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Development of a fleet vehicle replacement strategy

by

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Executive Summary

Change is the only way to stay ahead in a competitive environment. That is why company ABC has adopted a new focus on supply chain and is moving away from old warehouses to new, leaner, central warehouses. The company has decided to consolidate 240 of their warehouses into 5 new warehouses.

Along with the warehouse centralizations, company ABC also needs to assess the productivity of their fleet. It must also be determined if the current fleet will be able to meet the requirements of the new supply-chain network.

In this document, a study is performed to establish the optimal service life of a vehicle. As with any company, ABC also has some vehicles in their fleet that is nearing the end of their Economic Service life. The plan is to replace these vehicles over the next few years in the most cost effective way possible.

Secondly, a study is performed to establish the optimal fleet mix. Warehouse centralizations have numerous advantages as a result of fewer facilities that need to be maintained and run. Another advantage of warehouse centralizations is the possibility of the fleet to perform milk-runs. This ability to perform milk-runs could result in larger loads that need to be transported. Subsequently, the possibility of using different vehicles with different capacities must be considered. This is the reason why it is necessary to calculate the optimal fleet ratio of one-tonner to four-tonner vehicles.

Lastly, a study is done on the current fleet to establish how the fleet will be transformed in the most cost effective way. This is done by using the results of the Economic Service Life and fleet mix study. The deliverables form the aforementioned study is used as a guide to decide which vehicles need to be replaced at what stage. At this stage of the study, it could also be beneficial to consider various brands of vehicles to see if there could be vehicles that are more cost effective to run than the current models.

This document concludes with a summary of the cost savings, should the abovementioned results be employed.

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1) Introduction

ABC has always been a well known retailer in the furniture industry. The company expanded its market footprint by buying other furniture companies over the past few years. These companies included well known and established furniture retail companies. This formed ABC Holdings Limited (ABC).

Company ABC currently has 240 warehouses, 1200 branches under 13 brand names and a multiple of suppliers. It would not be uncommon to see 3 or 4 warehouses in the same region of the country in the old supply-chain network.

With the consolidation of the companies, ABC decided to consolidate all of their warehouses across South Africa into 5 leaner, bigger, centralized warehouses. A single warehouse, for example the Bellville warehouse, will carry all of the different brands' stock. Thus an entire regions' stock will be stored under one roof. The old warehouses will thus be closed down and everything will be moved to the new warehouses.

Warehouse centralizations have numerous advantages as a result of fewer facilities that must be maintained and run. Cost savings can be made in the following aspects of a business: Facility lease expenditure, municipality bills, salaries, cost of capital on equipment, stock and safety stock, etc.

Fleet maintenance and capital cost is an important factor to consider when planning a warehouse consolidation. As a result of all the stock being under one roof, shipments can be consolidated into bigger loads in bigger trucks. This type of shipment is known as a milk-run. Subsequently, company ABC could need a fleet that is comprised of trucks with larger capacity.

ABC does currently have a fleet replacement policy that they follow in order to replace vehicles. At this point it is not known if this policy is optimal or not. Vehicles are also sometimes sold on the basis that a profit can be made out of the selling transaction and not because the vehicle has become too expensive to maintain. ABC is thus currently not adhering to their own policy. Fleet replacement policies have saved many companies a lot of money through the optimal management of the fleet. This is the reason for the need to re-evaluate their current policy as to establish if it is optimal or not and to make sure that the policy is implemented thereafter.

ABC has a current one-tonner to truck ratio of 72.11% to 27.89%. It is suspected that this is not going to be optimal in the new supply-chain network due to the possibility of drivers to perform milk-runs. It would also not be optimal to totally transform the fleet from the current ratio to as many trucks as possible. This is why it is necessary to calculate the correct fleet mix that will assist the company to achieve its maximum profit potential.

This fleet transformation is to happen over a period of three years due to current vehicle finance contracts. For this reason, ABC is in need of a plan to follow on how this fleet is going to be transformed in the most cost effective way over the next three years.

2) Project Aim

The aim of this project is to guide company ABC to transform their fleet in the most cost effective way possible during the next three years.

3) Scope

The scope of this project extends only to the following deliverables:

3.1) 1st deliverable

If a fleet or vehicle is being examined, one has to ask when the vehicle is getting old and should it be replaced? Does the vehicle still complete the job at hand or has the condition of the vehicle deteriorated to such an extent that the downtime is having an adverse effect on productivity? One has to consider spending money on repairing or refurbishing the fleet? Should one buy a newer, secondhand model or a completely new vehicle?

Firstly, the current ABC fleet operating expenses must be analyzed in order to establish if the company is replacing their vehicles at the optimal time or not. The company does currently have a fleet replacement policy that states that a one-tonner vehicle should preferably not be in use if it has done more than 275 000 km. This policy is frequently ignored by the company as ABC have some vehicles that have kilometer readings in excess of 600 000km.

This is the reason why it is absolutely critical to examine ABCs fleet replacement policy to see if vehicles are replaced at the optimal time or not. One has to implement clear company policy for managers to follow with confidence in order for fleet management mistakes to be avoided.

3.2) 2nd deliverable

Due to the new operational requirements from trucks in the new supply chain network, there are numerous variables that need to be considered while this fleet is being replaced. One has to look at the type of vehicle that will meet these requirements in the best possible way. This has to do with the ability of the vehicle to complete the job at hand. In the new network, vehicles can perform milk-runs. A milk-run means that a delivery vehicle can load all of its loads, in the morning, that is scheduled for delivery during that specific day. Loads are subsequently consolidated which means that a truck can handle multiple loads each day without having to return to the loading area/warehouse. This potentially reduces travelling cost.

From the above it can be seen that having more, large trucks can be financially beneficial for a company under these circumstances. But company ABC cannot only have large trucks as it is necessary to have one-tonners in the fleet that can perform emergency and rural area deliveries. This contributes to the overall flexibility and effectiveness of the fleet. One must also consider the possibility of including large 8-ton vehicles. But now one sits with the question of how many of which vehicles to have in the fleet. This is why it is necessary to formulate a program that will assist the company to determine the correct fleet mix that they will acquire over the next three years.

All of the costs, variable and fixed, associated with running a specific vehicle must be considered. The ratio of trucks to one-tonners with the lowest total cost will be chosen as the plan on how the company is going to procure vehicles over the next three years.

3.3) 3rd deliverable

After the fleet replacement policy has been developed and the ratio of trucks to one-tonners has been established, the next deliverable is to decide which specific vehicles in the ABC fleet should be replaced by new, similar or by other types of vehicles.

At this point in the analysis, the brand of vehicle and type of vehicle is considered. This is concerned with the running cost and maintenance cost of a specific brand of vehicle. Another variable that plays a

determining factor in the selection of the vehicles is the amount of fleet discount on initial purchase that the agent can offer.

One also has to consider the financing options that are available from the different financing institutions. Most agents offer three main types of financing options namely:

- FML (Full maintenance lease)
- Operating lease
- Buy back

The full maintenance lease offers a 0% residual value and 60 monthly payments. The operating lease has a residual value of 30% and payments over a period of 48 months with a one month extended period if the buyer desires this. The buyback option then offers a 30% residual value with payments happening over a period of 36 months. ABC will however have the option to keep or to sell the vehicle back to the financing company.

The third deliverable of this project is a program that can calculate which vehicles are to be replaced and when. It will take all the above mentioned factors into consideration to guide ABC in procuring vehicles that will minimize fleet operating costs.

This program must also calculate the total cost of this fleet transformation over a period of three years. This program must subsequently calculate the total of all of the different financing options and operating expenses (fixed and variable) of the various brands of vehicles in order for the user to be able to compare all the vehicles and all the financing options.

3.4) 4th deliverable

After the fleet transformation plan has been developed, management needs to be convinced about the benefits of the implementation of this plan and everyone knows that management want to hear numbers and savings. That is why the final deliverable of this project is an account of the savings that can be made if this plan is employed.

But how does one go to work in solving such a problem? Let us look at some relevant literature relating to a project like this.

4) Literature Study

Due to the wide scope of this project, there is no single piece of literature that can be studied that will cover all the aspects of this project. For that reason all of the deliverables' needs are going to be studied individually.

