Dissertation On

Effective Operations and Maintenance (O&M) Practices of Vehicles: A Case Study on LGED.

Dissertation submitted in partial fulfillment of the requirement for the Degree of Masters in Procurement and Supply Management

Submitted by

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Preface

Masters in Procurement and Supply Management program under BRAC University requires a dissertation, after completion of Chartered Institute of Purchasing & Supply (CIPS) program, with an organization followed by a report assigned by the supervisor. Thus I was assigned to Local Government Engineering Department (LGED) under the ministry of Local Government, Rural Development and Cooperatives for the organizational attachment by my supervisor Md. Zohurul Islam, PhD, Academic Coordinator / Assistant Professor, BRAC Institute of Governance and Development, BRAC University; to conduct a study on the topic "Effective Operations and Maintenance (O&M) Practices of Vehicles: A Case Study on LGED".

The communication network is very much vital to achieve rapid economic growth of the country. LGED is responsible mainly for nation building network of all over Bangladesh. Such as construction and maintenance of Upazila Road, Union Road and Village Roads, rubber dam, primary school, tree plantation etc. The rural road network is crucial for the country like Bangladesh, as agriculture is still playing the major role to the rural area. The key players in the road sector are the Roads and highways Department (RHD) and Local Government Engineering Department (LGED). Currently LGED is implementing total 93 nos of projects, among which 66 nos are funded by the Government of Bangladesh (GoB) and the remaining 27 nos are donor assisted projects. A lot of vehicles are purchased under both from GoB and donor assisted projects. The purchase cost of the vehicle as well as maintenance cost of the same required a lot of public funds which need to ensure transparency and accountability on the spending of these huge funds. Every year there are some completed projects and on the other hand there are some projects in the pipe line for inclusion. The usage of government vehicles and its operations and maintenance activities raised a lot of questions by the administrations, Transparency International of Bangladesh, Anti-corruption commission, Audit sections and other watch dogs.

I have tried to focus and evaluate the total pictures on the operations and maintenance practices of large fleet of vehicles under Head office, LGED and discussed the strength and weakness of the ongoing activities as well as mentioned some recommendations to make it more effective, sustainable and transparent. All information and statistics that have been used in the study were collected from the LGED's concerned files, manuals, and Equipment management data base and direct interviewing of O&M personnel from mechanical unit etc.

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Second, I would like to convey my heartiest gratitude to Mr. Md. Wahidur Rahman, former Chief Engineer, Local Government Engineering Department (LGED) for giving me the opportunity to study MCIPS program by giving permission to join the class. I am particularly grateful to Mr. Elias Morshed, former Superintending Engineer (Admin.), LGED for providing me the opportunity in accomplishing the course. Next, I express my cordial thanks to all the concerned officers working with O&M of vehicles, for their best cooperation and all sorts of logistics support to fulfill this report.

I have been very opportunist to be associated with excellent classmates coming from different disciplines. I would like to acknowledge the interactions I have had with them.

Finally, I am deeply appreciative to my family members who have provided me with loving and supporting relationship needed to complete this program as well as this dissertation paper.

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ACRONYMS AND ABBREVIATIONS

ACC	Anti-Corruption Commission
ACE	Additional Chief Engineer
ACR	Annual Confidential Report
ADB	Asian Development Bank
ADP	Annual Development Program
AE	Assistant Engineer
BoQ	Bill of Quantities
BPATC	Bangladesh Public Administration Training Centre
BRAC	Bangladesh Rural Advancement Committee
CC	Cubic Centimeters
CE	Chief Engineer
CNG	Compressed Natural Gas
DCP	Direct Cash Purchase
DDO	Drawing And Disbursing Officer
DFID U.K.	Department For International Development
DPM	Direct Procurement Method
EPA	United States Environmental Protection Agency
EMS	Equipment Management Software
ERP	Enterprise Resource Planning
GDP	Gross Domestic Product
GHG	Green House Gas
GIS	Geographical Information System
GOB	Government Of Bangladesh
HP	Horse Power
HQ	Head Quarters
ICE	Internal Combustion Engine
ICT	Information And Communication Technology
IFAD	International Fund for Agricultural Development
IMED	Implementation Monitoring And Evaluation Division, Ministry Of Planning
LGED	Local Government Engineering Department

LKSS	LGED Staff Welfare Society
LTM	Limited Tendering Method
MBPS	Mega Bits Per Second
MoLGRD&C	Ministry Of Local Government Division, Rural Development And Cooperatives
MIS	Management Information System
MLSS	Member Of Lower Subordinate Service
MPG	Mile per gallon
MS	Microsoft
NGO	Non Governmental Organization
O&M	Operations And Maintenance
OT	Overtime
OTM	Open Tendering Method
PD	Project Director
POL	Petroleum, Oil & Lubricant
PWD	Public Works Department
RDEC	Rural Development Engineering Center
RHD	Roads and Highway Department
RFQ	Request for Quotation
ROI	Returned on Investment
SE	Superintending Engineer
SAE	Sub Assistant Engineer
SWOT	Strength, weakness, opportunity & threat
TPM	Total Productive Management
Tk	Taka
UN	United Nations
UNDP	United Nations Development Programme
VOC	Volatile Organic Compound
XEN	Executive Engineer

Abstract

LGED has the reputation as an “island of excellence” in the Government, with high standards of professionalism, and comparatively robust risk management systems. The report begins with a brief assessment of external environmental factors that affect LGED’s ability to adopt reforms to effectively address potential fiduciary & operational risks throughout the value chain of public expenditure for rural and urban infrastructure. This study has examined the present operations management practices of large fleet of vehicles at LGED Head Quater and analyze its effectiveness and compliance with existing rules and regulations of Bangladesh. To fulfill the overall objective of this study has undergone an in-depth procedure on verification of vehicle usages and allocation of vehicle procedures, it estimate preparation and approval procedures for maintenance, procurement process, has also checked procurement process as a tool for Public Procurement Rules (PPR-2008).

Factors at the national level include weaknesses in electoral, legislative, judicial and agency accountability, outmoded civil service rules and practices, lack of national audit capacity, and high levels of corruption. Progress in nationwide reforms for combating corruption and improving financial management and procurement has been encouraging in recent years, but there is a risk that it may not be sustained by the next political government.

At the sub-national level, LGED is subject to two lines of accountability. On the one hand, LGED has a sizeable budget of its own for implementing infrastructure programs at various levels of government. Here there is a strong emphasis on administrative and financial procedures to ensure the probity, integrity and effectiveness of activities. On the other hand, LGED also implements and manages rural and urban infrastructure funded under Annual Development Program allocations of sub national jurisdictions. In these cases, while there is a clearer accountability link to beneficiaries through their elected officials, risks can still arise due to weaknesses in local governance in planning, decision making and management. These risks need to be mitigated through local government reforms that will create a more efficient, effective and transparent environment within which LGED can function in the future.

The report gives a brief internal organizational assessment of LGED, reviewing its evolution from a rural works component of the integrated rural development program of the early 1960s to its formalization and rapid growth as a public sector department. Key functions are assessed, including human resources and financial management, procurement, engineering and ICT systems, corporate governance, and approach to land use and resettlement.

The report confirms LGED’s excellent reputation for professionalism, including quality delivery of many contracts on time and on budget. Although information and communication systems are relatively advanced in LGED compared to other government departments, the use of many different, non-integrated systems with inadequate supervision by core staff with ICT skills make it difficult for LGED to gather critical information needed to compare the results of the various projects, and complicates the reporting and control procedures within LGED (e.g. benchmarking, and detecting patterns indicating possible collusion on bids).

It has been discussed elaborately the strategy for benefits of improvement of communication system, its contribution to education sector, women empowering through women participation in rural infrastructure, community and local administration development as well as poverty reduction through participation of local level stakeholders and beneficiaries etc.

Chapter-I:
Introduction

1.1 Introduction

Local Government Engineering Department (LGED) is one of the largest public sector organizations in Bangladesh entrusted for planning and implementation of local level rural urban and small scale water resources infrastructure development programs. LGED works in a wide range of diversified programs like construction of roads, bridges/ culverts and markets to social mobilization, empowerment and environmental protection.

At present, LGED has 93 projects, of which 66 are GOB and 27 are donor assisted project. Every year a number of vehicles are procured under donor and GoB assisted projects for the supervision and management of developing works. There are more than 500 hundreds vehicles at LGED HQ only, let alone the vehicles at districts, regions and divisional levels. There are lots of jeeps, pickups, microbuses, cars etc. Besides the supervision of development works, these vehicles are used also to facilitate the office goers, meet up the emergency duties of the organization, important protocol duties etc. It involves efficient management, operation and maintenance program, mass procurement of MRO items (such as, Fuel, lubricant, spare parts etc.), payment of driver over time, handover of vehicles to the govt. transport pool after due completion of projects as well as disposal of old and damaged vehicles etc. It all incurs a lot of administrative, management, operations and maintenance costs. Vehicles are allocated to LGED officials as well as several officers of Prime Minister's Office (PMO), LGRD and other Ministries, govt. transport pool and so on. LGED as a pioneer organization in public sector, it has to satisfy also its key stakeholders through providing efficient operation and maintenance services of vehicles that needs to comply also with rules and regulations of Bangladesh.

1.2 Problem Statement

The Operations and Maintenance of around 500 of different category LGED vehicles incur huge amount of government money for the payment of fuel cost, driver overtime (OT), procurement of spare parts, maintenance and repair cost etc. LGED not only arranges transport facilities for its own in-house officers and staffs, it also provides logistic support to Government Transport Pool on special request for the uses of several ministries, Prime Minister's Office (PMO) and other external high govt. officials to strengthen and facilitate the

government for smooth operations and activities of the state. Moreover, driver overtime, Petroleum, Oil and Lubricant (POL) costs and maintenance cost etc are born by LGED. Transport facility acts as a force to motivate both external and internal key stakeholders. Vehicles in LGED are usually allocated on the basis of ranks in position, importance of job activities, availability of the vehicles and with due instruction from the concerned authority.

Maintenance of the large fleet of vehicles always needs timely actions for its periodic and other proactive routine maintenance, top and major overhauling to keep fit and running the LGED transport fleets. All these require a lot of finance for the procuring of spare parts, completing of repairing works etc. The transparency and accountability for the maintenance works are seriously criticized for several reasons such as lack of fund as compared to its big fleets, lack of efficient maintenance personnel, workshop facility, lack of knowledge, lack of time to execute the work, lack of proper ICT facility etc. The non-compliance of rules and regulations for usages of public vehicles and the spending of gross funds for its maintenance etc raises complexity.

Man, material, money, information and other valuable resources are used as input for the effective management and maintenance of vehicles at LGED. Moreover, vehicle life, best services and user satisfaction etc mostly depend on not only the quality of vehicle but also its proper operation and timely maintenance procedure throughout the year. The allocation and uses of vehicles, its O&M procedures such as estimation of repairing works, procurement of MRO items, supervision and due completion of the maintenance works, bill payment, its funding, proper document keeping and up to date database of large fleet of vehicles are seemed rather complicated and may raise several audit objections due to non-compliance with existing guidelines, rules and regulations for the usages and maintenance of government vehicles.

