

Minimizing Fuel Expenses In Fleet Management By Using Theory of Constraints

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1.0 INTRODUCTION:

The profit directly relates with fuel consumption after investment of the initial amount. The fuel consumption plays the major role in fleet management. There are different types of humans in handling the vehicles. Due to the difference in drivers, there is change in fuel economy. Beyond that the maintenance also plays the role. By maintaining the vehicle properly, there is an improvement in fuel economy. Less amount of fuel consumption increases the profit of transport management.

1.1 FLEET MANAGEMENT:

Fleet Management involves maintaining workshops, trip management, managing fuel filling stations and labour management. Providing efficient leaders and cost effective fleet management services are the key factors determining the efficiency of fleet management. This can be achieved through a visionary leadership team that is committed to the perpetual pursuit of excellence. The best way to predict the future is to create it. Strategic planning, benchmarking, and goal achievement can determine the destiny of the Fleet Management Division. Specific goals and objectives with time lines, can be utilized to maintain the highest standards of excellence in fleet management and administration. Vehicle acquisition and disposal, assignments and utilization, repair and replacement, commodity and service bids, and fueling of the fleet, also need to be satisfied.

1.2 THE TOC CONCEPT:

The concept of the TOC is,

- Every system must have at least one constraint. If it were not true, then a real system such as a profit making organization would make unlimited profit. A constraint therefore, “is any thing that limits a system from achieving higher performance versus its goal” (Goldratt, 1988, p.453).
- The existence of constraints represents opportunities for improvement. Contrary to conventional thinking, constraints should be viewed as positive, not negative. Because constraints determine the performance of a system, a gradual elevation of the system’s constraints will improve its performance.

1.2.1 USES OF THEORY OF CONSTRAINTS:

Some of the relevant uses of the TOC are listed below:

- Improved quality of products and services
- Drastic increase in profitability
- Management of statistical fluctuations
- Improved competitive position.

TOC has evolved into a philosophy that can be extended towards service industries in different facets. TOC provides a good way among constraints based approach. TOC also helps in determining whether the resources are fully deployed to have the most impact on the overall performance of the company.

2.0 OBJECTIVE OF THIS PAPER:

Use of the TOC concept in Automobile business for its continuous development and trails to break the constraints instead of governing it is our innovative objective. Thus, this research is designed to achieve the following objectives:

- To coin a method of connection between Fleet Management , Fuel Consumption and profits;
- Develop desirable qualities of Drivers;
- Develop professionalism in handling difficult operation and vehicle conditions;
- Understand the benefits of fuel economy; and
- Understand and apply management tools in profit limiting system.

2.1 ASSUMPTIONS FOR TOC IN BUSINESS

The assumptions that are used to develop TOC in implementation of fuel economy in transport department are

1. The goal of the transport department is to make profit in all aspects.
2. Throughout fuel quantity variable is used as a way to measure improvements.

2.2 PROBLEM DEFINITION:

“Integrate the use of the theory of constraints to evolve fuel economy approach for continuous development and profit in the transport department”.

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2.3 PROBLEM ENVIRONMENT:

Our management has 23 buses, 1 minibus and 7 LMVs. To maintain those vehicles, we have 2 mechanics and 1 maintenance supervisor beyond the vision of transport officer. There is an accountant to manage the accounts.

The strategy adopted for the function of the transport department towards positive motivation approach and observation in initial records shows us the difference in fuel economic performance of the same class of vehicles. It needs to fill the gap in improvement side when compared with efficient operating vehicle.

TOC is one of the continuous improvement tool applied in many areas. It can be extended to profit maximization in service industries. Study on fuel economy and its issues in automobile service industries and their continuous improvement possibilities are discussed in the following sections.

3.0 SOLUTION METHODOLOGY

In complex environments, each system is facing a number of critical problems for holding their operation in the growing trend. In order to face the problems, the transport department has to make a number of attempts and approaches to reach their goal. Fleet management consumes money for fuel, maintenance and labour. Out of these, fuel plays the major role in sizing the total expenditure of fleet management. Hence we consider fuel economy for reducing the total cost of fleet management. Maintenance also plays a role in determining the fuel economy. So that we consider fuel economy integrated with maintenance for evolving the goal. Theory of Constraints is taken as a tool to break the constraints available to bring out maximum profit from better fuel consumption.