4.1) Literature Study on Vehicle optimal economic life

According to Webster (2002), there is no 'magic formula' that an analyst can use to determine the optimal economic life of a vehicle. According to Webster (2002), a vehicle has reached its economic service life if the vehicles' depreciation becomes smaller than the maintenance cost. This was seen as a very simple way to determine the optimal replacement time for a vehicle but was criticized by many in years following the release of the article. This method will be tested but due to the different initial investment vs. maintenance expense and depreciation ratios that various countries have, it would be beneficial to study other methods as well. All the results of the various tests will be examined and the most feasible one will be used.

According to literature by Spitzley (2004), the following maintenance expenses should be considered: Oil, lube & filters, tires, scheduled service cost, unscheduled service cost and insurance. In this technique the analyst assigns factors and empirical values to the operating data. The analyst also needs to calculate values for the analyses rather than using real expenditure values. The author of this article assigns empirical constants to the purchase price, baseline fuel economy, depreciation and the vehicle model relative to the current year. This complicates the whole analysis but does however contribute a lot of meaningful information. This technique will not be used as it was originally developed for the analysis of American cars where the initial investment to depreciation ratio could be different. Subsequently, the analyst runs the risk of working with data acquired form a skewed picture if this technique is used.

Literature by Kim (2003) has a dynamic programming approach to establishing a vehicles' Economic Service Life (ESL). Dynamic programming uses an epoch where a decision is made that changes the state of the system. At the states of an ESL dynamic programming analysis, the decision would be either to

buy a new vehicle or to keep the original vehicle for one more year. This technique cannot be used to analyze a single vehicle without the comparison against a challenger as the decision at the nodes would be to carry-on using the current vehicle or to buy a new one. Thus, if this technique were to be used, the working data for the challenger must already be available. At this stage in the analysis of ABCs' fleet, the challengers' data is not available as a challenger has not yet been selected. For that reason dynamic programming would not be an optimal choice as it is only necessary to establish the optimal Economic Service Life of a vehicle and not to compare the vehicle against a challenger. It is also not known from the examples given by Winston and Vankataramanan (2003), if the dynamic programming approach considers lease payments. Lease payments must play a determining factor in the analysis of the vehicles' ESL due to this being an economic study that must consider lease payments.

As we have come to this point, it is important to notice that none of the ESL literature viewed thus far have taken monthly lease payments into consideration.

Due to South-Africa's high interest rate, it becomes more important to explore a vehicle's ESL through a monetary perspective that considers the interest rate (unknown author, n.d., http://www.cash-loans.co.za/vehicle-finance.htm (accessed 27 Jul 2010)). For this reason it would be better to have a financial management perspective on this problem. The Economic Service Life (ESL) method that seems to be the most practical choice is the method proposed by Blank & Tarquin (2005), called the Annual-Worth (AW) method. The author proposes the use of Microsoft Excel for this analysis.

In this method, the economic service life (ESL) is the number of years, *n* at which the equivalent uniform AW of costs is the minimum, considering the most current cost estimates over all possible years of asset service life. AW is the equivalent annuity value of all the costs incurred over the service life of the vehicle.

The best way to approach this analysis is to acquire data from as many vehicles as possible and to get averages for these expenses. The larger the sample from which data is drawn, the more accurate the analysis will be. The following factors must be considered:

- Interest rate and the compounding frequency
- Kilometers travelled each month

The analyst can ignore the following costs incurred from operating the vehicle:

- Fuel expense as this does not dramatically increase or decrease with the age of the vehicle
- Toll fees, driver salary and license fees

The following must be transformed into AW values for each number of years, *n* (*n* = 1, 2, 3, … , 11) that the vehicle is studied.

- The initial cost must be transformed into an AW value
- All the running expenses
- Year *n* salvage value
- End salvage value

These AW expenses will then be added together to get an Annual Worth of the Annual Operating Cost (AOC) for each year *n*. The Capital Recovery annual worth must then be added to the AOC to get the Economic Service Life (ESL) figures.

The optimal replacement time would be where the ESL is at a minimum. The corresponding number of years where the ESL has been reached will be linked to the distance that the vehicle has travelled and this will then form the Fleet Replacement policy.

4.2) Literature Study on vehicle fleet mix

Acquiring the correct fleet mix can increase a company's profit and effectiveness. According to Salhi (2003), current fleet vehicle mix models can be modified and adapted without much effort.

Couillard (2003) proposes the development of a Decision Support System (DSS) to solve a fleet mix planning problem. These systems help the fleet managers in the following way:

- Forecast demand
- Determine relevant criteria
- To develop and test alternative fleet plans
- And in the end help fleet manager to choose the most profitable fleet mix

The author of this journal also proposes that flexibility be built into the system. This allows the analyst to explore various alternatives more easily.

Although the DSS is a very useful tool, Microsoft Excel will rather be used as it is more readily available. The abovementioned literature gave insight into the important factors that should be considered when building this model illustrated in the bullets above.

Now for the operating parameters that should be used. According to Salhi (2003), it is advised to use the same unit running costs across the various types of vehicles. It is also important to consider variable costs of various vehicles. The following must be considered for each type of vehicle that could be considered as a viable option: The cost of labor for the drivers and crew for different types of vehicles, Vehicle operating cost for example, fuel economy, insurance, service cost, fuel & oil consumption, tires and maintenance. This has to be considered for every type of vehicle and it must be multiplied by the number of vehicles to get the total operating cost over a trail run period of five years.

One of the most important parameters is the capacity of the vehicle. This same article also states that interesting numerical results based on changes in the total fleet mix/configuration can be computed without much effort. This will be very useful in this project as the aim is to find the most cost effective fleet mix by experimenting with different fleet configurations.

This problem of fleet mix has to be solved for a period of five years. After the total cost of a specific fleet mix has been calculated, it will be beneficial to test and calculate the cost of running other fleet mixes over the period of five of years. The fleet mix will be solved as an integer problem. As an integer mix problem of percentages can have up to a 100 configurations, it is not going to be an easy task solving this problem by hand. This problem will have five years, which is equal to five stages. This problem will have as many as 100 x 100 x 100 x 100 x 100 = 1 x 10^{10} combinations of possible answers. This is the reason why a sensitivity analysis would not be very helpful as there are tools available that will be easier to use for an analysis like this. That is why this problem calls for a tool by the name of linear programming.

According to literature by Winston and Vankataramanan (2003), linear programming is tool that can be used to solve optimization problems in various fields including transport. A linear problem has an Objective Function (OF) that the user wants to minimize or maximize. In this case we are aiming to minimize the Objective Function that is the total and yearly expenditure to operate this fleet. A linear program also has constraints. In this instance, the only variables that need to be constrained are the four-tonner to one-tonner vehicle percentage split. This needs to be constrained as this percentage cannot be larger than 100% and not smaller than 0%. For example, ABC cannot have a fleet that is

comprised of 60% one-tonners and 50% four-tonner. The fraction of the types of vehicles must be equal to one.

After the program has calculated the optimal fleet mix, the results must still be analyzed to see if it is practically possible to obtain such a fleet mix. At this point the analyst's own judgment can override the programs' decisions if it were necessary.

After the optimal fleet mix has been established, a plan must be developed on how this fleet is going to be transformed into the desired fleet mix over the next three years as economical as possible.

4.3) Literature Study on fleet vehicle transformation plan

Due to South-Africa's high interest rate and due to the fact that vehicle finance comes at a higher price than other finance, it becomes more important to explore the best way to finance a vehicle.

There is no specific literature on the program that will assist ABC in choosing the vehicles that should be sold due to the specialized nature of the program. This is going to be a once-off program. According to a source at company ABC (J. Hattign), Microsoft Excel will be used to calculate the total costs of this fleet transformation.

The following costs will be considered for a prospective new vehicle:

- All the financing cost
- fleet discount
- Modifications needed to perform the job
- repair & maintenance costs
- Fuel economy
- salvage value
- initial cost

All the above mentioned costs will be compared for all the various vehicles that can be seen as a viable replacement for the current vehicle.

The following need to be considered for ABCs' current vehicles:

- Age
- Type of vehicle
- Distance travelled

The program must then exchange the old vehicle for a new one if the old vehicle needs to replaced.

Excel will be a very good choice as it has a built in function that can calculate the net present value of an investment by using a discount rate and a series of future payments (negative values) and income (positive values)

(http://office.microsoft.com/en-us/excel-help/npv-HP005209199.aspx (accessed 27 Jul 2010)).

