MSc Program
Engineering Management

Vehicle Fleet Management and Monitoring in international Organization – Case Study EULEX Kosovo

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"Master of Science"

supervised by
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AKNOWLEDGMENTS

To the memory of my late father, Erkki Mantere 1940 – 2011.

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ABSTRACT

This case study examines the transition from a manual Vehicle Fleet Management System to an electronic system within the International Organization, European Union Rule of Law (EULEX) Mission in Kosovo. The Mission currently operates an approximately 1300 strong vehicle fleet in the Balkan Peninsula. In addition to vehicle fleet monitoring, fuel management functions and data collection chains are studied and compared with the electronic system.

In comparing the two systems, this work looks to reveal the benefits of a modernized fleet management system, especially when operating large vehicle fleets in a mission environment. This operational context raises large numbers of variables in the form of the constant rotation of vehicle users, specific operational arrangements and the types and number of vehicles in service, which in turn place individual demands upon the system in place.

As a comparison, the United Nations (UN) Electronic Vehicle Management Solution (EVMS) is used as a state-of-the-art example, as the UN implemented the systems for their fleet in 1995 and have expert experiential knowledge concerning the placement of monitoring functions in order to obtain the best results for fleet optimization. This comparison helped to inform the tender process and solution choice.

Conclusions are drawn on the study findings, as well as proposals offered that may direct future enquiry.

1 INTRODUCTION

1.1 Motivation

A number of Humanitarian Aid Agencies have already drawn attention to the large measures of waste involved in the cost of running transportation operations, due to poor fleet management. It has been observed, that with a more stringent approach to the acquisition and employment of the vehicle fleet and a professional approach to overall fleet management, a single major humanitarian organization can achieve savings of around 3 million US $ per annum in their total fleet costs (Tomasini and Van Wassenhove, 2006).

Since the beginning of the millennium, the European Union has more actively participated in international crisis management, sending personnel and equipment to post-conflict zones. This participation in the stabilization process has been seen in the form of mentoring, monitoring and advising in Civilian Crisis Management and in military cooperation initiatives in form of Peace-Keeping missions. Civilian Crisis Management has been represented as core-competence within the EUs Common Security and Defence Policy (CSDP) agenda (Grego E, et al 2010).

The majority of these missions are geographically located within Mainland Europe, but the EU has also participated in missions in both Africa and Asia. (www.consilium.europa.eu/eeas/). When comparing Humanitarian Organizations and Crisis Management Organizations such as those produced by the EU and the UN, it can be seen that although the basic approach to situations in the host-country differs between the organizations, the actual work undertaken is often done in a similar environment and by teams facing similar challenges.

Humanitarian Organizations have already observed a possibility to reduce their transportation related expenses by implementing a practice for efficient fleet management. Often, the problems and challenges in managing the required transportation requirements are similar among the different organizations that may be involved, so it may be proposed that cooperation and knowledge sharing between these organizations could be fruitful. A good example of this collaboration may be found at an interagency association called Fleet Forum (2011). Their webpage can be

found at www.fleetforum.org. The association was founded to improve the efficiency and available capacity humanitarian aid transportation and improve fleet management, and acts as a knowledge sharing centre for those involved in such fields of operation. The initiative was undertaken primarily to tackle rising mission costs and have improve the potential quality of response for humanitarian missions involved. Given however, the similarities in the organizational structure of those agencies involved in the field, the nature of their operations and the overall number of vehicles operated; this collaborative approach may merit further consideration in the future planning of European Union CSDP operations.

The focus of this study is on operational fleet management, with vehicle fleet monitoring functions and electronic data transmission, being represented as key components of the system. To illustrate the potential benefits of an electronically controlled operational fleet management system, the related measures taken by one large scale crisis management mission are outlined.

1.2 Definition of the problem and research questions

In the current distribution ratio in EULEX Kosovo, it has been determined that the total vehicle fleet is close to 1300 vehicles, including 4x4, armored and utility vehicles. These vehicles are operated not only by designated drivers, but by individual members of the international mission and attached national staff. Currently, 2400 individual drivers have been issued mission driver permits.

The fuel supply element of fleet management services is currently provided through outsourcing. In this, the contractor provides a turn-key service for the Mission, providing the required fuel distribution facilities as well the necessary accounting procedures. The contractor invoices a vehicles fuel based on its monthly consumption; in other words, the ownership of the fuel is changed at the time of refueling, with follow-up invoicing. In EULEX Kosovo, such fuel distribution is operated only at dedicated fuel points which allow controlled access to the fuel pump. Operational fuel supply requires significant funds to be made available (EULEX 2010 - 2011 fuel budget for vehicle fuel is approximately 1.1 M €), and as such, a follow-up of cost and consumption has to be constantly undertaken.

Documenting the vehicles logistic and maintenance data, together with its fuel use is very labor intensive, when using a hard-copy mechanism. The responsibility for initial documentation rests with vehicles users (one vehicle can have several users each month), and also with the fuel attendants employed by the fuel contractor. The total number of individual documents produced reaches almost 48 000 documents per year.

After the hardcopy documents are produced, the data is recorded manually into an electronic database. Reflecting the large number of documents produced, their subsequent inspection and the large number of variables which result from the multiple step process of initial data recording, the potential margin for error is considerable. These errors contribute to corrupted information and thus undermine the reliability of the data which is subsequently produced. As such, when operating large scale vehicle fleets, an IT-based solution is required, to ensure that the handling of the necessary information is accurate, reliable and measurable.

Ideally, any solution will gather the required data automatically. In addition to posing a minimum disturbance for the vehicles user and the administrative staff, their lessened involvement would reduce the potential for corrupt data input / error and so improve the potential quality of the systems output.

This study aims to answer 3 major questions:

1. How does EULEX Kosovo manage its assigned vehicle fleet and fuel control mechanism within a manual system?

2. What influences could the implementation of an electronic Fleet Monitoring System (FMS) have for the transport unit organization and the overall Mission?

3. How could the organization best optimize its FMS in the future?

2 PROBLEM DESCRIPTION

2.1 Working methods

This thesis is presented as a case study. It monitors the implementation of the Fleet Monitoring System (FMS) project and the influence of an electronic fleet and fuel management system for Transport & Fuel unit operations within the European Union Rule of Law Mission - Kosovo (EULEX Kosovo). Additionally, it makes a critical comparison of the current hard-copy accounting system against the electronic version.

As previously mentioned, EULEX Kosovo has become the largest ever civilian crisis management mission in EU CSDP history. As such, it became obvious for those in charge of supporting the mission, that the small mission approach that had been employed on lesser scale operations was no longer effective. To illustrate the escalation in operational scale, the strength of the EU missions in Bosnia and FYROM Macedonia were $1/10^{th}$ of the commitment in comparison to that of EULEX Kosovo.

The fleet management function in civilian crisis management missions has not been studied widely, therefore informational sources are limited. In the field of commercial transportation however, the process and effects of efficient fleet management have been recognized and commonly implemented, though these are primarily driven by economic motivations, as oppose to those of a humanitarian impetus. Typically, in the field operations of aid organizations and United Nations and EU CSDP missions, the need for a fleet management function arises through management accountability, the monitoring of fuel consumption for resourcing and costing, vehicle allocation within the mission, fleet optimization and the organizational guidance of allocated drivers. Additionally, the numerous aspects of safety and security which are integral to such operations are to be taken in account.

3 FLEET MANAGEMENT FUNCTION

3.1 Fleet management as a logistics function

Fleet management is a logistics function related to transportation operations (CSCMP, 2011). As a study specialism, logistics has been historically focused on the efficient relocation of military troops (Tomasini and Wassenhove, 2006). In modern times however, the aspect of fleet management has developed into a function which allows companies or organizations to control the transport related costs of their operations. In terms of risk management, by implementing an efficient fleet management protocol it is possible to minimize or eliminate those risks associated with vehicular investment and fleet management. Efficient fleet management will also improve levels of fleet utilization and efficiency, as well as the overall productivity of the sector. This in-turn can lead to reduced overall transportation and staff-related costs (Wikipedia, 2007).

Fleet management as such is very broad topic and in commercial business, can mean several different things. The term can be applied from the period of the initial acquisition of the vehicle, right through until the final disposal of the vehicle, and everything else in between these phases.

An internet review of the solutions offered for fleet management reveals a range of systems and service providers. In the airline industry, fleet management refers mostly to strategic and cost efficient fleet acquisition and the maintenance and operation of the airlines carrier fleet. As well logistic and resource management, efficient and accurate data collection is shown as vital for reliable reports, allowing management to project the running and costing of future operations within the company (Barco.com,2011).

In maritime operation, fleet management is driven by the areas of cost efficiency, route planning and weather condition information. Fleet management systems in this area allow operations to be adjusted according current need and based on the required level of performance of the fleet components (Meteo Group, 2011).

In commercial transportation, business fleet management systems are (in addition to those outlined above) more customer oriented. In terms of cargo management, they commonly allow parcel tracking based on location data, monitoring of the temperature of the cargo area, driver comparison (driver management) and fuel efficiency (Best of The Web Verticals, 2011).

This study concentrates on ground transportation fleet management within an international organization.

Operational Fleet management usually consists of three major components: Vehicle Fleet Management, Fuel Management and Vehicle Driver Management. There are commercial solutions commonly available for these areas, with vehicle fleet management being most commonly addressed. Fuel management solutions are usually tailor made for the client organization in question. Although Vehicle Driver Management (driving performance monitoring) solutions are available, they are not yet commonly implemented. One reason for that is the resistance of the vehicle users raised concerns over privacy issues and being monitored but not benefiting from the on-board monitoring system (Misener J.A et al, 2007)

3.2 Cost factors and efficient fleet management

Due to the constant increase in crude oil prices (Fig. 1), fleet management and the monitoring of the use of transportation resources has become a vital part of cost control in most of commercial companies, especially in the ground transportation sector. Oil prices are known to be sensitive to political developments around the world, and often this leads to increased fuel costs which will inevitably affect international organizations with a high dependency on transport within their operations. As highlighted by Pedraza Martinez et al. (2010) in their study of Humanitarian Operations Fleet Management, the optimization of an organizations fleet management system can affect savings of up to 50% in total cost, of those items subject to optimization.

Since International Humanitarian Organizations (IHO) often operate in the atypical environment of post-conflict areas, the fleet management approaches of similar

organizations is a pertinent area of study when determining the challenges faced by other organizations operating in similar conditions and environments.

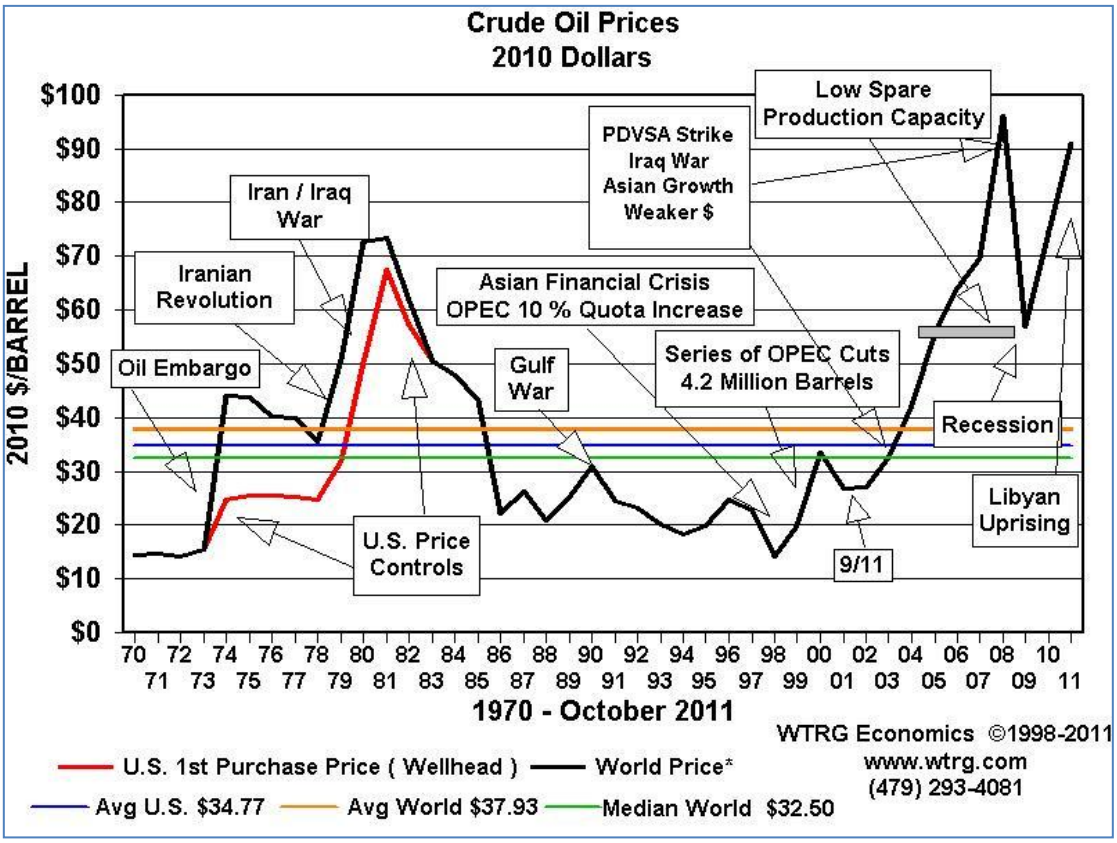

Fig. 1. Historical development of crude oil prices vs. political changes in the world (WTRG Economics, 2011) World (www.wtrg.com)

The known crude oil reserves are estimated to be 1,193.17 billion barrels in OPEC countries and judged to be sufficient to future decades. Known resources have increased 48% from the figures published in 1960 and according to the Organization of Petrol Exporting Countries (OPEC), more reserves will be available in the future due to more efficient research technology and advanced recovery techniques. However, the pressure for market price increases is justified by the costs incurring by the more demanding locations of indicated reserves and the requirement of specialized equipment needed for the oils recovery.

According to the statistics acquired from Department of Energy & Climate change (2011); over a 20 year projection, petroleum product retail prices in UK have been steadily increasing (Fig.2). This mirrors the general trend seen in other countries as well.

One way to tackle the increasing costs related to transportation in addition to acquiring an appropriate vehicle fleet (strategically suitable for the intended operations), is an efficient fleet management and monitoring system.

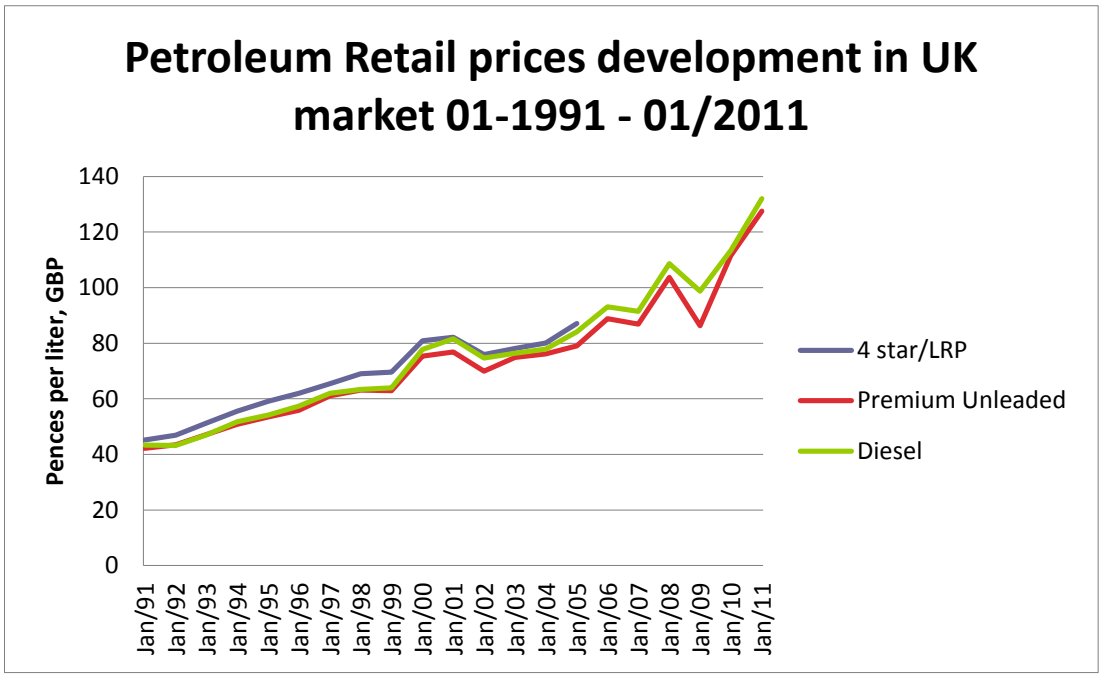

Fig. 2. Chart of historical development of petroleum products in UK markets. (Department of Energy & Climate Change, 2011)

As a general future guideline, organizations could observe the new energy strategy for Europe 2011-2020 (European Parliament, 2010), which "… takes the view that energy efficiency and energy savings should be key priorities of any future strategy, as they represent a cost-effective way of reducing EU energy dependency and combating climate change … (and) … calls on the Commission and the Member States to put energy efficiency at the top of the EU agenda."

Based on recent studies, it has been noticed that in international organizations, transportation represents the second largest overhead cost after human resources management (Pedraza Martinez et al., 2010).

When reviewing EULEX Kosovo human resource expenditure, costs represent 61% of the total mission budget, whilst transportation costs represent only 6% (Fig.3). The transportation figure includes helicopter services and after the deduction of these, transportation costs subsequently represent 4.4% of the total mission budget. (EULEX 2011a, restricted access information.)