1.3 Research Question:

Do the present O&M procedures of vehicle in LGED HQensure existing rules and regulations?

1.4 Objectives of the study

The objective of this study is to verify the present operations management practices of large fleet of vehicles at LGED HQ and analyze its effectiveness and compliance with existing rules and regulations of Bangladesh.

1.5 Methodology

In-depth verification of Vehicle usages and allocation procedures, Estimate preparation and approval procedures for maintenance, procurement of spare parts and other MRO items, supervision and management of vehicles, performance measurement , funding and bill payment of repairing works, workshop facilities, spare parts inventory, registers and related document keeping etc. would be performed. Then detail analysis of the available data and information would be performed to check whether they are compliance with Government Vehicle usage and maintenance guidelines, Manufacturer's recommendation for maintenance, Public Procurement Rules (PPR-2008) for procurement, vehicle condemnation rules, LGED Rate schedules and other guide lines and codes of practice.

1.6 Sources of Data

To compile the dissertation, data and other information for this study would be collected from several secondary and primary sources. The secondary data would be collected from related registers and documents, Manuals and Technical reports, media reports and others. The primary data would be collected through interviewing and discussions with concern officials and stakeholders, physical verification of documents and registers etc. The information collected would be verified and analyzed in details for drawing inferences and conclusions.

1.7 Scope and limitations of study

This research will mostly base on the practical work and as well as on the existing data available in LGED HQ. There are some limitations i.e. concerned persons are unwilling to provide much information about the sensitive and confidential issues. Vehicles O&M data are collected randomly for LGED HQ only. The data for vehicles of districts, regional and divisional offices are not taken into consideration. Extensive analysis of all the concepts and perspectives will be difficult due to the vastness and diversification of the topic.

Chapter – II:
Literature Review

2.1 Performance objectives of operations management

There are five performance objectives that can be applied to all operations: Speed; Quality; dependability; flexibility and cost.

Speed: is the faster customer response. This has two aspects : the speed with which the goods or services are delivered and the reliability with which this is achieved. The organization must be aware that if the speed of the customer offering in not matched with the reliability of supply then reputation can be quickly tarnished.

Quality: is the error free product and services. Quality must be adequate to meet customer expectations, but quality that is higher than actually required may result in increased costs with no return. Modern methods of quality management can serve to reduce costs, provide increased product reliability and places quality at the thinking centre of an organization.

Dependability: Dependability (ie delivering goods and services when they were promised, or the reliability of products and services) is another important market requirement. Customers judge dependability only after the good and/or service have been delivered. Dependability relates both to products (meeting the claimed performance) or services (such as trains running on time). Waiting (one of Taichi Ohno's seven wastes) does not add value; it serves only to add cost. Dependability gives predictability that things will occur or happen on time. This increases customer perceptions and, in consequence, their confidence in an organization. Dependability is a key performance objective for the operation functions.

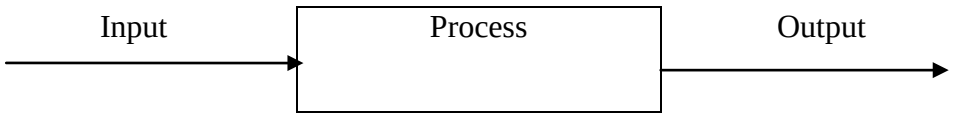
Flexibility: Flexibility is an essential requirement of the operations function in today's fast changing business environment. This includes fast introduction of new products, late customization to meet customer needs, linked with service offering (faster deliveries, timed deliveries, special packaging). The operations role must appreciate the need to meet customer demands and this in turn means designing processes that were able to change and adapt to suit differing circumstances. Whatever the situation, the operations role must be flexible enough to adapt. Flexibility must be built in to the operational processed and supported with considered contingency planning where events outside the anticipated norm may occur.

Cost: Finally, control of costs is important to any organisation, staff, facilities, machinery, technology and material costs (among others) need to be well managed and controlled. Cost is affected by all the performance objectives discussed above and the operations role is to strike an acceptable balance while still meeting the required customer services levels. The balancing of the five key performance indictors underpins the operational success of the organization. Successful management of these key factors contributes sustainability to an organization's success.

The above five performance objectives of operations management can also be used in effective O&M of vehicles in LGED. The speedy response of operations and maintenance personnel and quick delivery of vehicles after maintenance, through quality supply of MRO, offering dependable and flexible product or services, and controlling of cost etc are key success factors.

2.2 The 'Input-transformation-output (ITO)' model of operations management.

The transformation of inputs to output is central to operations management.



All operations are consisted of input–transformation-output processes. Inputs may be, for example, people, materials, energy, finance, or information: These are converted or aid conversion into a more refined or finished product or service via the transformation process to product, as an output, the goods or services designed to meet customer needs.

- People: the workforce who provide the skills, knowledge and competencies that underpin the operation. Here, people refer to operations and maintenance people of vehicles.
- Material: the raw materials or the assembly items that form part of the finished product. Here, material refers the MRO (Maintenance, repair & operations) items such as POL (petroleum, oil & lubricants), spare parts, stock in hands etc.
- Energy: the management of costs is central to operations management. Energy management represents just one area for consideration.
- Finance: the organization must have adequate finance for buying and updating capital items (such as plant and equipment) and for working capital (to meet running costs

such as wages, purchases and many other related areas of expenditures). For the O&M of LGED vehicles, lots of funds are required not only for purchasing of the vehicles but also for O&M of the same.

- Information: good information is essential to any operational activity in today's workplace. Data processing should be manage to deliver required information as and when required and in a meaningful form to their user. Equipment Management Software (EMS) was used in LGED to provide important information and generate required management report.

2.3 The volume-variety effect on O & M process

To understand the different types of operation we can differentiate between them by using four dimensions, sometimes called the four Vs of operations (or the dimensions of operations processes).

- Volume –how many products or services are made by the operation?
- Variety – how many different types of products or services are made by the operation?
- Variation- how much does the level of demand change over time?
- Visibility – how much of the operation's internal working are "exposed' to its customers?

In respect to LGED, volume refers to large amount of vehicle operations and maintenance works; variety refers to different types of services and activities performed by the O&M people; variation refers to the change of level of demand in case of O&M activities, forecasting of requirement of spare parts for maintenance etc; visibility may refers to the transparency and accountability of the activities related operations and maintenance.

2.4 Poka- yoke (Fail-Safeing)

The concept of fail-safeing is based on the idea that human mistakes are to some degree inevitable. The key consideration is how to prevent these errors becoming defects. Poke-yoke systems are simple fail- safe devices and methods initially designed to reduce human failures on production lines.

The goal of mistake- proofing or poka-yoke is to eliminate mistake. Paka-yoke is by using simple objects such as fixtures, jigs, warning devices, and the like to prevent people form making mistakes. These objects, known as poka-yoke device, are usually designed to stop the machine and alert the operator if something is about to go wrong. In addition to these types of devices, concepts, such as colour coding, texturing, and visual indicators are also used.

Poka-yoke concepts are not only use in manufacturing and assembly processes; they are also used in the product design process, designing parts that can not be assembled incorrectly. Connection points are often colour coded to prevent wiring or piping errors. Colour coding is also used to allow the quick identification of the correct materials.

In case of the O&M of vehicles, dashboard signals as well as sounds in vehicles also act as poka-yoke device. For example, when engine become over-heated, a red signal is visualized on dashboard that make sense the driver not to run further the vehicle in this heated conditions. If the driver does not take immediate actions, then further running may seize the engine and damage it. Similarly, timing belt signal in dashboard indicates that time has come to change the timing belt and screaming sound in brake indicates that there is excess erosion of brake pad which needs immediate change to avoid friction with brake drum etc.

2.5 Benchmarking

A useful definition of benchmarking is: “Measuring your performance against that of best-in-class companies, determining how the best-in-class achieve there performance levels and using the information as a basis for your own company’s targets, strategies and implementation’ (Pryor). The aim is to learn both where performance needs to be improved and how it can be improved, by comparison with excellent practitioners

Benchmarking performance targets and quality standards are likely to be realistic (since other organisations have achieved them), yet challenging (since the benchmarking organisation hasn’t yet achieved them); the most effective combination for maintaining motivation.

There are four types of benchmarking such as Internal benchmarking, Competitor benchmarking, Functional benchmarking and Generic benchmarking.

LGED being a public organization, benchmarking is mainly performed with other engineering public organizations such as RHD, PWD, City Corporation etc.

2.6 Value analysis

Value analysis has been defined as the organized, systematic study of the functions of a material, part, component or system to identify areas of unnecessary cost. It begins with the questions “What is it worth?” and proceeds to an analysis of value in terms of the function the item performs. Value analysis (VA) involves looking a fresh at a product already in existence. On the other hand, value engineering (VE) considers design from the conceptual stage.

2.7 Types of maintenance

The purpose of maintenance is to optimize the performance of equipment by attempting to prevent breakdown or failures.

The objectives of maintenance are-

- To maximize the useful life of the equipment
- To keep the equipment safe and prevent the development of safety hazards.
- To minimize the total production or operating costs directly attributable to equipment service and repair.
- To minimize the frequency and severity of interruptions to operating processes .
- To maximize production capacity from the given equipment resources.
- Differences between preventive and repair maintenance:

There are two approaches to repairs and maintenance: repair maintenance and preventive maintenance.

Repair (or breakdown) maintenance is involved with failures and related problem as they occur. This is reactive in nature. Unscheduled maintenance of this type can be highly disruptive to any production process and consideration should be given to the appropriate level of after sales support in this area at the time of unit purchase. The availability of spares, response times and costs should all be fully evaluated prior to purchase.

Preventive maintenance requires proactive approach and is concerned with the reduction of failure by the implementation of a rigorous preventive regime.

Preventive maintenance is defined as a system of daily maintenance, periodic inspection, and preventive repairs designed to reduce the probability of machine breakdown. The primary reason for preventive maintenance is to reduce unexpected downtime and repair costs caused by machine breakdown. Preventive maintenance is largely precautionary and will be undertaken according to a predetermined and regular schedule.

Preventive maintenance plays an important role in operations management with benefits ranging from cost reductions and decreased downtime to safety and improved performance. It involves routine machine inspection, servicing, cleaning and keeping accurate maintenance records.

Preventive maintenance policy should consider the alternative approaches that can be used and decide on the appropriate mix of approaches. The options available are as follows:

Work based: where maintenance is carried out after a set number of operating hours or usage. Usage can be gauged by counting (eg after 10,000 miles, 5,000 units or 50,000 copies etc)

Time based: Where maintenance is based on time intervals irrespective of usage. This system is easy to schedule and monitor but often neglects the problems that may become apparent if high_usage in an area is not recognized. (eg. servicing of vehicles after each 3 months).