There are also a large number of inputs associated with each vehicle that must correspond from different categories of data. This is the reason for the need of another tool by the name of macros, that's available on Excel. Macro's is a very good tool if the user wishes to perform tasks repeatedly.

http://office.microsoft.com/en-us/excel-help/about-macros-in-excel-HP005201201.aspx (accessed 27 Jul 2010).

The working data will be collected from the fleet manager at ABC. After the best vehicles have been chosen, a sensitivity analysis must be performed. Due to South-Africa's high interest rate and due to the fact that vehicle finance comes at a higher price than other finance, it is also important to explore the effect that a hike or fall in interest rate will have on the cost of financing a fleet. This analysis will be done with a tool called Sensitivity analysis. A sensitivity analysis can be performed by using an excel spreadsheet [5]. In this article [5] the writer also proposes that the analyst use a two-way data table. The analyst can subsequently be aware of the impact that any changes can have on the cost of finance.

4.4) Literature study on Cost comparison:

According to W. Seal (2009), financial accounting reports are generated for the use external parties such as shareholders and a revenue service. The tools that accountants and auditors use don't compare different costs but is just a way to declare the financial activity within a corporation for a given period of time. Financial accounting reports will thus not be used to compare and measure costs. One has to look outside the boundaries of financial accounting and look at some of the techniques used by managers in Managerial accounting.

For this analysis, costs will be compared in a straight forward way. A profit-loss account will be used.

5) Development of supplementary tools

As previously stated, Microsoft Excel will be used to calculate the total costs of this fleet transformation. Excel is a very good choice as the program is readily available and user-friendly.

Excel will also be a very good choice for the following reasons:

- It has a built in function that can calculate the net present value of cash flows.
- Excel has a very handy function by the name of macros that will be used extensively
- A sensitivity analysis can also be performed on this program

Excel also has an add-in feature by the name of Solver. This add-in can be used to solve linear problems without much effort. The user must define the following parameters and variables:

- The target cell which is the same as the objective function. The user must specify if this cell should be minimized or maximized
- The range of cells that can be changed by the program to find optimal values. This is known as the input data in a linear problem
- The constraints that forms the boundaries of the working data

6) Assessment of the current fleet replacement policy

As previously stated, it is necessary to assess the current fleet replacement policy as ABC implemented a fleet replacement policy without proper calculations. In this study, 464 vehicle's data will be analyzed over a period of 500 000km in order to analyze the fleet vehicles' Economic Service Life.

As previously stated, it would be best practice to implement a fleet replacement strategy based on the distance that a vehicle has travelled rather than on the age of the vehicle. That is why the data will be arranged to correspond to the monthly travel distance and not the years that the vehicle has been in the fleet.

The ABC one-tonners travel an average of 3598 kilometers a month. It would not be good to categorize 464 vehicles into a sample space of 0 to 500 000km with intervals of 3598kms as some of these categories will not have enough vehicles in them to create an accurate average. There will thus be 46 intervals, each over a distance of 10794 kilometers. Subsequently, the cost of maintaining a vehicle will be compounded every three months. The vehicles will then be categorized into their corresponding kilometers category and an average will be calculated from the respective categories. The operating data from vehicles from all provinces have also been considered as they have different operating conditions they work under. This is done because the vehicles in a province like Limpopo have to travel more to rural areas where the roads are in a bad condition. These vehicles tend to be more expensive to maintain and must be considered to have an accurate picture.

The following averages are needed:

- Market value
- Operating cost on kilometers travelled

The abovementioned operating cost on kilometers will be calculated from oil consumption and a general Repairs and Maintenance (R&M) category that ABC have collected data for over the years for every vehicle. This category is composed of the following: Scheduled - and unscheduled service cost, other repairs not done by agents, tires etc.

The market value is calculated from a monthly report by an independent company by the name of M&M. The vehicles have also been categorized and then analyzed according to this M&M value. ABC aims to receive an average selling price of 80% of the M&M value for newer vehicles and an average selling price of 70% for older vehicles when they are sold.

The following are the operating parameters:

Interest rate	2.52%	Assumptions:	Fuel is ignored
First cost	120786		Monthly lease payments ignored
Maintenace cost per kilometer	1.838799333		
Kilometers per month	3598	Compounding:	Monthly
Average maintenance cost/month	6616		

The yearly interest rate on vehicle finance is 10%. Due to the categorization of costs into 10794km brackets, the interest rate is calculated as 2.52% for every 3 months. The average initial cost of investment is R120786 excluding VAT for a Toyota 1 tonner workhorse.

The Annual Worth (AW) of the Annual Operating Cost (AOC) is calculated from the Operating cost on Kilos values. It is done by using the following formula:

=PMT(Interest rate, n, NPV(Interest rate,AW of AOC (n=1):AW of AOC (n=n))+0)

The Capital Recovery is calculated from the corresponding Market value for the kilometers travelled.

=PMT(Interest rate, n, first cost, MV (n))

The following results were obtained:

		Market value	Operating cost on kilos	AW of AOC	Capital recovery	ESL
Kilometers Travelled	10794	96880.2912	1037.975	R 1,037.98	R 26,925.36	R 27,963.33
	21588	96880.2912	2150.97	R 1,594.47	R 14,824.94	R 16,419.41
	32382	95922.04514	2155.172	R 1,781.37	R 11,103.85	R 12,885.22
	43176	94867.40756	2158.324	R 1,875.61	R 9,261.31	R 11,136.92
	53970	93919.19337	2177.708	R 1,936.03	R 8,130.98	R 10,067.01
	64764	93919.19337	2195.666	R 1,979.30	R 7,225.65	R 9,204.95

75558	90905.03314	2197.01	R	2,010.40	R	6,978.74	R	8,989.15
86352	90905.03314	2198.308	R	2,033.89	R	6,440.04	R	8,473.94
97146	90489.73903	2210.218	R	2,053.48	R	6,063.12	R	8,116.60
107940	88955.54237	2220.486	R	2,070.18	R	5,860.80	R	7,930.98
118734	88955.54237	2223.27	R	2,084.10	R	5,569.46	R	7,653.56
129528	87609.30255	2229.802	R	2,096.24	R	5,424.53	R	7,520.78
140322	85119.95369	2236.02	R	2,106.99	R	5,375.33	R	7,482.33
151116	83917.26466	2243.95	R	2,116.78	R	5,251.56	R	7,368.33
161910	83575.21095	2248.91	R	2,125.59	R	5,094.76	R	7,220.35
172704	83575.21095	2253.594	R	2,133.59	R	4,939.69	R	7,073.28
183498	83233.85578	2273.976	R	2,141.84	R	4,819.44	R	6,961.29
194292	81706.40201	2345.542	R	2,153.16	R	4,765.34	R	6,918.50
205086	81706.40201	2373.2	R	2,164.74	R	4,651.64	R	6,816.38
215880	81500.06095	2373.2	R	2,175.17	R	4,557.58	R	6,732.75
226674	79858.72402	2373.944	R	2,184.63	R	4,525.26	R	6,709.89
237468	78693.93101	2386.078	R	2,193.79	R	4,478.00	R	6,671.78
248262	78565.03778	2404.16	R	2,202.93	R	4,400.12	R	6,603.06
259056	75413.10269	2423.356	R	2,212.12	R	4,422.25	R	6,634.37
269850	73638.42255	2504.542	R	2,223.82	R	4,399.94	R	6,623.75
280644	70779.9805	2738.404	R	2,243.61	R	4,408.25	R	6,651.86
291438	69631.65178	2821.432	R	2,265.01	R	4,368.94	R	6,633.95
302232	68166.57971	2976.5	R	2,290.42	R	4,339.76	R	6,630.18
313026	67858.32777	3327.166	R	2,326.17	R	4,284.16	R	6,610.33
323820	64580.3928	3484.974	R	2,364.80	R	4,299.88	R	6,664.68
334614	64280.36815	3556.726	R	2,403.24	R	4,248.03	R	6,651.27
345408	62856.55869	4169.882	R	2,458.45	R	4,222.75	R	6,681.20
356202	62708.47706	4464.886	R	2,519.25	R	4,173.03	R	6,692.29
366996	61091.10515	4556.228	R	2,579.16	R	4,154.26	R	6,733.42
377790	60766.92899	4661.58	R	2,638.66	R	4,112.33	R	6,750.99
388584	60588.9997	4831.256	R	2,699.57	R	4,070.18	R	6,769.75
399378	57998.79855	4957.46	R	2,760.59	R	4,070.76	R	6,831.36
410172	57998.79855	5052.162	R	2,820.90	R	4,028.65	R	6,849.54
420966	57210.78055	5211.052	R	2,882.18	R	4,001.01	R	6,883.19
431760	53898.9662	5482.094	R	2,947.18	R	4,012.00	R	6,959.18
442554	52385.2386	5726.314	R	3,014.96	R	3,995.58	R	7,010.55
453348	46787.08003	5908.014	R	3,083.85	R	4,035.56	R	7,119.41
464142	44847.495	6068.442	R	3,153.25	R	4,023.32	R	7,176.58
474936	40204.49402	6393.046	R	3,226.89	R	4,045.48	R	7,272.37
485730	30567.36375	6892.232	R	3,308.34	R	4,126.41	R	7,434.75
496524	21117.45513	8414.462	R	3,419.34	R	4,198.41	R	7,617.75