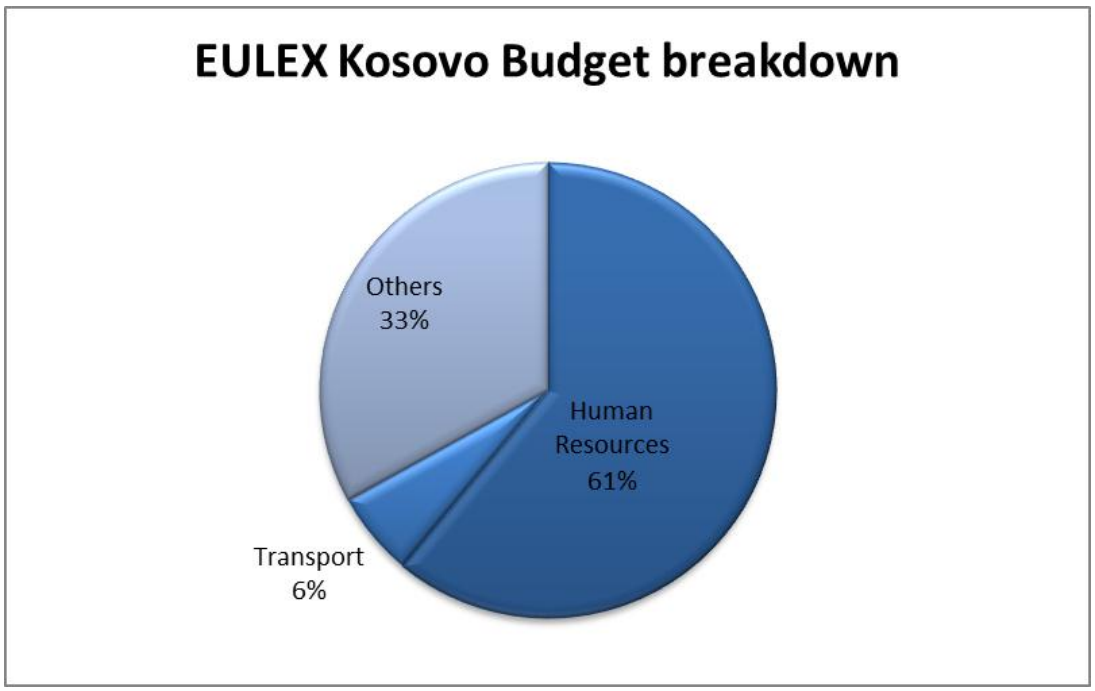

Fig.3. EULEX Kosovo budget breakdown (transportation figure inclusive of helicopter services). (EULEX, 2011a)

To keep the costs related to transportation operations at a manageable level, an effective fleet management system is required. This becomes progressively essential, especially when operating large vehicle fleets with a large number of vehicle users.

The number of variables in each organizations structure makes it well-nigh impossible to visualize the actual utilization level of a vehicle fleet, if based solely on a primitive accounting model, using paper-based documentation systems (Crowley, 2009).

3.3 Fleet Management Systems (FMS) as a tool for efficient fleet management and monitoring.

"The fleet management challenge is no longer only a question of available parts and local service. This is merely a matter of basic accountability. The challenge today is a matter of qualitative improvement in fleet management leading to the adoption of best-practices that not only maximize value, but also enhance safety, the environment and the operational efficiency of humanitarian organizations.
This is the new strategic imperative." (Disparte, 2007.)

Humanitarian Aid organizations have increasingly started paying attention to the cost of their transport operations. It is especially important to organizations like Médecins Sans Frontières (MSF, also known as Doctors Without Borders), which are operating based solely on funds donated to them. Reflecting their obligations of accountability and transparency towards their benefactors, MSF has set a specific goal to increase their overall efficiency and to minimize their administrative costs. However, there is a need for transportation services which are often integral to the programs execution, and in this aspect, cost reductions will directly affect the amount of available funds for each project (Médecins Sans Frontières, 2010).

The increasing number of vehicles within a fleet will subsequently increase the complexity of managing it. The processes of fuel supply and accounting require more labor, vehicle maintenance has to be arranged and the monitoring of each vehicles use is also more demanding. Unauthorized vehicle use will increase the expenses born by the organization, which should be able to concentrate primarily on its core competence (providing the service it is designed for) and less on the provision of associated transportation services

In order to increase the efficiency of transportation services, modern technology can provide suitable solutions for most operators in the form of a Fleet Management System, which usually incorporates vehicle mounted hardware and a computer operated software solution with a reporting interface.

Collected vehicle telemetry data is usually transmitted to the relevant database wirelessly using existing mobile phone networks via General Packet Radio Service (GPRS) or 3G protocol. In cases where these networks may be unavailable, a low-frequency Radio Frequency Identification (RFID) transmission module can be used

which connect over-air to individual receiving stations (Ruiz-Garcia et al., 2009).

The database of information is usually hosted by the service provider, although other solutions are available to accommodate the data protection needs of different organizations.

In order to utilize the organizations vehicle fleet efficiently, the support provision has to be of sufficient depth, according to the size of the fleet. With large fleets that might be allocated in geographically different locations, the number of support personnel required to undertake data collection and reporting will be vast. When looking for a technological solution to match the scale of provision, a fleet monitoring system with an appropriate data transmission interface will increase the efficiency of data collection and enhance vehicle usage monitoring and fuel issuance and usage control.

Since statistical and informational reports are generated by the system, the number of persons directly or indirectly involved (and thereby influencing the process) will decrease, leading to better information quality being obtained from collected data.

Using a fleet management system in large vehicle fleets with an active monitoring mechanism will have a positive impact for the vehicle utilization and related issues of expenditure, all of which are contributory cost factors in transportation operations. In practicing active control of their vehicle usage, an organization can achieve reductions in vehicle fuel consumption and maintenance and repair costs. Through improved fleet utilization, it is also possible to adjust the actual number of vehicles needed to perform their operational functions. It has to be noted however, that within organizations there can be differing opinions concerning the actual level of the vehicle fleet provision. In the field, the operational staff perspective of this need may differ greatly from that of the management (Pedraza Martinez et al., 2010).

Fleet management software based on automatic data collection from vehicles provides a more reliable and transparent image of the overall usage and subsequent needs of the vehicle fleet within an organization. This can therefore be used as a reference when allocating resources towards operations. In addition, efficient fleet management and usage monitoring will provide a higher compliance with

government / organizational legislation (duty of care). Often, fleet management is misunderstood as just a simple vehicle tracking system. Most of the available tracking systems provide a live-feed of the vehicles location and movements, whereas a Fleet Management System and the reports generated by the linked reporting tool are mostly based on post-fact information, according to the pre-set parameters in the data transmission sequence. However, there are systems commercially available which combine both functions (Zeimpekis et al., 2007).

Vehicle tracking is vital a part of fleet management and monitoring, but a Fleet Management System does not consist of this alone. A more important function is to monitor the vehicles usage and collect the required telemetry data. The reporting tool component of the system will utilize the collected data to create required reports which the fleet management software can produce and enable the actual management function to take place.

Fleet management software allows different reports to be conducted, as determined by the user. Based on the collected information, it is possible to target tasks and actions related to either the whole vehicle fleet, an individual vehicle, an individual driver, an organizational unit or perhaps a specific geographical allocation of an organizations vehicle fleet or personnel using the vehicle (Zeimpekis et al 2007).

Software (depending on its capabilities), allows functions such as asset management, driver and vehicle profiling, trip profiling, dispatch, vehicle efficiency, maintenance records, workshop storage control etc. It can provide remote control features, such as Geo-fencing, maintenance monitoring and active disabling. Current vehicle diagnostic information can also be related to the management side, depending on the type of hardware installed in the vehicle (IBM Corporation, 2008).

4 THE FLEET MANAGEMENT FUNCTION IN UNITED NATIONS PEACE KEEPING OPERATIONS – 'STATE-OF-THE-ART'

4.1 The United Nations solution to the problem

The United Nations (UN) has employed an electronically operated fleet management tool in their vehicle fleet since 1995. At this time, the United Nations Protection Force (UNPROFOR) Mission operating in the Former Yugoslavia, decided to pilot the system in UN owned vehicles. The initial implementation was done at the UN Logistic Base, Zagreb, Croatia. The author of this thesis was the supervisor of the installation team at the time.

To begin with, the monitoring function covered only those vehicles sending the collected data wirelessly to a dedicated receiving station using a Radio Frequency Modem. The data was downloaded manually to floppy disk format and transferred to the server unit. This process was necessary due the lack of proper technology for data transfer at the time.

The experiences drawn from the pilot program were so encouraging, that later the Electronic Vehicle Management System (EVMS) was adopted as the fleet management system for the UN Missions worldwide, replacing the manual solution based on vehicle trip ticket-based accounting (Fig.4). A framework contract was made with one system provider, in order to have a homogenous control system placed in all vehicle fleets of UN Missions worldwide, so allowing the rotation of the vehicles from one mission to another without replacing the vehicles hardware.

Fig. 4. UN EVMS system diagram (UN Carlog training manual.)

The contractor is E-Drive Technology Ltd and has already supplied 35000 monitoring systems to UN Missions worldwide (E-Drive Technology, 2010).

In addition to vehicle monitoring, the UN's monitoring function has been expanded to fuel issuance operations (Fig.5). In practice this is done by controlling the vehicle fuel distribution points with distribution pump monitoring devices. A generator fuel monitoring function, as well those on fuel distribution trucks have also been implemented.

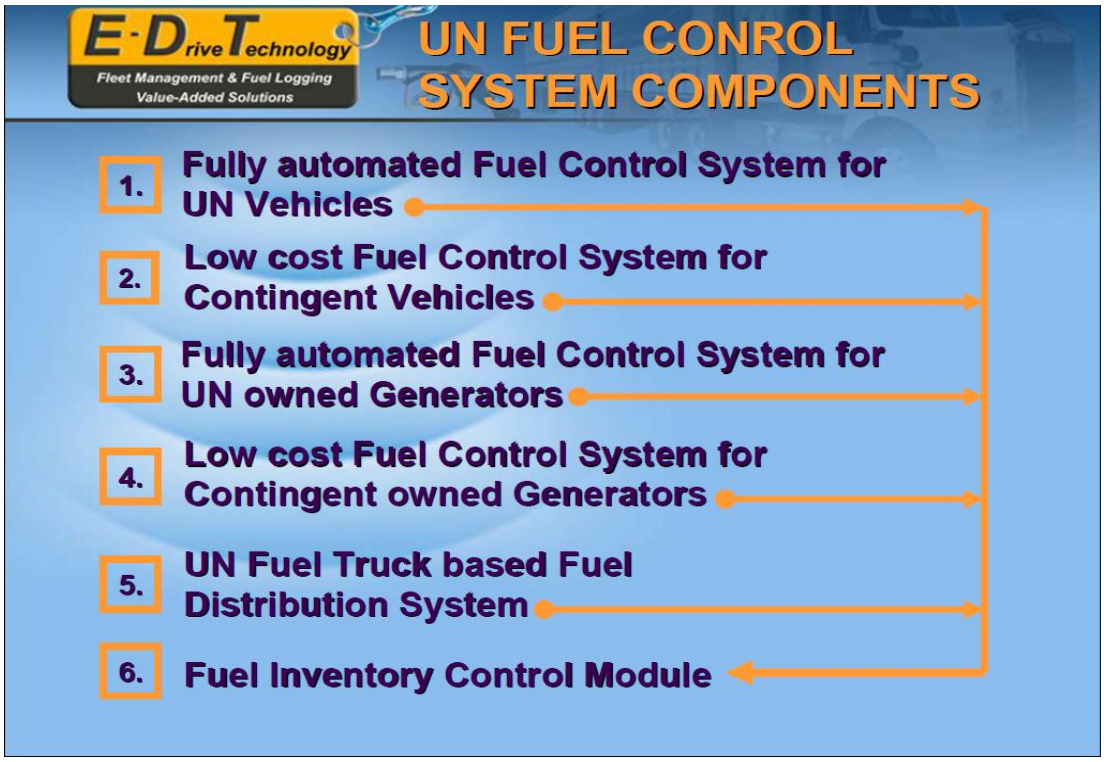

Fig.5. UN Fuel Control system function layout. (UN Carlog training manual)

The vehicle and fuel monitoring reports are composed of data provided by each system (Fig.6), which will allows various data combinations to be inputted in the desired reporting format. This encourages transparent and comprehensive reporting as well improving the overall data quality.

The fuel supplied to generators can be monitored as well (Fig.6). Refuel data and generator hours are recorded, so based on collected information, the generators fuel consumption can be monitored. This function becomes very important, especially when operating in an environment which has limited energy resources. Electrical energy produced in this way is very costly due to the fuel consumed by generator units; therefore it is important to monitor the expenses related to the alternative power production.

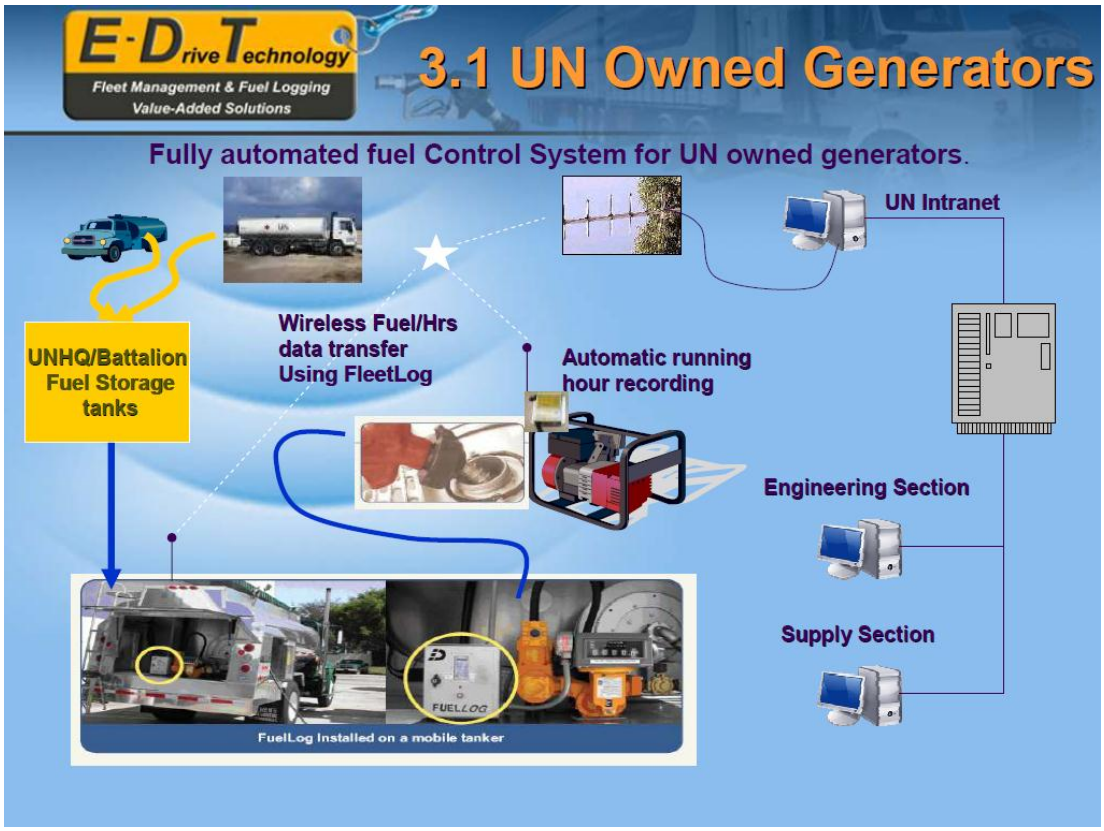

Fig. 6, UN generator fuel issuance monitoring system (UN Carlog training manual.)

One element of fuel control is the control of the fuel transportation trucks and limiting the fuel offloading to only dedicated discharging posts. Due to constantly increasing fuel prices, fuel has become a ‘golden liquid’ which has a ready market for those customers who are not interested about the origin of the commodity, as long as the price is suitable to them.

Fuel Supply within the UN is organized so that the UN takes the role of service provider; i.e. fuel purchasing is made in bulk from the contractor, but distributed through a UN organized supply chain according to their requirements. This however makes losses which occur during storage or transportation, financial damage to the UN itself. The UN has experiences of large scale fuel frauds [UN Office of Internal Oversight (OIOS) list of reports - July 2010 to June 2011 (United Nations, 2011)]. According to the case headings, there have been 3 ongoing investigations regarding fuel frauds, one audit regarding Fuel management, as well one audit regarding fleet monitoring (United Nations, 2011).

In order to tackle the losses caused by fraud to the organization, it is necessary to have the fuel delivery chain duly monitored as a whole, therefore UN Fuel Supply Operations have the vehicle monitoring devices fitted to fuel distribution trucks as well (Fig.7).

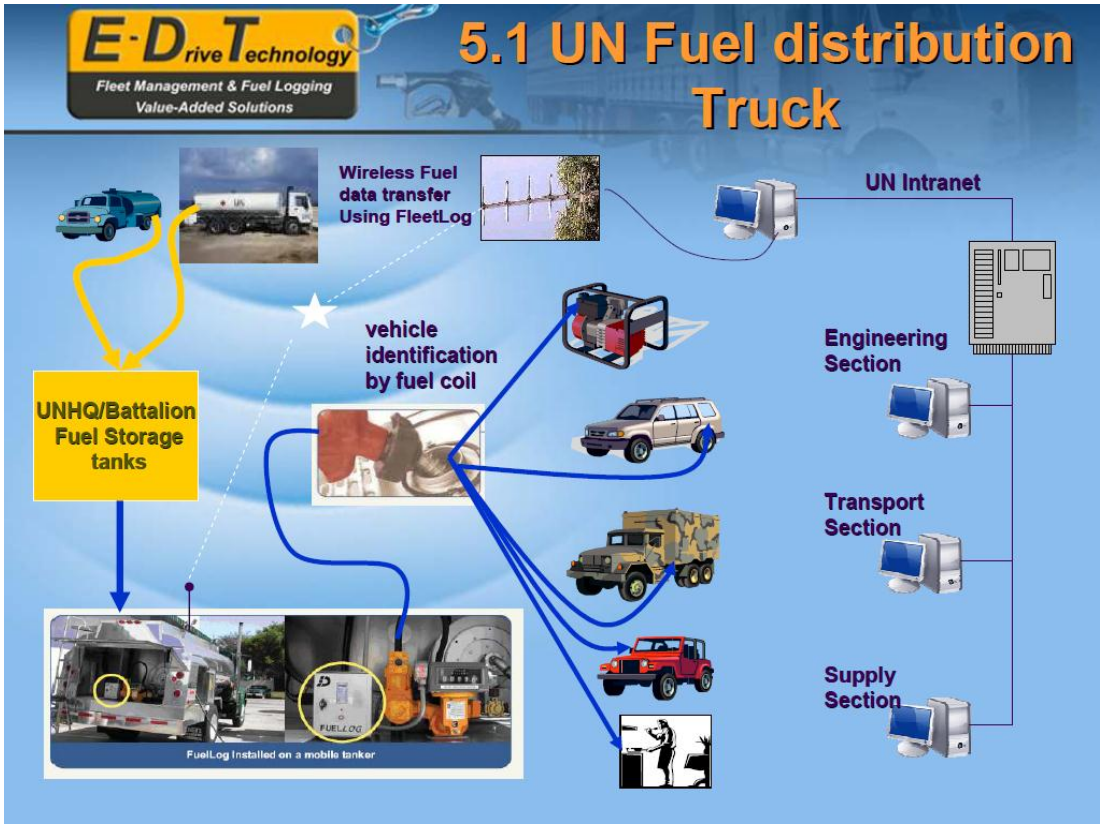

Fig.7. Fuel distribution truck monitoring system (UN Carlog training manual)

Reports from the trucks can be utilized by the Transport Section (monitoring the vehicle fuel consumption), the Engineering Section (monitoring the generators and Material Handling Equipment (MHE)), and also the Supply Section which has an overall view for fuel distribution, and power supply operations.

The collected data can be used for planning purposes as well the estimation of maintaining an adequate contingency stock level for the missions fuel supply. In case the usual supply chains are disturbed, a Fuel Inventory Control Module (Fig.8) has been developed which assists in decision making by providing the necessary data in a timely manner.

