC and WFP use hybrid models. Decisions regarding the fleet are shared between the FMU operating out of regional offices in Dubai, and the national offices. WVI uses a decentralized model. Fleet decisions are made by in-country programs.

Our research is field based. As part of the data collection process, we carried out interviews at headquarters, regional, national and field levels in Africa, the Middle East and Europe. We visited the ICRC headquarters in Switzerland. We also visited the ICRC regional logistics center in Kenya, the IFRC and WFP regional logistics centers in Dubai and the United Nations Logistics Base (UNLB) in Italy. We travelled to the national offices of ICRC, IFRC and WVI in Uganda, Kenya and Mozambique.

Finally, we visited the WVI field operations in Gurue, a remote village in northern Mozambique.

Our findings show that in the centralized and hybrid fleet management models, management of the fleet ends when vehicles arrive in the country of operation. As a consequence, it can be the case that more than 50% of the total cost of the fleet is not optimized. In the decentralized model we studied, total vehicle lifecycle is managed in silos by in-country programs. The concept of fleet management at the national level does not exist. We propose that by managing the fleet as a whole at the national level and coordinating this upstream with the FMU (in central and hybrid models) and downstream with programs (in central, hybrid and decentralized models), IHO can improve field operations performance.

The paper is organized as follows. Section 2 introduces the humanitarian context. Section 3 presents the theoretical framework. Section 4 outlines the research design. Section 5 describes the data collection process and the four cases: ICRC, IFRC, WFP and WVI (Appendix 1 provides a glossary of acronyms). Section 6 summarizes our main findings and propositions. Finally, section 7 presents the conclusions, limitations and future research agenda.

2. Humanitarian Context

IHO operate in an atypical context. Mandated to respond to human suffering through relief and development programs, IHO do not adhere to standard market principles that guide the activities of commercial firms. IHO are large, diversified multinational organizations (Prahalad and Doz, 1987). Typically, headquarters are located in developed countries while most of their operations are located in developing countries. This exposes IHO to unstable macroeconomic conditions,

tumultuous political environments, distinctive socioeconomic conditions and cultural diversity (Austin, 1990). No perfect market exists in the humanitarian sector. In contrast to multinational commercial companies, at their core IHO are non-profit oriented, but they are held accountable to three distinct groups: donors who finance the operations, beneficiaries representing uncertain demand, and the international community through public reporting of their actions.

Each of the IHO in this study has the majority of its operations in the developing world. Using the International Monetary Fund's list of developing countries (imf.org), we estimated that this amounts to the following: ICRC 84%, IFRC 73%, WFP 93% and WVI 73% of total operations. A note on terminology: some IHO refer to programs and others to projects. We group these under the term in-country programs, henceforth referred to as programs. Also, some IHO refer to national delegations, others to national offices or country offices. We group these under the term national offices. In-country operating conditions, particularly outside the urban centers, are difficult in terms of infrastructure, facilities, local knowledge, and security. IHO also face the high rotation of expatriates, with high decision making power, who usually occupy the top management positions of national offices. Local staff usually has a lower rotation but low decision making power creating high levels of organization specific uncertainty and market demand uncertainty (Beckman, Haunschild and Philips, 2004). As programs evolve from a context of relief to development, the objectives of the IHO also evolve (Jennings, 2002). IHO working in volatile and naturally unstable regions must constantly be prepared to respond to disasters, making contingency planning part of the day to day concerns of the organization as a whole.

In order for an operation to be considered humanitarian the three principles of humanity, neutrality and impartiality must be present (Tomasini and Van Wassenhove, 2009). This holds true for relief and development programs. Managing scarce resources (Van Wassenhove, 2006), IHO constantly face the trade-off between equity and efficiency (table 1). Equity refers to access that depends on need (Bevan, 2009). Efficiency refers to operating in the best possible manner with the lowest possible cost, time and effort. The logistics strategy of an IHO must support a service oriented humanitarian function to the recipients at low logistics costs (Van Wassenhove, 2006).

	In-Country Program	Fleet Management
Relief	Equity: Speed of aid delivery	Efficiency: Speed of vehicle delivery
Development	Equity: Access to and coverage of identified demand	Efficiency: Cost effectiveness, fleet availability

Table 1: Programs and Field VFM objectives in humanitarian operations.

IHO operate under multiple objectives (Moore, 2000; Lindenberg and Bryant, 2001) and incomplete contracts (Balcik, Beamon and Smilowitz, 2008). Transaction costs derived from unforeseen contingencies, information asymmetries and difficulties of enforcing contracts (Tirole, 1999) add to the challenging characteristics of humanitarian operations. For instance, some IHO contract other IHO or local humanitarian organizations, called implementing partners, to carry out last mile distribution of programs (figure 1). These implementing partners also have an impact on programs. We focus on purchased and donated 4x4 fleets for implementing IHO. Although important to mention, other sources of procurement as well as implementing partners are beyond the scope of this paper.

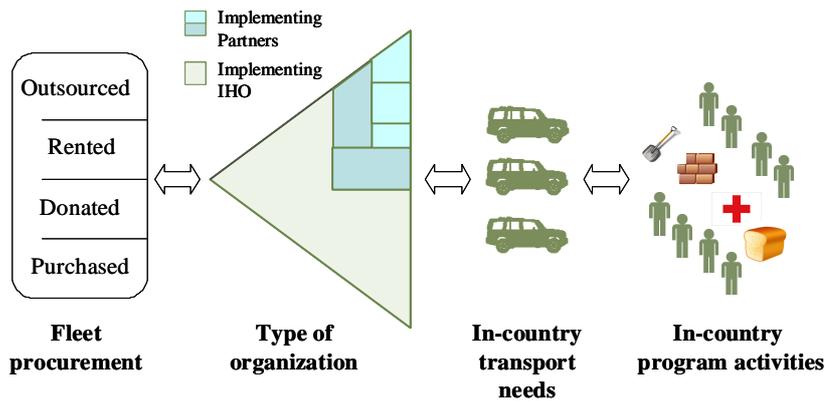


Figure 1: Field transport in support of programs.

In this atypical context our approach mirrored that of Edmonson and McManus (2007). We identified Field VFM in humanitarian operations as our target research area and defined Field VFM as our unit of analysis. This was done through participation in the Fleet Forum Annual Conference, the main humanitarian practitioner conference on transportation.

Resulting from widespread criticism of humanitarian relief operations such as Hurricane Mitch in 1996, and the responsibility to comply with UN Millennium Development Goals, IHO began to examine the management of their fleets (Samii and Van Wassenhove, 2002). The establishment of the Fleet Forum in 2003 as a joint venture between IHO like WFP, IFRC, WVI and the global express services company TNT, signaled a step forward. Issues related to humanitarian transport management, and the impact it was having on their programs were exposed at the Fleet Forum annual conferences. Through active participation in the Fleet Forum conferences since 2004 we identified fleet management in IHO as a potentially interesting research area.

We then narrowed the focus of study to field vehicle fleets based on in-depth discussions with humanitarian leading experts. We discussed IHO fleet management challenges with the founding Fleet Forum Coordinator, the ICRC Global Fleet Manager, and the WVI Associate Supply Chain Director. These discussions led to the

conclusion that concerns IHO were facing regarding their Field VFM demanded further research. Some of these concerns included: unknown global fleet sizes, oversized and aged fleets, non-homogeneous fleet configurations, rising fuel consumption, and uncertain vehicle availability. We also learned that depending on the IHO Field VFM can be centralized, decentralized or combine elements of both models. The Field VFM model determines the way fleet management functions like vehicle life cycle and fleet monitoring are performed.

The next section describes our approach to defining the research questions to understand Field VFM in IHO, and developing the theoretical framework used in the research design.

3. Theoretical Framework

We defined the research questions and developed the theoretical framework by conducting an extensive review of academic and practitioner literature on humanitarian logistics and commercial fleet management. First, combining the knowledge obtained via conferences and discussions with a literature review on humanitarian logistics we defined three research questions. Second, we complemented the humanitarian literature with a review of commercial fleet management literature and developed the theoretical framework used in the research design.

Most of the previous research on transportation and fleet management in humanitarian operations focuses on planning victims' evacuation and/or aid distribution in relief operations. In the work of Sherali, Carter and Hobeika (1991), the decision maker plans the evacuation for hurricanes considering the impact of shelter locations on evacuation time. Barbarosoglu, Ozdamar and Cevik (2002),

develop mathematical models in which the decision maker schedules a heterogeneous fleet of helicopters to evacuate wounded victims in a disaster relief operation. Using simulation Han, Yuan, Chin and Hwang (2002), investigate the problem of an emergency planner deciding flexible routes for evacuation-traffic distribution and assignment. Regnier (2008) models a decision maker facing a trade-off between the cost of evacuation and false alarms. Stepanov and Smith (2009) consider the impact of congestion on evacuation. In this formulation, the planner solves a multi-objective function combining excess total travel distance and excess clearance time. Saadatseresht, Mansourian and Taleai (2009), present an emergency planner who faces the trade-off of balancing safe area capacity and travelling distance to optimize victim's evacuation during a relief operation. In Yi and Ozdamar (2007), the logistics emergency planner has the multi-objective problem of dispatching commodities and assigning vehicles to distribution centers in affected areas and evacuation and transfer of wounded people to emergency units. In summary, the references mentioned above treat the decision maker as a central planner who has to coordinate the assignment of a vehicle fleet to available routes to satisfy evacuation demand.