From the above table the following graph was drawn:

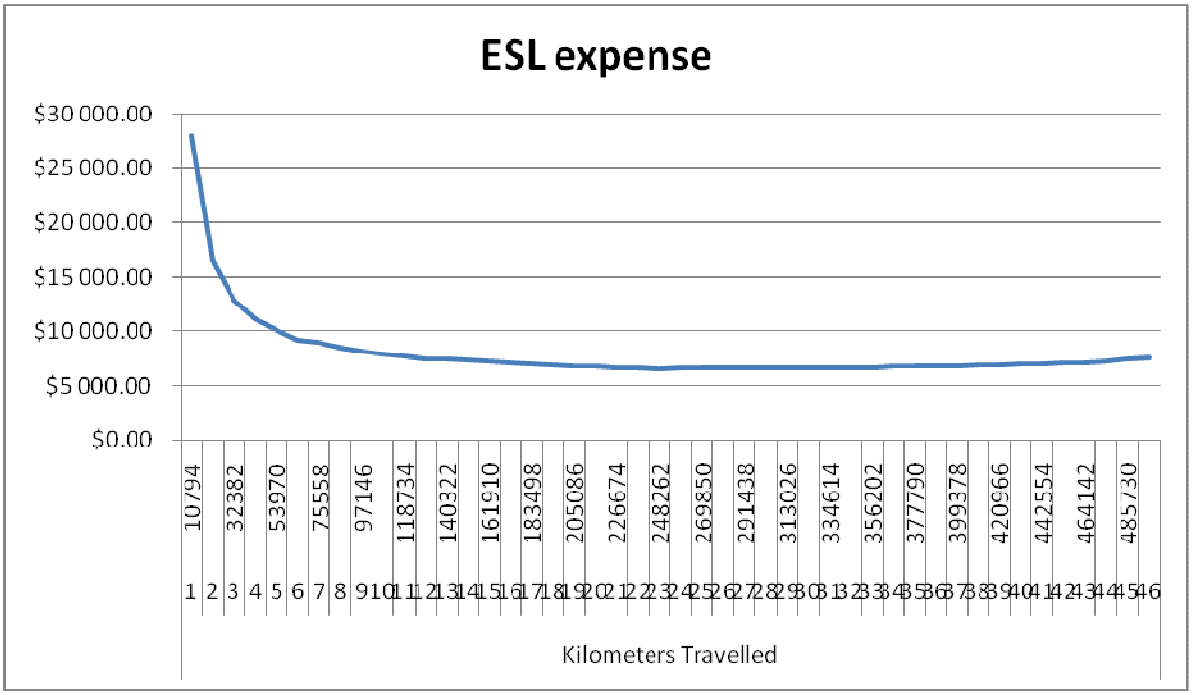


Figure 1: Economic service life (46-interval)

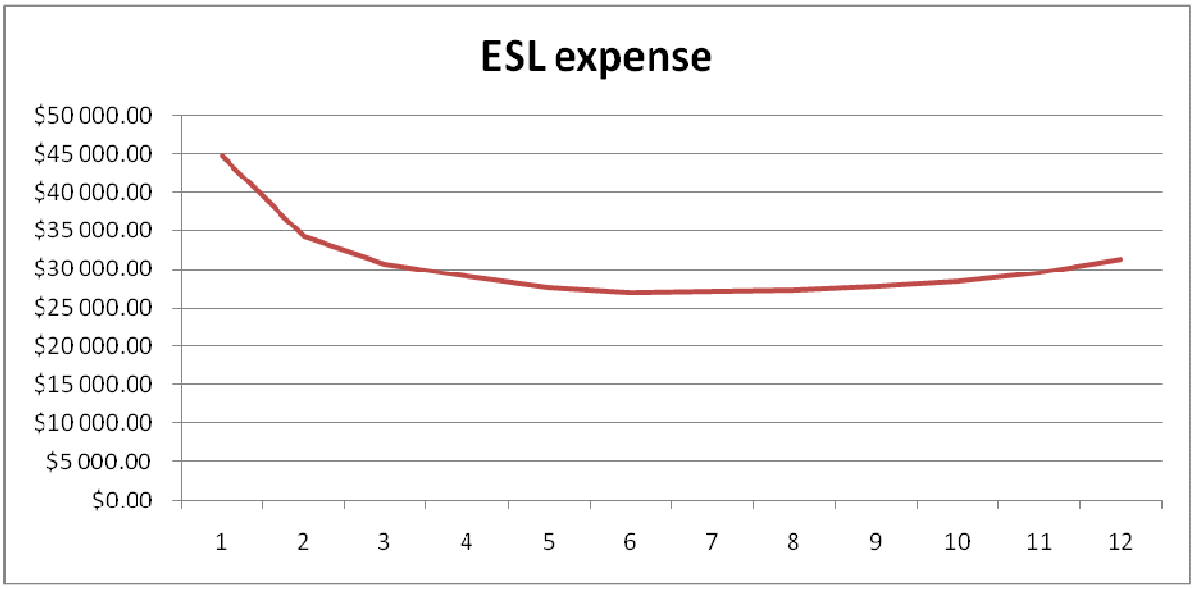
As previously stated, the optimal time for the vehicle to be replaced is when the ESL is at a minimum absolute value. This value is at a minimum on 248262 kilometers when then ESL is at a value of R 6,603. It can be seen that the ESL values decrease rapidly from 10800 km until about 220000 km. It then reaches a plateau until 345000 km where it increases from there onwards. This means that the vehicle can be replaced anywhere between the above mentioned boundaries and the replacement decision would still be close to optimal.

This could also be analyzed using fewer intervals:

	Kilometers travelled	ESL expense
1	43176	R44,833.46
2	86352	R34,297.38
3	129528	R30,623.49
4	172704	R29,075.07
5	215880	R27,667.38
6	259056	R26,989.85
7	302232	R27,058.20
8	345408	R27,315.75
9	388584	R27,770.92
10	431760	R28,392.28
11	474936	R29,515.24
12	496524	R31,373.76

Figure 2: Economic service life (12-interval)

The following figure was drawn from the table above:



As seen from the above figure, the optimal replacement time is also at 260 000km. This is why it is only beneficial to sell a vehicle a while after it has reached its optimal ESL in order to reap the full benefit of the inexpensive operating curve.

For this reason the chosen ESL is 275 000km. This is due to the results of the analysis and not to disturb current company policy. This analysis can be used to highlight the fact again to management that it is important to adhere to their company policy.

7) Analysis of generic running cost for various types of vehicles

To solve the problem of leading company ABC in acquiring the correct fleet mix, all the costs, variable and fixed, need to be considered for every type of vehicle to have an accurate account of the cost associated with running every type of vehicle.

Assumptions must also be made about the country's economic growth, the company's market share growth and other influencing economic factors. The following must also be considered in the model: daily distance travelled by the various types of trucks, excess fleet requirements due to breakdowns and services, maintenance cost and the raise in labor cost that the National bargaining council predicts. This model must also built on the new supply-chain network operating paramaters as it must calculate the future fleet vehicle split that will be able to perform the work that is required from the vehicles in the new network.