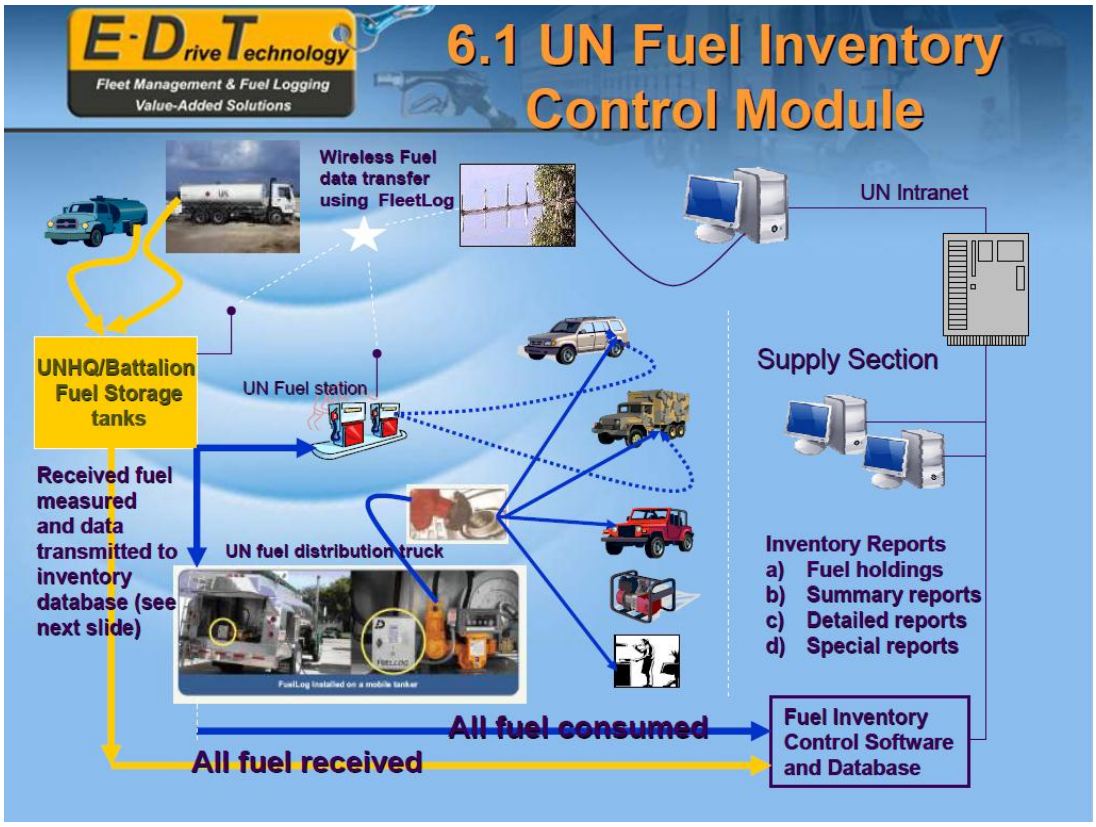

Fig.8. Fuel inventory control module scheme (UN Carlog training manual)

5 FLEET MANAGEMENT IN CIVILIAN CRISIS MANAGEMENT OPERATIONS IN KOSOVO

5.1 EULEX Kosovo and transportation

The European Union Rule of Law Mission in Kosovo (EULEX) is the largest Civilian Crisis Management Mission, coming under the umbrella of the Common Security and Defense Policy (CSDP) and set by the European Commission (European Union, 2008a). The stated strategy is to provide support to the Kosovo law enforcement authorities and the judicial system. The total strength of the Mission is 3200 persons (1,950 international and 1,250 national staff members), with a fleet of 1300 vehicles of various types. In addition to the vehicle fleet, EULEX Kosovo also operates 3 helicopters and one rigid-hull inflatable boat (EULEX, 2011f).

The vehicle fleet consists of heavy 4x4 vehicles (mainly Nissan Patrol and Pathfinder vehicles) which comprise 65% of the total vehicle fleet. 15% are light vehicles (VW Golf and Skoda) and also armored vehicles 8%. (Toyota Landcruiser).The remaining 12% are utility vehicles (Pick-up vehicles and minibuses), heavy trucks, medium buses and MHE (fork-lift trucks, loading systems and the like) (Fig.9).

Most of the heavy 4x4 vehicles have been purchased for the Mission during 2008-9. According to the general renewal policy in place, the calculated life of 5 years or 150 000km for these vehicles will extend until 2013-14 before the new acquisition of replacement vehicles will take place (European Union, 2008b).

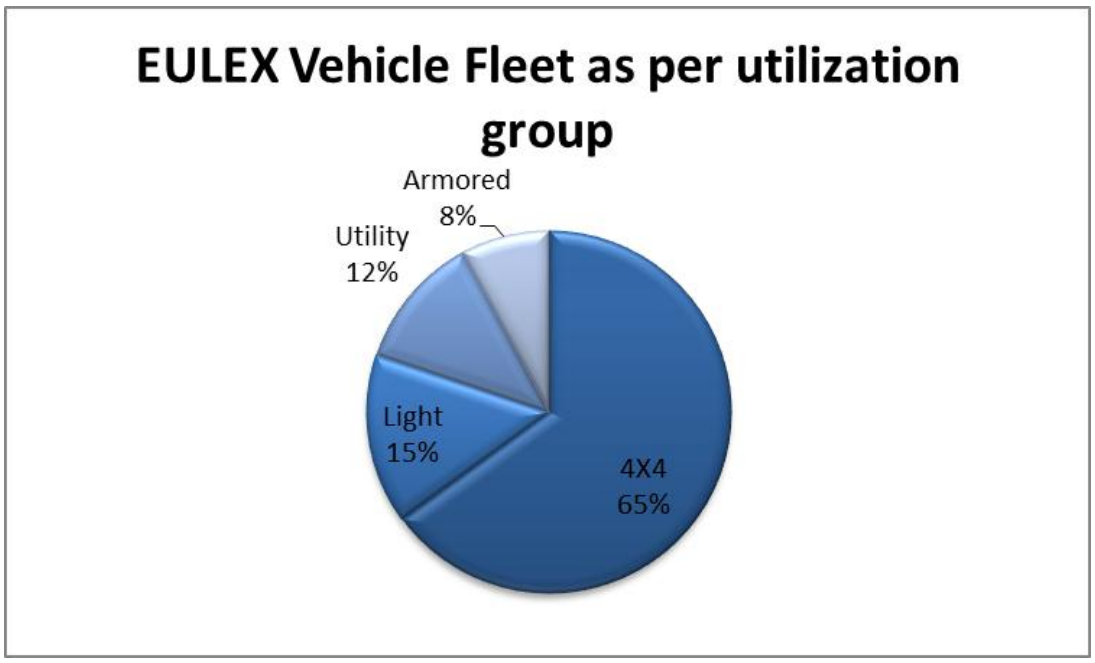

Fig.9. EULEX Vehicle fleet composition as per utilization group (EULEX Transport Unit)

EULEX Vehicles are used for fulfilling duties in the field, which are determined in the Mission Mandate and often described as Monitoring, Mentoring and Advising (MMA). MMA activities are conducted throughout Kosovo. In addition, certain units in EULEX Kosovo possess an Executive Powers in Law Enforcement function, which sets special needs for some vehicles, such as the right to use blue lights in emergencies and high-speed escort activities.

The Police Component holds 48% of the total fleet, Justice (13%) and Customs (6%). In addition, mission support functions are carried out by Administration, which holds 22% of the total vehicle fleet, and the Head of Mission (HoM) Office (Security and HoM Staff), who hold 11% of the total fleet (Fig. 10).

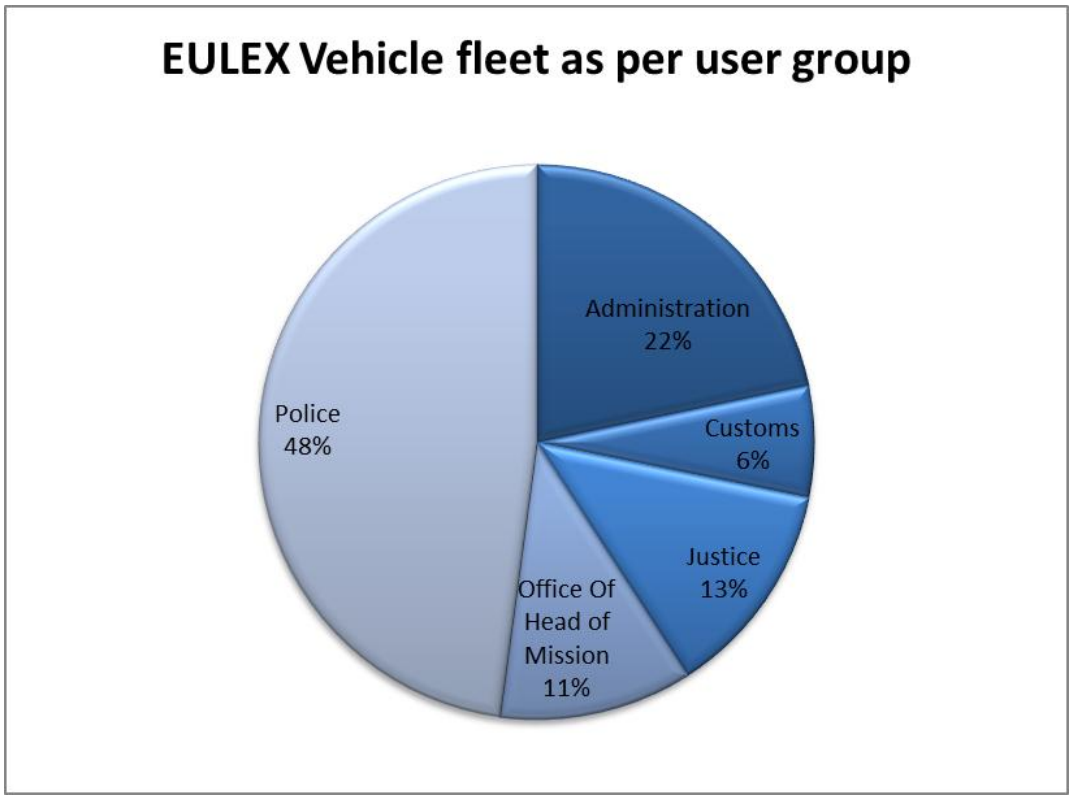

Fig.10. EULEX vehicle Fleet distribution as per user group (EULEX Transport Unit)

A mileage accumulation example (Fig. 11) is taken for September 2011, which indicates the Police Component as driving 36% of the total fleet mileage, Administration 25%, Justice 16%, HoM Office 15% and Customs 8% (weekends are included in these figures).

When reviewing the collected data, it can be seen that despite the fact that the Police Component has 48% of the vehicle fleet assigned, they accumulate only 36% of the mileage. This could be an indicator of inefficient vehicle distribution, and possibly require a management function to take place where fleet management tool becomes useful.

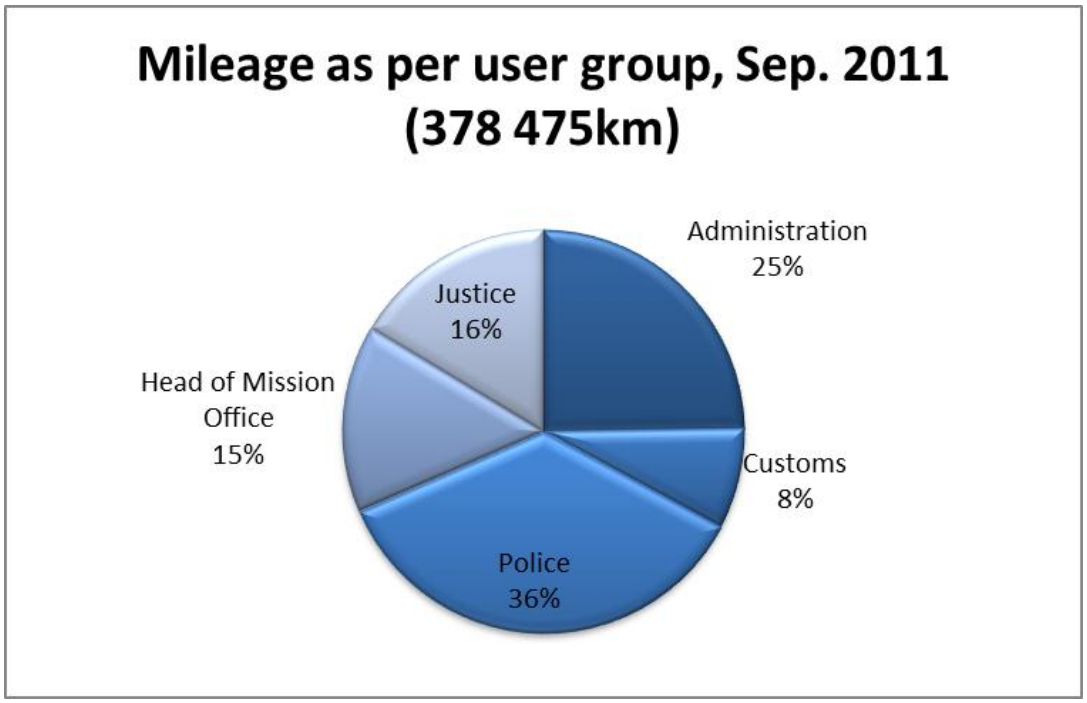

Fig.11. Mileage accumulation as per user group, September 2011(EULEX Transport Unit)

5.2 EULEX Kosovo Fleet Management function

According to Pedraza Martinez et al. (2010, 12-13), the Fleet Management function can be divided in three main model categories:

1) Centralized model: where vehicle procuring and acquisition is based on a centralized budget and vehicle use is regulated from the Head Office;

2) De-centralized model: where the field missions have the authority to purchase and regulate the use of the fleet autonomously;

3) Hybrid-models: which are combinations of both of centralized and de-centralized models.

When comparing the Fleet Management model in EULEX to those mentioned above, it can be determined, that the fleet management model used in EULEX Kosovo is a hybrid model. At the moment there is very little information or guidelines available in the general conditions and requirements that are dictated by the European Union External Action Service (EEAS) Common Security and Defense Policy (CSDP) and Headquarters Logistics Department in Brussels regarding the fleet management.

Most of the CSDP Field Missions take decisions individually and uncoordinated with the requirements and procedures of other field missions. The vehicles are acquired partially through tender procedures initiated in-Mission and partially through the existing System Contracts formed by the CSDP Logistics Department in Brussels. The rules and regulations governing the use of vehicles are also partially dictated by related CSDP directives, as well the EULEX Kosovo Operation Plan (OPLAN) [not referenced].

The vehicle fleet of EULEX Kosovo is distributed throughout the mission area and managed by five regional locations within the geographical area of Kosovo. The fleet management and data collection functions in EULEX Kosovo are distributed throughout several locations and involve a large number of staff in data collection and recording (Fig.12). At the Transport Headquarters level, the Force Vehicle Inventory Unit (FVIU) records and maintains vehicle allocation, registration and replacement records. Transport Dispatch is responsible for recording the data of vehicle usage, which is provided by individual vehicle users in the form of Vehicle trip tickets. These are imported into a database to produce monthly statistics. The Transport Fuel Unit records the fuel issue vouchers, whilst the Maintenance Office keeps the vehicle maintenance records. Regional Transport Units are responsible for the collation of data (as described) for their individual area.

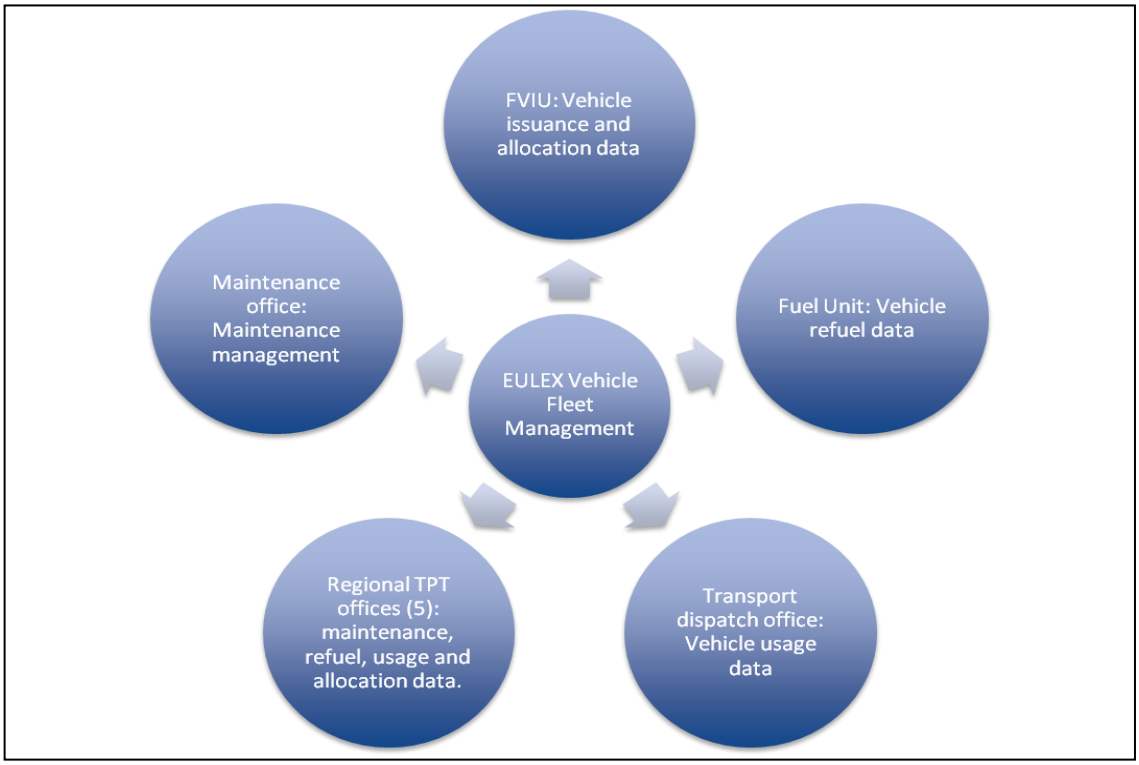

Fig. 12. The Fleet management task distribution in EULEX Transport Unit (EULEX Transport Unit)

5.3 General requirement and guidelines for fleet management in EULEX Kosovo

EULEX OPLAN sets up the administrative rules and regulations governing the vehicle use and the use of the Mission assets. OPLAN forms a 'constitutional' document for the Mission, and determines all those conditions given by the European Commission, under which to execute the mission. The EULEX OPLAN is a restricted document on the level 'EU SECRET' and therefore it is not possible to quote directly from the document in this study. For more detailed information on the area however, a Standard Operating Procedures (SOP) document for 'Transportation and Guidelines for Vehicle Fleet Management' (European Union, 2008b) has been produced to implement the rules and regulations stipulated to the practice. The justification for the provision of mission vehicles is defined as the following:

"Vehicles are provided to a Mission in order to ensure that adequate transportation is available to personnel for their official duties" (European Union, 2008b: 4.b.10.1).