Opportunity-based: Where maintenance takes place outside work hours (evenings and holidays) or when machine breakdowns provide downtime on other machines that can then be use for maintenance.

Condition-based: Often relies on planned, visual or measured inspection in order to assertion the need for maintenance (eg when brakes wear down to 1 mm minimum , tyre change etc.)

2.8 Total productive maintenance (TPM)

Total productive maintenance is a development from total quality management thinking and is designed to encourage the unit operative and those linked with the production process to take ownership of their role. The key features are as follows:

- To operate the use and effectiveness of equipment and eliminate unplanned failures.
- To involve the operator in maintenance activities where appropriate in order to develop a sense of ownership, involvement and responsibility.
- To encourage employees to be involved in continuous improvements in machinery and equipment operation.

The replacement of worn defective or damaged parts is an integral part of preventive maintenance. When the cost of repair is becoming substantial a new approach may need to be taken. A common method is to set a repair exceeds this repair limit and if the estimated cost of repair exceeds this repair limit then the machine is due for replacement.
Asset replacement is dependent on a number of factors. One of these factors is the repair limit but other considerations are dependent on the nature and value of the item to be replaced. This can include replacement cost and whole life costing, cask flow implications, downtime costs, obsolescence, and projected long-term production requirements.

2.9 Public Procurement System of Spare parts

Among the procurement system, the public sector usually uses the Open Tendering Method (OTM) for most transparency and wide competition. Though it is the most acceptable and transparency method, it is lengthy process and needs time, energy and money to make the OTM competitive.

For buying urgent and small value goods other useful methods such as Request for Quotation (RFQ), Limited Tendering method (LTM), Direct Procurement method (DPM) are important. Another favorable window in the PPR-2008 is the Framework contract that may be used where two or three years contract are made with preferred or pre-qualified tenderers.

It can be noted that other than open tendering method, all other methods such as RFQ, LTM, DPM, DCP etc are known as restricted method for which the approval from HOPE (Head of the Procurement Entity) is the essential with due justification. Each of these methods has financial thresholds which also limit the frequent use of these methods.

In LGED, the procurement methods used for the supply of spare parts are shown in descending order of RFQ > LTM > DCP >DPM > OTM etc.

2.10 Manufacturer's recommendation's about periodic maintenance :

Manufacturers of vehicles have their respective recommendation on periodic maintenance of its brands. For example, LGED have different brands of vehicles such as Toyota, Mitsubishi, Honda, Nissan, etc and the manufacturer's of those brands recommended to perform the periodic maintenances according to the nature and frequency of maintenance.

A recommended list of periodic maintenance is attached in **Appendix –I**.

2.11 Pareto analysis or ABC analysis

Pareto formulated the proposition that: ' In any series of elements to be controlled, a selected small factor in terms of number of elements (20%) almost always accounts for a large factor in terms of efforts (80%). The Pareto principle (or '80/20 rule') is a useful technique for identifying the activities that will leverage the time, effort and resources for the biggest benefits. It is a popular way of prioritizing between tasks or areas of focus.

In procurement context, the Pareto principle can be incorporated as 80% of spend being directed towards just 20% of the suppliers. This elementary form of segmentation can be used to separate the critical few suppliers (who supply important, high-value, high usage items, which can only be sourced from a limited supply market) from the trivial many (who supply routine, low-value supplies which can easily be sourced anywhere. Most procurement effort and energy needs to be focused on the critical or category 'A' suppliers and the products procured from them.

ABC analysis derived from the Pareto's 80/20 rule curve. It is also known as 80-20 concept.

- Category A items: High value, so stock must be minimized. Just in time (JIT) supply procurement method will be used. Most procurement and managerial control effort will be focused here.
- Category B items: A moderate level of control will be exercised in this area.
- Category C items: High in number, but with low usage value. In general, least procurement and managerial control effort will be focused here.

2.12 Total Cost of Ownership (TCO)

There is a vital difference between the purchase price of an asset (the sum paid to the supplier to secure access or ownership) and its total cost of acquisition or ownership. The total cost of ownership can be categorized under six headings, as follows: Total cost of ownership is known as total life cycle cost. TCO includes-

1. *Pre-acquisition costs* such as research, sourcing, preparation of tenders and structural changes to allow for the asset
2. *Acquisition costs* including the purchase price, the cost of finance (if borrowing is required to finance the procurement), delivery, installation and commissioning (starting operation)
3. *Operating costs* such as labour, materials, consumables, energy usage, and environmental costs (eg disposal of waste)
4. *Maintenance cost* such as spares and replacement parts, servicing, repair, periodic overhauls, and reduced output with age
5. *Downtime costs,* such as lost production, extra labour rtc if the asset stops working or fails to perform as it should
6. *End of life costs* such as disposal, ongoing liabilities, decommissioning, sale for scrap or resale.

Today, TCO is used to support acquisition and planning decisions from a wider range of assets that bring significant maintenance or operating costs across ownership life.

CIPS therefore consider whole-life costing (or lifecycle costing) as a best practice tool for evaluating options for any substantial procurement: establishing the total cost of ownership, and annual spend profile, over the entire anticipated lifespan of the product. In whole-life costing, all costs over the life of goods and services are taken into account. This enables savings in running costs to offset any increase in capital costs. The savings are calculated for each year of the equipment or service contract life. It shows either a simple payback time or the payback during the life of the equipment or service contract.

2.13 Air Pollution

Air pollution is a serious environmental health hazard affecting the populations of Bangladesh. Air pollution of Bangladesh is caused due to increasing population and associated motorization. Environment problems differ from country to country, even district . Cities in the South East Asia such as Dhaka, Delhi, Bangkok and Manila suffer from high

levels of lead, particulate matter, and oxides of sulfur. Central and South American cities such as Mexico City and Santiago experience frequent ozone problems. A comparison of air pollution in mega cities of the world is as follows: (Also see Appendix-2)

Suggested steps for pollution control

The government has taken some steps to improve the pollution control of Bangladesh. But the steps are not adequate. As such, few more steps may also be taken to improve the environmental degradation:

Use of Environmental Technologies and Methods: Environmental technologies and methods such as Geographic Information Systems (GIS), remote sensing and environmental impact assessment might be used for integrated policy formulation, decision-making, evaluation and monitoring of environment.

Development of Environmental Database: A comprehensive environmental database may be made and the environmental planners might have the access for environmental up-gradation, planning and management The database is to be updated regularly.

Environmental Education and Awareness.
Formal and informal methods of education might be adopted through local media, seminars, celebrations, workshops, walks and student competitions to aware the people regarding the process of environmental degradation.

Industrial and Solid Waste Management: The government might take appropriate measures to monitor emission limits and Market Based Incentives (MBI) for reducing pollution control. The industries might be given both technical and financial support for introducing mitigation measures, promoting green technologies, using less pollution technologies and recycling the waste.

Enforcement of Rules and Regulation: Environmental Conservation Rules of 1997, traffic rules and other relevant environmental laws might be enforced further to punish the violation of the emission limits.

Urban Transport Management: Government must strengthen vehicle emission standards, complete the emission inventory and conduct an investigation on the emission control measures. Auto-rickshaw must be restricted in Dhaka city. Government must replace old

vehicles, two-stroke engine vehicles, improve traffic conditions and promote an equivalent and efficient alternative public transportation services to improve urban transport management.

Reduce Sulfur in Diesel: Government must take necessary steps to remove sulfur content from diesel through hydro-desulphurization (HDS) process. The government must also enforce the vehicle manufacturers to install catalytic converters in every vehicle to reduce the vehicular emissions.

2.14 Sustainability issues

Sustainability relates to Social issues, Economical issues, Environmental and ethical issues. Alternatively, it is called the 'triple bottom line' which relates to 3Ps-People, Planet and Profit. In O& M context, people relates to social issue (eg effective manpower, diversity, health & safety etc), planet relates to environmental issues (eg less emission, less CO2, environmentally friendly product, CNG operated vehicles etc), profit relates to economical issues (eg use of less fuel, minimum distance travel, pooling, Economic of scale, locally available cheaper material etc)

Public sector organizations are owned by the government on behalf of the state, which represents the public. Public sectors' primary mission & purpose is, by definition, sustainability. The core drivers for sustainability, in the public sector, will be need for transparency and accountability in the use of public funds; and the potential for sustainability efficiencies and cost savings.

Transparency and accountability are the key issues to stakeholders and they are considered the great risks in public sectors. There may be a need for increased cross-functional collaboration, consultation and information, in order to align sustainability decisions and activities. 'Fuel economy' is achieved through eco-driving practices and technical vehicle enhancement such as use of officer's buses; combined or group use of vehicles instead of single/ individual use; plying of cost economy and environment friendly CNG driven vehicles or diesel particulate filter driven vehicles etc. All drivers are personally monitored on their fuel consumption and driving manner.

The following sustainable issues may be considered in the operations and maintenance of transports such as:

- Credit purchase of POL (Petroleum, Oil and lubricants) from fuel stations etc. increases the fuel bill. Purchase card may be used to buy fuel from any fuel stations to limit the cost.

- Delay payment of spare parts suppliers compelled to charge higher profit in supplying the parts to appreciate bank interest, setup and administrative cost etc.

- Vehicle loan from government should be granted to the officers to purchase their own vehicles and the amount can be deducted from the monthly salary (or govt. may provide soft loan etc., as for joint secretary and above to receive Tk. 25 lakh to purchase vehicle)

- Whole life costing (WLC) or Total Cost of Ownership (TCO) of vehicles should be considered while purchasing vehicles. Public sectors usually considers lowest price bid to procure vehicles. It is needed to select and buy reputed brands of vehicles, ensuring spare parts availability, after sales service facility, less maintenance cost or whole life cost etc.

Chapter –III:
Methodology

3.1 LGED vehicle usage and allocation procedures

LGED Vehicles are used mainly for supervision purpose. Vehicles are allocated primarily to executive engineer and above ranks. But the officers who have to spend extra time at the office for the official works, they are sometimes allocated vehicles and /or permitted to use vehicle on the basis of availability after due approval from the concerned authority.

All officers and staff are not allocated official vehicles, there are 9 (nine) Staff bus and 2 (Two) official buses to ease the office goers and they may use it with due permission from authority.

Standby vehicles are kept in LGED transport pool to support emergency and other important official duties such as for field visits, ADB/WB mission, Audit team, inspection team etc.

The use of Govt. Vehicles for personal purpose is fully discouraged. An officer is sometimes permitted to use govt. vehicles for personal use on payment basis only when there is availability of vehicles and that would not hampers government works. The officials apply to the concerned authority for the requisition of official vehicle to meet their important personal purpose, if permitted, the cash is paid according to the total account of distant and time uses through Treasury chalan.