7.1) Factors to be considered

The following table shows the economic factors to be considered:

Key Economic forecast:	2010	2011	2012	2013	2014	2015
	0	1	2	3	4	5
Headline CPI (Consumer Price Inflation)		6.50%	6.50%	6.50%	6.50%	6.50%
SA prime rate	10.50%	11.00%	11.50%	12.00%	12.50%	13.00%
REAL growth		7.00%	8.00%	9.00%	8.00%	6.50%

All of the above forecasted stats were acquired from company ABCs' strategy department. The Headline Consumer Price Inflation (CPI) will be used to forecast the company's expenditure on for example

service and maintenance. The SA prime rate is a forecast that will be used to calculate the monthly payments and rentals. The REAL growth is a forecast of the company's expected growth.

The first variable to consider is the amount of work that must be done during the next five years to know how many loads must be delivered per year. The REAL growth is used to predict the volume that will be transported each year.

These are the results for each year:

	2010	2011	2012	2013	2014	2015
Volume per annum (Loads)	720000	770400	832032	906915	979468	1043133
Days per month	23.8	23.8	23.8	23.8	23.8	23.8

The above figure for 2010 is a forecast actual that is used for the base of the other years' forecasts. The following years' figures are inflated by using the REAL growth. The figures for the years that follow 2011 are compounded on all the previous years' figures, multiplied by the REAL growth for that specific year. The figures represent an accumulative number for the total loads that must be delivered nationwide.

Next, one must consider the capacity of the different types of vehicles in order to know many loads can be transported by a specific vehicle.

The vehicle utilization parameters are the following:

Vehicle utilisation parameters	Distance per drop (km)	Loads per day	Vehicle capacity	Average Utilization	Cubic meters
1Ton	45	5.25	12	70%	5.25
4 Ton	25	10	23	70%	16.1

One-tonner vehicles have a loading capacity of 3 meters long by 1.8 meters wide and can be loaded as high as 2 meters. This gives a total volume of 12 cubes. A four-ton vehicle on the other hand has 23 cubes of loading space. Even though a one-tonner vehicle can load up to 12 m^3 and a four-ton vehicle can load up to 23 m^3, vehicles are never fully utilized as the shape of some pieces of furniture do not allow for tight packing. On average, one-tonner and four-tonners are only 70% utilized. This gives the one-ton vehicle a capacity of 8.4 m^3 and the four-ton vehicle a capacity of 16.1 m^3.

The average size of a delivery is 1.6 cubes. As for vehicle utilization parameters, a four-ton vehicle will handle $16.1m^3/1.6m^3$ = 10 loads on average a day and a one-tonner can handle $8.4m^3/1.6m^3$ = 5.25

loads a day. These figures are current operational statistics but will remain unchanged as the capacity will not change for newer models. This means that a four-ton vehicle has almost twice the capacity of the smaller vehicle.

With the milk-run property of the four-ton vehicle in the new supply-chain network, average distance travelled by a truck would be 25km a day while the distance for a one-tonner will be 45km. This makes it obvious that four-ton vehicles will be able to perform more work per vehicle.

Breakdowns must be considered to account for the excess fleet requirement. Excess fleet is required in the case of vehicle breakdowns in order for ABC to still be able to complete the deliveries to clients.

Breakdowns are handled in the following way:

Excess Fleet		% Req. per annum
Downtime per service interval (Days)	2	
1 Ton service intervals (km)	15000	3.96%
4 Ton service intervals (km)	10000	5.50%

Consideration for scheduled and forecasted unscheduled services and breakdowns has to be built into the model. Both types of vehicles have a forecasted two-day downtime every 15000km and 10000km respectively. The fleet requirement will thus be multiplied with the inverse function of the downtime percentage to build some flexibility into the model.

The % Annual Requirement that must be considered was calculated in the following way. Take the one-tonner for example:

((distance travelled/day) x (Loads/deliveries completed/day) x (23.8 working days a month) / (service interval in kilometers)) x (service interval downtime) / (52 weeks x 5 working days a week)

This formula gives the above numbers as a result. Next, one has to consider the labor cost associated with each type of vehicle. A one-tonner needs a driver plus one crew member to assist the driver to offload the vehicle. A four-tonner must have a driver and 2 crew members/general assistants on the vehicle, depending on the load.

The labour expense figures were acquired from the Road Freight Associations website: http://www.rfa.co.za/rfa/index.php

The following working data will be used for the labor calculations:

National Bargaining Council - Labour cost

			Crew/GA		Drivers
Grade			1		3
Basic / week		R	692.37	R	964.60
Weeks / month	4.33				
Basic		R	2,997.96	R	4,176.72
Provident	13.50%	R	404.72	R	563.86
Medical	R 1,100.00	R	-	R	-
Percentage (%)	0.0%				
Levies					
Wellness	1.14%	R	34.18	R	47.61
MTU	1.14%	R	34.18	R	47.61
SHIFT @ 21	23.80				
Holiday	3.60%	R	122.32	R	170.41
Leave	2.50%	R	84.94	R	118.34
Sick	4.60%	R	156.29	R	217.75
Union	0.00%	R	-	R	-
UIF (Max R125)	1.00%	R	29.98	R	41.77
Skills (taxable)	1.25%	R	37.47	R	52.21
Overtime (Guess)	30.00%	R	899.39	R	1,253.02
	Comp. Infl				
Total CTC 2010	9.50%	R	5,257.57	R	7,324.78

The above figures are given as a guide from the Road Freight Association. As seen from the above table, consideration must be made for basic salary, provident, medical, wellness, MTU, UIF and a forecast for overtime pay. All these costs must be considered for every type of crew member or driver. The total monthly Cost-To-Company (CTC) for a general assistant is R 5,257 and R 7,324 for a driver in the year 2010. This value will inflate with 9.5% each year until 2015. There must also be a percentage of 9.23% excess staff supplied as per current standard business requirement.

This number is calculated with the following formula:

(15 days leave + (36 days / 3 years at 75%)) / (total working days)

The following fixed expenses must also built into the model:

- Lease Admin costs @ R175 pm per vehicle
- Annual vehicle license fees @ R600 per 1 Ton
- Annual vehicle license fees @ R950 per 4 Ton
- Washing of vehicles - Once a week @ R40
- Satellite tracking - Netstar (Hijack & Recovery) – (R230 per vehicle per month)
- Fuel management fee per vehicle (R4.50 per month)
- COF's (R400 per month)
- Insurance excess (used as a total of R870K for 358 vehicles)
- Vehicle insurance (5.8% of book value per annum as given from insurer)

All these costs are then summed together to get a total fixed expense account yearly.

Now for the variable costs associated with the whole fleet. Company ABC pays a premium of 33 cents per liter of fuel above wholesale prices and the price is inflated according to a forecast by the company, not according to CPI. The one-tonners have a given average fuel consumption of 7.5km/l and the four-tonner has an average fuel consumption of 5.5km/l. The kilometers that the different vehicles travel must be split in order to compare the total cost of fuel that is incurred by the specific fleet mix.

Fluids and consumables are calculated as 0.5% of the total fuel used yearly. The model then also takes the following variable costs into consideration:

- Toll fees as R0.02/km travelled
- Maintenance & tires for a one-tonner at R0.23 a kilometer (R4000 for a set of tires every 40000km + service cost of R2000 every 15000km)
- Maintenance & tires for a four-tonner at R0.64 a kilometer

The cost of leasing a specific vehicle is calculated by using a weighted average of the total current fleet lease costs for the year 2010. This number is then inflated yearly by the Consumer Price Inflation percentage. The total lease expense is calculated by considering the various types of vehicles and excess fleet. The lease expense for a one-tonner is R 2150 and R 3320 for a four-tonner.

All the above mentioned costs are summed together to calculate a total fleet operating cost for a specific mix of fleet for each year.

7.2) The Model

In the above cells the user must enter the desired vehicle split as a ratio of four-tonners to one-tonners. As previously mentioned, the current one-tonner to four-tonner ratio is 72.11% to 27.89%. The user can enter the desired percentage of loads that should be handled by a truck for a given year in the yellow blocks as indicated. This number is not a representation of the amount of trucks that are in the fleet for the specific year, but rather the amount of loads that are transproted via a specific mode.