In practice this means that the strength of the vehicle fleet has to fulfill the daily operational needs, as well as those exceptional needs that may arise. The nature of the EULEX Kosovo Mission is a Civilian Crisis Management Mission and the operational situation can be volatile and hence subject to critical change.

The mission vehicle fleet consists of two main groups, which are the Operational Fleet and a Reserve Fleet. The Operational Fleet implies those vehicles which are allocated for the actual operational use whilst the Reserve Fleet is those vehicles which are in good working condition and kept on stand-by status and ready for deployment as required. The current strength of the reserve fleet in EULEX Kosovo is 5% of the total fleet.

In exceptional cases it is possible to use Mission vehicles for private use or recreational purposes in cases where the operational situation allows it and it is approved in advance by the Transport Unit (European Union, 2008b). Understandably, this form of usage will not be a priority in the operations of EULEX Kosovo and is approved only on case-by-case basis.

Procedures for fuel accounting in EULEX Kosovo are laid down in the instructions for the management of Petrol, Oil and Lubricants (POL). Below, are the subtracted main points from the POL management document (EULEX, 2008) which govern the accountability of POL issuance and determine the requirement for the monitoring of consumption.

"*Status of Fuel – A Commodity.* It is immaterial that fuel is used in vehicles, generators, heaters, etc. The key issue is that, although they have special handling and safety characteristics, POL are commodities. As a commodity, the Transport Section within EULEX has the primary responsibility for all matters related to POL."

"*Responsibility & Documentation.* To assist in the process of rationalizing the management of fuel in the Missions, the Transport Section under the Chief Transport Officer is directed to document all POL procedures addressing (although not exclusively) fuel planning, ground fuel quality control, safety procedures, the budgetary process, monitoring of consumption & expenditure, fraud prevention and training."

"*Security.* Fuel is considered one of the most attractive commodities in the mission and is therefore subject of fraud and misappropriation by both, staff members and contractors employees."

"*Definition of Accounting – Fiscal and Quantitative.* The term accounting is generally regarded as a financial term. However in the context of managing a Fuel Contract, it also embraces the monitoring of quantitative measures, i.e. the recording of how much fuel is consumed and for what reason."

"*Monitoring – Transport Section.* Although the accountability for fuel issued to drivers, operators, or Police Units ceases to be the responsibility of the Transport Section; nevertheless the Transport Section is specifically tasked to:

"*Monitor.* Monitor the fuel consumption pattern for all vehicles, generators, Police Units."

(SOP for The management and accounting for Petrol, Oils & Lubricants in EULEX Kosovo.)

These guidelines give a great weight to the accountability and consumption monitoring of fuel. In a mission with large vehicle fleets and a manual fleet management system, this requires a number of forms and laborious data recording.

5.4 Vehicle maintenance control

The primary responsibility in a vehicle's maintenance lies with vehicle user. Experience has shown that although related training is available and guidance is given to vehicle users, there are often vehicles that are presented to the Transport Maintenance office without an adequate maintenance history. This increases the potential for costly breakdowns, not to mention the increased risk for the vehicle's users in regard to road accidents arising from technical fault. A manually operated Fleet Management System (FMS) does not provide the required information in advance for the Transport Maintenance Office, so as to allow the follow-up and projecting of the upcoming maintenance needs of the vehicle fleet. Physical maintenance work is carried out utilizing a hybrid-model of in-house workshop or services provided by external Contractors.

5.5 Field Mission context

When comparing fleet management in a Field Mission context, as opposed to that of Commercial Fleet Management; the biggest difference can be noted in that commercial principles (e.g. most economical route or fast delivery times) are not amongst the parameters which guide operations in the Field Mission.

As studied by Stapleton, et al. (2010), in their case based approach of Fleet management in the International Humanitarian organizations (IHO), the IHO Field Missions work in an atypical environment and do not prioritize common commercial principles in their operations. This is mainly due to the nature of their activities are non-profit driven and with humanitarian values. These values and motivational drivers are difficult to standardize, because of the large number of variables encountered in different operational environments.

Usually, the operations are carried out in the developing world with a poor infrastructure, uncertain security and lacking in routine facilities. A high rotation of expatriates participating in the Field missions is also causing an extra burden to solve. Due to the instability of the working environment, IHO:s maintain relevant contingency planning in order to be able to carry out operations, which may encompass changes in their security situation, as well as natural disasters. This contingency planning concerns the whole organization and includes fleet management (Stapleton et al., 2010).

The EULEX Kosovo operating environment has a lot of similarities with IHO Field Missions. Although the basic approach is Civilian Crisis Management in form of MMA as opposed to humanitarian aid, the political volatility of the Kosovo region and potentially rapid changes in the situation have to be considered when determining the techniques employed in fleet management.

As raised within IHOs; EULEX Kosovo also has high rate of rotation among the personnel operating vehicles, due the staff rotation policy (determined by the personnel contributing countries), which ranges from six months up to three years among the Missions internationally recruited personnel. The vehicles and equipment are mainly European Union Owned Equipment (EUOE) and in addition to these,

EULEX Kosovo has a degree of Contingent Owned Equipment (COE), which is used by specialized forces (such as Riot Police) sent by contributing country (Fig. 13). Due the specialized nature of these units, it has been agreed between the Mission and the contributing countries that they will contribute the personnel as well their necessary equipment to the mission.

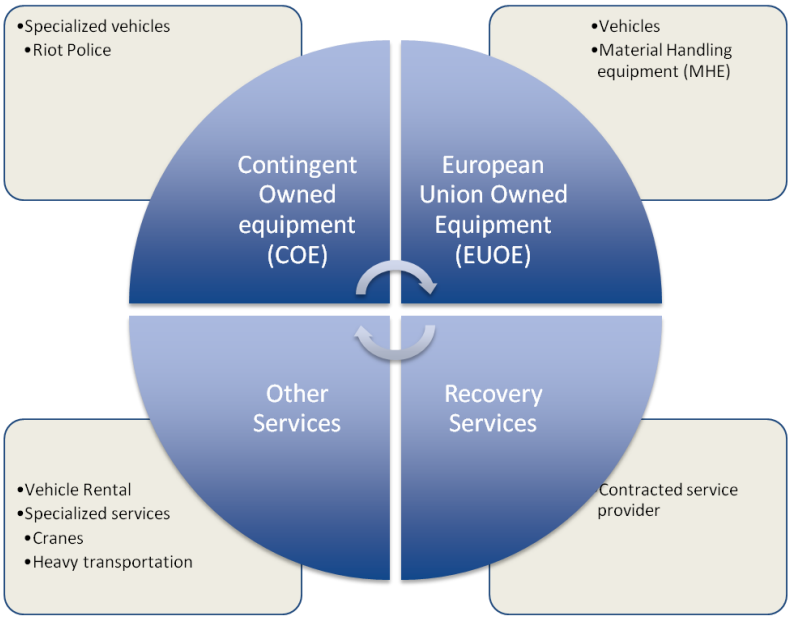

Fig.13. EULEX Transportation resource utilization (EULEX Transport Unit)

In order to be financially efficient, EULEX Kosovo Transport has also outsourced some of its transportation operations, such as vehicle recovery services which require specialized equipment, as well as part of its heavy transportation and crane services. Vehicle rental services are engaged for such tasks that cannot be conducted with the vehicles available.

6 FLEET MANAGEMENT AND MONITORING IN THE MANUAL SYSTEM

6.1 Guidelines for the control of EULEX vehicles use

6.1.1 Vehicle Trip Ticket

The vital part of the control mechanism is the Trip Ticket data collection form. This is an individual paper for each vehicle, which is used on a daily basis to record the required data. It is returned to the relevant Transport Unit office on monthly basis and the data collected will be recorded (Table 1).

Table 1. Data collected from the vehicle trip tickets

Vehicle Registration number	Vehicle model	Fuel Type used	Month of the use	Date of the use	Route/ Destination
Vehicle odometer reading in the start and at the end of the trip	Breakdown of mileage accumulation	Fuel refueled	Oil added	Remarks	Daily Check*
Driver name	Driver ID number (EULEX ID)	Office / Unit location	Approval marking in case required	Number of passengers	

***** *"To ensure maximum operational readiness, the vehicle should be maintained systematically and inspected every day it is operated, so that defects may be discovered and corrected before they result in serious damage or high repair costs. Maintenance consists of regular daily preventive maintenance and planned periodical maintenance. Daily preventive maintenance is conducted by the driver of the vehicle"*

(Guidelines for vehicle fleet management).

It is the responsibility of the current vehicle user to maintain the Monthly Trip Ticket in adequate manner and record all of the required information accordingly.

6.1.2 Data recording

The Vehicle Trip Ticket accounting system is very labour-intensive, because all data has to be collected manually and then converted into electronic form. When informally interviewing staff responsible for handling the data collected from the Monthly Trip Tickets, it was estimated that one trip ticket takes approximately 4 minutes to process thoroughly, starting from the inspection of the sheet, through to importing the data to the relevant database. Annually, approximately 15,600 vehicle trip tickets are processed into the system.

When multiplied by the number of vehicles (1300) and the average working time in the mission (7.6 hours/day), we may appreciate the input required.

Labour is marked as L. With given figures we get following result:

L= (4x1300)/60 minutes = 86.66h/7.6h = 11.4 working days per month.

11.4 x 12 = 136.8 days

Labour therefore = 136.8 working days per annum

Based on the example, 136.8 working days of labour per annum is used to process the trip tickets. The amount equals for 27.36 working weeks (6.8 months) of manual labour per year.

In addition, experience has shown that when operating large vehicle fleets and managing a vast amount of individual drivers, ‘Human Error’ plays significant role. This presents in form of man-made errors, typically with mileage recording, fuel consumed, driver name, ID number, vehicle registration number etc. Whilst maybe trivial to the user, this vital information which will directly affect the reporting result and reliability of the information gathered, having both a strategic and economic impact.

6.2 Fuel Accounting

According to the Transport Section – Fuel issues per Mission report 01/06/2010 – 31/05/2011 (EULEX, 2011d), the EULEX Kosovo fuel consumption for vehicles per annum was 1, 484,648 liters.

Accounting for vehicle fuel is based on the Vehicle Trip Tickets and with a comparison made against Fuel Issue Vouchers. Monthly report is composed from the information retrieved from Trip Tickets, fuel contractors Fuel Issue Vouchers, the fuel contractors monthly invoice and the EULEX operated "Fuel Supply" database solution, which allows reporting as required.

The process for data collection is as follows: A driver will mark the Trip Ticket document the vehicle mileage the time of refueling. The refueled liters will be recorded on the Trip Ticket and after completion; the Fuel Attendant will record the information on the contractor's fuel accounting system and print out a Fuel Issue Voucher that the driver will sign. Details of the voucher number, date, time, vehicle registration number; odometer reading, staff name and ID number and the Mission name are recorded. The fuel attendant then stamps the Vehicle Trip Ticket, indicating the location of refueling.

6.2.1 Fuel Data recording

A copy of the Fuel Issue Voucher is then submitted to Transport and Fuel Unit for recording and transfer of data to the relevant database. Based on informal interviews and the estimations of the personnel handling the Fuel Issue Vouchers, the data input from the Fuel Issue Voucher to the Fuel Supply database averages as 20 seconds per voucher. The data is recorded manually, which gives potential for human error to take place in following places:

a. Incorrect data in trip ticket (Driver)

b. Incorrect data in fuel issue sheet (Fueling attendant)

c. Incorrect input to the Fuel Supply database (Fuel administration assistant)

In the period 01.06.2010 – 31.05.2011: a total of 32,312 individual issue vouchers were manually imported to the system (EULEX, 2011e).

In order to estimate the required labor for the process, following can be determined:

32,312 vouchers x 20 seconds = 646 240 seconds = 10 770.66 min = 179.51h

179.51h ÷ 7.6 hours = 23.61 working days

The calculation shows that 23.61 working days equates to 4.7 working weeks used annually to import data manually to the Fuel Supply database.

Errors in the database information are common and detectible. Most errors involve the vehicle registration number and mileage, instead of the actual amount of fuel in liters. This is attributable to the double bookkeeping involved, one being kept by the Mission and one by the fuel contractor.

All Vehicle Trip Tickets have to be returned to the Transport Unit no later than the 5th day of the month, in order to allow timely reporting. Based on the trip tickets received and the information gathered from them, the transport & fuel assistants in their respective regions will compose a monthly report which will then be submitted to the Transport Sections Fuel Unit.

The composition of the monthly report will take approximately 30 minutes, undertaken on a monthly basis in five different locations. This gives an estimated working time of 3.9 working days per annum.

6.3 Vehicle maintenance control

"Periodic maintenance should be carried out in accordance with the appropriate vehicle manual or as stated below under normal conditions. If conditions are more severe it is justified to service the vehicles more frequently. Mission should consider setting up its own maintenance plan according to the conditions within its AoO (Area of Operations).

A- Maintenance - at 7500 km intervals

B- Maintenance – 15000 km intervals

C - Maintenance - 30000 km intervals

D - Maintenance - 45000 km intervals" (European Union, 2008b)

As per the above guidelines, the EULEX Kosovo Transport has decided to conduct the maintenance needs not only based on mileage accumulation, but also in-line with every six months of service. This will ensure that the roadworthiness for each vehicle is evaluated and inspected by EULEX Transport staff at least twice a year, regardless the vehicles mileage accumulation.

Predicting the actual need for fleet maintenance services for is only possible through extensive study of the mileage accumulation prognosis based the data recorded on the Vehicle Trip Ticket system. Given the labour intensity of the manual accounting system and the issues of inaccurately recorded data leading to unreliable reports, in practice this means that such prediction is rarely undertaken as part of the operational processes, with the exception of annual cost formulations for budgeting purposes.

6.4 Driver management

The manual system provides no tools to monitor the behavior of the driver. All EULEX Kosovo drivers are informed of the rules and regulations of the Mission. In order to acquire EULEX Kosovo driver permission, they have to pass a practical driving test. After this is successfully completed, permission to use Mission vehicles is granted.

The EULEX Security and Safety Unit do not conduct roadside control, or speed control for EULEX vehicles or their drivers. In accordance with local legislation, all EULEX international staff are subject to the Vienna Convention on Diplomatic Relations. As a result, the local police are reluctant to intervene in the behavior of EULEX vehicles, even if they are seen to be breaking the local traffic rules and regulations. This has led to the situation whereby a number of international staff driving EULEX vehicles are not controlled by any authority and which undermines the traffic morale of EULEX vehicle users and additionally the public image of the EULEX Mission.

7 EULEX KOSOVO FLEET MONITORING SYSTEM (FMS)

7.1 Overall objective

"The overall objective is to have in place a long-term, cost-effective solution for Fleet & Fuel management system for the EULEX fleet of vehicles within the mission area of operations. For this purpose, EULEX Transport section needs to have a Framework Contract with a Service Provider for providing such service for EULEX vehicles & Fuel distribution points."

(EULEX, 2009)

The objective outlined above worked as a guideline when the FMS definition was determined. Technical capabilities were carefully studied and determined according to the actual service needs. The announcement of a tender procedure for interested candidates stated following:

"The overall objective of the project of which this contract will be a part is as follows: Provision of services related to a fleet and fuel management system (including installation of hard- and software, data collection, maintenance, training etc) for EULEX Kosovo's vehicle fleet of approx. 1300 vehicles. The system shall monitor, record, report and store data such as usage of the fleet, fuel usage, driver's activities and fuel distribution."

(EULEX, 2010)

As with all procurements of supplies or services in EU ESDP missions, the EULEX Kosovo FMS acquisition was processed through competitive selection, as regulated by European Union procurement legislation.

The maximum budgeted value of the contract was € 1,092,000. Due to the specific nature of the project, which was service oriented and included the supply of hardware; it was decided to launch the tender under 'restricted procedure' regulations. This involved a two stage approach for the candidates, from whom the Contracting Authority would select and invite potential candidates to participate in the tender process (Fig.14). The minimum number of invited candidates participating for service evaluation is 4 and the maximum is 8. In this instance, 8 companies were invited to submit their tender document in order to ensure the best view of the solutions available (European Union, 2011).

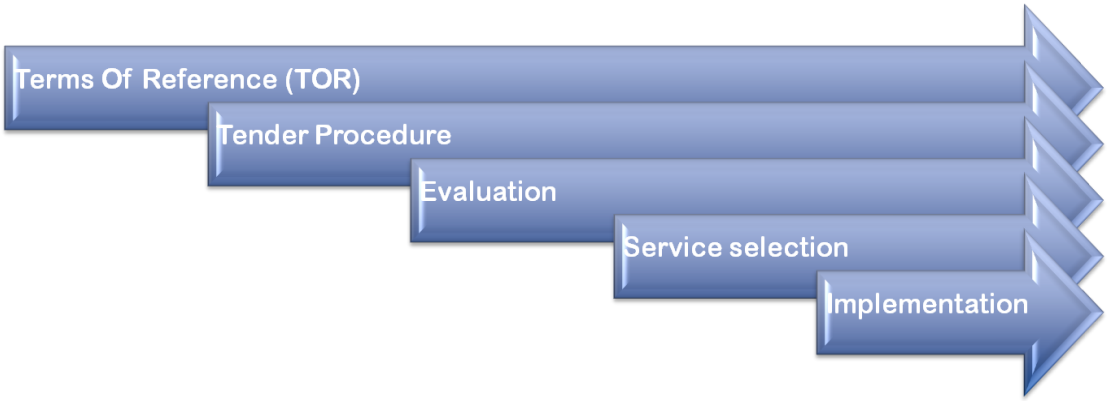

Fig.14. The EU tendering process chart (European Union, 2011).

7.1.1 Technical requirements

The author of this study determined the technical requirements and composed the TOR for the system to be purchased. Below is a general listing of the main required functions in order to record the anticipated data and their associated technological requirements:

Technical requirements (collected data for reports) for Vehicle Mounted System(s)

- Driver ID
- Vehicle ID
- Date & time at the start of the trip
- Date & time at the end of the trip
- Vehicle odometer reading at the start of the trip
- Vehicle odometer reading at the end of the trip
- Vehicle speed information (top speed & average speed of the trip)
- Vehicle location (GPS grid & route display on the map when required)
- Real-time vehicle position on demand if in network area.

- Data transfer using GPRS or 3G network systems. (Non-EULEX networks, commercially operated)

- Data download once per day automatically or when required (separate cost of additional download must be indicated).

- Geo-fencing capability (i.e. geographical area of vehicle usage can be determined; if the vehicle leaves the area, system will notify accordingly.)

- Vehicle fuel consumption liters/100km.

- "Next maintenance"- notifying. The system will notify the vehicle user (beeping sound, warning light etc.) about the upcoming regular maintenance programmed into the vehicle database. If overdue, the system will enforce a 2nd level warning (continuous beep etc.). When overdue, the system has to record the time and mileage when the 2nd level warning has been active.