Accountants are not allocated any vehicle officially. But to release fund and to communicate with ministry, to maintain liaison with bank, to go to AG office, to face the audit objection and when he is needed in office he may be supported with a standby vehicle for movement.

Officers, who are engaged in emergency utility services duty such as electrical sub-station, stand by generator, pump station, fire-fighting security of the offices and equipment, protocol duties etc. are allocated to use vehicle all the time even at closing days. Some officers also frequently visit other districts for the supervision, inspection of several development works as well as conducting official activities as per their charter of duties with due permission of concerned authority.

Officers are strictly prohibited to use govt. vehicles outside of their working stations without due permission from the top authority. If any misuse of govt. vehicle of this type is known, departmental proceeding or other administrative action is taken against the concerned officer.

Govt. Transport pool, on special cases, requests LGED to provide good quality vehicles to support to run the government effectively. Sometimes vehicles are provided to Govt. Transport Pool, Prime Minister's Office (PMO) and other officials for their uses. About 81 LGED vehicles are provided outside of the department as per request from Govt. Transport Pool, PMO and related Ministries etc. LGED has supported the Govt. Transport pool with vehicles and drivers. POL of most of these vehicles is provided by the Transport Pool. But servicing and maintenance are done by LGED.

3.2 Vehicle operation and maintenance staffs

Vehicles Operations and management are solely controlled by vehicle section at Head quarter. All the drivers of vehicles are centrally controlled by this unit with the support from the senior executives. The vehicles are allocated and drivers are deployed for respective vehicles duties and monitoring on these drivers is carried out by the operations personnel.

In LGED Headquarters, there are about 650 vehicles but the personnel engaged for its proper operations and maintenance are only a few, below 10 person only including officers and maintenance staffs. The management and maintenance of large number of vehicles, its drivers and rapid & timely maintenance operation etc are really a tough job without proper resources. There is obviously a great lack of expert manpower to handle this O&M of large fleet of vehicles. There are a few trained personnel on O&M of vehicles. Skill and knowledge on maintenance works are essential to keep the large vehicle fleet safe and sound in cost-effective way. Vehicle life also depends on expert driving. The proper care and understanding as well as reporting on vehicle problem to the concerned authority at the right time will also assist effective O&M of vehicle.

3.3 Estimate preparation, approved procedures

Most of the maintenance of vehicles is performed at Central workshop of LGED HQ. The brief procedure of vehicle maintenance is as follows:

- Application by Driver or request from the vehicle user, when there arises any problems in vehicle.

- Prepare an estimate after detail supervision, examination and diagnosis in the central workshop by the concerned personnel.
- Put up the file for estimate approval from the concerned authority.
- After the approval of the repairing works, necessary executions as per Public Procurement Rules 2008 (ie, OTM, LTM, DPM, RFQ, DCP etc) are carried out for the supply of spare parts and repair works.
- Spare parts of the vehicle are purchased from the market with direct supervision of workshop-in-charge or other concerned personnel along with driver of the vehicle.
- After detailed verification of the supplied spare parts, the vehicle repairing work is performed in LGED central workshop in presence of our own mechanics, concerned mechanical engineers and driver as well.
- After completion of repairing works, the vehicle is examined and tested in details. Bill payment of repairing work is done only when the vehicle's repairing work is done as per work order and it performance are certified satisfactory by mechanical section with due guaranty of repairing works by the supplier. Every step, from vehicle problem identification to payment repairing, is completed through proper supervision.
- Some works ie air-conditioning, fuel pump calibration, denting-painting etc, which are not available in central workshop is done from outside workshops.

3.4 Procurement system of spare parts

In LGED, spare parts of vehicle repairing works are usually purchased through Request for Quotation (RFQ) methods. So, usually a few preferred sellers can be given priority to supply of spare parts in LGED HQ.

The another most important methodology for taking supply of spare parts, and repairing as well, is the Direct Procurement Method (DPM) from the respective sole distributors of several brands of vehicles, such as of Toyota, Mitsubishi, Honda, Nissan etc. These types of vehicles are got repaired from their respective sole agent's established workshop to ensure availability of genuine parts and gives guaranty for the maintenance work. It may bring longevity of the maintenance work and hence more customer satisfaction. So, in other word, repairing through sole agent's workshop ensure quality in repairing of vehicle works as well as value for money (VFM).

Some of the vehicle maintenance is performed through limited tendering method (LTM) where notice of repairing works is distributed among enlisted workshops. The enlistment

should be updated every year to give opportunities to the new suppliers or workshops. But enlistment of repairing works is not updated for long time in LGED HQ.

Some of small value items of maintenance work which might be treated as urgent and emergency items are purchased and adjusted through Direct Cash Purchase (DCP), the threshold of each time purchase is below or equal to TK. 25,000.

The last but not the least is the Open Tendering Method (OTM). Though it is treated as most transparent and widely acceptable method in public sectors, it is sometimes difficult to ensure quality and standard in O&M of vehicles in this method. Because it is difficult to find out a qualified supplier by merely following this general method. On the other hand, the supplier might cut corner to get profitability.

3.5 Maintenance and Supervision of vehicle

In LGED, the number of actual equipment and vehicles are far more than that of approved Table of Equipment (TOE). As a result, the revenue fund allocation from GOB in the budget on the basis of TOE for LGED is very less than actual requirement for operations and management. As a result, maintenance of all vehicles at the right time with right quality is not always possible due to lack of fund and is a constraint for the maintenance people. The financial supports from several projects play a vital role on the way of timely maintenance as well as smooth operations of vehicle fleet.

Supervision of vehicles and maintenance of the same are carried out by only a few personnel, not sufficient and skilled on relevant field to deliver the job effectively. All the vehicles, whether in project or in central pool, are centrally controlled. Though the cost of vehicle operations and management is also financed separately from different sources, the drivers of all vehicles are controlled by the vehicle section. Similarly, their transfer, duty, fuel issue, overtime payment etc activities are recommended and initiated by vehicle section and no action of this type would be taken by any project directors or other stakeholders without the comment of concerned personnel.

3.6 Performance appraisal and payment

Performance of maintenance works is thoroughly checked by the expert of workshop-in-charge before the final payment of the repairing works of vehicles. There is also provisions of

warranty clause for a period of Six month or 50,000 km for major units-from the date of delivery.

Payment of bills for POL and maintenance is mainly done from project funds. GoB fund allocution is so scarce that a few vehicles could only be possible to maintenance from this fund. Actually govt. allocates GoB fund according to the TOE (Table of Equipment) of an organisation. In LGED, the ToE was prepared in 2002 and at present the actual quantity of vehicles is very large with respect to that of ToE.

3.7 **Record keeping and Management of required Registers**

Proper record keeping and management of registers are essentials for both operations and maintenance purpose. For effective operations and record keeping the following registers are very important. Such as –vehicle inventory Registers, log book, POL(Petroleum, Oil and Lubricant) issue registers , Driver Overtime register, Vehicle protocol duly(or movement) registers, Vehicle on–payment duly register, Vehicle purchase register, Vehicle condemnation register Returned (or handover) of vehicle to transport pool, vehicle accident & lost registers etc are some of them.

Similarly, for effective maintenance the following registers are important:

Estimate approval register, Job card, Maintenance History Register, Dead stock register for old parts, Bill (payment) approval register etc.

Moreover, each vehicle has separate file to keep record of maintenance and sometimes computers are used to keep important data of operations and maintenance as a whole.

3.8 **Workshop facility (CEMWS[1])**

There is a workshop at LGED HQ, mainly uses for diagnosis of vehicles, servicing and other trouble shooting purposes. All types of routine check-up and periodic maintenance are performed in this central workshop. Sometimes engine overhauling, suspension overhauling, brakes, electrical works are also carried out in the workshop provided the parts would be supplied by the concerned vehicle user or project officers. Vehicle repairing works at central workshop are treated as more transparent and reliable than repairing of vehicle through outsourcing. It becomes visible and easy to monitor not only by the expert maintenance engineer but also by the user or other stakeholders, if needed.

[1] CEMWS means Central Equipment Maintenance Workshop

The central workshop has the facilities all types of repairing maintenance works except denting- painting, Air-conditioning, fuel pump calibration etc. In office campus, the repairing works which creates noise are avoided.

CHAPTER-IV:
DATA ANALYSIS AND DISCUSSIONS

4.1 Operational Management:

Operations management refers to all the managements related to the operations that include vehicle allocation, controlling of vehicle movement, issuing of POL (Petroleum, Oil & Lubricant), payment of drivers' overtime duty, returned of vehicles after project completion, proceeding for condemnation of old and damaged vehicles etc.

4.1.1 Vehicle allocation- force for motivation

Vehicle allocation to LGED officials acts as force for the motivation because transport is essential for the officials not only for going office and back in time but also for the security and timely movement of them as well as their family members. Officials having a vehicle to use may feel safety and security for any kind of movement for him for official purposes, even in case of delay return due to important works after office time and safe movement of his family members in the busiest Dhaka city in absence of the officers as well. This motivation helps internally the officials to be absorbed fully in the work.

Table 1: Types and levels of vehicle allocation

Ranks	Jeeps	Cars	Carry boy Pickups/ Micro	Total
Additional CE to CE	5	5	0	10
XEN to SE	133	8	25	166
Below XEN	35	14	25	74
Outside the LGED	58	6	1	65
Others (as standby etc)	10	9	13+13=26	45
Total	**241**	**42**	**77**	**360**

Source: This data is taken from the database of Mechanical Unit, LGED in November, 2014.

According to the policy on authorization and use of Government Transport, the government official having rank of Joint Secretary and above will be entitled to whole-time use of Government transport on the basis of Tk. 200.00 payment per month.

Joint Secretary is equivalent to the rank of Additional Chief Engineer in LGED and the vehicle allocated on these rank is only 10 in numbers of which only 5 are Jeeps and other 5 are cars as duplicate vehicles. All vehicles (about 97% of total transport fleet) are allocated to the equivalent rank of below Joint Secretary; hence they are not entitled to whole-time use of Government transport.

4.1.2 Fuel cost

Fuel cost of fleet of vehicles at LGED Head Quarter is shown in Table 2. The Table shows the average fuel actually allotted for each type of vehicle operatioons which may vary greatly with the limit of fuel use for government transport.

Table 2: Fuel Bill of Vehicles:

Sl. No	Type of Vehicles	Fuel Type	Quantity of Vehicles	Av. Fuel allotted per month (Liter)	Av. CNG used per month	Monthly fuel bill	Annual Total fuel bill
1	Car	Octane/CNG	42	40	400 cum	670320	8043840
2	Jeep	Diesel	211	400	0	5739200	68870400
3	Jeep	(Petrol/CNG)	30	40	400 cum	468000	5616000
4	Pick-Up	Diesel	64	400	0	1740800	20889600
6	Microbus	Diesel	13	400	0	353600	4243200
			360			8971920	**107663040**

Source: Market Rate of Fuel: Diesel: Tk 68.00; Petrol/ Octane: Tk 99.00; CNG: Tk 30 / cum on December, 2014.