Models for aid distribution are found in Yi and Kumar (2007). The authors examine a response planner who optimizes commodities' dispatching to distribution centers in the affected areas and evacuating the wounded people to medical centers. Viswanath and Peeta (2003) plan aid distribution in relief programs based on the threat of earthquake. The emergency planner minimizes the total fleet traveling time over a set of routes and maximizes the total population covered, subject to a budget constraint. Barbarosoglu and Arda (2004), model a disaster response planner with the task of transporting first-aid commodities to disaster-affected areas during emergency response. Tzeng, Cheng and Huang (2007), model a central planner with the

objective of minimizing the cost and total travelling time while maximizing the minimal satisfaction during the planning period to respond to an earthquake. In Balcik *et al* (2008), a decision maker minimizes the sum of routing costs and penalty costs for backordered demand for last mile distribution in relief operations. Campbell, Vandenbussche and Hermann (2008), model fleet routing for critical supply distribution. The relief planner minimizes the travel time between demand points.

Similar to the victims' evacuation literature, most of the research on relief delivery and transportation management in humanitarian logistics assumes central planning coordination. To the best of our knowledge, operations management research on implementation of real humanitarian operations is very scarce. De Treville, Smith, Rolli and Arnold (2006), model the case of the World Health Organization (WHO) to distribute tuberculosis vaccines. They use queuing models to reduce the lead-time of vaccine delivery showing the potential of operations techniques for improving humanitarian logistics. De Angelis, Mecoli, Nikoi and Storchi (2007), models WFP weekly planning of emergency deliveries of food aid by plane in Angola. Their model increases demand fulfilment by optimizing plane scheduling and routing.

Nevertheless, academic understanding of real humanitarian operations is still too limited (Altay and Green, 2006; Van Wassenhove, 2006) to conclude whether central planning optimization approaches are implementable in this context or whether implementation is prohibitively expensive or infeasible due to the system's complexity. Our research aims to contribute to fill this gap in the literature by understanding the way IHO implement fleet management. As such, we define our research questions as: 1) How do IHO manage their field vehicle fleets? 2) What are

the critical factors affecting IHO Field VFM? 3) How does Field VFM affect program delivery?

The theoretical framework for this research is focused on the factors affecting Field VFM in humanitarian operations. According to the literature, VFM consists of “*making the vehicle repositioning and vehicle-to-load assignment decisions so that some performance measure (profit, cost, deadhead miles, number of served loads, etc.) is optimized*” (Topaloglu and Powell, 2007). This definition can be decoupled into two main objectives: 1) to guarantee availability and cost-efficiency by effective procurement and sales (Wu, Hartman and Wilson, 2005), maintenance (Haghani and Shafahi, 2002), safety and vehicle drivers management (Mejza, Barnard, Corsi and Keane, 2003), 2) to find the optimal vehicle routes through a set of users to serve a set of loads, subject to capacity (Powell and Carvalho, 1998) and time constraints (Powell, Carvalho, Godfrey and Simao, 1995). Fleet management objectives can be affected by diverse factors, some outside the control of the IHO, and others within their control. Following Farris II and Pohlen (2008) we classify these factors into external and internal to the organization.

3.1. External factors

Operating conditions (Balcik et al, 2008), demand uncertainty, and donors (Edwards and Hulme, 1996; Oloruntoba and Gray, 2006; Oloruntoba and Gray, 2009) have a direct impact on the objectives of Field VFM. Also, they have a potentially strong effect on IHO as a whole and particularly on Field VFM. Lack of stability and security are serious issues to consider (Tomasini and Van Wassenhove, 2009). They can decrease the speed of vehicle delivery to programs and increase operating costs. Another characteristic of humanitarian operating conditions is the lack of local

infrastructure and facilities. To face this problem IHO have three options. First, they can build their own infrastructure and facilities. Second, IHO can improve existing infrastructure and facilities in partnership with local suppliers. Third, they can adapt their fleets to work with the existing infrastructure and facilities. Driving conditions are also poor compared to those in developed countries.

Tax status affects costs and procedures related to procuring vehicles, spare parts and fuel. IHO can have total, partial or no tax exemption. Although conceding tax exemption is discretionary to each country, very often IHO belonging to the United Nations or the Red Cross Movement are duty free. Finally, IHO may face highly fluctuating exchange rates that can affect sourcing and disposal decisions and capacity allocation (Kogut and Kulatilaka, 1994; Kouvelis and Gutierrez, 1997; Dasu and de la Torre, 1997; Ding, Dong and Kouvelis, 2007).

Donors are the main source of funding in humanitarian operations (Fowler, 1995; Edwards and Hulme, 1996; Bogdanova, 2008; Chhotray and Hulme, 2009; Koch, Dreher, Nunnenkamp, and Thiele, 2009; Oloruntoba and Gray, 2006). Governments are the main donors, followed by private foundations, individuals (Dunn, Akni and Norton, 2008) and firms (Thomas and Fritz, 2006). Donations can be earmarked to specific programs or to support IHO operations in general.

3.2. Internal factors: organization level

At the organization level we study mission, background and organizational structure. These factors are affected by the external factors described previously. Similarly, they impact on Field VFM objectives and functions. Mission dictates the objectives of the IHO. The core mission can be relief or development oriented. Relief programs can generate an unforeseen increase in the demand of transportation while

transportation requirements for development programs are more stable in the short run. The organization's background explores the antecedents of the IHO in terms of age and geographic coverage. It would be logical to expect more experienced IHO in a particular country to have greater knowledge of the local conditions. In terms of geographic coverage, the size of the geographic area covered by programs has a direct impact on fleet management functions via fleet scheduling and routing.

Typically, large IHO have four organizational levels: headquarters, regional offices, national offices and field offices. Most of the large IHO have their headquarters in developed countries. Regional offices are in charge of coordinating operations in geographic regions like Asia, Middle East, Africa and the Americas. National offices manage humanitarian operations at the national level and interact with host governments (Doz, 1985; Prahalad and Doz, 1987) and other humanitarian organizations and NGOs. Finally, field offices are responsible for coordinating and executing last mile distribution which is often the most important element of the order fulfillment (delivery) process (Esper and Jensen, 2003).

3.3. Internal factors: fleet level

At the fleet level we focus our attention on the fleet management model and fleet management functions: fleet structure, deployment and routing, vehicle life cycle, drivers and road safety, and monitoring and evaluation. These factors impact on fleet management objectives. We defined and studied three types of fleet management models: centralized, hybrid, and decentralized. We define centralized models as those where the fleet is procured with a centralized budget, and fleet management policies are designed and monitored by the FMU and implemented by national offices and programs. Decentralized models are those in which country offices procure fleets with

national budgets and are autonomous to design and implement their policies on fleet management. Hybrid models combine elements of centralized and decentralized models in terms of procurement and policy design.

Fleet structure is described using fleet size, age and vehicle brands. Fleet deployment and routing are studied at the program level. As highlighted above, most of the academic literature on humanitarian logistics focuses on planning response by optimizing routing and deployment for responding to disasters. We focus on current routing and deployment as a conceptual basis for understanding Field VFM.

The term vehicle lifecycle management refers to the stages of vehicle management from procurement to disposal. We study procurement, insurance, maintenance and repairs, fuel management and vehicle disposal. IHO have four sources of vehicle procurement: purchasing, donations, rental and outsourcing (figure 1). Insurance policies must deal with security issues and geographic coverage. Maintenance refers to preventive maintenance, the most widely used maintenance policy (Ozekici, 1995). Repairs are unplanned maintenance. They can be due to component failure (Brosh, Shlifer and Zeira, 1975), accidents or sabotage. Fuel management relates to fuel sourcing and fuel monitoring. Finally, vehicle disposal and replacement deal with the end of vehicle life cycle. Academic literature on replacement is extensive. Wang (2003) classifies replacement policies in age or mileage based, repair limit based or up to failure. Examples of these policies can be found in Brosh *et al* (1975), Rust (1988), Bertsekas (2005), Cho and Rust (2008), Cho and Rust (2010) and many others.

Drivers are a critical component in Field VFM. Mejza, Barnard, Corsi and Keane (2003), find the best performers of motor carriers in the US as to driver management practices. They find that careful hiring processes lead to better

performance. Formal reward systems are identified as best practices in driver management. We investigate driver hiring, training, rewards and turnover.

Road safety refers to the actions taken by drivers and passengers to avoid accidents. Some measures of road safety are: the mandatory use of seat belts, no more than 8 hours driving per day (Jones and Stern, 1987), driving only during daylight time (Orris, Buchannan, Smiley, Davis, Dinges and Bergoffen, 2005) and stopping to rest at least every 4 hours (Lin, Jovanis and Yang, 1993). Car accidents can be a serious issue for IHO especially when they involve a third party. We explore the consequences of accidents for the fleet.

Monitoring and evaluation is carried out via data collection and analysis. Key performance indicators related to Field VFM are used by IHO particularly to monitor vehicle lifecycle. We look at how data is collected, at what level of the IHO it is collected, how it is used within the IHO and for what purpose. Figure 2 summarizes the theoretical framework. The arrows represent the directions of the relations.