- "Panic-button"- emergency information system. When pressed, the system will send all relevant information of the driver & vehicle location to the allocated point of contact in EULEX Kosovo.

- Vehicle immobilizer, i.e. vehicle cannot be started without specific individual activation enabled by authorized driver. This can be a proximity-card type solution or other relevant system which can be monitored. Restricted use of vehicles should be allowed according to the vehicle category or vehicles requiring special training (i.e. armored vehicles)

- Remote immobilizer, i.e. engine cut-off which can be enabled remotely.

- Accident data collection. At least 5 minutes of data must be saved prior to when specified parameters (deceleration/acceleration) are exceeded. This data should be saved in the unit and can be downloaded individually or sent to the network. A graphic presentation should be produced by the system to determine the speed, driver, location at the time of event & the 5 minutes prior.

- Vehicle units must be suitable for vehicle installation and tolerant for extreme cold winter weather (-25C) and extreme hot summer weather (+40C). Splash-waterproof. Resistant for vibration and dust.

- Operational voltage 12-24V, depending on the vehicle electrical systems operating voltage.

- Back-up battery must support the unit data for at least a period of 6 months.

- Can be re-cycled and re-programmed from one vehicle to another if required.

Technical requirements (collected data for reports) for Fuel Distribution Point mounted system(s):

- Driver ID
- Pump ID
- Vehicle ID
- Amount of fuel supplied in liters.
- Fuel type supplied.
- Vehicle odometer reading at the time of refueling
- Date & time & location of refueling
- Data transfer using GPRS or 3G network systems. (Non-EULEX networks, commercially operated)
- Data download once per day automatically or when required (separate cost of additional download must be indicated).
- Must have dual recognition system, i.e. Fuel Pump must identify the vehicle first, after that the driver has to activate the pump by using same personal individual activation as per overriding the vehicle immobilizer. (Proximity-card etc.). If only one ID is recognized, the fuel distribution shall not commence.
- Possibility to by-pass the dual recognition system in case of emergency using secure and tamper proof lock-switch etc. Clear indication of by-pass activation must be in report when required.
- If vehicle ID is not recognized according the pre-set sequence of time during refuel, the fuel pump must have a cut-off function. This function is to avoid the unauthorized refueling of jerry cans etc.
- Pump units must be suitable for outdoor installation and tolerant for extreme cold winter weather (-25C) and extreme hot summer weather (+40C). Must be waterproof against heavy rain, snow & wet snow. Resistant for vibration and dust.
- Operational voltage 230V.
- Pump units must be tamper-proof, can be sealed and with secured access.
- Can be re-cycled and re-programmed from one fuel pump to another if required.

Technical requirements for the Personal Individual Activation System(s) (Dallas-button, proximity-card etc.):

- De-activation remotely in case of loss.
- Must have individual ID number
- Operational in cold & hot climate
- Tolerant for the water, dust, heat, sunlight, mechanical stress in normal use
- Maximum size 90mm x 60mm x 5mm
- Printable (possibility to use as an Driving permit, preferred)"

(EULEX, 2009)

The Mission area climate presented an additional requirement for the hardware. In Kosovo, the climate varies from relatively cold winters to hot summers; this had to be taken into account when determining the desired hardware characteristics, in regard to stability and performance when operating in a variable climate. Additionally, the electrical supply in Kosovo in general is low in quality standards. Power-cuts are common and the voltage regulation is volatile. Usually, back-up power is produced by diesel operated generators which will give extra stress especially for the Fuel Pump Monitoring devices, which are powered by regular power supply network.

7.1.2 Reporting requirements

The author of this study determined the reporting requirements and composed the TOR for the system to be purchased. Below is a general listing of the main reporting functions:

Vehicle Reports

- Vehicle use report, period of time
  - Mileage
  - Location
- Fleet use report, period of time, mileage
- Vehicle use per driver (component, unit, location, area, time)

- Vehicle use per driver group (component, unit, location, area, time)
- Report of abnormalities, (eg. vehicle is refueling more than the tank capacity allows etc.)
- The Report(s) period of time as requested by user

Fuel distribution reports

- Fuel use per vehicle, fleet, unit, component, location (liters/100km)
- Fuel use per driver, component, location
- Fuel issuance report per distribution point, period of time, detailed report
- Fuel issuance report per distribution point, period of time, general report
- Fuel loss report.
- The Report(s) period of time as requested by user

Driver info report

- Driver performance report, time date, location, speed, mileage (individual, component, unit)
    - Reports of erratic driving, heavy acceleration & braking, location, time & speed of such event
    - Vehicle use outside Mission area, vehicle, time, date, speed, mileage.
- Driver activity report
- Over speeding report (vehicle ID, driver, time, date, speed (average, top speed), location)
- The Report(s) period of time as requested by user"

(EULEX 2009)

7.1.3 Evaluation process

During the first phase, a total of 24 companies expressed their interest in tender participation. Of those, the Evaluation Committee (4 members and a secretary) selected 8 companies, of which 6 submitted their Tender Dossier document before the deadline of submission. Of those 6 candidates, five were found to technically comply with the TOR document.

After careful examination of the proffered systems, a technical evaluation was made and graded accordingly. The TOR evaluation gave more weight for the technical capabilities of the proposed system, rather than the base-line price.

After the grading was finished, the financial offers were opened and examined. Due to the confidential nature of the tender process, direct referrals to these documents are not possible.

7.1.4 Service selection

The Evaluation Committee grading of technical factors, the result of calculations (including the weight factors allocated for technical evaluation) and a financial evaluation, were combined to give a Weighted Product Model (WPM). Considering the multiple factors involved in the evaluation process and given that the technical specification was elected to be the most important feature of the service (therefore comprising the *critical criterion* element of the analysis (Triantaphyllou and Sanchez, 1997), it was determined that a WPM was the optimal analysis tool to be used in selection. After the technical evaluation of the services was completed, the financial offers were opened and evaluated. After conducting the WPM, it was found that Taipale Telematics Ltd from Finland was chosen to supply the required service. Due the confidential nature of the process, direct referral to the evaluation document is not possible.

The selected company received the best grading regarding the technical solution from each of the Evaluation Committee members. Their proposed solution was fully compliant with the TOR specifications and in addition, their system provided very detailed profile information concerning the vehicles usage and driver behavior. It was thought by the group, that the enhanced driver management capability would provide

added value for the FMS in EULEX Kosovo and no other solution reviewed for the tender offered such a high level of function.

8 FLEET MANAGEMENT AND MONITORING IN EULEX KOSOVO

8.1 Controlling EULEX vehicles use as per guidelines

As described above, the solution for fleet management and monitoring was determined through competitive selection. The contract is service based and the contractor is responsible to provide reports as per the TOR requirements, as well as the installation of the required hardware for data collection. The hardware has been installed into the vehicles and also the fuel distribution points for fuel issuance monitoring within EULEX Kosovo.

The system in general is collecting data provided by the vehicles, drivers and the fuel distribution pumps (Fig.15). The vehicle data includes both the driver ID and vehicle data, whilst fuel pumps send all the data related to fueling events.

The collected data is then transmitted to a database through a GPRS data transmission protocol, utilizing the existing local commercial GPRS networks. The data is then processed within the FMS database and made available to the reporting tool.

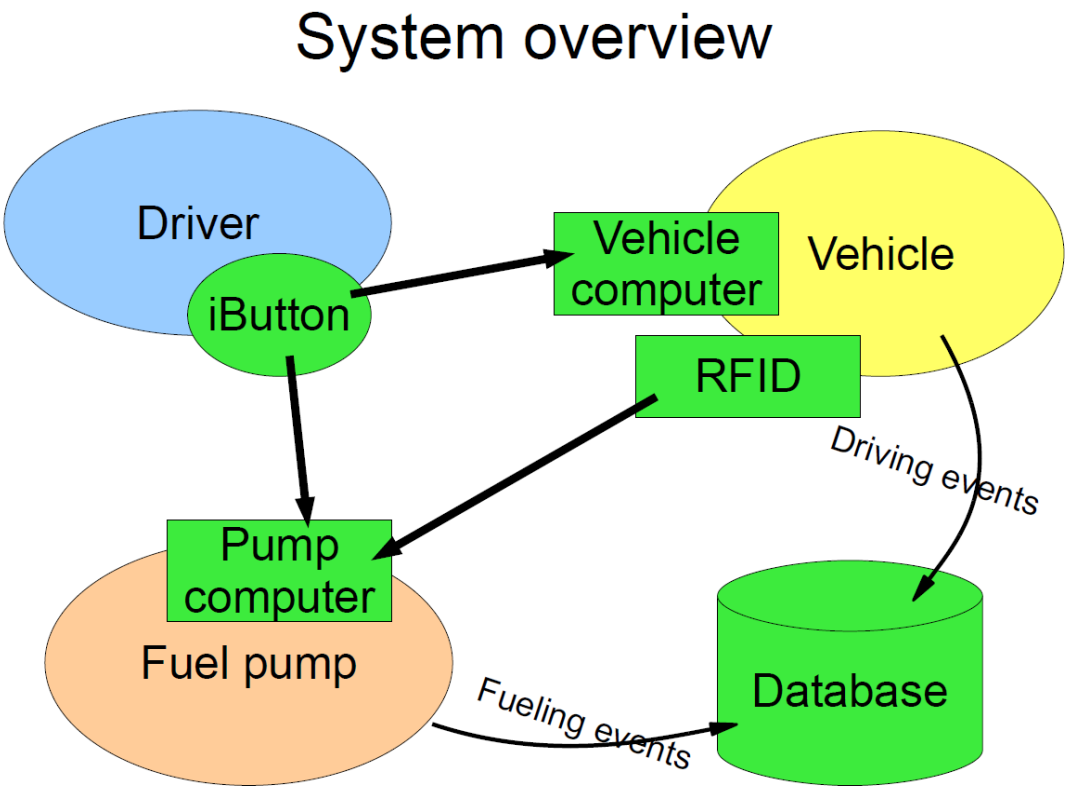

Fig.15. EULEX Kosovo Fleet Monitoring system overview.

The reports can be created by using various data combinations which allow report formation on a customized basis. These reports are made available to the user through a web-based solution, requiring no additional software to be installed.

Data collection for vehicles is performed automatically when the vehicle is started and during its use (Table 2). The system will record events without the participation of the driver; only the driver login function is required before the trip. The login is facilitated by a personal iButton device (Fig.16) which has its own 64-bit ROM registration number that is factory carved into the chip and provides a unique identity for traceability. The stainless steel package is resistant to environmental hazards such as dirt, moisture, and shock. The coin-shaped profile of the iButton is self-aligning with its mating receptacles in the system. Data is transferred serially via the 1-Wire protocol, which requires only a single data lead and a ground return.

Fig.16. iButton device used for driver login function.

The parameters monitored are shown in table 2.

Table 2. . FMS vehicle unit data collection

Start time and date of the trip	Start location of the trip	Virtual odometer reading at the start of the trip	Top Speed of the trip
End time and date of the trip	End location of the trip	Virtual odometer reading at the end of the trip	Average Speed of the trip
Driver ID	Driven route	Total mileage of the trip	Acceleration parameters (centrifugal forces) affecting to the vehicle

Through the collected data, it is possible to generate reports almost in real time, depending upon the transmission sequence and given that the vehicle in question is in a GPRS network coverage area.

Using the FMS reporting tool, it is possible to obtain reports based on various levels. These are most commonly on the individual vehicle or user, the vehicle fleet and also the user group. These reports can be created to cover a freely determined time period as needed.

8.2 Fuel Accounting

In EULEX Kosovo, FMS fuel distribution points are monitored by an external control device which is installed at the fuel distribution point. This device monitors the fuel pump usage and records the data as shown in Table 3.

Table 3. Recorded and monitored data in Fuel Pump unit

Vehicle RFID	Driver ID	Refuel Amount liters	Fuel type
Date	Time	Location	Abnormalities

In order to ensure that the access to fuel is restricted to authorized vehicles and persons, a ‘dual-identification’ process is implemented.

To enable fuel distribution, the fuel pump monitoring device has to first identify the vehicle requiring fuel (wirelessly through a vehicle installed individual RFID tag (Fig. 17). After successful recognition, the individual driver has to identify himself to the fuel control device (Fig.18) using the assigned iButton which transmits the driver ID to the system. The system checks the authorization for both the vehicle and the driver (Fig.19). After recognition patterns are successful, the refueling will initiate and the refueled amount is measured and recorded. Simultaneously a vehicle odometer reading will be recorded into the FMS database. By this approach, all of the required data is collected in a timely manner and the accuracy of reports is ensured.

Fig.17. RFID tag installed to the vehicle

Fig.18. Fuel pump control device with an RFID recognition antenna on top.

Figure 19. Fuel pump control unit system status indicator lights and login-application

8.3 Vehicle maintenance control

The maintenance instructions for the EULEX Kosovo vehicle fleet determine the need for maintenance to be both, mileage-based (every 7500km) and time-based (every 6 months). To monitor and ensure timely maintenance, the FMS has an in-built maintenance monitoring control interface.

As a part of maintenance check-out process (i.e. the release process for a vehicle that has undergone maintenance), the EULEX Kosovo Transport Section Maintenance Office will update the next scheduled maintenance point through the FMS reporting tool interface. This will then monitor the mileage accumulation based on the vehicles virtual odometer reading, as well the date of the last maintenance service recorded.

When the next scheduled maintenance is approaching, the system will send an email notification to the vehicle driver, as well to the maintenance office. Based on this notification, the Transport Section Maintenance Office can pre-schedule the maintenance in advance, awaiting the booking request from the vehicle user. Also, a report can be extracted from the reporting tool to project the wider up-coming

maintenance needs of the fleet.

If maintenance is not undertaken according to pre-set conditions (mileage/time), a 2nd level notification will come in force. This is an audio warning sound in the vehicle and an email notification to the vehicle user. The event is also flagged up to the Maintenance Office. In case of the vehicle user still not bringing the vehicle for maintenance, it is possible to prevent vehicle use by remotely immobilizing the vehicle and thence recovering it to the Transport Section Workshop for maintenance.

8.4 Controlling the use of the vehicle

In addition to maintenance notifications, it is possible to monitor through the FMS reporting tool, how a particular vehicle has been used. The on-board system device monitors both the driving style and the G-forces affecting the vehicle.

This information becomes useful when trying to determine the cause of technical breakdown, especially with transmission and undercarriage faults. It also helps to prevent such events happening in the future.

As shown in the report extract (Fig.20); the analysis of vehicle use shows that the vehicle is driven primarily on main roads, since no record of ‘bumps’ (meaning potholes and bad road surfaces) is recorded. The vehicle has been involved in heavy breaking (5 times) and in (sharp) accelerations (8), with sharp steering events occurring 5 times. Overall, this represents the normal use of the vehicle during the two month period covered by the report.

Reporting period: 14.06.2011 11:25 - 14.08.2011 11:25

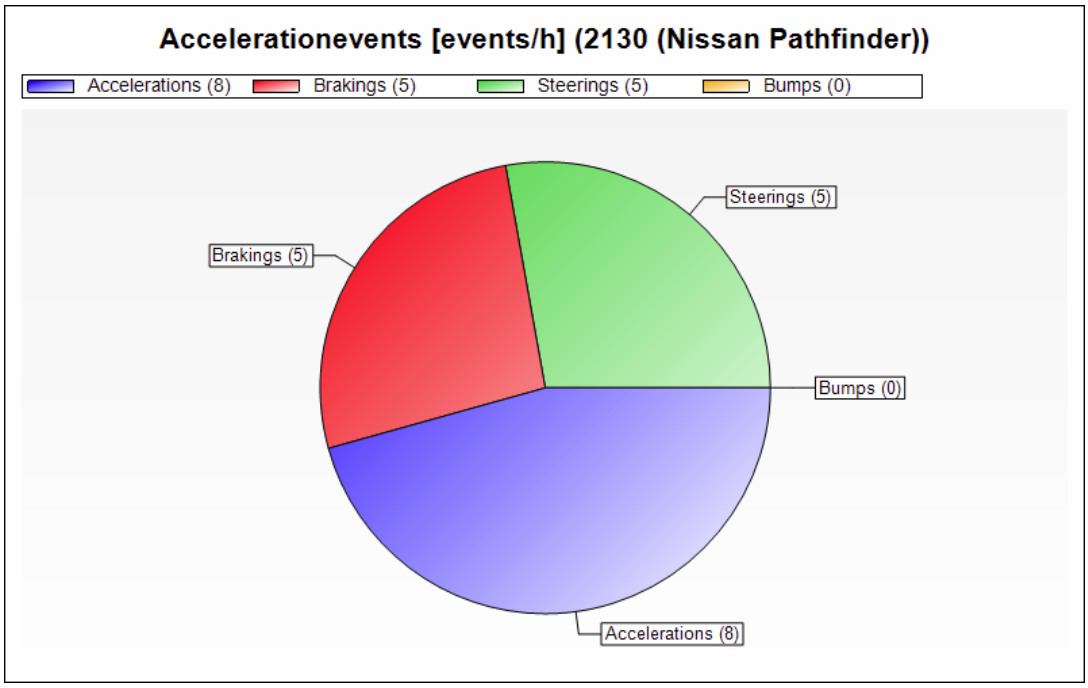

Fig.20, Acceleration events / vehicle (data extract from EULEX Kosovo FMS reporting tool 14.08.2011)

8.5 Driver management

Recent studies indicate that the levels of driving performance can differ, dependent upon the driver's cultural background, infrastructure, the level of traffic density and the stress level of the driver (which may lead to aggressive driving)(Wallen Warner et al., 2011).

In order to promote traffic safety in EULEX Kosovo, driver management was seen as an important factor that should be taken in account.

The composition of staff operating EULEX Kosovo vehicles involves personnel from 32 different nationalities (EULEX, 2011c). In the Crisis Management Environment it is possible that the stress level of individuals is potentially higher than normal, given the fact that most of the driving is undertaken in an environment that the driver is not familiar with.

The usage of the vehicle often impacts upon the future need of additional repairs to the vehicle in question. Experience has shown that an aggressive driving style will not only increase fuel consumption, but also result in premature wear and tear, so shortening the economic lifespan of the vehicle. In addition, an aggressive driving style will increase the risk of road traffic accidents and undermine the public image of the Mission. As mentioned in the EULEX Code of Conduct (EULEX, 2011b), each staff member is expected to 'act in a professional way' and 'respect the law in force'. Therefore the possibilities for driver guidance and monitoring were applauded when the service selection was made.

The FMS is providing an extensive selection of reports, regarding driver performance. In addition to informing the vehicle driver about the rules and regulations governing the use of Mission vehicles and behavior on the road through training, the FMS will constantly guide the driver (through hardware and statistical reference) to drive according to the Mission rules.

8.5.1 Vehicle hardware

The vehicle FMS unit display indicates the driver's level of performance by visual signs. 4 LED lights showing *green* will indicate the driving performance has been within parameters, pre-set by the Mission. Depending upon the severity of a recorded event, the number of green LED's will diminish accordingly. If the driving performance is still poor, the LED's will turn *red*.