Vehicle operating Cost	2010	2011	2012	2013	2014	2015
Vehicle split (4Ton vs. 1Ton)		30%	50%	70%	90%	90%
Number of 1Ton required		360	277	181	65	70
		12	10	6	2	2
Number of 4Ton required		81	146	222	309	329
		4	8	12	17	18
Total Vehicles required		*457*	*441*	*421*	*393*	*419*
Leases						
4 Ton average fleet monthly lease		3,533	3,763	4,008	4,268	4,546
1 Ton average fleet monthly lease		2289	2437	2596	2764	2944
1 Ton	2148.84	10,216	8,394	5,825	2,223	2,544
4 Ton	3317.74	3,604	6,954	11,254	16,697	18,928
Total Lease (R000)		**13,820**	**15,348**	**17,078**	**18,920**	**21,472**
Lease Admin costs @ R175 pm per vehicle	2.10	1,022	1,050	1,068	1,062	1,206
Annual vehicle license fees @ R600 per 1 Ton	0.6	238	189	131	50	58
Annual vehicle license fees @ R950 per 4 Ton	0.95	86	157	255	378	428
Washing of vehicles - Once a week @ R40	2.08	1,012	1,040	1,058	1,052	1,194
Satellite tracking - Netstar (Hijack & Recovery)	2.76	1,343	1,381	1,404	1,395	1,584
Fuel management fee per vehicle	0.054	26	27	27	27	31
COF's	0.4	195	200	203	202	230
Insurance excess	2.45	1,192	1,225	1,246	1,239	1,406
Vehicle insurance	5.80%	3,290	4,442	5,805	7,170	7,815
	given from insurer	**8,404**	**9,711**	**11,197**	**12,575**	**13,952**

The number of four-ton vehicles that are needed to handle the daily volume can be calculated in the following way:

((The fraction of loads handled by a four-ton) x (annual volume)) / ((12 x 23.8 workdays/month) x (the number of loads a vehicle can handle))

The number of one-tonners needed can be calculated as following:

((1 - The fraction of loads handled by a four-ton) x (annual volume)) / ((12 x 23.8 workdays/month) x (the number of loads a vehicle can handle))

But this does not yet take the excess fleet requirement into consideration. This is done in the same way as the above calculation but the final number is multiplied by the percentage excess fleet required per annum. These numbers are then summed together to get a total number of vehicles required.

All the expenses mentioned in part 7.1 of this document are then multiplied by the number of a specific vehicle required. For example, if the company chose to keep the current vehicle mix:

Vehicle operating Cost	2010	2011	2012	2013	2014	2015
Vehicle split (4Ton vs. 1Ton)		28%	28%	28%	28%	28%
Number of 1Ton required		370	400	435	470	501
		13	14	15	16	17
Number of 4Ton required		76	82	89	96	102
		4	4	5	5	6
Total Vehicles required		*463*	*500*	*544*	*587*	*626*

It would cost them the following to run the fleet for the specific years:

	FY2011	FY2012	FY2013	FY2014	FY2015	
Total operating costs (R 000)	**R 158,025**	**R 185,233**	**R 219,058**	**R 257,305**	**R 295,360**	**R 1,114,982**

The cost of running a specific fleet mix is thus calculated by multiplying the number of a specific vehicle required by the following expenses:

- Labour Costs
- Monthly lease cost
- Lease Admin costs
- Annual vehicle license fees
- Washing of vehicles
- Satellite tracking - Netstar
- Fuel and Fuel management fee per vehicle
- Fluids and consumables
- Maintenance and tyres
- Toll fees
- COF's
- Insurance and Insurance excess

The question still remains about which mix of one-tonners to four-tonners would be the most cost effective to run for a year? To calculate this, there would be as much as 100 x 100 x 100 x 100 x 100 combinations for this problem. This is why this problem should be solved with linear programming with the help of excel solver. In this case, the objective is to minimize the total cost of running the fleet over the next five years. The vehicle split is the only variable that needs to be constrained.

To calculate the optimal fleet mix, the program must calculate the cost of running all the fleet mixes by changing the fleet mix and computing the cost of running that mix of vehicles. The program must then choose the most economical one.

The linear problem is formulated in the following way:

$X_i \triangleq$ The percentage four-tonner to one-tonner vehicle split in year i, $\forall\ i \in \{1,\ldots,5\}$

$Y_i \triangleq$ The cost of operating a specific fleet in year i, $\forall\ i \in \{1,\ldots,5\}$

Objective function:

Min Z = $\sum_{i=1}^{5} y(i)$ [Minimize the total expense of operating the fleet over five years]

Subject to:

$X(i) \geq 0, \forall\ i \in \{1,\ldots,5\}$ [Percentage four-tonners cannot be smaller than 0]

$X(i) \leq 100, \forall\ i \in \{1,\ldots,5\}$ [Percentage four-tonners cannot be larger than 100]

7.3) Results

After running the model, the following results were obtained:

Vehicle operating Cost	2010	2011	2012	2013	2014	2015
Vehicle split (4Ton vs. 1Ton)		100%	100%	100%	100%	100%
Number of 1Ton required		-	-	-	-	-
		-	-	-	-	-
Number of 4Ton required		270	291	318	343	365
		15	16	17	19	20
Total Vehicles required		*285*	*307*	*335*	*362*	*385*

	FY2011	FY2012	FY2013	FY2014	FY2015	
Total operating costs (R 000)	**R 130,630**	**R 152,277**	**R 179,896**	**R 210,290**	**R 240,680**	**R 913,773**

This means that that the company should aim to achieve a fleet that is comprised only of trucks as soon as possible. However, after consultations with the company's fleet managers, it was decided that having a 100% four-tonner fleet mix would not be the best decision. ABC sometimes has to deliver loads in rural places where these larger trucks would not be able to reach. Adding one-tonner vehicles will also increase the flexibility of the fleet.

A figure of 10% one-tonners was seen as a feasible solution. This number was however not calculated but was rather estimated from the logistic manager's experience.

A fleet mix like this will be composed in the following way:

Vehicle operating Cost	2010	2011	2012	2013	2014	2015
Vehicle split (4Ton vs. 1Ton)		90%	90%	90%	90%	90%
Number of 1Ton required		51	55	60	65	70
		2	2	2	2	2
Number of 4Ton required		243	262	286	309	329
		13	14	16	17	18
Total Vehicles required		*309*	*333*	*364*	*393*	*419*

It would have the following running costs over the next five years:

	FY2011	FY2012	FY2013	FY2014	FY2015	
Total operating costs (R 000)	R 134,310	R 156,711	R 185,201	R 216,842	R 248,588	R 941,651

The model can also be used to calculate the cost of running other mixes of fleet. For instance, if the company were to choose to remain with the current fleet mix of 28% four-tonners, it would cost them the following over the next few years:

The costs would be the following for the next five years:

	FY2011	FY2012	FY2013	FY2014	FY2015	
Total operating costs (R 000)	R 158,025	R 185,233	R 219,058	R 257,305	R 295,360	R 1,114,982

This amounts to a total of R171 331 000 in savings over the next five years if the company could immediately change their fleet to a fleet that is comprised of only four-tonners. But would converting the fleet to a 90% four-tonner mix be the most cost effective thing to do? This is the reason for an analysis on how this fleet is going to be transformed over the next few years.

8) Fleet Replacement Strategy

Up to this point in the analysis of company ABC's fleet, the following has been established:

- The optimal service life of one-tonners is 275 000km,
- The given optimal service life for four-tonners is 300 000km,
- The future optimal fleet mix which is an aimed ratio of 10% one-tonners and 90% four-tonners.

It would be ideal to transform the fleet to the desired ratio as soon as possible but that would not be the most economical choice. The above aimed values are constrained by the company's current lease and finance contracts that have not yet reached the end of their service lives. For this reason one must consider all the vehicles that are available to be replaced. These vehicles are the ones that are more than four years old, the one-tonners that have 275 000km or more on the clock and four-tonners that have 300 000km or more on the clock.

At this point in the analysis it is also important to consider different brands of vehicles that could also meet the requirements of the job at hand. This means that the company can choose which type of vehicles they want to use to replace the current models. Company ABC currently use Toyota Hilux one-tonners and Toyota Dyna four-tonners. The following one-tonners can be considered as viable alternatives:

- Nissan CABSTAR - single cab
- Hyundai H 100 Bakkie
- Toyota one-tonner Bakkie
- Isuzu NLR 150

The following four-tonners can also meet the requirements of Company ABC:

- Hino 300 series 714 LWB
- Hino 300 series 814 LWB
- Mitsubishi Canter FE7-136
- Nissan UD40L
- Hyundai HD 72

- Isuzu NPR400

(NOTE: The Toyota Dyna has been discontinued and was replaced by the Hino 300 series 714 and 814.)