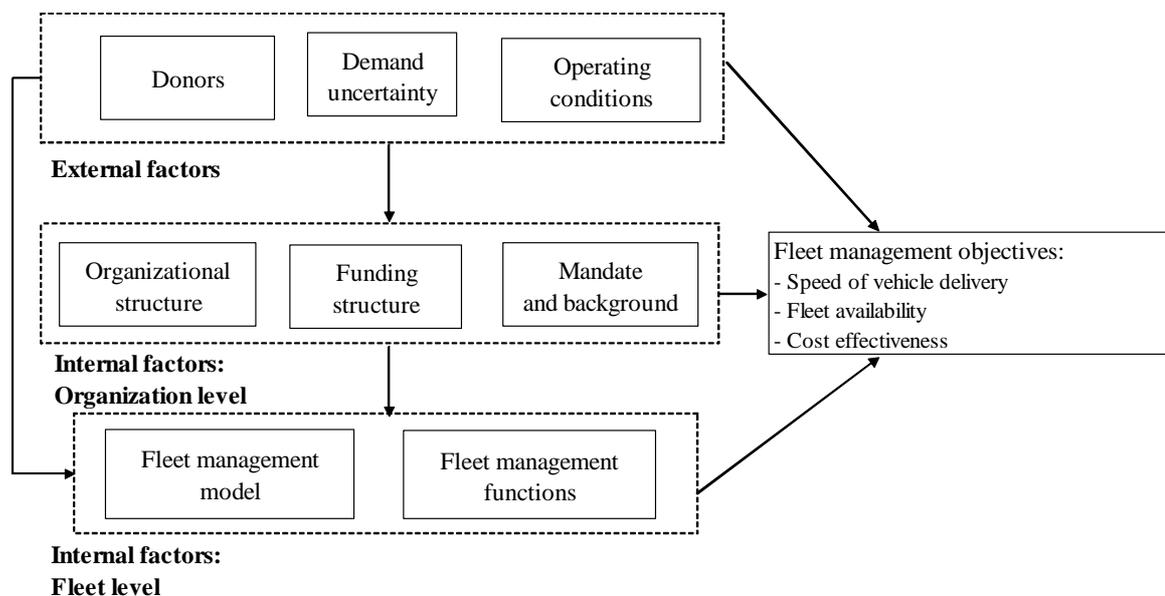


Figure 2: Theoretical framework showing the potential factors affecting Field VFM objectives in humanitarian programs.

In summary, the theoretical framework considers the potential factors affecting Field VFM objectives (figure 2). External factors such as donors, demand uncertainty and operating conditions seem to affect IHO both at the organization level and at the fleet level. They can also affect fleet management objectives directly. Internally, mandate, organizational structure and funding structure potentially affect the fleet level and the fleet management objectives simultaneously. The following section describes the research design of the paper based on the defined research questions and theoretical framework.

4. Research Design

This section introduces the research methodology used, the theoretical sample and the selection of sites for collecting data, the type of data collected, the data collection tools and procedures, and finally, the type of analysis carried out.

4.1. Research methodology

This research is based on field study. The reasons behind the use of field study are twofold. First, given the fact that we conducted nascent theory research for which little previous theory exists field study was appropriate to stimulate new theoretical ideas based on exploratory research (Edmonson and McManus, 2007). Second, considering our intention to produce relevant results that could be applied to IHO (Greenwood and Levin, 1998) it was critical to explore how real “flesh and blood” organizations (McGrath, 1964) manage their field vehicle fleets.

We use a case study based methodology to investigate Field VFM in IHO. The complexity of the humanitarian context, combined with a lack of well supported definitions meant that case study research offered the methodological fit to advance

relevant theory on Field VFM in IHO (Yin, 2003; Yin, 2003 b; Stuart, McCutcheon, Handfield, McLachlin and Samson, 2002; Edmonson and McManus, 2007; Fisher, 2007). We define the unit of analysis as the Field VFM model. The Field VFM model is composed of individuals grouped with task of managing the field vehicle fleet.

4.2. Theoretical sample

We study Field VFM in large IHO with operations in developing countries. The theoretical sample was chosen after examining the mission and Field VFM model of Fleet Forum members.

Mission	Model and fleet size (vehicles)					
	Centralized		Hybrid		Decentralized	
Relief	UNPKO	(8500)	UNHCR	(7000)	MSF	(1600)
	ICRC*	(1770)	IRC	(600)		
	OSCE	(1000)	IFRC*	(535)		
Relief and development	UNRWA	(500)	WFP*	(1900)	WVI*	(2000)
			CRS	(1300)	OXFAM	(700)
			MCorps	(500)	STC	(500)
					CARE	(2500)
Development	Riders for Health	(500)			GTZ	(900)
					WHO	(800)

Table 2: International humanitarian organizations members of the Fleet Forum with more than 500 vehicles based on 2004 or 2007 data. (*) Theoretical sample. Sources: Estimations from 1) Founding Fleet Forum Coordinator; 2) Global fleet managers of: ICRC, IFRC, WFP, WVI, Oxfam, UNHCR, WHO.

Table 2 shows the IHO members of the Fleet Forum with 500 or more vehicles. Our theoretical sample includes two dimensions: organizations' mission and Field VFM model. The mission can be relief or development oriented. It dictates the objectives of the IHO which determine the type of transportation needs of programs. The Field VFM model determines the way the IHO respond to these transportation needs. Our theoretical sample includes four IHO: ICRC, IFRC, WFP and WVI, given their disposition to participate in our project.

The selection of sites for collecting data was done in collaboration with the fleet managers of each IHO and the founding Fleet Forum Coordinator. Two researchers participated in the field trips and performed interviews at four levels: headquarters, regional, national and field. We chose to visit the headquarters of ICRC in Switzerland because the FMU is located in Geneva. We selected the United Arab Emirates because the FMUs of IFRC and WFP are located in Dubai. Given that the majority of the humanitarian programs take place in African countries, we focused our national and field visits in Kenya, Uganda and Mozambique. Mozambique has WVI's largest field vehicle fleet, cyclical relief programs, and long term development programs. Security conditions are also a consideration when carrying out field research in the humanitarian sector. At the time of the study, Mozambique offered us the opportunity to visit remote program locations that may not have been possible in Kenya and Uganda. We visited program offices at Quelimane, Mocuba, and Gurue located in the Zambezia region, north of Mozambique. For this, we travelled approximately 750 Km by road, over the course of a 2 day round trip to observe field vehicle fleets in action.

4.3. Type of data collected, data collection methods and procedures

Due to the exploratory nature of this research, we collected qualitative open-ended data for interpretation (Edmonson and McManus, 2007). We used rigorous data collection techniques, causal, as well as anecdotal observation (McGrath 1964) to obtain a deep understanding of “real-life” fleet management in the IHO we studied.

Data was collected predominantly through semi-structured and informal interviews at ICRC, IFRC, WFP and WVI and with service providers. In total, between January, 2008 and September, 2008 we carried out 46 interviews, 3 of which

were in groups while the rest were individual. Appendix 2 shows the breakdown of interviews in terms of location time, organization, level, and position of those interviewed. The base questionnaire used in the interviews is shown in appendix 3. The questions focused on seven categories of the theoretical framework. Questions on the eighth category, demand uncertainty, were embedded in the categories of operating conditions and fleet management functions. Specific questions for each interview were selected depending on the position of the interviewee.

Two researchers conducted each interview, except for the interviews in Dubai, where three researchers were present. One was responsible for posing the questions and the others were responsible for taking notes on the content and context (Eisenhardt, 1989b). The interviews were recorded except in 6 cases where lower ranked interviewees (drivers and mechanics) requested otherwise. Each interview began by asking the person their name, educational or career background, and the responsibility of their position. The preselected interview questions were complemented with others that yielded deeper descriptions of specific facts and events. The average duration of an interview was 90 minutes. Interviews were often interrupted by the interviewee's need to fulfill unexpected requests.

The field research team followed strict procedures for data collection and storage. Firstly, at the end of each day of interviews, the research team had a debrief session of 2 hours to cross-reference each researcher's notes and share general impressions. Secondly, based on the discussions, the questionnaire was updated to prepare for the next day of interviews. Thirdly, following the 24 hours rule, detailed interview notes were compiled and completed within one day of carrying out the interview (Eisenhardt, 1989b). Finally, concise interview notes were compiled in a database under the pre-defined categories. As information was collected per level

across all four IHO, rather than per IHO, it allowed for ongoing comparison of the cases at the information gathering stage, what Eisenhardt (1989) refers to as the overlap between data collection and data analysis.

IHO work within a wide and complex network of actors. This network includes donors, disaster response coordination bodies and service providers. To establish a complete picture of Field VFM we also carried out interviews with key actors in this network not included in the theoretical sample. Further, we conducted a tour of the UN Humanitarian Response Depots (UNHRD) in Dubai and Brindisi, Italy, two of the largest logistics and support facilities operating in the humanitarian sector today. Secondary sources of data, where available, included annual reports, procedure manuals, spreadsheets, vehicle logbooks and maintenance schedules.

4.4. Data analysis methods

The case-writing process produced four detailed write-ups on the IHO. Given the complexity of the cases, we opted for a cross-case inductive analysis to examine emerging patterns. We identified keywords related to each category such as: “earmarked funding”, “unplanned trips” and “local procurement”. We counted the frequency of keywords and positions of respondents. We then performed a pair wise analysis of categories to know the effect of one category on the other. This preliminary analysis allowed us to focus on critical factors affecting IHO Field VFM.

Following Eisenhardt (1989) we developed comparative tables between the IHO in the study. From these comparisons we induced provisional propositions. We then went back to the case studies to confirm whether or not the propositions were validated by the data and worked iteratively to refine the initial propositions. Once we finalized the inductive process, we performed a “reality test” by meeting each of the

IHO fleet managers and the founding Coordinator of the Fleet Forum individually to present our propositions and receive feedback. Finally, we presented our propositions at the Fleet Forum conference in 2008 and used the feedback to refine our findings. What resulted, were five propositions on Field VFM in the humanitarian sector related to performance, incentive alignment, earmarked funding, transportation demand and operating conditions. Figure 3 illustrates the research process of this paper.