But according to the Office memorandum of Transport Section, Establishment Ministry, dated 03-01-1990, whole time vehicle use entitlement officers can purchase himself at the rate of 7 liters petrol/ octane/ diesel daily from any fuel station and again according to the Office memorandum of the same ministry dated 26 December 2005; the maximum amount of monthly fuel to be issued to the all time vehicle entitled officers is 180 liters instead of 200 liters petrol/octane (10% reduction of cost) and for CNG operated vehicles the fuel used to be at the following rate:

a) For starting EFI/ MPFI engines: Monthly 30 liters petrol/ octane.
b) For starting Carburetor engines: Monthly 15 liters.
c) Total fuel to be received per month per vehicle: 300 cum CNG.

From the analysis of above table-2, annual total fuel bill for the LGED fleet is Tk. 10.76 crores. The average fuel cost per vehicle per month is Tk 25,000 and average fuel cost per vehicle per year is around Tk 3,00,000. It is also analysed that some vehicles which are used for VIP purposes and made frequent field visit would require more than the limit mentioned in the office memorandum. The average actual phenomenon for fuel allocation are as : for diesel vehicle : 400-450 liters diesel instead of max 200 liters diesel; For CNG operated vehicles: 40-50 liters of Octane/Petrol instead of 30 liters octane and 400 cum CNG instead of max limit of 300 cum. As a result, annual excess bill goes beyond 47% more than that of the limit of government slots.

4.1.3 Returned the vehicles after project completion

According to the Office memorandum of Transport Section, Establishment Ministry, dated 08 January 2006, all the running vehicles of the project shall be returned to Government Transport Pool within 60 days after completion of the project. If the project vehicles are not handed over within specified time the Govt. Transport Pool will inform it to the Establishment Ministry.

In continuation of the completion project, if the project is upgraded to next phase or extended and there is provision for vehicles in the extended projects, then after new approval of TPP/ DPP (Technical Project Proforma/ Development Project Proforma), necessary numbers of vehicles can be kept to the next phase of the same project with due approval from the approving authority of Establishment Ministry.

If there is shortage of vehicles in TO&E (Table of Organisation and Equipment), then only that very vehicles can be used after inclusion them in the TO&E. The vehicles which are not included in the TO&E must be returned to the Govt. Transport Pool within 60 days after completion of the project.

It can be mentioned that 117 vehicles have already been returned to Government Transport Pool in running condition after completion of LGED projects. Moreover, 20 motor vehicles were condemned with due approval from Ministry Condemnation committee and also 140

motor vehicles of LGED Gazipur stackyard are awaiting for getting approval from condemnation committee. It can be noted that no vehicle is handed over to Govt. Transport Pool after 2006, though a lot of projects have been completed in between periods.

4.1.4 Line of command

Vehicles are allocated randomly to the LGED officers on the basis of availability with due approval from the top authority. There is no policy for vehicle allotment. There is also no committee for vehicle allocation to rationalize the vehicle requirement. So, sometimes junior officers might get better vehicles than senior officers and the allocation of this type might raise dissatisfaction among the seniors who are given inferior vehicles than juniors. It is always seen that right person may not get the right vehicle as it were proposed as when available for allocation, though emphasis are mostly given to the senior officers who have no vehicles to use. The officer-in-charge of vehicle section proposes vehicles as per instruction of top authority. The vehicles become available for allocation to the officers mainly from the transferring officers to districts, handover of vehicles to the LGED transport pool from the government personnel outside of LGED and sometimes procurement of vehicles under several projects.

4.2 Maintenance Management:

4.2.1 Maintenance details

Vehicles are regularly maintained for optimum performance, and kept in good repair. In emergency situations the maintenance personnel is sometimes tasked with the responsibility of managing the vehicle fleet. To streamline vehicle management the maintenance personnel should put in place a simple process. Such a process could entail the following:

4.2.1.1 Maintenance Options

There are three main options;

1. "In house maintenance" – performed using the facilities and staff of the organisation.
2. "Outsourced maintenance" – under taken by an outside contractor or workshop.
3. "Contract hire" - undertaken by an outside contractor as part of a vehicle operating system.

There has workshop facility at Head quarter in small capacity where testing and diagnosis of vehicles are mainly performed to prepare an estimate and servicing of the vehicles. Sometimes engine overhauling and other major maintenance are performed in-house at the central workshop if the parts are supplied to this workshop; otherwise all the major maintenance works are generally performed at external workshops through outsourcing. LGED authority never goes to 'contract hire' maintenance option.

It will be necessary to review the operational requirements and match the most suitable form of maintenance to the individual operation. Whichever mix is selected, it must be preventative and must be under the control of a competent manager; if it is not, the condition of the vehicles may quickly decline and running costs may increase.

4.2.1.2 Maintenance Planning

Whichever maintenance options is followed, vehicle maintenance schedules must be drawn up together with, and published by the fleet manager as part of the vehicle planning. All members of the management team must make a commitment to respecting the scheduled dates for maintenance. A master vehicle inspection and servicing schedule should be drawn up for one year – a wall chart is recommended. This chart can also be used to show fitness and tax token renewal, annual inspection dates, etc. Vehicle servicing is a compromise between inadequate attention, resulting in progressive deterioration in condition and the ensuing serious consequences, and too much attention, which is costly and unnecessary. The person responsible for the condition of the vehicles must decide the scope of the servicing work required and how often this should be carried out; taking into account the manufacturer's guidelines and kilometers travelled and in which type of environment the vehicle has been used. At present, there is no vehicle maintenance plan or schedule drawn by maintenance personnel for LGED vehicles to perform the maintenance at

4.2.1.3 Preventative maintenance

Preventive maintenance is defined as systematic inspection, detection, correction, and prevention of incipient failures, before they become actual or major failures. It is a proactive maintenance.

This is done on an ongoing basis. This type of maintenance addresses the basic things that could cause a problem in vehicles if they are not properly maintained. The maintenance

personnel develop an inspection check-list to be used by all drivers as a guide. Each day, the first driver to use a vehicle will inspect the vehicle using the check-list.

4.2.1.4 Routine or Periodic maintenance

Routine maintenance is defined as simple, small-scale activities (usually requiring only minimal skills or training) associated with regular (daily, weekly, monthly, etc.) and general upkeep of a building, equipment, machine, plant, or system against normal wear and tear. Routine maintenance to an asset that is planned and performed on a regular and consistent basis. Periodic Maintenance is just as it sounds. It's based on a periodic time and/or cycle.

Routine maintenance has the following general attributes that distinguish it from other forms of maintenance:

- The routine is most commonly based on fixed intervals of time, such as "every x hours of machine time", "every x days".
- It usually occurs quite regularly, since as daily, weekly, monthly or quarterly.
- The routine activities are funded from the annual operating budget.
- Depending on the type of building, it represents anywhere from 10-30% of the operating.
- Many of the tasks are performed by contractors under a service agreement and is therefore a form of planned maintenance.
- The majority the routine maintenance tasks are performed as time-based maintenance (TbM).
- It is proactive in nature.

This type of maintenance is done on a weekly, monthly, quarterly or yearly basis. It may cover the following:

- the vehicle supervisor should periodically organise a test drive each vehicle and report on its condition and also ensure that normal/regular service has been done for all vehicles in due time (every three months or 5000 km intervals);
- tyres: any abnormal wearing should be reported to the responsible maintenance personnel; and
- cleaning of the engine at least once a month etc.

4.2.1.5 Selection of Garage

Based on the organization's needs, the criteria for selection of the right garage is set with the input of the maintenance personnel keeping in mind the organisations approved procurement procedures. For example the minimum requirements may include: number of qualified technical staff and details of qualifications; list of minimum equipment; services offered; accessibility/location; credit facilities; satisfactory References; financial stability; repair/service costs; spare parts available; back-up services etc.

4.2.1.6 Basic spare parts in a workshop

The organization should decide to manage its vehicle maintenance in-house, certain fast moving spares are recommended for stocking. LGED may stock most frequently required good quality filter and servicing elements (eg air filters, fuel filters, lub oil filters, spark plugs, engine fans, head light bulbs, fuses etc.), through Pareto 80/20 rule or ABC analysis, to mobilise the periodic servicing at the central workshop at head quarter. This will reduce vehicle down-time. The number of vehicles owned by the organisation will determine the purchase of these parts and equipment.

4.2.1.7 Maintenance Documentation

The following maintenance related documents are essential for proper record keeping as well as effective maintenance:

Vehicle maintenance history or summary: whoever maintains the vehicles must make a detailed written servicing record report, listing the work done, parts and fluids used and costs incurred on each job. The maintenance personnel must keep this with the individual vehicle file.

Workshop job cards: when the written order is received, the workshop raises a workshop 'job card' for each vehicle entering for inspection, service or defect rectification. Work should not be carried out without a job card; each card should include the following information:

- details of all work required to be carried out;
- actual work carried out;
- name of staff and hours worked;

- details of spare parts and materials used; and
- space for the cost of the work.

Once all relevant information has been taken from the job cards they should then be filed with the vehicle files.

Vehicle Files and documentation: general vehicle correspondence files should be maintained for each vehicle. This file should contain the following documents to facilitate tracking of expenditure and maintenance:

- Driver application;
- Estimate approval;
- Purchase method approval;
- copies of purchase request;
- copy of local purchase order;
- invoice or challan;
- all important documentations (bill of lading, etc);
- copies of all repair bills;
- job order;
- accident report, if any; and
- bill payment records etc..

In LGED context, individual vehicle files are maintaining properly keeping the maintenance related documents in it through which previous maintenance activities are known. But vehicle maintenance history and workshop job cards have not yet maintained due to lack of manpower, the LGED concerned added.

4.2.2 Maintenance cost:

Table 3: Annual cost of Vehicle Periodic and Major maintenance:

Sl No	Vehicle Description	Quantity	Total Routine & Periodic Maintenance (Tk.)	Major Maintenance with 40% (Tk.)	Others Total (Tk.)	Total amount (Tk.)
1	*2*	*3*	*5*	*8*	*10*	*11*
1	Car	42	840,000.00	4,200,000.00	1,344,000.00	6,384,000.00
2	Jeep	241	6,748,000.00	43,380,000.00	14,942,000.00	65,070,000.00
3	Pick-Up	64	1,536,000.00	8,192,000.00	3,200,000.00	12,928,000.00
4	Microbus	13	338,000.00	1,820,000.00	585,000.00	2,743,000.00
	Total :	**360**	**9,462,000.00**	**57,592,000.00**	**20,071,000.00**	**87,125,000.00**
	% of Total Maintenance		**10.86 %**	**66.10 %**	**23.04 %**	**100 %**

From the above table-3, Total maintenance cost of LGED fleet at head quarter is 8.71 crore, of which periodic and routine maintenance is only 94.62 lakh (10.86 %) and major maintenance and others are together 7.75 crores (89.14%) that is, major maintenance cost is about 8 times greater than periodic maintenance cost. Average repair of maintenance cost per vehicle per year is about Tk. 2,42,000.00.