The maximum speed permitted for EULEX-Kosovo Mission vehicles is 80km/h. In case of the driver exceeding 90km/h, the FMS in-vehicle display unit will draw attention to the over speed by giving short beep, prompting the driver to reduce speed. If the driver continues driving above the permitted speed limit, the green LED lights on FMS display unit start gradually decreasing and eventually turning to red. This is a visible and easily notable indication for a driver to improve their driving style.

Simultaneously, the accelerometer built-in to the FMS vehicle unit monitors the G-forces influencing the vehicle performance. If the vehicle maneuvering is exceeding the pre-determined safe limits of vehicle, the FMS will notify the driver by an audiovisual signal (Fig 21).

Fig.21. FMS Vehicle unit display

8.5.2 Security function

In addition to driver guidance, the FMS has a security function included on the on-board display for the driver. In case of a threatening situation or traffic accident, the driver can indicate his/her exact geographical location to the EULEX Security Operations room by pressing the red button displaying ‘EMERGENCY’ (Fig.21). This will generate an emergency notification message which will be sent by SMS to the EULEX Security Operations room duty phone, as well an email message with a link to a map display showing the exact location of the vehicle (Fig 22). The message includes the vehicle number and the drivers identity who has logged in to the system.

This allows the EULEX Security to get in contact with the person through either the High Frequency (HF) radio system or mobile phone and act according to the situational requirements.

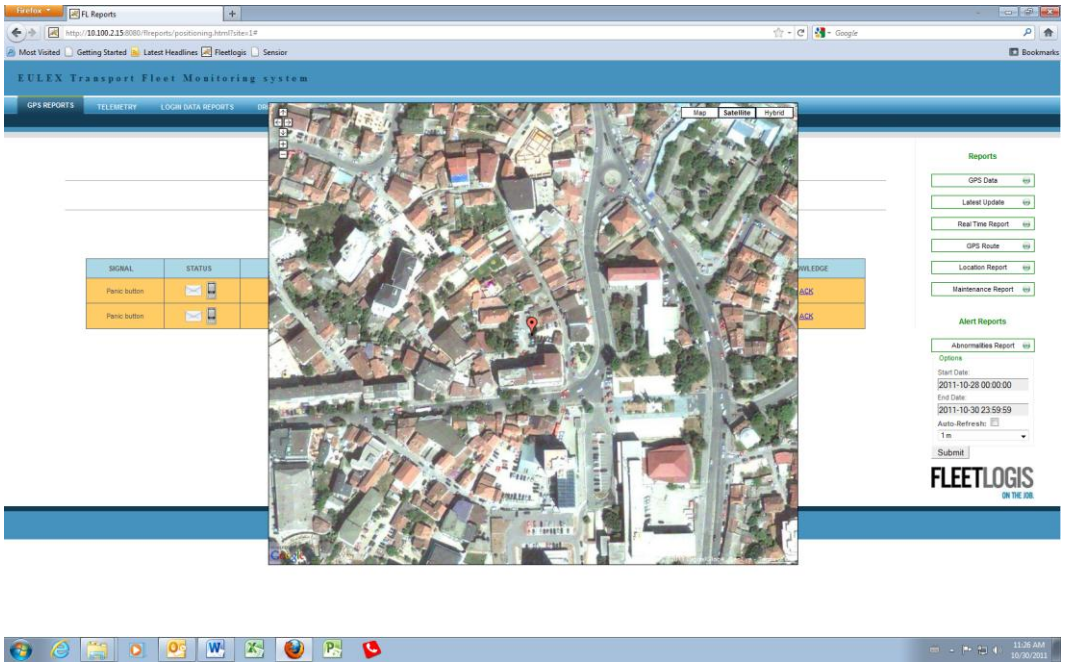

Fig.22. Emergency notification report with the location display.

8.5.3 Reporting tool

All driving performance is recorded and composed as the drivers Behavior Index (Fig. 23). This indicates the performance level of each individual driver compared to the other drivers in the organization, component or unit levels. This sample report includes information comparing the individual performance level against the average EULEX Kosovo driver performance, as monitored in the selected time period.

The index number of 100 represents full compliance with the pre-set parameters and indicates that the driving performance has been successful.

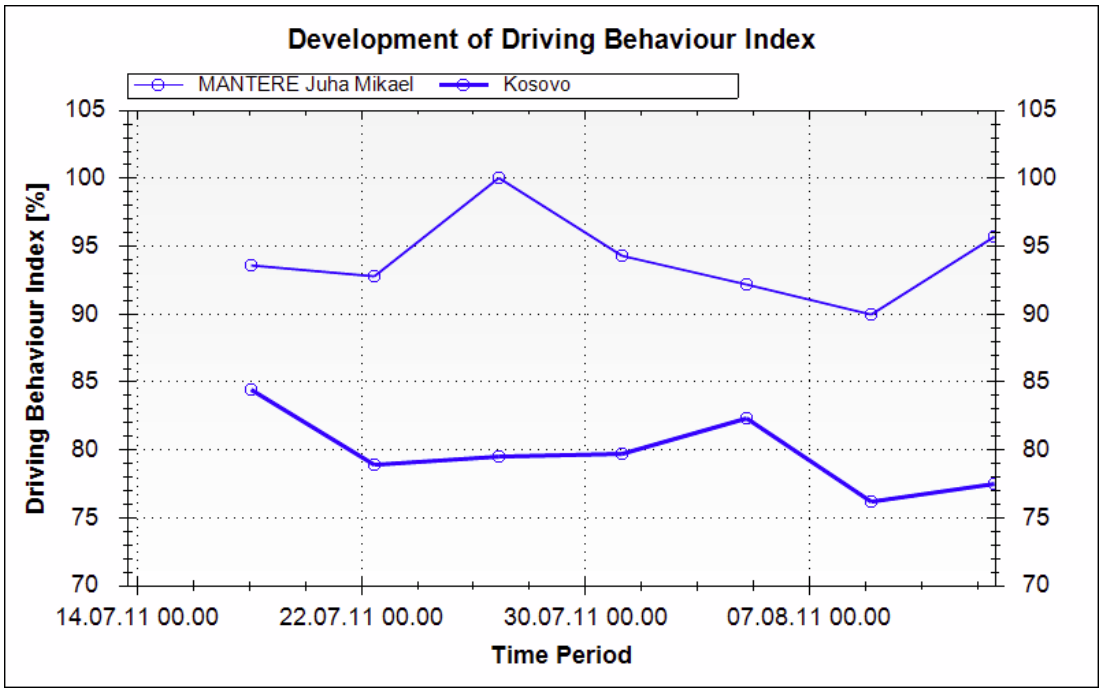

Fig.23. Sample of Driver Behavior index report. (Extract from EULEX Kosovo FMS reporting tool 13.08.2011)

By monitoring driver behavior, the overall driving performance of individuals is anticipated as developing towards the required levels. Generally, it can be determined that a 'smooth' driving style will increase traffic safety and reduce fuel consumption of the vehicle as well the need for maintenance. The monitoring function does not recognize the cultural or national background differences. Instead, drivers are evaluated based on equal parameters, which provides objective and transparent results.

9 INFORMATION HANDLING AND REPORTING: THE MANUAL SYSTEM PROCESS

9.1. The data collection system

In the manual system, all data is collected from produced documents. These documents include the 'Monthly Trip Ticket'-document and the 'Fuel Issue Voucher'. The data collection and recording sequence for the 'Monthly Trip Ticket' is on a monthly basis, whilst the 'Fuel Issue Vouchers' are recorded more frequently, usually on a daily basis.

9.1.1 Vehicle Trip Ticket

Trip ticket information is collected into a 'Monthly Statistics'-report format, which basically is a Microsoft Excel spreadsheet. Data transfer from the Vehicle Trip Tickets to the spread sheet is performed by several individuals at the beginning of each month. Vehicle users should submit the Monthly Trip Ticket for the previous month to the respective Transport unit office no later than the 5th of each month. The process is described below (Fig.24)

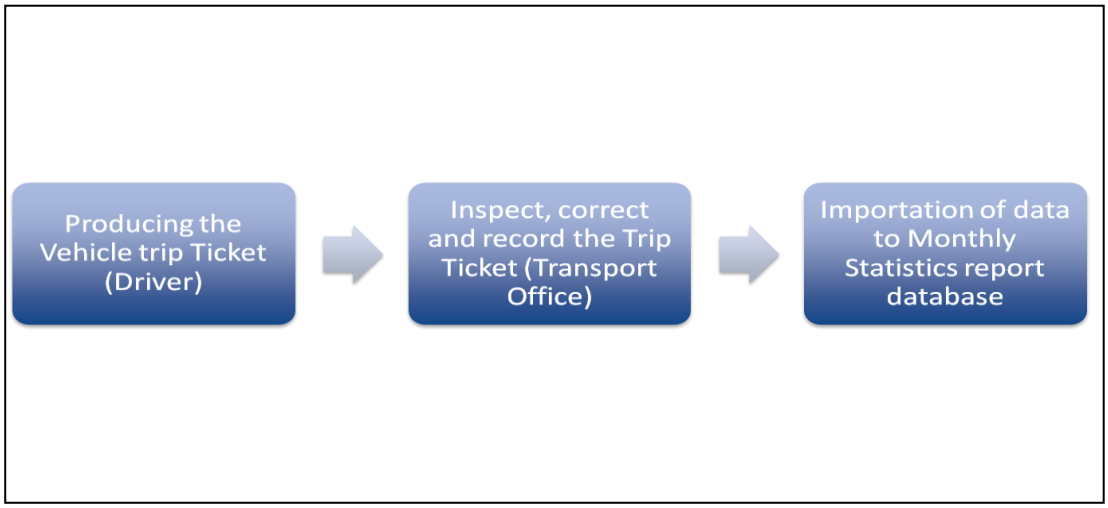

Fig. 24. Vehicle data processing using Vehicle Trip tickets

After the Monthly Trip ticket has been received, the necessary statistical data is collected as shown in Table 4.

Table 4. Data collected to the 'Monthly Statistics'- report

Reg. No.	Fuel Type	Mileage reading			Liters	Liters /100km
--	--	Odometer Start	Odometer End	Total Km Driven	Region	--
Last maintenance km	Date of last maintenance	Next maintenance km	Next type of maintenance	Km to maintenance	Date of next maintenance	Remarks

9.1.2 Fuel Issue Voucher

The Fuel Issue Voucher is generated every time a EULEX Kosovo vehicle acquires fuel from a dedicated fuel distribution point. The document is produced by the Fuel Supply Contractor and then submitted to the respective Transport Unit office, usually on a daily basis.

The Fuel Issue Voucher information is recorded onto the 'Fuel Supply Database' which is a basic accounting and reporting type of software and constructed in-house by the EULEX Kosovo Database Development Unit. The data collection process is described below (Fig. 25).

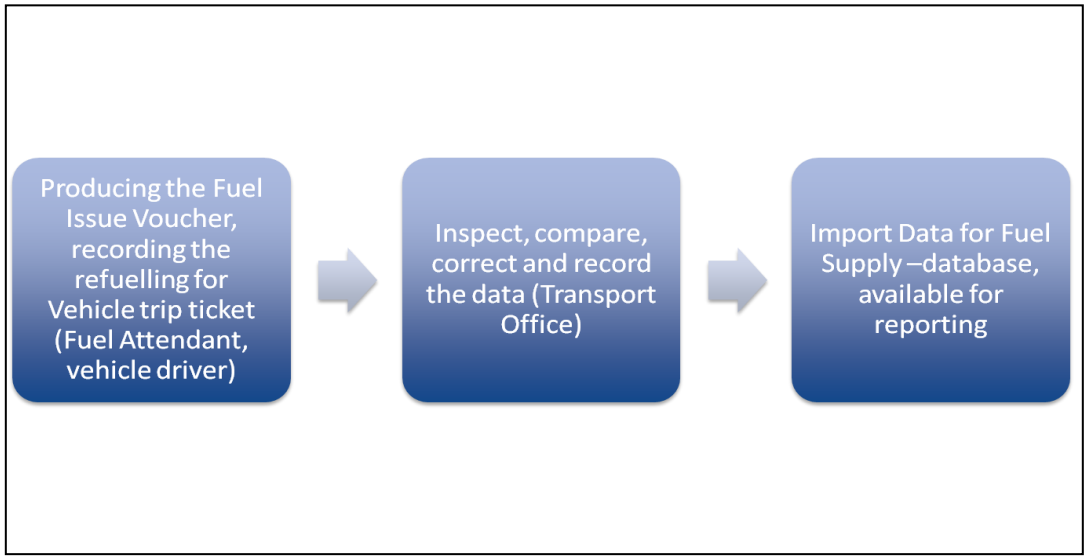

Fig.25. Fuel data collection process using Fuel Issue Vouchers

The information from individual Fuel Issue Vouchers is imported to the database manually, usually on daily basis due to the large number of individual vouchers. As mentioned before, during 01.06.2010 – 31.05.2011 total 32 312 individual Fuel Issue Vouchers were transferred onto the database.

The Database allows the search / update of an individual Fuel Issue Voucher, in case back-tracking is required. Additionally, several reports are available for compilation, regarding fuel consumption on unit and individual levels, as well those based on vehicle and refueling location details.

9.2 Information quality in the manual process

9.2.1 Monthly Statistics report

The following observations can be made when studying the Monthly Statistics report for June 2011, in which a sample of 165 Volkswagen group vehicles was reviewed to determine the input information quality. A Vehicle Trip Ticket has to be submitted, even if the vehicle is not used during the period. (European Union, 2008b: 4.b.12.4)

According to the report, the 165 vehicles in the sample accumulated a total of 1,280,234 km in the month of June 2011 (extracted from the Monthly Statistics Report, June 2011). Each vehicle would have averaged 7759 km in a month.

This is obviously incorrect data and caused by the missing vehicle mileage information at the end of the month of June 2011. In addition, the average mileage until the next scheduled maintenance is recorded as 22934.35 km, which indicates (based on this data) that all vehicles are on average overdue for maintenance which should be carried out every 7500km. This also does not represent reality and the resultant figures are incorrect due to missing maintenance information on the Vehicle Trip Tickets.

None of the recorded vehicles had all their required information recorded in the Monthly Report. A number of parameters were missing: for example, of 165 vehicles only 86 vehicles had the start and end mileage indicated within the Monthly Report. In other words, the monthly vehicle mileage accumulation is known only for 52% of the observed vehicles.

Of these 86 vehicles, 16 (17%) had no refueling information recorded on the Trip Ticket, even the mileage accumulation would have necessitated refueling to take place during the month.

After correcting the database and examining only those vehicles will full mileage details and fuel records, it was found that 48,859 km had been accumulated by 42% of vehicles in the report. The average fuel consumption rate was 5.2L/100km for the reporting period. (EULEX 2011e)

9.2.2 Fuel Supply Database

The Fuel Supply Database holds the information imported from the Fuel Issue Vouchers, The data recording is done manually, firstly at the Fuel Distribution Point by the fuel attendant. It is recorded a second time as data is transferred to the Fuel Supply Database by the respective Transport Unit who type the information into the database, as extracted from the Fuel Issue Vouchers.

When studying the Fuel Supply Database for the same period, the total recorded mileage accumulation for the VW vehicles refueled during the period is 37,508 km with an average consumption rate of 19.26 l/100km. The Report covers the same 165 VW vehicles as Monthly Statistics Report, however the VW Touareg vehicles used by the Romanian Formed Police Units are excluded, as these are not included in the 165 vehicle total, covered in the Monthly Report. (EULEX 2011e)

10 FMS PROCESS

10.1 The data collection system

In the electronic FMS, all data related to vehicle usage is collected automatically by the device installed in each vehicle. The collected data is sent through a GPRS interface to the host server in the EULEX Kosovo server room, where it is stored. The transmission frequency of the FMS service contract is determined to be a minimum of once /day, but in practice the data is sent every 15 minutes. After the data is received by the server, it is instantly available for reporting use.

The data related to fuel use is also collected automatically and sent to the server using the same GPRS network. Transmission frequency is set to take place after each refueling event has been completed and again, the data is available for reporting purposes as soon it is received by the host server. An illustration of the data collection process is given below (Fig.26).

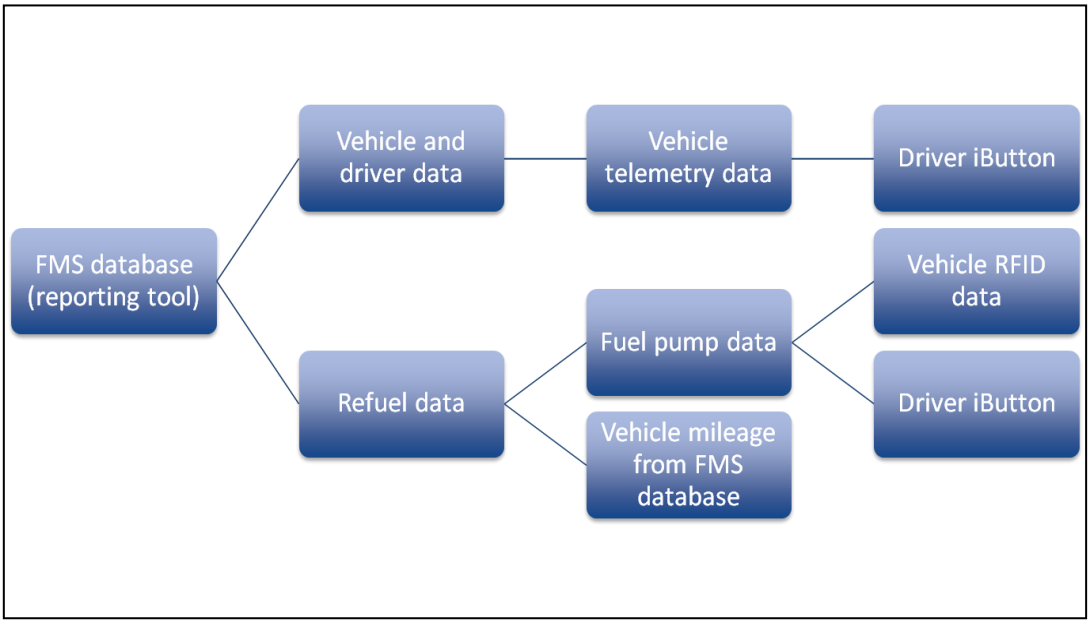

Fig.26. FMS data collection process

10.1.1 Vehicle reports

Vehicle reports include reports based on telemetry-data collected from the vehicle (vehicle user, ignition sensor, motion sensor, and vehicle activity) as well those collected from GPS data (speed, mileage, location and route).

This combination of different data types will allow reports to be both accurate and informative; for example a speeding event could be located on the map in order to evaluate the seriousness or context of the violation.