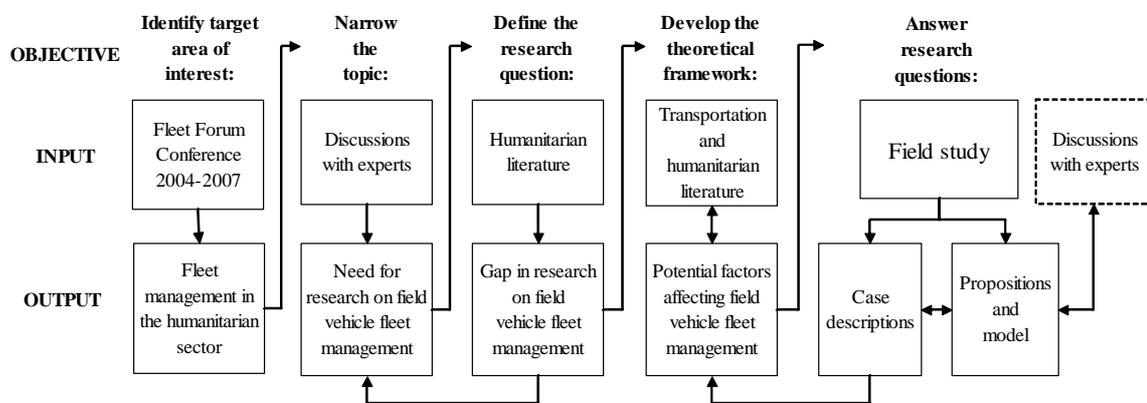


Figure 3: Iterative field research process (based on Edmonson and McManus, 2007).

5. Case Descriptions

To answer the first research question on how IHO manage their field vehicle fleets, this section provides a summary of the cases studied: ICRC, IFRC, WFP, and WVI. They are presented following the theoretical framework. The full cases can be accessed from the corresponding author.

5.1. ICRC

Founded in 1863, ICRC's mission (known as the mandate) encompasses the delivery of relief to victims of national or international conflicts. It is also engaged in some development activities. The nature of their work and the regions in which they are located have generally resulted in 3 clear implications for the field operations.

Firstly, security is a major consideration and the political state of the country is always taken into account in relation to program planning. Secondly, the local infrastructure and facilities are generally lacking, particularly in the early stages of an operation. Thirdly, in order to serve their programs, vehicle availability is important. The ICRC has tax free status worldwide, though this does not guarantee border clearance without delay. Governments and institutional donors make up the main portion of ICRC funding. This IHO avoids earmarked donations if at all possible because this imposes constraints on the use of resources. Funding is allocated to regions, countries or to a central budget to support services such as fleet management or administration.

Field VFM within the ICRC is a centralized function run out of the headquarters FMU in Geneva, established in 2000. FMU calculates the annual budget for Field VFM based on requests coming from the national offices. This amount is requested from the finance department. FMU defines fleet management as:

“The selection, management and maintenance of vehicles and logistics assets with the aim of providing the effective and efficient movement of goods and personnel to achieve the operational goals of the delegation [National office]” (ICRC, 2004)

FMU procures vehicles directly from Toyota in Japan using the annual budget. Once delivered, the vehicles are stored in 3 warehouses, in Brussels, Nairobi and Amman, where they are equipped before being sent to the national offices. FMU is also in charge of transporting vehicles to the country of operation.

Delivery to the national offices takes approximately 6 months when the vehicle is ordered from the manufacturer, 1 month when the vehicle is in one of the warehouses and 2 weeks in the event of a disaster. Upon arrival in a country, the national office leases the vehicle at a monthly rate of 1.66% of the purchasing cost from FMU over 5 years. This cost, plus the cost of running the fleet is covered by the

national budget. Demand for transportation comes from the programs based on their own demand forecasts. The requests are compiled at the national office and sent to the FMU. Vehicles are used to transport people, materials and food. Allocation and routing of the vehicles takes place on a weekly basis at field level and is approved at the national level. Car pooling is explicitly recommended in the Logistics Field Manual but it is not monitored by the FMU. Under difficult security conditions vehicles in the same location are required to travel in pairs.

Programs must follow strict maintenance schedules every 5, 10, 20 and 60 thousand kilometers. The maintenance policy is dictated by the FMU and it is respected by national offices. Countries with more than 50 vehicles have their own maintenance workshops and employ a national fleet manager. ICRC has 29 workshops worldwide. Stock for these workshops is replenished by the manufacturer through Geneva. Vehicles often have to travel long distances to be serviced or repaired.

ICRC employs a rigorous hiring process for drivers, who are recruited at national level. Policies related to road safety state that driving is not permitted after dark and drivers should take a break at least every 4 hours. Training is mandatory in the first 6 weeks, although after this, little training is given and promotion within the organization is not generally offered. Recognized as valuable due to their local knowledge, drivers are also the main safety concern. Road accidents and sabotage are common and in addition, theft and driving style have a serious impact on fuel consumption. Driver performance is measured based on accidents and fuel consumption. Penalty systems are in place for bad driving, speeding and accidents.

In the event of accidents, theft or damage from war, ICRC uses three levels of insurance. National budgets cover up to USD \$ 170 worth of damage, while the global

budget covers up to USD 4220. For anything larger, ICRC vehicles are covered using an external insurance company with a monthly premium per vehicle of USD 85. This is a blanket premium for all insured vehicles regardless of age or condition. Due to the areas in which they work, ICRC must also adopt the role of claims adjuster.

FMU imposes a replacement policy of 5 years or 150,000 Km, following the manufacturer's recommendation for commercial companies working in normal environments. However, programs are allowed to keep vehicles beyond that threshold when justified. Disposal of 4x4 vehicles takes place through sale, donation or scrap. Sales are carried out at the national level through auction or tender and the total revenue from each sale is fed back into the global investment budget of the FMU.

Policies and procedures, contained in the logistics field manual, are decided by the FMU and given to national offices. Data on each of the vehicles is sent to the FMU using the centralized *FleetWave*¹ information system, implemented in 2001, though the primary source of data is the driver's logbook. The recorded information including fuel, accidents, maintenance, insurance, kilometers driven and cost per kilometer constitute the key performance indicators the vehicles.

5.2. IFRC

Founded in 1919, the mission of the IFRC is to respond to natural disasters. As part of the Red Cross/Crescent Movement their national offices also work on development programs with the National Societies². The nature of their work and the regions in which they are located have generally resulted in 3 implications for field operations. Firstly, speed of delivery is a major consideration. IFRC have established 3 regional logistics units in Dubai, Panama and Malaysia and 3 sub-regional stocks in

¹ Internet-based fleet management software provided by the Resonance Group (www.resonancegroup.com.au/AF_FleetWave.htm)

² There are 186 National Red Cross and Red Crescent Societies around the world made up of volunteers and staff. National Societies support the public authorities in their own countries as independent auxiliaries to the government in the humanitarian field. (www.ifrc.org)

Zimbabwe, Senegal and Kenya, to increase the speed of response. Secondly, the local infrastructure and facilities are generally lacking, particularly in the early stages of a relief operation. Thirdly, in order to serve their development programs, vehicle availability is important. IFRC has to apply for tax free status for individual countries, and border clearance can be a problem.

Governments and institutional donors make up the main portion of IFRC funding. Most of disaster response funding is earmarked. Funding is allocated via relief appeals, through the national societies, or to a central budget to support services such as fleet management or administration.

Field VFM within the IFRC uses a hybrid model. The FMU located in Dubai, runs the vehicle rental program (VRP), established in 2002. The FMU manages vehicles for 60 national offices and 20 national societies. The FMU is responsible for:

“The strategy, planning, development, procurement and management of the vehicle rental program (VRP) and the fleet management system, FleetWave (IFRC, 2008)”

Speed of response and flexibility are particularly important to the IFRC. Procurement of 4x4 vehicles is divided 80% to 20% between the FMU global sourcing and the national offices using an approved FMU budget. This gives national offices greater decision making power in hybrid models compared to that of centralized models. National offices can decide fleet composition as long as they comply with FMU standards. Vehicles purchased nationally are later incorporated in the VRP. The FMU procures vehicles directly from Toyota and Nissan, using double sourcing to avoid monopoly. Once delivered by the manufacturers to the FMU, vehicles are stored in one of the regional warehouses located in Dubai, Panama and Kuala Lumpur to be equipped before being sent to the national offices. The FMU has

a permanent stock of 5 fully equipped 4x4 vehicles in Dubai ready to be shipped in the event of a disaster. FMU is in charge of transporting vehicles to the national level.

IFRC generally opts for a homogeneous fleet within a single country. Delivery time takes approximately 6 months if coming from the manufacturer, 3 months if coming from one of the warehouses and 2 weeks in a disaster. Upon arrival in the country, the national office leases the vehicle from the FMU at a monthly rate for 5 years. The national office runs the vehicle, using the national budget. Allocation and routing of the vehicles is decided at the national and field level and approved by a dispatcher if the country has more than 4 vehicles. Car pooling between programs is recommended in the Fleet Manual but it is not monitored by the FMU.

Programs must follow strict maintenance schedules every 5, 10, 20 and 60 thousand kilometers. Maintenance is carried out by an authorized dealer or a local workshop approved by the national office. Vehicles often have to travel long distances to be repaired although the FMU are establishing a system whereby a year's supply of spare parts will be sent to the national office with the vehicle.

IFRC employs a rigorous hiring process for drivers, who are recruited in-country. The FMU has put policies in place related to road safety. Expatriates are not supposed to drive and driving is not permitted after dark. Drivers should not undertake more than 8 hours driving per day and the speed limit in the country should be obeyed. In the event that there is no speed limit in the country, the maximum limit will be decided by the national office or the regional fleet coordinator. Training is given at the beginning of the contract but little thereafter, and promotion within the organization is not generally offered. Drivers are recognized as valuable due to their local knowledge but they are also the main safety concern. Road accidents are common and in addition, theft and driving style have a serious impact on fuel

efficiency. All this is closely monitored by FMU via *FleetWave*. Although no definition of a good driver is given, accidents and fuel consumption are two indicators by which drivers are measured and penalty systems are in place for bad driving, speeding and accidents.

In the event of accidents, theft or war, IFRC uses three levels of insurance. Local insurance is taken out in the country, and IFRC also have global third party insurance with an external insurance company. In addition to this, IFRC use a self insurance scheme whereby up to USD 840 is deductible from the national office renting the vehicle, in the event of an incident. Insurance claims are made through the FMU.