4.2.3 Transparency and accountability problems

Maintenance management of large fleet of vehicles in LGED is a great problem. Maintenance of some vehicles is performed on an urgent basis and before the approval of estimate, method of procurement and due executions. Similarly, the execution of some maintenance works is known to be performed even after couple of months. So it creates problem later during getting estimate approval, bill certification and payment and raises suspicion due to such delayed executions. Sometimes carelessness and whimsicality of concerned junior officers cause late to put up the files before the higher authority for approval.

Very few expert manpower for discharging this sensitive duty is also the cause of lack of transparency and accountability.

There is also the limitation for repair and maintenance of vehicles as per Delegation of Financial Power (DoFP) such as a departmental Head can approve maximum Tk 75,000 on repair of a vehicle per year, but for supply of spares the capacity is unlimited. So, maintenance people need to be careful so that repair cost per vehicle per year remains within the limit.

4.2.4 Sustainability Issues- the Economic and Environmental Issues

The transportation sector contributes to 28% of the national inventory for greenhouse gas emissions. When standard gasoline or diesel fuel is burned, carbon dioxide, a greenhouse gas, is emitted. Each gallon of gasoline and diesel buried creates between 20 and 22.5 Ibs of CO2. That's about 6 to 9 tons of CO2 each year for a typical vehicle.

There are simple low- and no-cost approaches that we can take in reducing the transportation sector's contribution to climate change. Many of these strategies can even save money. The fuel efficient vehicles and Alternative Fuels Smart Choice provides users with various tools and resources to help them smart choices about alternative fuel usage, fuel efficiency improvements, preventive maintenance practices, and green fleet procurement. These are described as follows:

- Green Fleets
- How to Choose
- Driving & Maintenance
- Fuel Selection
- Increase Efficiency
- Resources

4.2.4.1 Green vehicles

Green vehicles have high fuel economy, low greenhouse gas emissions, and low criteria pollution emissions. These pollutants cause smog and soot – include oxides of nitrogen, volatile organic compounds (VOCs), carbon monoxide, and particulate matter. Green vehicles can run on low-carbon fuels, such as grid-supplied electricity and sustainable biofuels. Examples include high efficiency hybrids, plug-in hybrids, battery electric vehicles, flex-fueled vehicles that actually run on sustainable biofuels, flex-fuel plug-in hybrids.

4.2.4.2 Driving and Maintenance Practices

EPA is responsible for providing fuel economy (gas mileage) data that is posted on the window stickers of new vehicles. These fuel economy estimates help consumers compare the fuel economy of different vehicles.

Gas mileage usually decreases rapidly at speeds above 60 mph. Each 5 mph you drive over 60 mph is similar to paying an additional $0.24 per gallon for gas. Observing the speed limit will save you $0.19 to $0.61 per gallon of gasoline.

Maintenance

According to the Federal Energy Management Program (FEMP), preventive maintenance is one of the most cost effective ways to reduce fuel use. FEMP notes that preventive maintenance programs:

- Increase cost effectiveness in many capital intensive processes and equipment
- Provide flexibility for the adjustment of maintenance periodicity
- Increase component life cycle
- Generate energy savings
- Reduce equipment and/or process failures
- Result in an estimated 12–18 percent cost savings over that found in a reactive maintenance program

Regular vehicle maintenance makes fleet vehicles more fuel-efficient and reduces emissions. Performing regular power-train maintenance including changing the air filter, changing lubricants with the recommended grade of oil, and keeping tires properly inflated can improve fuel efficiency by as much as 19%. Cumulatively, regular maintenance can create substantial fuel economy benefits with relatively small inputs.

Fleet fuel tracking programs can help ensure vehicles are properly maintained and retrofitted or replaced when needed. Fleet operators monitor a fleet's fuel economy by vehicle and class to determine when a vehicle is not running properly or if there is an emissions related problem. In addition, tracking the total annual fuel usage is a relatively easy way to show measurable improvements in overall fuel efficiency and cost savings over time.

Fuel-Efficient Driving Practices and Training

As the primary users of fleet vehicles and equipment, drivers and operators are critical to successfully reduce fuel consumption and greenhouse gas emissions. Education and training for drivers and operators on methods to help optimize fleet efficiencies is an important step. As demonstrated below, driving habits can greatly affect fuel consumption and efficiency.

Quick acceleration and heavy braking can reduce fuel economy by up to 33 percent on the highway and 5 percent around town. New EPA tests account for faster acceleration rates, but vigorous driving can still lower MPG.

Excessive idling decreases MPG. The EPA city test includes idling, but more idling will lower MPG.

Driving at higher speeds increases aerodynamic drag (wind resistance), reducing fuel economy. The new EPA tests account for aerodynamic drag up to highway speeds of 80 mph, but some drivers exceed this speed.

Cold weather and **frequent short trips** can reduce fuel economy, since the vehicle engine doesn't operate efficiently until it is warmed up. In colder weather, it takes longer for the engine to warm, and on short trips, the vehicle operates a smaller percentage of time at the desired temperature. Note: Letting your car idle to warm-up doesn't help your fuel economy, it actually uses more fuel and creates more pollution.

Cargo or cargo racks on top of your vehicle (e.g., cargo boxes, canoes, etc.) increase aerodynamic drag and lower fuel economy. MPG tests do not account for this type of cargo. **Towing** a trailer or carrying **excessive weight** decreases fuel economy. Vehicles are assumed to carry only three hundred pounds of passengers and cargo during testing.

Running electrical accessories (e.g., air conditioner) decreases fuel economy. Operating the air conditioner on "Max" can reduce MPG by roughly 5-25% compared to not using it.

Driving on hilly or mountainous terrain or on unpaved roads can reduce fuel economy. The EPA test assumes vehicles operate on flat ground.

Using 4-wheel drive reduces fuel economy. Four-wheel drive vehicles are tested in 2-wheel drive. Engaging all four wheels makes the engine work harder and increases crankcase losses.

4.2.4.3 Fuel Selection:

Alternative fuels are derived from resources other than petroleum. Some are produced domestically, reducing our dependence on imported oil, and some are derived from renewable sources. Often, they produce less pollution than gasoline or diesel.

Consumers have more choices now than ever before when it comes to clean and efficient vehicles. Although gasoline still dominates, new hybrid technologies, alternative fuel vehicles and advanced emission control systems allow the cars we drive today to be significantly cleaner. Even among the cleanest technologies, however, environmental impact, fuel efficiency, cost, benefits and availability can really vary.

Among the alternative fuels, some are Hybrid Electric, CNG, Ethanol, Diesel, Plug-In Hybrid, Fuel Cell, ICE, Propane, Biodiesel etc

Hybrid Electric: Hybrid electric vehicles commercially available today combine an internal combustion engine with a battery and electric motor.

Compressed Natural Gas (CNG): Natural gas can be used in all classes of vehicles -jeeps, pick-up, cars, motorcycles, even trucks and staff buses. Natural gas can be used either by converting an existing gasoline or diesel engine, or by using a purpose built natural gas engine. Natural Gas reduces 60-90% smog-producing pollutants, and lowers 30-40% greenhouse gas emissions.

Ethanol (E85): Ethanol is mostly used in flexible fuel vehicles, which are capable of operating on gasoline, E85 (85% ethanol, 15% gasoline), or a mixture of both.
Flex Vehicles operating on E85 usually experience a 20-30% drop in miles per gallon due to ethanol's lower energy content.

Diesel: Diesel vehicles may be making a comeback. Diesel engines are more powerful and fuel-efficient than similar-sized gasoline engines (about 30-35% more fuel efficient). Plus, today's diesel vehicles are much improved over diesels of the past. Diesel vehicles are 30-35% more fuel efficient than gasoline. Ultra Low Sulfur Diesel is a cleaner-burning diesel fuel that contains 97% less sulfur than low-sulfur diesel (LSD).

Plug-In Hybrid: Plug-in hybrid electric vehicles (PHEVs) combine the benefits of pure electric vehicles and hybrid electric vehicles. Like electric vehicles, they plug into the electric grid and can be powered by the stored electricity alone. Like hybrid electric vehicles, they have engines that enable greater driving range and battery recharging.

Hydrogen Fuel Cell: Hydrogen fuel cell vehicles are zero emission and run on compressed hydrogen fed into a fuel cell "stack" that produces electricity to power the vehicle. Hydrogen produces no air pollutants or greenhouse gases when used in fuel cells.

Hydrogen Internal Combustion Engine (ICE): A hydrogen internal combustion engine (ICE) vehicle uses a traditional ICE that has been modified to use hydrogen fuel. The U.S. Department of Energy's FreedomCAR and Vehicle Technologies Program have identified hydrogen-powered ICE vehicles as an important mid-term technology on the path to the hydrogen economy.

Propane: Propane, also known as liquefied petroleum gas (LPG), is used by many fleets. It has a high energy density, giving propane vehicles good driving range, and propane fueling infrastructure is widespread.

Biodiesel: Biofuels are those made from feedstocks that have taken their carbon content from the atmosphere relatively recently (i.e., in the last few decades). By contrast, fossil fuels are made from carbon fixed from the biosphere millions of years ago. This difference has implications for the global-warming potential of the fuel, as the carbon emitted by biofuels is recycled from the atmosphere while fossil fuels dump excess carbon into the atmosphere. Biodiesel should be domestically produced from non-petroluem, renewable resources.

In LGED context, there are mostly diesel operated vehicles, and a few are octane or CNG (compressed natural gas) operated vehicles. There is no hybrid electric or other alternative fuel operated vehicles in this department.

4.2.4.4 Increase Efficiency and Reduce Vehicle Miles Traveled

Employ a 'right vehicle, right job' approach to fleet management. One fuel saving strategy is to match each employee's job to the smallest possible vehicle for that job. For example, if a sport utility vehicle (SUV) is necessary for a particular job, a midsize SUV that gets 24 miles per gallon might be more appropriate choice than a full size SUV which runs at

15 miles per gallon. Similarly, for the ride of 2-3 persons, the use or allocation of a micro bus of 15 seated, 3000 cc may not be feasible in context of fuel economy. For example, for field visit by two persons and off riding conditions, a double cabin pick-up would be more comfortable and fuel-efficient than a 15 seated micro bus. So, vehicles may be selected according to purpose and occupants.

Upgrade vehicles for fuel efficiency (e.g. fuel efficient tires, and improving aerodynamics)- it is possible to upgrade fleet vehicles to make them more efficient in a number of ways: purchase tires with low rolling resistance, etc.

Establish fuel-efficient vehicle purchasing requirements*:* LGED's technical specification committee of Goods may specify the fuel efficient vehicle requirement of having more power and torque at lower displacement of engines (eg lower CC/hp ratio[2]) during purchasing vehicles. Moreover, public organizations can require, or set targets for, the purchase of high-efficiency vehicles through ordinances, city fleet purchasing requirements, or incentives. Fuel-efficient and hybrid vehicles can reduce city or municipal fleet fuel consumption, saving money and reducing GHG emissions.