10.1.2 Fuel Reports

Fuel reports are based on the information recorded by the FMS monitoring device, attached to the fuel distribution pump. These reports can be created based on vehicle information, location (pump) information or individual user information in a selected time period, as determined by the user.

10.2 Information quality in the FMS process

The required data for fleet management is received on almost a live-basis. This short lead-time will allow data to be more realistic and up-to-date, so representing the actual situation in the field more accurately.

Since all relevant data is collected and transmitted automatically and the human influence on the collected data is minimal, it can be assumed that the accuracy of the collected data is good. This is primarily due the absence of typical human errors, such as typing errors, incorrect mileage and non-recorded data (barring technical events). As previously discussed, data accuracy is important, especially when using the information for projecting the vehicle fleet usage or for budgeting purposes.

10.3 Information security

All collected data is sent by the data collection unit (vehicle unit or fuel pump unit) by utilizing a GPRS data transmission interface. The data is encrypted in the transmission phase and the International Mobile Equipment Identity (IMEI) –code is sent to the server and confirmed before the data transmission will commence. The data is encapsulated with 16 bit Cyclic Redundancy Check (CRC), checking against data changes.

The user interface is web-based page, using Hypertext Transfer Protocol Secure system (HTTPS). Access to this is limited to the Internet Protocol (IP) address belonging to the EULEX network. In addition, a username and password is required to access the data. Access to the collected data can be further limited by different user profiles; for example, a vehicles location data is perhaps only made visible to authorized users who are required to access the data for duty purposes.

11 CONCLUSIONS

11.1 Object of the study

This study looked to answer three major questions:

1. How does EULEX Kosovo manage its assigned vehicle fleet and fuel control mechanism within a manual system?

   [This aspect was analyzed prior to issue of a tender notice for an electronic FMS and aspects highlighted to inform the choice of solution]

2. What influences could the implementation of an electronic Fleet Monitoring System (FMS) have for the transport unit organization and the overall Mission?

   [This was considered prior to tender and a comparison made to the United Nations FMS, with which the author had experience and knowledge of. Following purchase and installation (commenced in February 2011), the EULEX Kosovo FMS was analyzed to highlight the solutions provided to the identified issues of fleet management, and also to provide examples of added value factors that brought benefit to the organization. It should be noted that whilst the change in systems is still transitional at time of writing (November 2011), there is enough comparative data, to draw conclusions that may validate the selection of an IT-based system]

3. How could the organization best optimize its FMS in the future?

11.1.1 How does EULEX Kosovo manage its assigned vehicle fleet and fuel control mechanism within a manual system?

Analysis of the previous manual system (when in place) revealed clear inefficiencies when studying the data collection mechanisms and different databases where the data was stored and collated. The processes for data collection were complex and time consuming. The data compilation for the overall monitoring function came from several locations, and the data input and structure was not identical, which produced different results even when the same search parameters were employed.

This was mainly caused because of a large vehicle fleet, operated by large number of individual drivers which resulted in a vast number of paper documents from which the data had to be transferred manually to the database(s). Manual labor was required

extract data from the documents, which was done by several persons and in several phases of recording. This increased the possibility for the input of corrupted and incorrect data to the system.

In addition, the basic accounting was mainly based on basic excel-spreadsheet documentation and volatile for errors. Excel-spreadsheet data backtracking is almost impossible, especially if data is deleted (either by accident or on purpose) by the user.

All of the above factors lead to a low level of reliability and accuracy towards the data produced; therefore it was not an optimal resource for decision making. Data security was also seen to be poor, since access to it has limited control and files can be copied or printed and sent outside the system.

In addition, the manual system was very labor intensive as explained earlier in this study. In the observation period of 16.06.2010 – 31.05.2011 the manual system resulted for almost 48 000 (47 912) individual documents which were processed and recorded to the system, requiring a total working time of 1248.7 hours (8.2 working months) of manual labor used just for recording of data to the databases (Fig. 27).

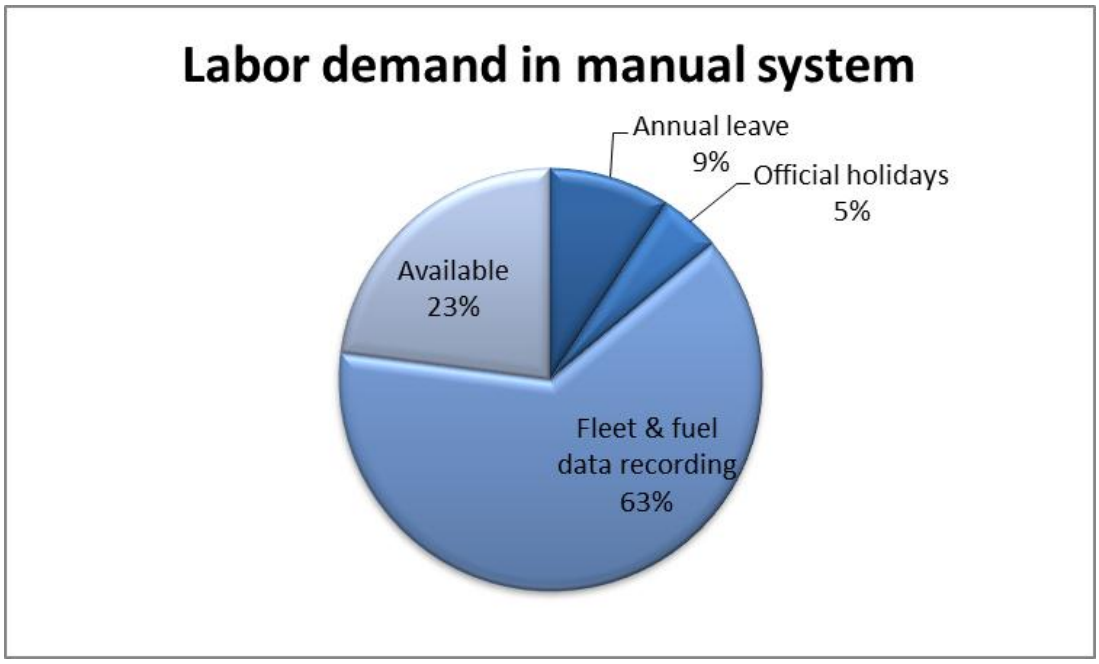

Fig.27. Labor demand in percentage in the manual system i.e. required working time per annum per person.

The labor of data input is usually conducted by EULEX National Staff (NS) members and the following calculations are based on the NS working time schedule. Knowing that it is not usual to maintain a constant pace of work for such activity for humans, [i.e. 7.6 hours of efficient working time / day , deducting leave days (24 days / annum) and official holidays (12 / annum) from the annual working time (260 days)] it can be estimated that at least 2 persons (Whole time equivalent) working hours in the EULEX Transport & Fuel Unit were consumed annually for the recording of the collected data for the databases.

All of the above mentioned issues regarding the reliability and accuracy of reported data has weakened the level of usage in terms of monitoring and management purposes. Resultantly, data was collected but not necessarily utilized because of the conclusions that the corrupted and out-of- date information rarely represented the situation in the field.

11.1.2 What influences could the implementation of an electronic Fleet Monitoring System (FMS) have for the transport unit organization and the overall Mission?

When reforming the organizations Fleet Management function (still in transition), it is essential to recognize the needs of the host organization and what is to be achieved by a more efficient fleet management system. Usually the goals are related to improvement in physical fleet size and effective fleet usage, as well financial effectiveness.

Efficient operational fleet management has been shown to cut costs in vehicle maintenance, insurance costs and most visibly in fuel budgeting. Commonly, up to a 10-14% reduction can be achieved through the implementation of more efficient monitoring mechanisms (IBM Corporation, 2008, Sirola, 2011).

As a reference drawn from the experiences of commercial companies which have implemented a similar system; cutting unauthorized vehicle use, implementing active speed control and using administrative measures to reinforce the rules, can contribute to this 10-14% reduction in the vehicle fuel consumption. It is therefore feasible that this may be achieved also in EULEX Kosovo.

Efficient fleet management is based primarily on the reporting and monitoring function of the system. Because of the complexities of data collection highlighted in the analysis of the manual process, a significant proportion of the staff working time is used in data collection and not for creating usable reports. Inaccurate data also decreases the attractiveness of reports as discussed, since the included data is not reliable and therefore cannot be used as a sound basis for decision making.

11.2 Development of driving behavior

The Fleet Management System implementation started in February 2011. The implementation involved hardware installation to the vehicles and fuel distribution pumps, as well as the inception of a software solution to process the received data.

In May 2011 the initial data was already being received from the majority of vehicles, however the system was not fully operational as the reporting tool was still under implementation. It was noticed that the improved data relay meant it was possible to receive data how the vehicles were being used, without the driver knowing that his/her driving performance was being monitored. Such a real-time data collection function was not possible before the FMS was installed.

The activation of the driver identification system and the guidance displays was done during 18.07.2011 – 02.08.2011. From this date it is not possible to start a vehicle without a driver login to the vehicle in question. Additionally, the driver guidance display inside the vehicle was activated, which indicated the level of driving performance to the driver. The driver performance is then recorded and a percentage is given, which can be a useful contributory factor when determining the cause of the accidents or vehicle breakdowns.

The report on the initial impact of driving management (Sirola N, 2011) published on 19.10.2011 indicates that after the driver guidance function was activated, the exceeding of the speed limit of 80km/h which was previously 2% of all driving was reduced to 0.5%. The drop could however be seen as starting before the system was activated, the reason being that an advisory email was sent out on 07.07.2011 to all staff by the Chief Transport Officer (CTO), advising that such a system would soon be activated (Fig.28).

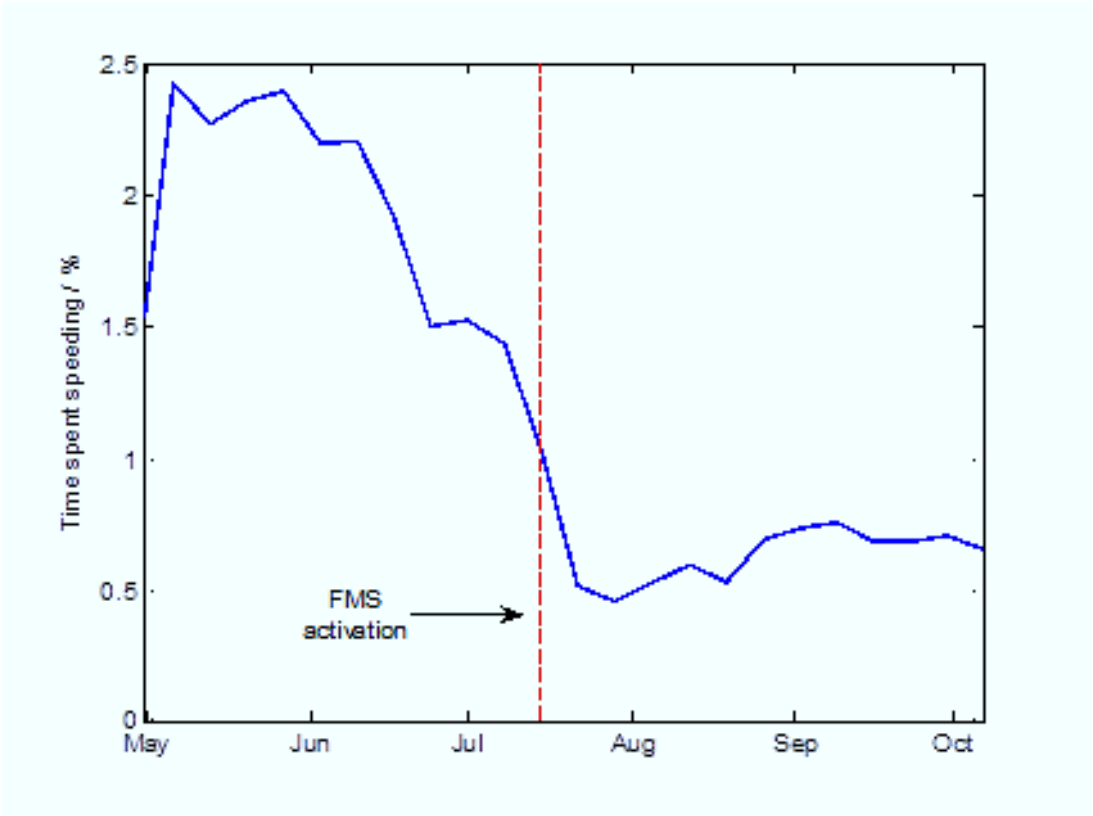

Fig.28. The reduction of over speeding (speeds over 80km/h) and impact of advisory message to staff members in EULEX (Sirola, 2011).

In addition to this, the report reveals a radical change in the speed profile of the overall mission fleet which happened after the system was activated. The following graph (Fig.29) clearly indicates that a number of vehicles were regularly driving 100 km/h or more during May – June 2011, despite the fact that the Mission speed limit is 80 km/h and the general road conditions in Kosovo rarely permit higher speeds than 80 km/h.

In lower section of the figure, it can be noted, that following activation when the driver knew that he/she was being monitored, in the period of September-October the 'hump' of close to 100 km/h has disappeared and in addition fewer vehicles are exceeding 80 km/h.

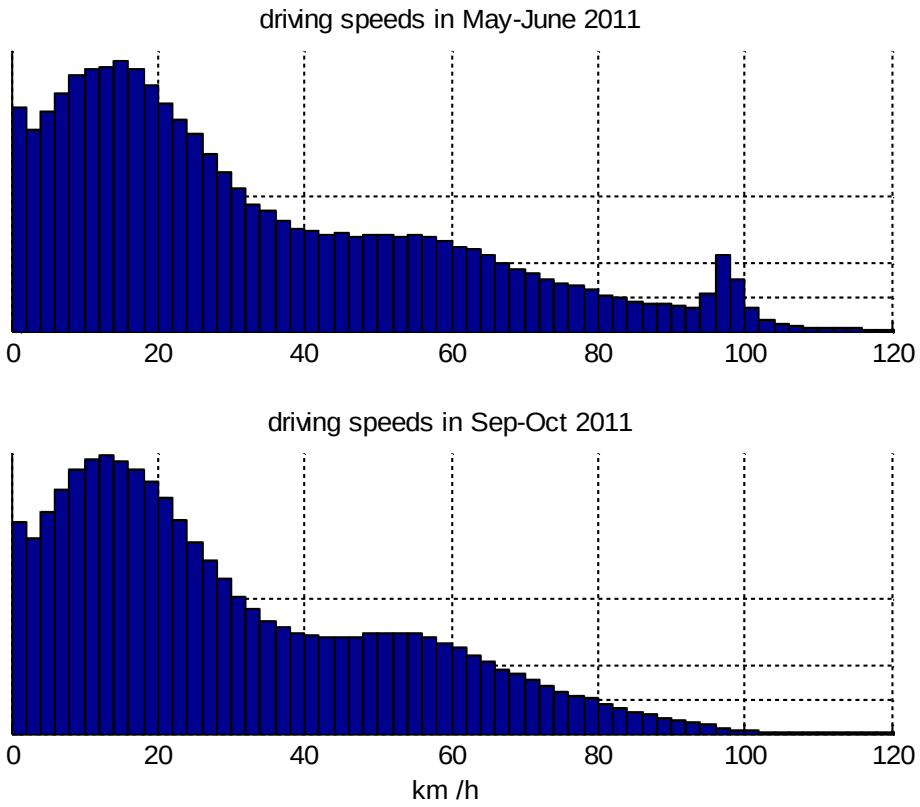

Fig.29. EULEX vehicle speed profile development before and after activation of FMS (Sirola N. 2011)

The effect of the activation on the driving index is also visible (Fig.30). Prior to the activation, the mean driving performance index was 85% Following activation and when driver monitoring and guidance was performed, the mean driving performance index increased by 5%, indicating that a significant number of EULEX vehicle users improved their driving. Based on the experiences of commercial fleet operators, a 5% improvement in the mean index usually correlated to a < 10% reduction in fuel consumption and an even larger reduction in repair and maintenance costs in the long term.

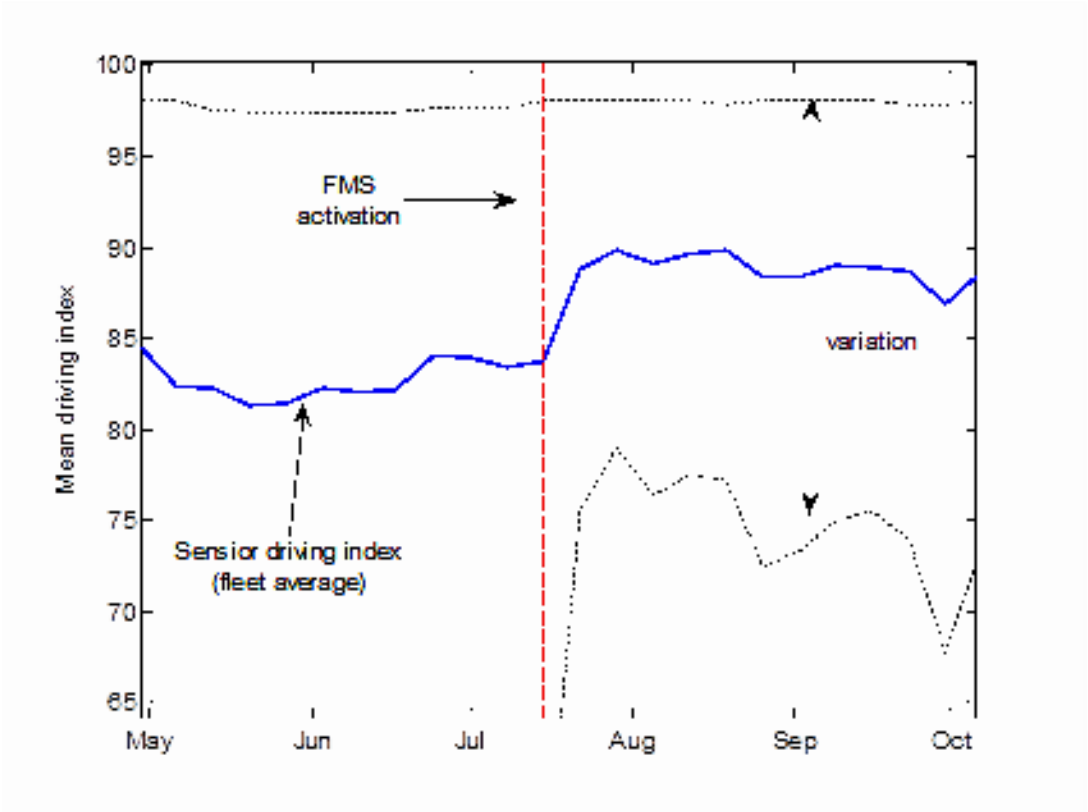

Fig.30. Development of average driver performance index before and after system activation. (Sirola N. 2011)

In conclusion, it is estimated, that by merely activating such systems, a 75% reduction in over speeding was achieved and the average driver performance was improved by 5%. In practice this means that with an indicated 14% fuel consumption reduction; when compared to the vehicle fuel consumed in the period 01.06.2010 – 31.05.2011, EULEX Kosovo will consume 207,850 liters less fuel in their vehicles per annum, leading to an approximated €145,000 reduction in current fuel expenses per annum. The additional savings in maintenance, accident reduction and labour costing, has yet to be evaluated, but is likely to be significant to the overall expenditure and efficiency of the fleet.