Following the ICRC, the IFRC FMU imposes a mandatory replacement policy of 5 years or 150,000 Km. Disposal of 4x4 vehicles takes place through sale, donation or scrap. Sales are carried out regionally or in-country through auction or tender depending on the market price and exchange rates. Then, 90% of revenue from each sale is fed back into the FMU investment budget for the purchase of new vehicles, making the VRP self-sustaining in terms of cost. 10% of the sales revenue goes to the national office budget.

Most of the policies regarding the fleet are drawn up by the FMU and summarized in the fleet manual which is given to all national offices. Data on each vehicle is sent to the FMU using the centralized *FleetWave*, implemented in 2006. The primary source of data is the driver's logbook. The recorded information including fuel, accidents, maintenance, insurance, kilometers driven and cost per kilometer determines the key performance indicators of the vehicles. National societies do not necessarily use the same information system.

5.3. WFP

Founded in 1962, WFP's mission is to respond to disasters and engage in development programs through the delivery of food. They are the lead IHO in the UN Logistics Cluster. WFP works with over 2,000 implementing partners who carry out the last mile distribution. However, "*where private truckers are unavailable or inadequate, WFP-owned fleets are deployed.*"(WFP, 2010). The nature of the work and the regions in which they operate have generally resulted in three clear implications for their programs. Firstly, speed of delivery is a major consideration and WFP manage the 5 regional UNHRD in Dubai, Panama, Italy, Ghana and Malaysia to increase the speed of response. Secondly, the local infrastructure and facilities are generally lacking, particularly in the early stages of a relief operation. Thirdly, in order to serve their development programs, vehicle availability is important. The WFP has tax free status worldwide. Governments make up the main portion of WFP donors. The organization avoids earmarked donations if at all possible. Funding is allocated via relief appeals, through the national offices, or to a central budget to support services such as fleet management or administration.

Field VFM in the WFP uses a hybrid model, established in 2006 and based on the IFRC's vehicle rental program. The FMU located in Dubai runs the Global Vehicle Leasing Program (GVLP). The fleet management objectives at this level are stated as:

"[to] Deliver the right size fleet to the right place at the right time at the right cost"

All national offices have been instructed by the WFP directorate to procure and run their vehicles through the FMU. Procurement of 4x4 vehicles is divided 80% to 20% between the FMU and the national offices using an approved FMU budget.

Vehicles are procured from Toyota and Nissan. Since the establishment of the GVLP, fleet size has decreased by 13.6%. The target for FMU is to reduce it by a further 21%. Once delivered from the manufacturer to the FMU, the vehicles are stored in the warehouse in Dubai. As required, they are transported directly to the national offices. Delivery time is approximately 6 months if the vehicle is coming from the manufacturer, 3 months if the vehicle is in stock or 2 weeks in the event of a disaster. The FMU has a permanent stock of 5 fully equipped 4x4 vehicles in Dubai ready to be shipped if required. FMU is responsible for transporting the vehicles to the national office.

National offices pay 6 months of the lease up front. The lease begins 30 days after the vehicle arrives in the port of a country. The national office leases and runs the vehicle, using the national budget. Allocation and routing of the vehicles is decided at the national and field level based on operational requirements. Vehicle sharing is based on proximity on an ad hoc basis, and in the event of high security vehicles must travel in pairs.

Maintenance is carried out based on the manufacturer's guidelines. A standard tender process is employed to choose the workshop although the FMU policy is to use original parts. FMU are now considering a system whereby a year's supply of spare parts will be sent to the national office with the vehicle.

In the past drivers were hired in an opportunistic manner. Today WFP insists that all drivers go through a hiring and training process in-country. Drivers are considered the main security point and long trips need authorization. There is no specific policy on breaks, the number of daily driving hours or speed limit. A good driver is defined as:

“One who looks after the vehicle has the least number of crashes and maintains a good attitude.”

WFP are currently implementing a form of reward system where good drivers will be used to train others and be sent abroad as international trainers.

Fuel is procured locally from a single approved supplier, using cash or vouchers. Fuel inefficiency is caused by bad driving, theft or engine problems and this is monitored closely at FMU.

All national offices are insured using the self insurance system based on a premium of USD 450 per vehicle per year. In the event of an accident all claims are made through the FMU. The national office pays the initial USD 1,000 of the claim.

The FMU imposes a replacement policy of 5 years or 150,000 Km following the IFRC model. Still in its infancy, the FMU has yet to dispose of one of its vehicles. Disposal of 4x4 vehicles will take place through sale, donation or scrap. Sales will be carried out either at regional or national level through auction or tender considering price differentials and exchange rates. If carried out at regional level, the national office will pay the cost of transporting the vehicle to Dubai. Revenue from each sale will be fed back into the FMU investment budget for the purchase of new vehicles, in line with the cost recovery component of the GVLP.

Data on each of the vehicles in the FMU is sent to Dubai using the centralized *FleetWave* software. The primary source of data is the driver's logbook. The recorded information including fuel, accidents, maintenance, insurance, kilometers driven and cost per kilometer determines the key performance indicators of the vehicles.

5.4. WVI

Founded in 1951, the mission of WVI is based on implementing development programs, although it does also engage in relief activities. The nature of their work and the regions where they operate have generally resulted in 3 clear implications for

their programs. Firstly, speed of vehicle delivery is a major consideration. Due to the proximity of their operations, WVI programs are often in the position of first responder in the event of a disaster and therefore need to have the capacity to respond. Secondly, the local infrastructure and facilities are generally lacking, particularly in the early stages of a relief operation. Thirdly, in order to serve their development programs, vehicle availability is important. WVI must apply for tax free status per country. Governments and private child sponsors make up the main portion of WVI donors. Funding is allocated directly to programs usually on an itemized basis, such as vehicles.

Field VFM at WVI uses a decentralized model. We describe WVI – Mozambique, the largest national fleet of WVI with a number of vehicles between 220 and 270 units, representing more than 10% of the total WVI fleet. An FMU does not exist. Programs have total control over their fleet. They are responsible for procuring and running vehicles using the program budget. Vehicles are procured regionally or nationally depending on suppliers' availability, price and speed of delivery. Although programs generally opt for Toyota or Nissan for their 4x4 fleet, this is not homogeneous within or across countries. The main fleet management objective at this level is:

“To increase the availability of vehicles”

In the event of a disaster, the Humanitarian Emergency Assistance team in each country must request vehicles from ongoing programs. If none are available, they purchase. Allocation and routing of the vehicles is at the program coordinator's discretion and vehicles are not generally shared due to donor constraints or lack of information about overlapping routing.

Preventive maintenance is not widely practiced throughout the IHO and maintenance is generally based on program coordinator or driver discretion, usually on an ad hoc basis. They use authorized dealers, approved local workshops or their own workshops. Original spare parts can be very difficult to obtain locally and are usually stored in the field office until needed.

Drivers are recruited in-country and must go through a rigorous process. Once hired, training is not generally offered. Road safety regulations are in place. Driving is not permitted after dark, drivers should not undertake more than 8 hours driving per day and speed limits should be obeyed. In the event that there is no limit, the maximum speed is 100 Km per hour. Opportunities for promotion are rare and although no definition of a good driver is available, penalty systems are in place for bad driving, speeding and accidents.

Fuel is procured locally through different suppliers. Vehicles often have to transport fuel over long distances and storage facilities are poor. Fuel efficiency is negatively affected by theft and driving quality though this is not taken into consideration in the monitoring of fuel consumption via the drivers' log book.

Vehicles are insured regionally using a single insurance company. They impose a blanket premium per year of 2% of the purchasing price of the insured item, unrelated to age or condition. Claims are made directly from the program to the insurance company which also recommends which workshop to use for repairs.

The *ad-hoc* replacement policy is 5 years or 150,000 Km but it is not mandatory. Disposal of the vehicles is at the discretion of the program through donations, sale or scrap and involves a long drawn out and bureaucratic internal process. Sales are carried out locally using a tender process. Revenue from the sale of a vehicle goes back into the program budget.

Data on vehicles is gathered and stored using unstructured databases like excel spreadsheets and text files. The primary source of data is the driver's logbook. Key performance indicators for the fleet have not been defined and the data is generally compiled for auditing purposes only.

5.2. Case summary

Comparative key facts and figures of IHO are shown in table 3:

Category	Key indicator	ICRC	IFRC	WFP	WVI
Organisation	Founded	1 863	1 919	1 962	1 951
	Beneficiaries (millions)	20	250	86,1	100
	Countries	80	75	77	98
	Expenditures (US\$)	784,1 million	394,2 million	2,97 billion	2,2 billion
	Staff (People)	12 000		9 139	31 000
Fleet	Managerial structure	Centralised	Hybrid	Hybrid	Decentralized
	Fleet size	1 770	535	1 900	2 000
	Avg fleet age (months)	42	33	18	63
Vehicle life cycle	Procurement	Global	Global 80% Local 20%	Global 80% Local 20%	Regional Local
	Vehicle suppliers	1	2	2	2
	Brands (World wide)	1	4	2	4
	Maintenance	Authorized dealers Own workshops	Authorized dealers ICRC workshops	Authorized dealers	Authorized dealers Own workshops Particular workshops
	Replacement policy	5 years or 150,000 Km	5 years or 150,000 Km	5 years or 150,000 Km	5 years or 150,000 Km
	Sales	Local auction or tender	Local or regional	Local or regional	Local auction or tender
	Vehicle use	Transport of: Relief items in-country and to beneficiaries Staff coordinating or delivering services to beneficiaries Staff and materials related to development programs	Very frequently Very frequently Very frequently	Occasionally Very frequently Occasionally	Rarely Very frequently Occasionally

Table 3: IHO basic facts and figures, 2007. Source: IHO annual reports and research cases.