Eliminate unnecessary idling: While in traffic congestion, it is not logical to run the engine at idle speed. Because idling contributes to GHG and air pollutant emissions and significantly reduces fleet efficiency. An engine consumes up to one gallon per hour when the car is idling. Thus running of air-conditioning at idling speed also adds a significant amount of costing. Government can support idle reduction by helping to finance or otherwise encourage the development of infrastructure that eliminates or greatly reduces vehicles' need to idle, especially in high congestion areas. Local governments or agencies can establish driver education programs that offer courses on idle reduction techniques. Some programs, aimed at transit drivers, teach techniques to reduce idling time and to plan more efficient routes.

Fuel Consumption and Vehicle Use Tracking: Collecting and reporting fuel and vehicle/equipment use data is key to understanding fleet efficiency. The right data management system for each fleet depends primarily on fleet size, annual miles traveled and resources available to each fleet. For small fleets, an electronic spreadsheet may suffice as a data management system. For larger fleets, dedicated software and telemetry systems may be more appropriate for optimal efficiency. Many fleet managers find that data management systems are also integral to properly maintaining vehicles, providing satisfactory customer service, and meeting organizational and departmental goals. Systematically tracking vehicle

[2] CC = Cubic centimeters and HP= Horse power

information makes it easier for busy managers to ensure their vehicles are both safe and efficient.

4.2.5 More Sustainability issues- the Social and ethical issues

There are other social and ethical sensitive matters which need to be considered not only for the sustainability of the vehicle operations and management systems but also building the image and reputation of the organization.

4.2.5.1 Vehicle usage

This aspect of vehicle management is very sensitive and also the most abused. It is therefore necessary to have a clearly defined policy regarding vehicle usage and staff benefits. Understandably, like LGED, most organisations do not have the capacity to assign an expert driver for each vehicle that they own. Under these circumstances, staff may be authorised to self-drive, after testing. On the other hand, the driver should not be engaged more than eight hours which also demands overtime payment and in absence of overtime payment, it sounds as unethical. The vehicles would in most cases be pooled and rotated based on needs and availability when it is purchased or obtained in the case of transferring officials. For practical reasons, light vehicles are utilised for office operations and within urban settings and heavy vehicles for field based operations.

4.2.5.2 Vehicle disposal

Running old vehicles may lead to high costs of maintenance and uneconomical fuel consumption. To avoid this, organisations should have approved and clearly stipulated policies and procedures on how and when to replace and dispose of vehicles/assets. The need to dispose may arise due to any of the following reasons:

- as a result of extensive unrepairable damage, or cost-prohibitive repairs;
- when the vehicle attains the stipulated mileage or years for disposal;
- when the vehicle is no longer economically sustainable;
- when the model is obsolete and spare parts are not available;
- when the vehicle is no-longer required; and
- when programs downscale or shut down.

4.2.5.3 Health, Safety & Security

Vehicle safety is one of the key roles of the Operations and maintenance personnel. It leads to staff safety and enhances road safety. WHO estimates 1.2 million people died and 50 million were injured in road crashes in 2013. The key to successful observance of health and safety is the development of an organisational culture of awareness of, and compliance with health and safety issues. To ensure that this is possible the Health & Safety policy document must be practical and be incorporated within day to day tasks.

There are five areas specific to transport management where local health and safety procedures will probably need to be agreed and documented by the fleet technical staff:

1. Fuel stores, if any
2. Safe operation of vehicles, as per BRTA driving rules and obligations;
3. Accident and incident procedures for vehicles;
4. Vehicle workshops
5. Security of vehicle assets

4.2.5.4 Drivers' skill

As part of fleet management it is necessary to divide drivers into categories based on skills and competence. Constant evaluation of their skills, regular training and refresher courses will improve driver and vehicle performance, reduce number of accidents and reduce maintenance costs. Each organization has the responsibility of identifying relevant training and courses available. These could be included in organizational capacity building programs for drivers.

4.2.5.5 Ethical issues

TIB Complains and others: The Transparency International of Bangladesh (TIB) studied on LGED in 2012 and reported that LGED vehicles are not using properly as per guideline of Government Vehicle Usage Rules-1982. All junior Engineers and even accountant officers at HQ use vehicles for going to office and back, though they are not entitled to use vehicles. Vehicles are uses all time for personal purposes from Executive Engineers to Superintendent Engineers. Vehicles are frequently used outside of Dhaka for personal purposes. Moreover, a large number of LGED vehicles used illegally by Ministry officials and Payment of driver's

overtime from office also incur a lot of public funds. In addition to that the project vehicles are not handed over to the Government Transport pool after the completion of the projects.

Regarding maintenance of vehicles, it is also reported that vehicles are sent to workshop without any problem. Money is pocketed through fake bill. Spare parts purchased from same shops etc.

Similar complaints are raised by anti-corruption commission investigations, external auditors etc. The complaints of these kinds destroy the so-called earned reputations through a long span of time of the organization in a moment. Thus 'Reputation is hardly earned but easily lost'.

Mechanical Engineer Manpower setup: According to the Procedures for Repair of Government Motor Vehicles of Transport Section, Ministry of Establishment, it is stated that any vehicle requiring more than Tk. 5000 (five thousand) shall be to be a major one. All Government Department's shall maintain History and Log Books in respect of each vehicle in the existing forms. While sending any vehicles to the Government Motor Workshops or to the Maintenance Inspector-cum-Inspector of Vehicles the History Books must accompany the vehicle and be produced for inspection or demand with the log book. Any vehicle requiring less than Tk.500 (five hundred) for any one repair may be exempted from the above procedure provided that not more than two such repair may be allowed to any vehicle in any one month and further provided that such total expenditure should not exceed Tk. 6000 in a year.

Offices having their workshops and having at least an Assistant Engineer (Mech./ Automobile) to look after the workshop may be exempted from the above procedures when such vehicles are required to be repaired by them. But they must maintain History Books and Log books as usual. Thus, for LGED, no need to send their vehicles to the Government Motor Workshops or to the Maintenance Inspector-cum-Inspector of Vehicles for repairing and maintenance works whatever the estimate is. Because LGED has the mechanical engineer set-up at both HQ and district levels.

But there is gross dissatisfaction among the incumbent mechanical engineers who are responsible in operations and maintenance of LGED vehicles and equipment due to no ladder of promotion to higher positions in existing setup[3], though their tenures are running

[3] Existing Mechanical setup: 1 XEN, 23 AEM, 66 MF only.

successfully on an average more than 19 years. Unlikely to other engineering department such as Roads and Highway department (RHD), City Corporations, Public Works Department (PWD), they have the positions up to Additional Chief Engineer (Mechanical) and Superintending Engineer (Mechanical) accordingly. But in LGED, there is no upper position except Executive Engineer (Mechanical). As a result, the civil engineers who are so junior to mechanical engineers are becoming their boss and creating an imbalance and image problem in service and social life. So it is the time to take initiative by the concerned authority to create upper position for the existing senior mechanical engineers in LGED.

4.3 SWOT Analysis of LGED on O&M of vehicles

SWOT (strengths, weaknesses, opportunities, threats) analysis is a technique of corporate appraisal, used to assess the internal resources of an organization (or procurement function or supply chain) to cope with and/ or capitalize on factors in the external environment in which it operates.

SWOT analysis of LGED organization on the specific field of operations and maintenance of large fleet of vehicles is done here. Internal appraisal of strengths and weaknesses cover aspects such as: the availability of physical and financial resources; human resources; the efficiency and effectiveness of functions, operations and systems, organizational structures; distinctive competencies etc. Opportunities and threats are factors in the external environment that may emerge to impact on the business. The SWOT analysis on the issue of O&M of vehicles under LGED organization are shown below in Table-4:

Table 4: SWOT analysis of LGED organization on O&M of vehicles

Internal	**Strength** • Own set up of Mechanical Engineers, no need to seek favour from BRTA, Govt. Transport pool etc. • Workshop facility at Head Quarter • Sufficient Quantities of Vehicles • Top management support on O&M of vehicles • Allocation of Revenue funds in budget • Availability of projects funds	**Weakness** • Less GOB fund allocation, repairing mostly dependent on project fund • Less manpower in O&M with respect to large fleet of vehicles • Workshop facility not sufficient • Mostly Old (or aged) vehicles-replacement or condemnation problem • Lack of ICT use,
External	**Opportunity** • Ministry supports • Goodwill of LGED • A large number of new projects are in pipeline and some are donor assisted • Opportunity to purchase new vehicles • After sales services are available.	**Threats** • High costs of fuel and spare parts, • Environmental effect: eg Greenhouse gas emissions etc • Social and Ethical issues eg ACC, TIB, Audit objections, cost of accident, reputational risks etc • Compliance with vehicles rules and guide lines of government • Media Coverage

CHAPTER-V:
CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion:

The large vehicle fleet management in LGED is expensive. Vehicles are valuable assets and critical for business continuity. They therefore require adequate attention.

LGED vehicles, all need regular servicing otherwise their performance deteriorate and consume more energy resources. Typically vehicle efficiency will reduce by 2% if tires are under-inflated. Inefficiency will increase to 4% if the front wheel tracking slightly out of alignment. Add to this the potential of a further 10-20 % loss due to a sticking automatic choke, poor carburetor settings, or blocked air filter. Maintenance is therefore considered a worthwhile activity as each decrease in efficiency of 1% is the same as paying more money for every gallon of fuel used. The need for maintenance is clearly indicated by manufacturer's recommended mileage intervals and maintenance of each vehicle should be performed as per guide line of the vehicles manufacturer.

Regular vehicle maintenance makes fleet vehicles more fuel-efficient and reduces emissions. Purchasing energy efficient vehicle-energy efficiency isn't just part of effective maintenance. It is also part of an effective purchasing policy. Engineers should not just consider the cost of the equipment and its basic payback. They should also consider the running cost and/ or whole life cost.

Every vehicle has a life cycle. When the fleet vehicles are new they are at the beginning of the cycle. As they are used over time, the various vehicles in the fleet will need repairs and will wear down. At a certain point, the vehicles go past their usefulness and cost more to maintain than not. This is when authority will take action to sell or condemn the old vehicles and replace them with new ones. Usually every vehicle is given a life cycle estimate; for example, minimum eight (8) years for jeeps and cars. The operations and maintenance personnel have to track each vehicle, find a way to keep a viable vehicle fleet with each vehicle's cycle.

Fleet maintenance also involves keeping track of each vehicle's maintenance schedule. It is a well-known fact that regular oil and filter changes can preserve a vehicle much longer. Maintenance personnel who monitor their organisation vehicles for preventative maintenance

needs can save thousands of dollars in avoiding unnecessary repairs. So it's a major cost control to have a fleet manager chasing down oil and filter, tire, and hose and belt changes as they are needed.