For every one of these vehicles, the following must be considered: The initial purchase price, the cost of modifications to equip the vehicle to be able to perform the job, the running cost (fuel) and maintenance cost. Another variable that plays a determining factor in the selection of the vehicles is the type of fleet discount on initial purchase that the agent can offer.

The working data for the vehicles are given the tables below:

Toyota Hino Four-tonner

Finance Options	Rate	# of months	Residule Value	Extended Period	Km
FML (Full Maintenance Lease)	13%	60	0%	0	
Operating Lease	13%	48	30%	1	
Buy Back	13%	36	30%	0	300000

Vehicle Options	Hino 300 Series 714 LWB	Hino 300 Series 814 LWB
Purchase Price	R 278,640.00	R 294,167.00
Weight	2346	2395
kW	100	100
Fuel economy	6.26	6.13
cost of fuel	7.6	7.6
running cost/km	1.214057508	1.239804241
running cost/month	R 8,256.00	R 8,430.00

Mitsubishi Canter FE7-136 Four-tonner

Finance Options	Rate	# of months	Residule Value	Extended Period	Km
FML (Full Maintenance Lease)	13%	60	0%	0	
Operating Lease	13%	48	30%	1	
Buy Back	13%	36	30%	0	300000

Suggested Retail Value		R 265,000.00
Less fleet owners discount		-R 25,175.00
Sub Total		R 239,825.00
Extras		
-	Supply and Fit 4.5m x 2,2m x 2.1m high volume van body single side door on kerb side	R 43,850.00
Purchase Price Excluding VAT		R 283,675.00
V A T @ 14%		R 39,714.50
Purchase Price Including VAT		**R 323,389.50**
Weight		2430
kW		100
Fuel economy		6
cost of fuel		7.6
running cost/km		1.266666667
running cost/month		R 8,613.00

Nissan UD40L Four-tonner

Finance Options	Rate	# of months	Residule Value	Extended Period	Km
FML (Full Maintenance Lease)	13%	60	0%	0	
Operating Lease	13%	48	30%	1	
Buy Back	13%	36	30%	0	300000
Chassis Cab			R 272,125.00		
Mega Fleet Discount			-R 64,315.00		
Sub Total			R 207,810.00		
Extras:	Pre Painted chromadek van body with 3mm std floor, 2 x rear doors, double side doors in centre, rope rails with hosing, battery box, mudflaps, tape & fuel saver 5.4m x 2.4m x 2.3m wide		R 64,000.00		
On The Road Fees			R 2,950.00		
Purchase Price Excluding VAT			R 274,760.00		
VAT			R 38,466.40		
Purchase Price Including VAT			R 313,226.40		
Weight		2400			
kW		90			
Fuel economy		6.8			
running cost/km		1.117647059			
running cost/month		R 7,600.00			

Hyundai HD72 Four-tonner

Finance Options	Rate	# of months	Residule Value	Extended Period	Km
FML (Full Maintenance Lease)	13%	60	0%	0	
Operating Lease	13%	48	30%	1	
Buy Back	13%	36	30%	0	300000
HYUNDAI HD72 CHASSIS CAB		**R 245,526.32**			
Less Rebate		**R 22,000.00**			
		R 223,526.32			
Cromodeck Van Body (double rear doors & Double Side door		**R 62,890.00**			
L-5.3m / W-2.4m / H-2.1m		R 286,416.32			
vat @ 14 %		**R 40,098.29**			
		R 326,514.61			
Lic/reg		**R 2,500.00**			
		R 0.00			
TOTAL		**R 329,014.61**			
Weight		2515			
kW		114			
Fuel economy		5.12			
cost of fuel		7.6			
running cost/km		1.484			
running cost/month		R 10,091.00			

Isuzu NPR 400 Four-tonner					
Finance Options	Rate	# of months	Residule Value	Extended Period	Km
FML (Full Maintenance Lease)	13%	60	0%	0	
Operating Lease	13%	48	30%	1	
Buy Back	13%	36	30%	0	300000
Vehicle Options	**Isuzu NPR 400**				
Purchase Price	R 303,500.00				
Weight	2610				
kW	114				
Fuel economy	4.9				
cost of fuel	7.6				
running cost/km	1.551020408				
running cost/month	R 10,547.00				

In the new supply-chain network, four-tonner trucks are going to run the following distance per month:

(25 km/load) x (10 loads/day) x (23.8 working days/month) = 5950 km/month

The total monthly operating cost is calculated from the vehicle's fuel economy multiplied by the kilometers travelled per month, plus service costs and insurance. The following monthly operating costs were obtained:

	Hino 300 Series 714 LWB	Hino 300 Series 814 LWB	Mitsubishi canter	Nissan UD40	HYUNDAI HD72 CHASSIS CAB	Isuzu NPR 400
Variable cost	R 8,256.00	R 8,430.00	R 8,613.00	R 7,600.00	R 10,091.00	R 10,547.00

One also has to consider the financing options that are available from the different financing institutions. The vehicle that is the most economical to purchase and run will be chosen as the replacement four-tonner. Thus, the vehicle must have the lowest sum of financing cost plus variable running costs. Most financing agents offer three main types of financing options namely:

- FML (Full maintenance lease)
- Operating lease
- Buy back

The full maintenance lease offers a 0% residual value and 60 monthly payments. The operating lease has a residual value of 30% and payments over a period of 48 months with a one month extended period if the buyer desires this.

The buyback option then offers a 30% residual value with payments happening over a period of 36 months. The vehicle can however be sold back to the lease company. Trucks can be returned on 300 000km while one-tonners can be returned on 270 000km.

As with the current state of the world economy, it is beneficial to inspect the effect that an interest rate change would have on the running costs of the fleet in terms of financing costs. This is done by the help of a tool called sensitivity analysis.

The variable and fixed costs incurred per vehicle per financing option on the different financing options are the following:

Full Maintenace Lease							
Interest Rate	Expense Type	Hino 300 Series 714 LWB	Hino 300 Series 814 LWB	Mitsubishi canter	Nissan UD40	Hyundai HD72	Isuzu NPR 400
9%	Monthly lease	R 5,784.11	R 6,106.42	R 6,713.02	R 6,502.06	R 6,829.79	R 6,300.16
	Variable costs	R 8,256.00	R 8,430.00	R 8,613.00	R 7,600.00	R 10,091.00	R 10,547.00
10%	Monthly lease	R 5,920.28	R 6,250.18	R 6,871.06	R 6,655.13	R 6,990.58	R 6,448.48
	Variable costs	R 8,256.00	R 8,430.00	R 8,613.00	R 7,600.00	R 10,091.00	R 10,547.00
11%	Monthly lease	R 6,058.31	R 6,395.90	R 7,031.26	R 6,810.29	R 7,153.56	R 6,598.83
	Variable costs	R 8,256.00	R 8,430.00	R 8,613.00	R 7,600.00	R 10,091.00	R 10,547.00
12%	Monthly lease	R 6,198.19	R 6,543.58	R 7,193.61	R 6,967.54	R 7,318.73	R 6,751.19
	Variable costs	R 8,256.00	R 8,430.00	R 8,613.00	R 7,600.00	R 10,091.00	R 10,547.00
13%	Monthly lease	R 6,339.92	R 6,693.20	R 7,358.09	R 7,126.85	R 7,486.08	R 6,905.56
	Variable costs	R 8,256.00	R 8,430.00	R 8,613.00	R 7,600.00	R 10,091.00	R 10,547.00