Field VFM can be divided in two stages: prior to arrival in the country of operation and within the country of operation (figure 4). In the centralized and hybrid models we studied how FMU fund the procurement of vehicles, equip them and send them to the countries. Once in country, national offices allocate vehicles to programs. FMU are responsible for cost of capital (by charging national offices vehicle depreciation) and spare parts. National offices are responsible for maintenance while scheduling, routing and running costs are the responsibility of programs. Although in commercial fleets the cost of capital represents 53% of the total fleet cost, while the running costs represent 47% (Pattullo, 2004), the situation in the humanitarian sector seems to be different. On the one hand, the tax exemptions for vehicle procurement decrease significantly the cost of capital. On the other hand, the difficult operating conditions in terms of roads and infrastructure tend to increase the running costs of the fleet (Pedraza Martinez and Van Wassenhove, 2009). Hence, it seems correct to expect that the running costs of the fleet can represent more than 50% of the total cost of the fleet. At the end of the vehicle lifecycle national offices sell vehicles or ship them to be sold elsewhere. Revenues go back to FMU budgets.

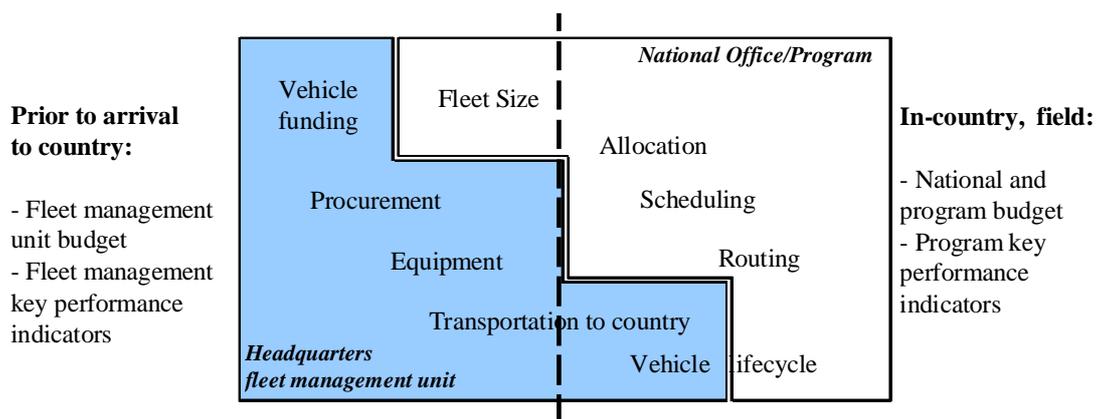


Figure 4: Interdependencies between Fleet management units, national offices and programs. Source: Case descriptions.

In the decentralized model we studied procurement is assumed by programs with the approval of national offices. All other functions at national level remain the same as those in centralized and hybrid models except for vehicle lifecycle which is managed at the field level. Based on the case descriptions, the next section presents our findings and develops a set of propositions of critical factors affecting Field VFM in humanitarian operations.

6. Main Findings and Propositions

To answer the second research question on what are the critical factors affecting IHO Field VFM, sub-sections 1 to 5 present the key findings and propositions from our case analysis. To answer the third question on how Field VFM affects program delivery, sub-section 6 presents the resulting model of Field VFM in IHO derived from the research propositions.

6.1. The effect of external factors

Our first proposition relates to external factors affecting Field VFM in IHO. We claim that operating conditions and external demand uncertainty affect both the coordination of fleet management functions and program performance. Security considerations oblige IHO programs to use strategies such as routing fleets in convoys or avoiding late trips. Lack of infrastructure and facilities makes activities like maintenance scheduling or fuel sourcing complex, especially in remote areas. It is not uncommon for 4x4 vehicles to travel long distances for routine maintenance services or to have long downtimes while waiting for spare parts to arrive in the country. Driving conditions also affect vehicle life cycle. Usually IHO operate in difficult terrain with extreme road conditions. This shortens the life of vehicles and calls into

question the suitability of applying fleet management policies recommended to companies working in normal environments. All the IHO we studied aim to replace vehicles every 5 years or 150,000 Km. However, the optimality of that replacement policy has not been tested in the humanitarian context, rendering it impossible to conclude whether it works efficiently.

Tax status and exchange rates affect vehicle procurement and disposal decisions. Usually IHO can apply for tax free status in the countries of operation. However, this process can be long and bureaucratic, involving political considerations. In the case of disposal, some IHO incorporate tax status and exchange rate to choose the location for sales by comparing expected salvage value in the country of operation to the sum of transportation cost plus expected salvage value in other locations.

Environmental concern is growing between IHO particularly related to the UN millennium goals and changes in acceptable limits for exhaust emissions of new vehicles such as the European Emission Standards. The seventh millennium goal stipulates ensuring environmental sustainability of operations. The direct implication for IHO is to reduce their carbon footprints. In accordance, countries are raising their emission standards creating restrictions to the choices of vehicle sourcing. Environmental sustainability is an interesting area for future research on humanitarian logistics.

Finally, high levels of beneficiary migration induced by changes in the intensity of conflicts or the proximity of natural disasters to their homes creates uncertainty of program transportation needs. This uncertainty potentially impacts on fleet size, vehicle procurement, fleet scheduling and routing, affecting both the coordination of fleet management functions and fleet performance. Uncertainty of this

type could be mitigated via integrated information systems matching demand with fleet availability.

Proposition 1 (P1):

Uncertainty in demand and operating conditions negatively affect both the coordination of fleet management functions and fleet performance.

6.2. Artificial transportation demand uncertainty

We find that a considerable proportion of transportation demand uncertainty in development programs is due to the lack of coordination in vehicle scheduling and routing. Although globally IHO are constantly engaged in relief programs, at national level relief programs are generally the exception, not the rule. Thus, development program transportation daily routine should be relatively stable although with some uncertainty due to the highly dynamic situation in some developing countries.

In the absence of disasters, transportation needs are planned on a weekly basis. However, the lack of transport coordination between programs allows the persons in charge of scheduling to dynamically allocate vehicles to trips, not included in original weekly plans, as and when they are requested to do so. Within countries, Field VFM is subordinated to instead of coordinated with programs. This situation creates an “artificial uncertainty of demand” for transportation that could be attenuated through information sharing, unified reporting systems, scheduling and route planning. The lack of coordination of daily routine transportation needs between program management and Field VFM at the national level creates artificial transportation demand uncertainty that negatively affects fleet performance.

Proposition 2 (P2):

Reducing the artificial uncertainty of transportation demand will have a positive impact on fleet performance.

6.3. The effect of earmarking funding for vehicles

Centralized and hybrid models have separated vehicle funding from program funding. It prevents donors from imposing constraints on the procurement, use, allocation and disposal of vehicles. In contrast, we find that in the decentralized model vehicle lifecycle is managed in silos at the program level. The concept of fleet management at the national level does not exist. The funding structure is such that vehicles are requested directly from donors as part of the program funding proposal. Accountability for vehicles flows from programs to donor. As pointed out by the Head of Administration, Zambezia, WVI – Mozambique:

“All the programs are working in islands. Each program is autonomous”

No standardized policies and procedures are enforced. Programs can procure the vehicles without consideration of the potential advantages of having a homogeneous national fleet. Programs do not generally share vehicles because of lack of central planning. Maintenance schedules and suppliers are decided by each program. Additionally, vehicle replacement is often postponed waiting for funding availability or vehicles are kept until the end of programs. Thus, it is common to find vehicles either operating beyond the recommended age of replacement, or left idle due to lack of funding. Table 3 shows that WVI – Mozambique’s average fleet age is 63 months while the replacement policy recommends replacing every 60 months. There is no nationwide standard vehicle replacement policy. The earmarked structure of vehicle funding offers disincentives for IHO to run their vehicles as a national fleet.

It helps explaining problems like lack of fleet homogeneity (Dejax and Crainic, 1987), excessive fleet size and excessive fleet age, highlighted in section 2.

Proposition 3 (P3):

Earmarking vehicle funding to programs negatively affects the coordination of fleet management functions and fleet performance

6.4. Incentive alignment in central and hybrid models

We find that the way centralized and hybrid models are designed means efficient management of the fleet ends once vehicles are delivered to the country of operation. The FMU manages the fleet up to arrival in the country. As the ICRC fleet manager commented:

“Our emergency ends once the vehicles have reached the national office but for them [national offices and programs] it is just the beginning”

This is also clear from the stated functions of the FMU in the IHO we studied. ICRC FMU is responsible for selection, management and maintenance of vehicles and logistic assets. IFRC FMU responsibility is to manage the vehicle rental program. WFP FMU is responsible for delivering the right fleet to the country of operation.

Data collection, key performance indicators and the *FleetWave* systems are designed to monitor FMU performance. Except for fleet size, variables related to the field fleet as a whole like allocation, scheduling, routing, use and driver management are not monitored by the FMU or by national offices (figure 4). These variables are critical for field operations and can represent more than 50% of the total cost of the fleet. Nevertheless, they are at the discretion of programs. Although programs are responsible for the running costs of the vehicles, Field VFM is not part of program performance evaluation. Programs are service oriented. Often their transportation

needs are private information and their objective is to have a vehicle available whenever it's needed; the bigger the fleet, the higher the availability. Programs may have incentives to claim higher transportation needs than actually expected. The FMU are cost oriented. The bigger the fleet, the higher the fleet cost. Fleet cost is national office's responsibility. Although improving monitoring via integrated information systems would help fleet management to get a better estimation of programs' transportation needs, the problem is structural. The current centralized and hybrid fleet model designs allow a misalignment of incentives between headquarters, country and field levels. As a consequence, it can be the case that more than 50% of the total cost of the fleet is not optimized.