TOC will continue to be a tremendous tool for profit improvement regardless of the nature of the problem. Although priorities and success factors may change, the industry can utilize TOC as an effective framework for identifying, prioritizing and solving issues that constrain the profit of the transport department.

3.1 THE FOCUSING PROCESS USING TOC

The working principle of TOC provides a focus for a continuous improvement process. The principle consists of five focusing steps (Goldratt, 1990) [4], which are summarized below within the defined problem area.

Step 1: Identify the system's constraints:

Constraints under consideration:

Some of the constraints evaluated from the transport department are:-

- | | | | |
|------------------------------|--------------------------|----------------------|-----------------------------------|
| o Unskilled driving | o Maintenance of vehicle | o Record maintenance | o Road type |
| o Improper loading[GCV] | o Condition of vehicle | o Traffic situations | o Improper reporting |
| o Frequent change of drivers | o Rolling friction | o Fuel quality | o Drive line friction |
| o Air resistance | o Auxiliaries | o Idle timing | o Weather |
| | | | o Improper time management[speed] |

Maintenance:

Maintenance can be subdivided into two:

- Lubrication
- Cleaning, inspection and adjustment

Lubrication:

In an automobile, different parts need different types of lubricants for their state of operation. The parts moving from normal speed to high speed need lubricating oil. Such parts are engine bearing, cams and gears. Some of the slow moving parts need heavier lubricant or grease. Such parts are joints, pivot pins, spring shackles etc.

- Check the engine oil level daily morning, add oil up to maximum mark on dip stick if the level is low.
- Replace the engine oil for every 15000 kms.
- Use the grade of fuel as per manufacturer's recommendation.
- Replace the gear oil and crown oil for every 24,000 kms.
- Lubricate the free wheel of starter with some special grease and plunger with some thin oil.
- Lubricate the wheel and steering system properly.

Cleaning:

- Clean the FIP regularly.
- Clean the exhaust line (manifold, exhaust pipe, catalytic converter, and blower).
- Clean the engine cylinder, piston & piston rings.
- Clean the sump regularly.
- Clean the fuel filters with kerosene for every 5000 kms.
- Clean the injector nozzle regularly.
- Clean the air filter with heavy blow of air.

Inspection:

Maintenance schedule differs from vehicle to vehicle. Hence the maintenance is done periodically or on basis of mileage. Periodical maintenance is split up into different periods such as weekly, monthly, yearly etc.

Daily inspection:

- | | | | |
|--------------------------|---|--|---------------------|
| o Check engine oil level | o Check water level in radiator | o Check fan belt tension | o Check air cleaner |
| o Check tyre pressure | o Check brake pedal toe-board clearance | o Check clutch pedal toe-board clearance | |

Driving mode:

Each person drives the vehicle in a different manner. Some adopt rash driving just for style but it increases consumption of fuel. Some drive the vehicle with average speed and during sudden changes in acceleration, its very effective.

Fuel efficient driving:

Fuel-efficient driving is a manner of driving intended to reduce the fuel consumption of an automobile. Apart from driving technique, the other factors contributing include technical aspects of the car, road conditions, and fuel quality. Though in some cases these may be outside the driver's control, any attempt to conserve fuel may prove rewarding to him or her, for reasons of personal, financial, or global concern.

One method of improving fuel efficiency is by driving at constant, conservative speeds. This allows the engine to operate powerfully without being hindered by the aerodynamic drag associated with high speed.

Road condition:

- o More obstacle
- o Speed brakes
- o Traffic jam & signals
- o Curves or bends in road

Improper loading:

- o Load the vehicle to their capacity
- o Load the stock equally in the cabin

Controlling of fuel consumption:

Tuning: Always keep the vehicle properly tuned up to get maximum mileage.