11.3 Quality effect

The manual accounting and fleet management function has some characteristics that are not suitable for an organization operating large vehicle fleets. As described in *9.1.1*, the manual data handling chain was volatile for error and therefore the database(s) were easily corrupted.

Systems requiring a large amount of manual labor in several steps of the data collection chain, are prone to error causing unreliable and 'noisy' or meaningless data. Noisy data causes corruption of relevant databases which in turn causes unreliability in the reporting mechanism when used to monitor the use and average fuel consumption of Mission vehicles. The inefficient control of fuel consumption makes possible fuel fraud detection increasingly difficult and undermines the validity of the information being presented.

By automating the data collection chain, the factor of human error is minimized. The data from vehicles and fuel distribution points is collected remotely and at several times per day. The accuracy of the essential information, such as vehicle mileage, refueled amount, person refueling, time, date etc. (core information required for effective reporting and noted as being a causative source of error in the manual system) will lead to more accurate fleet management and cost control, in addition to the improved information quality.

Durakbasa and Osanna (2009) in their study of Total Quality Management (TQM) mention, that the principals of TQM can be applied to almost any organizational improvement despite the fact that the origin of TQM comes from a background of manufacturing operation control. EULEX Kosovo Transportation Operations in a technological sense can be defined as a service organization. Therefore the principle of "Quality is the responsibility of everyone" (Durakbasa and Osanna, 2009) can be easily adopted for EULEX Kosovo transportation operations. The Senior Management has already committed to the principle by allocating funds to be available for such a project and the Transport Unit is implementing it on a ground level. To increase the quality of the information, the number of errors has to be decreased.

Durakbasa and Osanna (2009) quote Lord Kelvin (1824-1907) in their book of TQM:

"If you can measure what you are speaking about and can express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meager an unsatisfactory kind".

The sentiment has been expressed in simpler way: "If you cannot measure it, you cannot improve it."(ibid)

This describes in a nutshell the idea of efficient fleet management. In order to improve the efficiency of fleet management operations, the operations have to be measurable. As such, data has to be correct and data collection has to be timely. As described by International Organization of Standards, in the ISO 9000 quality management standards, one important improvement step is to improve the speed and quality of the data flow and the required response action improvement as the motivation for system improvement (cited Durakbasa and Osanna, 2009)

As Pedraza Martinez et al. (2010) found in their study of the International Committee of the Red Cross; only 66.8% of the monthly mileage data collected to the relevant database was found to be reliable. In their field study it was found, that sometimes due the circumstances, the data collected by the ICRC was very noisy and therefore bringing the reliability of the data into question.

In this case study, a similar pattern of incorrect data was found, although it is acknowledged that only 11% of the collected vehicle fleet data was inspected thoroughly.

Based on TQM principles, it can be assumed that through the better quality of the available information used for decision making, the EULEX Transport Unit will reduce the costs involved in fleet management by optimizing the fleet size, allocating the available transportation assets to ensure a higher utilization, as well as reducing the maintenance costs by monitoring the unauthorized use of the vehicles. Additionally, the driver management function will decrease the fuel consumption and the potential need for repairs, as well as improving the related driver image of the EULEX Mission.

11.4 Mission regulations and the accountability of a staff member

Accurate data is also important in EULEX Kosovo as an assurance of the conformity to rules and regulations set governing the use of Mission vehicles. It serves the Mission itself, as well the rights of a staff member possibly being subject to an investigation. Accurate and reliable data is essential when determining possible disciplinary action against an individual staff member suspected to be in violation of rules or regulations.

The EULEX Code of Conduct (EULEX 2011b) states: "Any EULEX Kosovo staff member found to be an accessory to any violation shall be considered as a principal *and shall be subject to investigation***"**

A timely and effective fleet management reporting function, together with data collected automatically and with a minimum of human interface, is likely to provide impartial evidence and may help in such circumstances.

In organizations such as those represented by EULEX and in addition to the above; accountability is an important factor, when considered as part of the implementation of overall management systems. As the IHOs have noted, transportation is the second largest overhead cost after human resources and therefore cannot be ignored(Pedraza Martinez et al, 2010).

11.4.1 The FMS influence on Transport Unit organization

After the FMS is fully implemented, the data which has until recently been provided by several sources to several databases and with poor or non-existing coordination, will be provided as shown in Figure 31. The system will increase the transparency of data provided, simplify the data collection structure, eliminate the potential for variations in same source data and make the resultant information more accessible and useful to the Fleet Management function. The strategic role of the offices and units in transportation will change from that of data providers to data consumers.

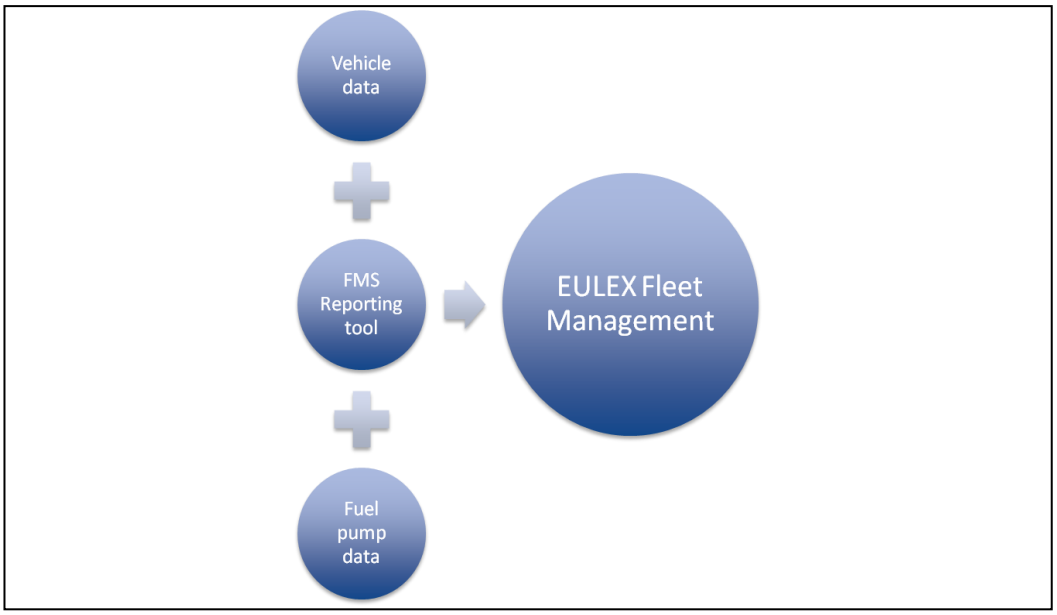

Fig.31. The data collection process in FMS

By lifting the burden of the collection of information from the paper documents, the personnel can concentrate on monitoring the use of the Missions vehicles and fuel, fulfilling the requirements set out in the rules and regulations that govern vehicle use. The accurate data makes the reporting function to be more attractive to those who would use it and the information (of both input and output) more trustworthy. In addition, a deeper analysis of issues can be formulated, when based on the real-time data. This also allows simulations to be made for future projections, when a sufficient amount of background information is collected and available for use.

11.5 How could the organization best optimize its FMS in the future?

In order to obtain the best return for the investment made in the system, the organization should appoint specialized personnel to monitor, manage and analyze the use of the transportation fleet.

In addition, a strong support from the Mission administration is required, as indicated by Sirola (2011) in his analysis of the initial impacts of FMS in the EULEX mission:

“It is already known that just the knowledge that driving is being monitored has a large impact on drivers' conduct. For the EULEX fleet, installing the FMS units and activating driver identification and the guidance display already have cut speeding by 75%, and also shown a sharp improvement in the Sensior driving index. In

commercial fleets, such 5% improvement in the average index usually means over 10% savings in fuel consumption, and even more in reduced repair/maintenance needs. However, the initial impact will fade slowly if it is not enforced by follow-up and interventions where needed. We expect another sharp and lasting improvement when the rest of the driving management reports and tools for intervention are in place." (Sirola, 2011)

If the Mission is only relying on the existence of the FMS and does not reinforce its fleet management through the implementation of administrative rules and regulations relating to the misuse of these assets, the positive results seen so early in the implementation program will eventually fade causing a general lack of respect of the system. This could well result in the subsequent raising of costs and run contrary to the intended outcomes of the project.

EULEX could also expand the monitoring function to generators, as the United Nations (UN) has done. The UN has focused specifically on fuel consumption monitoring, using the supplied liters vs. running hours of the generators as a measurement tool. However, a more productive view could be implemented for generator monitoring.

The same hardware could be employed, as used in the vehicles (with minor software modifications) could be used for monitoring generator use. The telemetry monitored could include: fuel consumption, engine telemetry data (revolution counter, engine temperature, oil pressure and exhaust temperature), running hours, power production in kilowatts (Kw) and maintenance notification function based on running hours or time, as is done with vehicles.

This data could be remotely monitored, resulting in the reduced need of maintenance personnel on ground and allowing improved work planning and more accurate cost estimations for future scenarios.

11.6 Future research

The constraints of the presented system(s) relate mostly to the data transfer infrastructure. The described solution implemented by EULEX Kosovo can be used only in areas with developed GPRS data transfer networks, which are not always available in Area of Operations (AoO) of different Missions.

Data storage to the vehicle units is one approach and the UN has been using RF data transfer in areas where the GPRS function is not available or not cost effective. The data download is facilitated by dedicated download stations, usually located at the vehicle fuel distribution points. The data download is done through an RF-receiving station antenna when a vehicle approaches the download area. Although this approach solves the data collection problem, it affects the data availability and quality. Since the data download frequency per vehicle unit is irregular and cannot be accurately determined, the reports do not represent the current accuracy in information and the delay of data has to be noted when reports are formulated.

Alternative data transfer solutions therefore need to be researched. One possibility could be data transfer via a satellite network system, such as Inmarsat BGAN (Inmarsat, 2011). It provides data transfer systems for the areas with poor or no coverage of telecommunication networks. Transferring data via satellite would remove the dependency of the mobile operator roaming arrangements for the related GPRS network access. However, the chosen solution should be cost effective so that the data transfer costs do not outsource the savings gained through the fleet management function.

Satellite data transfer would allow one office to monitor vehicles worldwide. This could prove essential to those organizations with vehicle fleets composed of smaller units, distributed in several locations. In such instances, the efficiency problem exists, that each unit is too small to justify the expenditure of implementing a fleet management system, but as a whole, the combined fleet is too big to be efficiently managed based only on a manual system.

The same approach could be applied to generators as well, although this requires development work to be done in both hardware solutions as well as the related software.

The harmonization of the fleet management function in CSDP operations would also be one field for future study. The UN has implemented an identical Fleet Management System for all UN vehicles, regardless of which Mission the vehicles are used in. This allows the reallocation of a vehicle with the installed FMS hardware to another Mission and generates a homogenous structure for the total fleet management system. Long-term, this is seen as improving both the management and

accountability of transportation operations, in form of personnel using the system, the maintenance of the system and required hardware solutions. Also, with such a wide-scale implementation, a significant purchase cost reduction can be foreseen, when negotiating system provisions for the whole CSDP fleet.

When viewed as a case study, the review and implementation of the Fleet Management System of EULEX Kosovo, can be seen as not only a logistic and economic success, but also a process that can impart its learning curve to other organizations, involved in similar endeavors.

12 References

Barco.com, (2011). *Airline Fleet Management*, www.barco.com/defense_aerospace/product/1352 accessed on 03.11.2011

Best of The Web Verticals, (2011). *Software Solutions* www.verticals.botw.org/Software/Transportation/Fleet-Management , accessed on 03.11.2011

Council of Supply Chain Management Professionals (2011). *CSCMP Supply Chain Management Definitions*, http://cscmp.org/aboutcscmp/definitions.asp accessed on 12.11.2011

Crowley, F., (2009). *Driver Compliance hits the Online Highway*, J.J Keller Associates, Inc.

Department for Energy & Climate Change, (2011). *Energy Price Statistics, Table 4.1.3,Typical retail prices of petroleum products (1)(5) 1978 to 2011*, www.decc.gov.uk/en/content/cms/statistics/energy_stats/prices/prices.aspx , accessed on 03.11.2011

Disparte D., (2007). *The Postman's Parallel*, Kjaer Group A/S

Durakbasa, M., Osanna, P., (2009). *Total Quality Management*, Abteilung Austauschbau und Messtechnik, ISBN 3-901888-23-3

E-Drive Technology, (2010). *Case Studies and Customer responses*. www.e-drivetech.com/case-studies , accessed on 22.10.2011

European Commission Energy, (2011). *Market Observatory, Oil Bulletin, Time series History from 2005 onwards*, www.ec.europa.eu/energy/observatory/oil/bulletin_en.htm , accessed on 11.09.2011

European Union, (2008a). *Report on the Implementation of the European Security Strategy – Providing Security in a Changing World*: S407/08

European Union, (2008b). *Guidelines for vehicle fleet management*, [4.b.9.2, 4. b.27.1.2 4.b.27.3]

European Union, (2011). *Practical Guide to Contract procedures for EU external actions published : www.ec.europa.eu/europeaid/index_en.htm*, accessed on 03.2011

European Parliament, (2010). *European Parliament resolution of 25 November 2010 on towards a new Energy Strategy for Europe 2011-2020 (2010/2108(INI))* www.europarl.europa.eu/sides/getDoc.do?type=TA&reference=P7-TA-2010-0441&language=EN&ring=A7-2010-0313, accessed on 11.09.2011

European Union External Action Services, (2011). *Overview the Missions and Operations of the European Union October 2011*, 2011, www.consilium.europa.eu/eeas/security-defence/eu-operations.aspx?lang=en, accessed on 03.11.2011

European Union Rule of Law Mission in Kosovo, (2009). *Terms of Reference (TOR), Fleet and Fuel Management services*. [Internal Publication]

European Union Rule of Law Mission in Kosovo, (2010). *EULEX Kosovo Service Procurement notice*. [Internal Publication]

European Union Rule of Law Mission in Kosovo, (2011a). *EULEX Kosovo Finance Unit Budget* [Internal Publication - classified information]

European Union Rule of Law Mission in Kosovo, (2011b). *Code of Conduct and Discipline.*

[Internal Publication]

European Union Rule of Law Mission in Kosovo, (2011c). *EULEX Staff info*,2011 www.eulex-kosovo.eu/en/info/StaffInfo.php , accessed on 17.09.2011

European Union Rule of Law Mission in Kosovo, (2011d). *EULEX Staff info*,2011 www.eulex-kosovo.eu/en/info/StaffInfo.php - accessed 17.09.2011

European Union Rule of Law Mission in Kosovo, *Terms of Reference (TOR), Fleet and Fuel Management services*, 2009

European Union Rule of Law Mission in Kosovo, *The Management and Accounting For Petroleum, Oils & Lubricants in EULEX*, 2008

European Union Rule of Law Mission in Kosovo, *Transport Unit – Fuel issues per Mission report 01/06/2010 – 31/05/2011*, [Internal Publication].

European Union Rule of Law Mission in Kosovo, (2011e). *Transport Unit, Vehicle fuel issues per Mission 01.06.2010 – 31.05.2011, detailed report,* [Internal Publication].

European Union Rule of Law Mission in Kosovo, (2011f). *What is EULEX ?* www.eulex-kosovo.eu/en/info/whatisEulex.php , accessed 11.09.2011

Fleet Forum, (2011). *Driving humanitarian aid*. http://www.fleetforum.org , accessed 06.11.2011

IBM Corporation, (2008). IBM, *Microlise and Motorola: Delivering the best in fleet optimization*, TTS03003-USEN-00

Inmarsat, (2011). *BGAN Coverage*. on www.inmarsat.com/Support/Coverage/BGAN.aspx , accessed on 30.10.2011

Médecins Sans Frontières, (2011). *Financial Independence and Accountability*, www.doctorswithoutborders.org/donate/info.cfm?ref=main-menu – Accessed 11.09.2011

Meteo Group, (2011). *Fleet Management*, www.meteogroup-maritime.com/index.php?id=589 - Accessed on 03.11.2011

Misener J A, Nowakowski C, Xiao-Yun L, Marculici T, Spring J, Johnston S, ZuWhan K, Dickey S, Kuhn K, Kretz P, Robin J, Walker M, 2007, *Onboard Monitoring and Reporting for Commercial Motor Vehicle Safety Final Report*, University of California Partners for Advanced Transit and Highway (PATH), pp. 16,122,138

MSF International Movement, (2010). *MSF Financial Report*, pages 12, 25

Organization of Petroleum Exporting Countries (OPEC), (2011). *Conventional Resource Base*, www.opec.org/opec_web/en/data_graphs/332.htm , accessed on 03.11.2011

Pedraza Martinez, A.J., Hasija, S., Van Wassenhove, L.N., (2010). *An Operational Mechanism Design for Fleet Management Coordination in Humanitarian Operations*, INSEAD

Tomasini, R., Van Wassenhove, L., (2006). Fleet Forum: *Rethinking Humanitarian Fleet Management*, INSEAD

Ruiz-Carcia, L., Lunadei, L., Barreiro, P., Ignacio Robla, J., (2009). *A Review of Wireless Sensor Technologies and Applications in Agriculture and Food Industry: State of the Art and Current Trends*. Sensors, ISSN 1424-8220

Sirola, N., (2011) *EULEX Kosovo: Initial impacts of driving management*, Taipale Telematics Oy Ltd.

Stapleton, O., Pedraza Martinez, A.J., Van Wassenhove, L.N., (2010). *Field Vehicle Fleet Management in Humanitarian Operations: A Case-based approach*, INSEAD

Triantaphylloy E, Sanchez A, (1997). *A sensitivity analysis approach for some deterministic multi-criteria decision making methods*, 1997, Decision Sciences, Vol. 28, No.1 pp. 151-194

United Nations, (2011). *List of OIOS Reports to Programme managers*, www.un.org/depts/oios/pages/7_10_to_current_by_report_no.pdf , accessed on 22.10.2011

Wallen Warner, H., Özkan, T., Lajunen, T., Tzamalouka, G., (2011). *Cross-cultural comparison of driver's tendency to commit different aberrant driving behaviors*. Transportation Research Part F, Elsevier Ltd.

Wikipedia 2007, *Fleet Management*, en.wikipedia.org/wiki/Fleet_management – accessed on 03.11.2011

WTRG Economics, *Oil Price history and analysis*, 2011, www.wtrg.com/prices.htm - accessed on 03.11.2011

Zeimpekis, V., Tarantilis, C., Giaglis, G., Minis, I., (2007). *Dynamic Fleet Management. Concepts, Systems, Algorithms & Case Studies pages 200-213*, Springer, ISBN 978-0-387-71721-0