Proposition 4 (P4):

Aligning the fleet management objectives and performance measures of fleet management units, national offices and programs will increase the coordination of fleet management functions increasing the performance of fleet management

6.5. Performance of field operations

Currently IHO measure the performance of field operations based solely on program performance. Fleet performance is measured only up to the arrival of vehicles to the country. Within the country only the vehicle lifecycle is monitored by FMU and transportation needs are completely determined, without coordination, between programs.

However, there are task interdependencies (Wageman, 1995) and outcome linkages (Siemens, Balasubramanian and Roth, 2007) between FMU, national offices and programs that make these separate measures of performance inadequate for field

operations. For instance, programs and national offices decide their required fleet size while the fleet belongs to the FMU. On the other hand, the FMU decides on vehicle lifecycle while national offices pay the running costs with their budget and programs observe the state of the vehicle (figure 3). At the end of the vehicle lifecycle national offices sell the vehicles but most of the revenues flow back to the FMU.

In the case of decentralized models fleet performance at the national level is not evaluated at all and vehicle lifecycle is monitored only at the field level. We claim that a unified measure of performance aligning program and fleet management objectives and incentives will benefit program performance.

Proposition 5 (P5):

Including Field VFM performance into field operations performance metrics at the program level will have a positive impact on the performance of programs

6.6. Model of Field VFM in IHO

This research explores Field VFM in humanitarian operations. The third research question was: how does Field VFM affect program delivery? Field Vehicle Fleet performance in IHO is determined by external and internal factors affecting fleet Field VFM. Factors external to the IHO like operating conditions and program demand are sources of uncertainty (P1). Although that uncertainty is unavoidable, it can be mitigated with the use of information integration. Nevertheless, there is another source of uncertainty that is internal to IHO. Artificial transport demand uncertainty (P2) is created due to the lack of coordination between programs' transportation needs and fleet schedules. It is exacerbated by the subordination of fleet management to program management. Field Vehicle Fleet performance is also

affected by the funding structure of vehicle procurement. We propose that earmarked vehicle funding has a direct and negative effect on the coordination of Field VFM functions between FMU, national offices and programs (P3). For instance, donor constraints via earmarked vehicle funding reduce incentives for fleet sharing and coordinating schedules between programs in the field. But programs are not the only party involved in Field VFM. There are three interacting parties defining Field FVM: Headquarters (via FMU), national offices and programs. These 3 parties have different objectives and incentives regarding fleet use and the coordination of fleet management functions. FMU is responsible for balancing global fleet costs and in-country transportation needs. National offices are responsible for in-country cost and for guaranteeing fleet availability to programs. Programs, the ultimate users of Field Vehicle Fleets, are service oriented and are not accountable for fleet cost. We propose that by aligning the incentives of headquarters, national offices and programs Field Vehicle Fleet performance can be improved (P4). Finally, we propose that improving Field Vehicle Fleet performance will have a positive impact on program delivery performance (P5). Better managed fleets will provide better support to program delivery by increasing fleet availability, and coordinating fleet scheduling and routing. Figure 5 illustrates the model of field VFM in IHO. It shows the critical factors affecting field vehicle performance and its effect on in-country program performance.

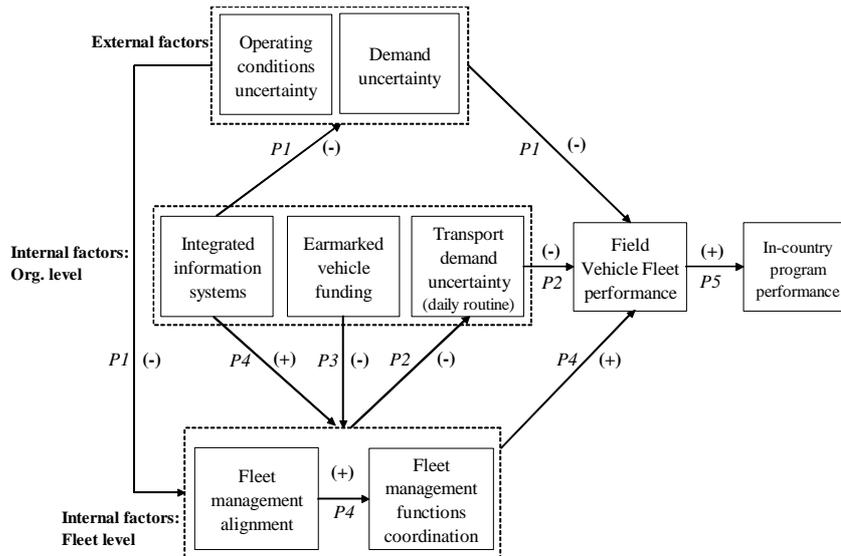


Figure 5: Model of Field VFM in IHO. The numbers indicate the proposition represented by the arrows. Arrows indicate the direction of the relation.

7. Conclusions, limitations and further research

This study is the first of its kind on humanitarian logistics. It describes Field VFM in 4 of the largest IHO and sets the scene for future research on fleet management in humanitarian operations. It examines Field VFM in humanitarian operations as a component of in-country programs. We focus on 4x4 vehicles, the most widely used transportation assets to coordinate and execute humanitarian last mile distribution. First, our aim is to understand how IHO manage their 4x4 fleets. Second, taking the humanitarian context into consideration, we use a theoretical framework to identify the critical factors affecting 4x4 Field VFM. Third, we examine how Field VFM impacts on in-country programs. Taking Field VFM model as the unit of analysis we use a multiple case-based methodology to examine how this operates in ICRC, IFRC, WFP and WVI, the four IHO in our theoretical sample. Through rigorous data collection, case comparison and analysis we present five propositions regarding Field VFM in humanitarian operations. From this, we develop a model illustrating the impact of fleet management as a determinant of in-country

program performance in humanitarian operations. We draw the following conclusions from this research.

Since the late 1990s, IHO have been paying more attention to how they manage their vehicles. The development of a central fleet management unit within ICRC, IFRC and WFP is testament to that. These units have centralized all asset management functions related to the vehicles including procurement, maintenance policies, insurance policies, disposal and administration of the *FleetWave* information system to compile data on the vehicles. Fleet management units have had the effect of reducing the fleet size, reducing the cost of vehicle procurement and increasing the speed of delivery to national offices. Further improvements are possible however. Fleet use for in-country programs at the national and field level can account for more than 50% of the total cost of the fleet. Improving the way the fleets are run at these levels will further reduce costs and increase the efficiency of the fleet. Nevertheless, management objectives and incentives should be aligned.

The majority of IHO programs are carried out in remote areas of developing countries with high levels of uncertainty in operating conditions. Some of the uncertainty they face relates to poor driving conditions, lack of infrastructure and facilities, tax status, exchange rates or security problems. This uncertainty, usually unavoidable although reducible, negatively impacts coordination of fleet management functions and fleet performance.

Another source of uncertainty comes from in-country programs' transportation demand. We found that transportation demand uncertainty has two components. The first is derived from external demand uncertainty and is unavoidable but can be mitigated through unified reporting systems and information systems. The second is artificial uncertainty derived from lack of coordination and planning of transport

needs at the field level. Reducing this artificial demand uncertainty through coordination of planning schedules and routing at the field level will have a positive impact on field vehicle fleet performance.

Earmarked vehicle funding for programs has a negative impact on Field VFM performance. One of the advances made in some IHO we studied is to separate vehicle funding from in-country program funding. It gives them greater autonomy in vehicle procurement, use and disposal. In the decentralized model we found that earmarked donations negatively impact the coordination of Field VFM functions.

FMU and in-country programs have different objectives. The FMU is a support function. Its objectives relate to efficiency in securing vehicles for the national level as quickly and cost effectively as possible. In-country programs' objectives relate to equity in delivering assets and services to those in need. FMU and in-country programs' performance are measured according to different key performance indicators. This leads to a misalignment of incentives between fleet management prior to and after the arrival of the vehicle in a country. Aligning the objectives, incentives and key performance indicators of FMU, national offices and the in-country programs will have a positive impact on both fleet management performance and in-country programs' performance. At field level, Field VFM is subordinated to in-country program management. This has a negative impact on fleet performance but also on program performance. At the national level, coordinating Field VFM with in-country program management instead of subordinating it will increase overall performance.

This research has some limitations. First, we limited our research to purchased or donated field vehicle fleets of IHO. This was necessary to develop an in-depth understanding of the research questions in the IHO studied. Second, we cannot

generalize our results to the sector as a whole. However, having presented our research to the members of the Fleet Forum, we are confident that the issues identified here also apply to the IHO they represent (table 2). We cannot generalize our results to truck fleet management. As one of the reviewers suggested, the economics of light 4x4 vehicles in-country lend to IHOs buying and owning vehicles. The economics of trucks lend to IHOs not buying and owning these vehicles.

Given the complexity of humanitarian operations, there is space for more research on this challenging topic of operations management. Field research and empirical research on the relationship between IHO contracting and implementing partners in terms of fleet management would complement our findings. Also, the strategic interaction between these two players has not been analyzed although it is an important component of humanitarian logistics. Research examining the particularities of the humanitarian context would also be valuable. We believe the trade-off IHO face between multi-objective relief and development programs offers interesting research opportunities. For instance, table 2 suggests an association between mission orientation and degree of decentralization pointed out by one of the reviewers: IHO more oriented to development are more decentralized. Nevertheless, finding good quality data for analysis in the humanitarian context is still very challenging.

Finally, although theoretical optimization models are valuable in their own right, in order for them to be implemented in humanitarian operations it is first necessary to examine the way IHO function. At the moment managerial structures, incentive systems and key performance indicators are misaligned, strongly reducing the capacity of IHO to implement these models and challenging the applicability of prescriptions given by central planning based optimization models.