Brake binding: Brake drag not only puts extra load on engine resulting in high fuel consumption but can be a reason for accidents, due to poor brakes.

Clutch: If the acceleration is poor when the accelerator pedal is pressed, one of the reasons could be the slipping of the clutch. Slipping of the clutch will waste a lot of fuel.

Clogging of air cleaner: The air cleaner is clogged with dust. There will be restriction in flow of fresh air and then fuel consumption will increase.

Tyres: Running a vehicle with low air pressure causes load and drag on drive mechanism resulting in high fuel consumption.

Exploit the system constraints:

These constraints are evaluated and ranked based on driver survey. The survey rating was made for the following constraints. The survey was made at different level and handling of drivers. The results of the ranking is

Rank for constraints identification:

Sub-ordinate all other processes to the above decision:

The maintenance and its related impacts show us the top priority among other constraints and all other constraints are sub-ordinate to it and need negligible consideration. For first attempt we consider maintenance and in second attempt driving mode is the constraint. To elevate the constraints one and two, we use two attempts and these are discussed in following sections.

Step 4: Elevate the system's constraints:

In this step, the identified constraint is analyzed in detail, which involves study and survey of the maintenance procedure towards fuel efficiency and decides the type of service required. The possible ways of improvement and its route cause can be worked out by exploring this constraint to find the better solution from them.

The feasible way is to study the real needs in maintaining a vehicle by considering the study samples of K.L.N.C.E transport buses. Analysis tools, like fishbone diagram, can represent the limiting factors of this analysis.

Fuel consumption deciding parameters:

Mainly two parameters affect the fuel consumption:

- How the vehicle has been driven
- How the vehicle has been maintained

Step5: Continuously improve the quality and avoid managerial inertia

Some of the effective strategies for improving the fuel economy by maintenance are discussed as under;

Maintenance can be arranged in various ways:

- Written contract with commercial mechanics.
- Development of an in-house maintenance program.
- A combination of any of the above.

Several factors should be evaluated in deciding on a maintenance arrangement:

- Extent to which the transit system wants to maintain control over maintenance.
- Interest in using an employee as a mechanic to maintain control.
- Effectiveness of communication if service is provided in-house versus privately.
- Cost to the system.
- Availability of the proper facilities.
- Ability to recycle or dispose of oil/fluids.
- Availability of equipment to lift vehicles.
- Availability of a complete set of tools.

Suggestions for initiating a maintenance program are:

- Obtain a list of authorized maintenance facilities from vehicle vendor(s).

Rank for constraints identification:

Sl.no	Constraint	Rank
1.	Driving habit	2
2.	Maintenance	1
3.	Road type	3
4.	Higher load	5
5.	Speed	4

- Work with the transit system's transit project manager.
- Talk with transit systems that have established maintenance programs.
- Make use of maintenance software.
- Take advantage of training offered by professional transit organizations, vendors, manufacturers, etc.

Maintaining a good scheduled maintenance program

Scheduled maintenance is performed at predetermined inspection intervals. The intervals are usually determined by accumulated mileage, time or condition of specific parts. Scheduled maintenance helps keep public transit vehicles on the road.

An organized program of inspections, scheduled service, and immediate adjustments or repairs increase vehicle safety, vehicle useful life and minimizes mechanical failures.

Perform Daily Vehicle Inspection

Daily inspections can detect problems at an early stage and are crucial to a successful preventive maintenance program. Prior to departure, the driver performs these inspections, and records the results on a Daily Vehicle Inspection Checklist.

Record starting mileage, date, and vehicle number

Inspect each item on the checklist, and make a check mark if it is satisfactory.

Describe problems that are found. If a problem affects safety, it should be reported to the mechanic for correction before the vehicle starts its run.

Implement a Maintenance Schedule

After a maintenance system has been selected, a basic maintenance schedule should be reviewed with drivers and mechanics. Mechanics should become familiar with the scheduled maintenance requirements for each of the transit system's vehicles. Most scheduled maintenance information, covering the chassis, bus and major subcomponents, can be found in the applicable owner's manuals. Some vendors and manufacturers offer training. Follow the manufacturer's maintenance schedule contained in the owner's manual. Maintenance checklists can also be developed.