The vehicle fleet operations and maintenance personnel have to keep track and update a working database of where each vehicle is, its current registration and licensing, and which employee it is assigned to and which driver is operating it etc. The operations and maintenance personnel should keep records of who is using which vehicle and when. This is perhaps the most basic part of vehicle management. They need to know which driver has what vehicle, and during which times. So they need to create a log for the drivers to sign that includes driver name, the date, the vehicle number, the time taken and the time returned. They should keep records of vehicle condition and mileage. They should make sure that regular maintenance is done on the vehicles according to the mileage and if it isn't done in-house, keep regular appointments with an auto shop to keep the fleet tuned and repaired. They should store all of the records both physically and digitally. If the records are transfered over to computer then they're easy to look up, but the physical copy should also be stored just in case it is needed to verify what the computer tells us. The right policies combined with the right technology can make managing a vehicle fleet much easier on the public sector's time and budget.

To Manage a Vehicle Fleet it is needed to take steps in order to keep that fleet fully functioning. GPS tracking devices can be put on the fleet vehicles. This isn't necessary, but it is helpful, especially if the fleet vehicles go very far afield such as out of Dhaka etc. GPS tracking devices will show where the vehicles are at what time and it can eliminate the need for a driver to call in and check with the base. It will also eliminate unnecessary driving because driving patterns can be checked. Lastly, GPS tracking devices are very useful in case a fleet vehicle gets stolen.

Vehicles should be parked out and garaged in stipulated time. All government vehicles should be parked at office campus to ease the monitoring and operations activities. Residential parking should be restricted because the vehicle may be misused or sometimes privately used and the vehicle usage may not be controlled properly. LGED has a great scarcity of parking space so it may consider to construct the multi-storied parking.

5.2 Recommendation:

Fuel economy: Driver is the first defense for fuel economy. Because fuel economy mostly depends on the efficient and inefficient driving, driving habits of drivers etc. Moreover, fuel cost can be reduced through regular periodic maintenance, introducing vehicle tracking system and driver monitoring, control vehicle mileage etc. Mileage isn't a fixed cost – it's a controllable cost that, across a large fleet, can have significant effect on overall cost. During purchase of vehicles, engineers may consider fuel efficient vehicles, selection of vehicles considering whole life costs instead of only vehicle purchasing price. And with fuel contributing between 20% and 30% of a vehicle's whole life costs, there are big savings to be made by tightly controlling fuel budgets. For buying fuel within a limit, purchase card can be introduced to each driver to control the monthly fuel bill. Green fleets with use of alternative fuel such as Hybrid Electric, CNG etc. can ensure fuel efficiency and less emission greenhouse gases which also lead to sustainability in the operations and maintenance of large vehicle fleets.

Vehicle policy: There should be a vehicle policy to provide guidelines for the management and use of vehicles and other mobile assets. Policies are designed to facilitate and encourage accountability, monitoring of usage and costs, provide internal control and to serve as a management tool for better decision. In LGED, there is no better policy for the allocation, operations, management and maintenance of vehicles. The policy would have also planning, approval and budget process, procurement, approved types for vehicles, ordering of vehicles process, assignment of vehicles, personal use of vehicles by staff, management of vehicles: control of fuel, maintenance/repairs of vehicles, vehicle insurance scheme, vehicle replacement, condemn or sale of old vehicles; guidelines for drivers: assignment of Motorcycles, security, environment, reports etc.

Maintenance: On-time maintenance of fleet vehicles and payment to the workshops or suppliers helps to lessen the cost. Routine or periodic maintenance should be done properly to reduce major repairing cost, fuel cost, accidental loss etc. and increase health & safety, vehicle life etc. In LGED, periodic maintenance cost is 10.86% of total maintenance cost and major repairing and overhauling cost is about 89.14 %. On the other hand, fuel cost is greater than maintenance cost for LGED vehicle fleet. Cumulatively, regular maintenance can create substantial fuel economy benefits with relatively small inputs. The overall maintenance cost will reduce if routine and periodic maintenance is performed in due time. A yearly inspection and maintenance plan showing schedule dates of maintenance, fitness, tax token renewal,

annual inspection dates etc. may be drawn by the maintenance people for each vehicle and strict inspection and maintenance schedules should be followed to check the vehicles health.

On the other hand, outsourcing maintenance from external workshops should be reduced to slash down costs. Because it not only adds a lot of price for workshop service charges and profit margin, but also delayed in total delivery and lacks in customer satisfaction.

Regular vehicle inspection reports: Keeping track of vehicle condition helps for two reasons: it gives a strong audit trail which helps protect the organisation in the case of disputes and also helps flag up potential issues before they turn into bigger problems. Involving employees in the process also helps them understand the responsibilities maintenance personnel have towards maintenance of the fleet and it can be reiterated their own responsibilities as they run through the process. If employees are unsure, they should be provided with training so they are confident in basic maintenance. Each vehicle should have a log book and a service record for keeping record of movement, fuel used, servicing etc. Moreover, there should be workshop Job card and maintenance history for any kind of repairing works and parts changed during the repairing and maintenance of vehicles.

Safety and accident: Drivers should be instructed to drive their vehicles according to the traffic rules and road harmony in full concentration to avoid any kind of accident. Public sector should keep control of the costs and improve the safety of the vehicle fleet by reducing internal and external risks. Driver habits and policies can have a large impact on both expenses as well as safety of the drivers. Frequent pressing on brake and clutch, over speeding etc are some of the causes of high fuel consumption and engine overheating. No mobile phone call or talking while driving vehicle would be allowed and the driver as well as front seated passenger must fasten their seat belts especially in long drive.

Procurement and Stocking: Public sectors always need transparency to spend the public fund whatever the amount is. In this sense, total involvement of stakeholders or Total Productive Maintenance (TPM), stakeholder buy-in etc. are very important in context of public procurement of vehicles as well as procurement of spare parts. LGED authority may think economy of scale in the procurement of spare parts through ‘buying consortia’ or collective buying centrally instead of purchasing individually from different projects. A framework contract for 2 to 3 years with qualified suppliers of spare parts may be done to get delivery of spare parts of vehicles, as and when required, for repairing and maintenance works of the organization. E-procurement may be also introduced in case of the quality purchasing of vehicles as well as spare parts for maintenance of the same.

A few spare parts inventory may be maintained in LGED on the basis of importance and frequent needs for enhance the maintenance activities. ABC analysis or Pareto analysis can be applied for the selection of most importance spare parts for the organization vehicles. Generally, spare parts for periodic maintenance such as filter elements, etc. could be of great value. Other parts needed for maintenance can be stocked in vendors managed inventory (VMI) to reduce stock holding costs.

Centralize vehicle management software. At present, LGED has no effective database or software for the management of the vehicles as well as equipment. There is no unique software, LGED personnel are now using MS-access, MS-excel or even MS-word to keep records of the operations and maintenance of their vehicle fleet. The previous old version of Equipment Management Software (EMS) cannot be operated now due to non-compatibility with the computer software. The fleet management software market is mature now and there are advanced solutions on the market that sit as a centralised point of contact for all other important data flows. Cloud-based centralised management software, are ramping up the savings available as well as providing a lower point-of-entry. LGED authority is trying to introduce the web based vehicle management software so that information can be entered from several individual points or stations and the same can be managed centrally. It may make the information most accurate and authentic. Also, more and more fleet management software is delivered as a service via the cloud, making cost of entry much lower. Through the advancement of ICT, ERP may be introduced in LGED , a pioneer organization, instead of running so many individual software such as PMIS, financial management, asset management, vehicle management software etc. The use of ICT is far lagging in operations and maintenance personnel. Thus the use of ICT may bring positive results in management, operations, maintenance and control of large fleet of vehicles.

Integrate a GPS tracking system. It's essential to know the location of vehicles at all times for effective fleet management, and this means installing a GPS tracking system would be a great help not only for vehicle monitoring but also for the effective operations of large fleets of vehicles. It may help the operations and maintenance personnel to eliminate the fraudulent claims of drivers as well as work as a safety tool for the authority in case of theft of vehicles.

It should be noted that fleet management depends on accurate and organized data so make sure that the information you receive from the GPS tracking system is centralized and analyzed so that it provides a real use.

Trending. Companies should track both the distance covered in vehicles and also the fuel used – these two metrics can build up a more accurate picture than just one alone. By analysing this data, efficient and inefficient driving can be identified and training provided to maximise ROI from fuel. Accurately-recorded mileage is also important to protect against fraudulent claims and misuse of POL than expectations. It is also a good practice to incentivise and reward drivers for positive behaviours to encourage them to treat vehicles with respect. These could be linked to metrics established at end-of-contract e.g. state of vehicle, state of engine etc.

Choose the most suitable vehicle for the task. Vehicle fleet includes a variety of vehicles of different sizes and they are therefore probably all best suited to slightly different tasks. It is important to use the more appropriate vehicle for each and every job to have effective use of vehicle and fuel economy.

Go green and cut costs. As we all know being as green as possible is a good idea for the sake of the environment but by reducing your fuel emissions and energy waste you will also find that you reduce your expenditures. Fleet management can help you save on fuel by cutting idling times, reducing speeding, and reducing harsh braking.

It is essential to cut greenhouse gas emission to save the world from catastrophe. So, ensure that vehicles fall below the emission of 130g/km. Air pollution from transportation systems in urban areas mainly occurs due to smoke emission from automobiles, burning of fossil fuel, use of low lead gasoline, high sulfur in diesel, increasing number of two stroke engine and overall poor traffic management.
Immediate effect of smoke inhalation causes headache, vertigo, burning sensation of the eyes, sneezing, nausea, tiredness, cough etc. It's long term effect may cause asthma and bronchitis. Lead affects the circulatory, nervous and reproductive systems as well as affects kidney and liver including liver cancer or cirrhosis. Carbon monoxide hampers the growth and mental development of an expected baby. Nitrogen oxides cause bronchitis and pneumonia.

Similarly, the noise pollution is a major health hazards in the country. Noise pollution causes mental and physical illness among the people. Sound pollution causes deafness to heart attack. Any sort of noise pollution seriously affects expecting mothers. It also causes high blood pressure, tachycardia, headache, indigestion, and peptic ulcer.

It is a serious but neglected issue throughout Bangladesh. Government as well as other organizations must take adequate steps to reduce the environmental pollution of Bangladesh.

Be compliant to all regulations. When it comes to fleet management there are various regulations and compliance that need to be adhered to at all times. Effective data keeping on the part of both the driver and those analyzing, should help to ensure that all regulations are being respected. Rules for use of Govt. transport-1982, Public Procurement Act (PPA)-2006 & Public Procurement Rules- 2008 (PPR-2008)-, Motor vehicles Ordinance, Traffic Rules, Environmental Rules and Regulations, contemporary circular etc. are some of them.