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Appendix 1: Glossary of Acronyms

Acronym	Meaning
CARE	Cooperative for Assistance and Relief Everywhere (No longer used)
CRS	Catholic Relief Services
FMU	Fleet Management Unit
GTZ	German Technical Cooperation
GVLPP	Global Vehicle Leasing Program
ICRC	International Committee of the Red Cross
IFRC	International Federation of the Red Cross
IHO	International Humanitarian Organisation(s)
Mercy Corps	Mercy Corps
IRC	International Rescue Committee
MSF	Médecins Sans Frontières
OSCE	Organization for Security and Co-operation in Europe
OXFAM	Oxford Committee for Famine Relief (No longer used)
Riders for Health	Riders for Health
STC	Save the Children
TNT	Global express delivery company
UNEP	United Nations Environmental Program
UNHCR	Office of the United Nations High Commissioner for Refugees
UNHRD	United Nations Humanitarian Response Depot
UNPKO	United Nations Peacekeeping Officers
UNRWA	United Nations Relief and Works Agency
VFM	Vehicle Fleet Management
VRP	Vehicle Rental Program
WFP	World Food Program
WHO	World Health Organization
WVI	World Vision International

Appendix 2: Summary of Interviews

Location and Time	Organization and Level	Position
Switzerland, January 2008	ICRC: Headquarter Level - Geneva	<ol style="list-style-type: none"> 1. Fleet Manager 2. Head of Fleet Unit 3. Deputy Head of Operations West Africa 4. Senior Purchaser 5. Head of Administration Division

Mozambique, April 2008	World Vision Mozambique: National Level – Maputo	6. Fleet Management Coordinator 7. Transport Coordinator 8. Administrator 9. Assets Coordinator 10. Human Resources Director 11. Humanitarian Emergency Assistance Manager
	World Vision Mozambique: Programme level – Mocuba	12. ADP Manager 13. Driver
	World Vision Mozambique: Programme level – Quelimane	14. OVATA project coordinator 15. Finance manager 16. Transport Coordinator
	World Vision Mozambique: Field Project Level – Gurue	17. OVATA project coordinator 18. Mechanic 19. Driver 20. Mechanic
Kenya, April 2008	ICRC: Regional level - Nairobi	21. Fleet Manager Assistant 22. Regional Fleet Manager 23. Warehouse assistant 24. Workshop Manager
Uganda, April 2008	ICRC: National level – Kampala	25. Logistics Coordinator 26. Vehicle Fleet Manager 27. Logistician
	Uganda Red Cross: National level – Kampala	28. Driver 29. Logistic Coordinator 30. Logistics Officer 31. Programme Officer 32. Warehouse manager 33. Workshop Manager 34. Head of Logistics
	WVI Uganda: National level – Kampala	35. Country Director 36. Programme Officer
Dubai, September 2008	IFRC: Regional level – Dubai	37. Global Fleet Base (GFB) Coordinator Regional Fleet 38. Coordinator (RFC), 39. Fleet Wave Administrator
	WFP GVLP: Regional level – Dubai	40. Chief Project and Emergency Services 41. GVLP Fleet Manager 42. Administration Officer
	WVI GPRN: Regional level – Dubai	43. Logistics Coordinator 44. Finance and Accounting
	World Wide Auctioneers: Dubai	45. Director Sales and Marketing Mid- East
	Al Futtaim Trading Enterprises Company: Dubai (Vehicle pre-delivery inspection)	46. Service supervisor

Appendix 3: Research Questionnaire

EXTERNAL FACTORS	
<ul style="list-style-type: none"> • Operating Conditions 	<ul style="list-style-type: none"> – What kind of operations does the organization manage? – Can you describe this operation step by step? – Which are the transportation needs for the different types of operations? – What do you use the vehicles for? – How do you calculate the required number of vehicles? – What's the required number of vehicles per staff? – What's the average duration of an operation (project)?
<ul style="list-style-type: none"> ○ Security 	<ul style="list-style-type: none"> – How do security conditions affect the use of vehicles?
<ul style="list-style-type: none"> ○ Driving Conditions 	<ul style="list-style-type: none"> – Which are the road conditions you face? – How do they affect vehicle maintenance policy? – What's the average distance travelled per day?
<ul style="list-style-type: none"> ○ Tax Status 	<ul style="list-style-type: none"> – Does the organization have a duty free status? – How does this affect fleet management?
<ul style="list-style-type: none"> ○ Exchange Rate 	<ul style="list-style-type: none"> – How does operating with different exchange rates affect the costs associated with vehicle lifecycle management?
<ul style="list-style-type: none"> • Donors 	<ul style="list-style-type: none"> – Who are the main donors? – How does the funding process work? – Do you apply for funding on a yearly basis or by project? – Do donors fund the procurement of vehicles? – Do donors donate vehicles? – How do donors influence vehicle disposal?
INTERNAL FACTORS – Organization Level	
<ul style="list-style-type: none"> • Mandate and background 	<ul style="list-style-type: none"> – What is the mandate of the organization? – What is the role of fleet management to fulfil the mandate?
<ul style="list-style-type: none"> ○ Organization Background 	<ul style="list-style-type: none"> – What is the size of the organization? (Annual budget, geographic presence, staff, total fleet size, total fleet cost/year) – Can you briefly describe the organization's history?
<ul style="list-style-type: none"> ○ Collaboration 	<ul style="list-style-type: none"> – Given its mandate, how collaborative is the organization with other organizations operating in the same areas? – Does your organization share vehicles with other organizations operating in the same areas?
<ul style="list-style-type: none"> • Organization Structure 	<ul style="list-style-type: none"> – What is the organization structure? – Do you have an organigram? – Which are the main positions in the fleet management team? – Which are the responsibilities of each player?
<ul style="list-style-type: none"> • Funding Structure 	<ul style="list-style-type: none"> – Can you describe how you allocate budgets to operations? – How does it affect fleet management?
INTERNAL FACTORS – Fleet Level	
<ul style="list-style-type: none"> • Management model 	<ul style="list-style-type: none"> – Is the fleet managed centrally, using a hybrid model or by country/project (decentralized)? – Can you describe the fleet management model? – What's the fleet management strategy? – What is the main objective?
<ul style="list-style-type: none"> • Fleet management functions 	<ul style="list-style-type: none"> – What's the fleet size? Per country? – Related to other organizations, is it a small, medium or a big fleet?
<ul style="list-style-type: none"> ○ Fleet structure, deployment and routing 	<ul style="list-style-type: none"> – What's the average age of your 4x4 fleet? – What's the proportion of different brands/references in your 4x4 fleet?
<ul style="list-style-type: none"> ▪ Fleet size ▪ Fleet composition ▪ Fleet allocation/routing 	<ul style="list-style-type: none"> – How do you plan vehicle routing? – How do you decide vehicle allocation?
<ul style="list-style-type: none"> ○ Vehicle lifecycle management 	<ul style="list-style-type: none"> – How do you source your vehicles? – Can you describe the different ways of ownership used in the organization? – Can you describe the procurement process? – Can you describe the registration process?

<ul style="list-style-type: none"> ▪ Maintenance/ repairs 	<ul style="list-style-type: none"> - Who does the maintenance? - How often are vehicles maintained? - Do you use manufacturer's authorised workshops? - What's the cost per service? - What's the service time per service per vehicle? - How far do vehicles travel to be maintained? - What is the source of spare parts? - Do you purchase locally, regionally or globally? - How do you handle repairs? - Do you use manufacturer's authorised workshops? - What if you do not have the spare parts necessary to repair the vehicle? - Can you describe vehicle stock (cars and spare parts) management? - Do you have a safety stock of vehicles and/or spare parts?
<ul style="list-style-type: none"> ▪ Fuel management 	<ul style="list-style-type: none"> - Do you have a duty free status for fuel? - Do you have a unique supplier per country? - How do you control fuel consumption? - How do you control fuel quality? - What is the average fuel consumption per kilometre? - Do you have guides for saving fuel driving?
<ul style="list-style-type: none"> ▪ Disposal / replacement 	<ul style="list-style-type: none"> - What determines the decision of replacing a vehicle? - How often do you replace vehicles (cost, mileage or age)? - What's the replacement process? - How do you dispose of replaced parts e.g. tyres or batteries?
<ul style="list-style-type: none"> ○ Drivers and road safety <ul style="list-style-type: none"> ▪ Drivers ▪ Road safety 	<ul style="list-style-type: none"> - What is the hiring process for drivers? - Do you have training programs/certifications for your drivers? - Do you have a maximum number of kilometres per day for a driver to drive? - Do you have a maximum time without resting driving time?
<ul style="list-style-type: none"> ▪ Accidents/ insurance 	<ul style="list-style-type: none"> - Do you have a record of accidents? - What proportion of accidents is responsibility of the driver? - What's the estimated annual cost of accidents? - What proportion of fleet management budget is this? - What type of insurance policy do you use? - How much is the premium? - Is it attached to the age of each vehicle? - Does it cover vehicles beyond borders? - Can you give an example of an insurance claim and payment?
<ul style="list-style-type: none"> ○ Monitoring and evaluation <ul style="list-style-type: none"> ▪ Policies/ procedures 	<ul style="list-style-type: none"> - Does your organization have standard policies and procedures regarding fleet management? - Are their printed manuals containing policies and procedures on fleet management? - Who is in charge of monitoring policies and procedures implementation?
<ul style="list-style-type: none"> ▪ Data collection 	<ul style="list-style-type: none"> - What kind of data collecting system do you have? - What kind of data do you capture? - How frequently do you capture data? - What quality controls do you make to your data? - How reliable is your data? - What decisions do you make based in your data? - Can you describe the data capturing process?
<ul style="list-style-type: none"> ▪ Key performance indicators 	<ul style="list-style-type: none"> - Which are your KPI for fleet management? - Who analyzes these KPI? - What decisions you make based on these KPI?

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