Maintain a Comprehensive Maintenance Record

A good maintenance program should also include a comprehensive maintenance record or file for each vehicle in the transit system. This file provides:

- o A quick reference guide.
- o A complete history of repairs.
- o An indication of fuel consumption and mileage trends.
- o A record of responsibility for repairs.
- o A record of the amount of time a vehicle is out of service.
- o A list of chronic problems.

Rotating buses between routes and/or locations

Schedule newer buses for work at farthest locations, which is away from maintenance facilities. Rotate buses between rural and urban routes so that wear and tear on vehicles is equalized.

By adopting this methodology for evaluating constraints to achieve customer satisfaction and organizing workshops earns the increased profit. The constraints are again evaluated and the step 1 to 4 continues until we keep the workshop at the desired profit level.

4.0 RESULT AND DISCUSSION:

In the conventionally used system, the mileage of a vehicle is determined by filling the fuel in the fuel tank, noting the odometer reading and noting the odometer reading when the fuel gets exhausted in the fuel tank. The ratio of difference between odometer reading gives the total kilometers run by the vehicle to the number of litres of fuel filled in the tank gives the mileage of vehicle.

- Let X1 be the odometer reading when the fuel is filled
- Let X2 be the odometer reading when the fuel is exhausted.
- Let n be the total no of litres of fuel filled

$$\text{Mileage} = \frac{X2 - X1}{n}$$

Table: 1 Record of fuel consumption

Bus code	Kilometre run		Diesel consumption	
	April 2005	May 2005	April 2005	May 2005
Q	705	878	219	200
V	1258	1066	317	249
L	1486	452	472	137
Total	3486	2396	1008	586

Total cost of transport operation= fuel cost +maintenance cost +labor wages + documents (F.C permit, insurance)

Except the fuel cost, all the other costs are assumed as constant for this work. Also we have taken Fuel Cost Rs: 35/lit, average mileage run/vehicle per month=1000.

Table: 2 Mileage Improvement

Bus code	Month & year		
	April 2005	May 2005	Percentage increase
Q	3.2	4.3	1.1
V	3.0	4.3	1.3
L	3.1	3.9	0.8

Table: 3 Cost analysis

Bus code	Fuel consumed		Cost of fuel in Rs		Savings in Rs
	April 2005	May 2005	April 2005	May 2005	
Q	312.50	232.55	10937.05	8139.25	2797.8
V	333.55	232.55	11674.25	8139.25	3535
L	322.58	256.41	11290.30	8974.35	2315.95
Total	968.63	721.51	33902.05	12525.28	21376.77

There is an improvement observed and fuel cost was saved.

5.0 CONCLUSION:

By using the theory of constraints, we break out the selected constrain and attain the improved profit based on fuel consumption. The constraints selected for this work based on the survey made are poor maintained vehicle producing less mileage and poor driving skill towards fuel economy. There is an improvement in less fuel consumption in May compared with April, so profit is attained by the transport department in May. Average saving per vehicle per month is Rs 7125. Total cost saving will be Rs 1, 63, 875, if all heavy vehicles are playing in the routes. In this work we have achieved a considerable improvement in the profit by considering one of the strategy (Theory Of Constraints) and the fuel economy is also improved. We can extend this work for maximizing the profit of transport industry in considering all cost function.

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One internal industry documents review by Business Week revealed another fact that maximum factories in China used to keep double sets of books. In the past 4 years, the percentage of Chinese manufacturers caught in submitting false payroll records has risen from 46% to 75%. According to Tang Yinghong, Former Administrator of Ningbo Beifa Group, "Tutoring and helping factories deal with audits has become an industry in China".

Nike and some other companies thought that improvement in the method of production might reduce the labor-hour requirement. But was it possible to change the profit-seeking mind of the producer which helps the economy to grow-up?

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