Operating Lease							
Interest Rate	Expense Type	Hino 300 Series 714 LWB	Hino 300 Series 814 LWB	Mitsubishi canter	Nissan UD40	Hyundai HD72	Isuzu NPR 400
9%	Monthly lease	R 5,480.72	R 5,786.13	R 6,360.91	R 6,161.01	R 6,471.55	R 5,969.70
	Variable costs	R 8,256.00	R 8,430.00	R 8,613.00	R 7,600.00	R 10,091.00	R 10,547.00
10%	Monthly lease	R 5,643.52	R 5,958.00	R 6,549.86	R 6,344.02	R 6,663.79	R 6,147.03
	Variable costs	R 8,256.00	R 8,430.00	R 8,613.00	R 7,600.00	R 10,091.00	R 10,547.00
11%	Monthly lease	R 5,807.38	R 6,130.99	R 6,740.03	R 6,528.21	R 6,857.27	R 6,325.51
	Variable costs	R 8,256.00	R 8,430.00	R 8,613.00	R 7,600.00	R 10,091.00	R 10,547.00
12%	Monthly lease	R 5,972.28	R 6,305.08	R 6,931.42	R 6,713.59	R 7,051.98	R 6,505.12
	Variable costs	R 8,256.00	R 8,430.00	R 8,613.00	R 7,600.00	R 10,091.00	R 10,547.00
13%	Monthly lease	R 6,138.23	R 6,480.28	R 7,124.02	R 6,900.13	R 7,247.93	R 6,685.88
	Variable costs	R 8,256.00	R 8,430.00	R 8,613.00	R 7,600.00	R 10,091.00	R 10,547.00

Buy Back							
Interest Rate	Expense Type	Hino 300 Series 714 LWB	Hino 300 Series 814 LWB	Mitsubishi canter	Nissan UD40	Hyundai HD72	Isuzu NPR 400
9%	Monthly lease	R 6,829.41	R 7,209.98	R 7,926.20	R 7,677.11	R 8,064.07	R 7,438.73
	Variable costs	R 8,256.00	R 8,430.00	R 8,613.00	R 7,600.00	R 10,091.00	R 10,547.00
10%	Monthly lease	R 6,990.25	R 7,379.78	R 8,112.87	R 7,857.91	R 8,253.98	R 7,613.91
	Variable costs	R 8,256.00	R 8,430.00	R 8,613.00	R 7,600.00	R 10,091.00	R 10,547.00
11%	Monthly lease	R 7,151.88	R 7,550.41	R 8,300.46	R 8,039.60	R 8,444.84	R 7,789.97
	Variable costs	R 8,256.00	R 8,430.00	R 8,613.00	R 7,600.00	R 10,091.00	R 10,547.00
12%	Monthly lease	R 7,314.30	R 7,721.89	R 8,488.97	R 8,222.19	R 8,636.62	R 7,966.88
	Variable costs	R 8,256.00	R 8,430.00	R 8,613.00	R 7,600.00	R 10,091.00	R 10,547.00
13%	Monthly lease	R 7,477.52	R 7,894.20	R 8,678.39	R 8,405.66	R 8,829.34	R 8,144.66
	Variable costs	R 8,256.00	R 8,430.00	R 8,613.00	R 7,600.00	R 10,091.00	R 10,547.00

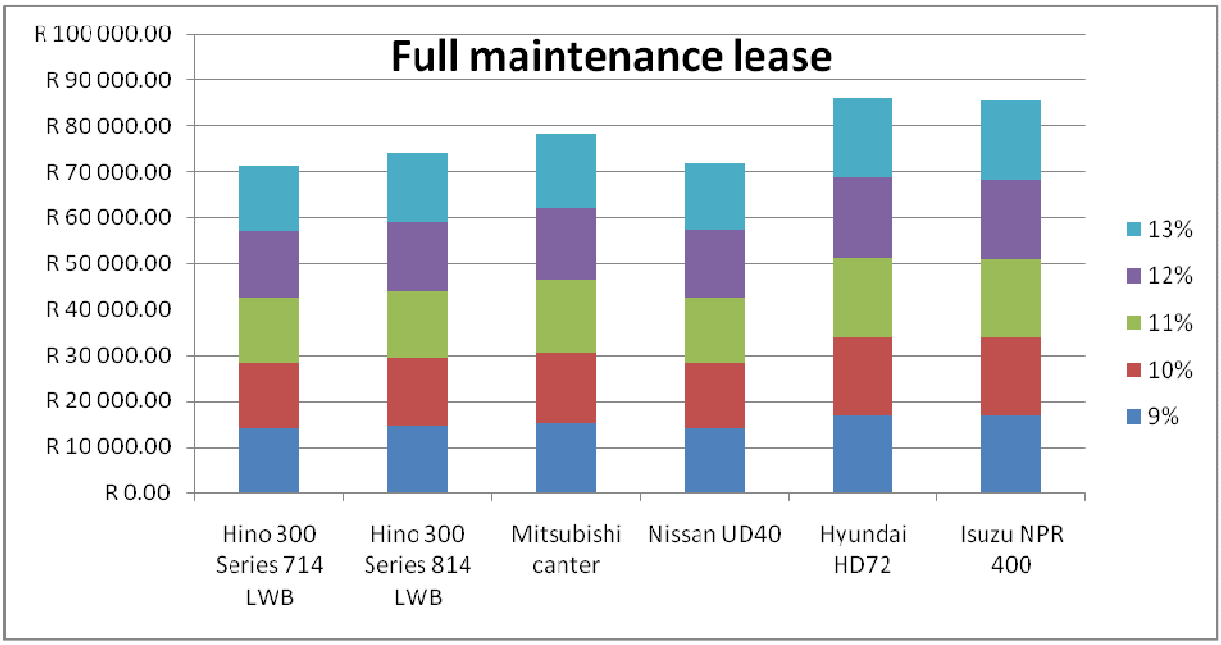
This amounts to the following total monthly expenditures per vehicle for each type of financing option:

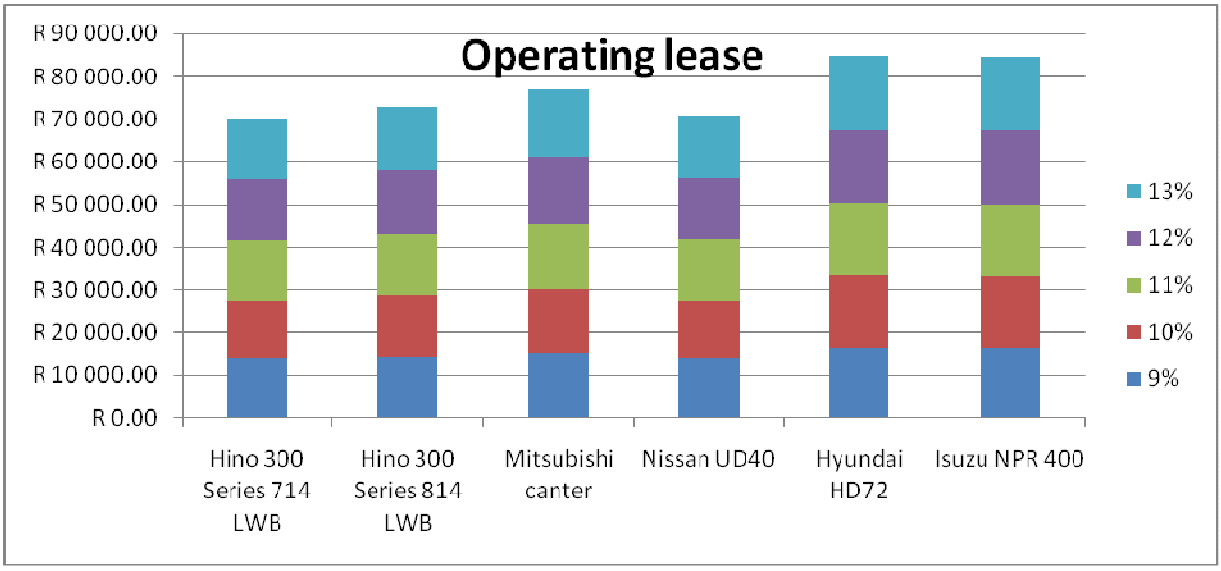
Full maintenance lease						
	Hino 300 Series 714 LWB	Hino 300 Series 814 LWB	Mitsubishi canter	Nissan UD40	Hyundai HD72	Isuzu NPR 400
9%	R 14,040.11	R 14,536.42	R 15,326.02	R 14,102.06	R 16,920.79	R 16,847.16
10%	R 14,176.28	R 14,680.18	R 15,484.06	R 14,255.13	R 17,081.58	R 16,995.48
11%	R 14,314.31	R 14,825.90	R 15,644.26	R 14,410.29	R 17,244.56	R 17,145.83
12%	R 14,454.19	R 14,973.58	R 15,806.61	R 14,567.54	R 17,409.73	R 17,298.19
13%	R 14,595.92	R 15,123.20	R 15,971.09	R 14,726.85	R 17,577.08	R 17,452.56

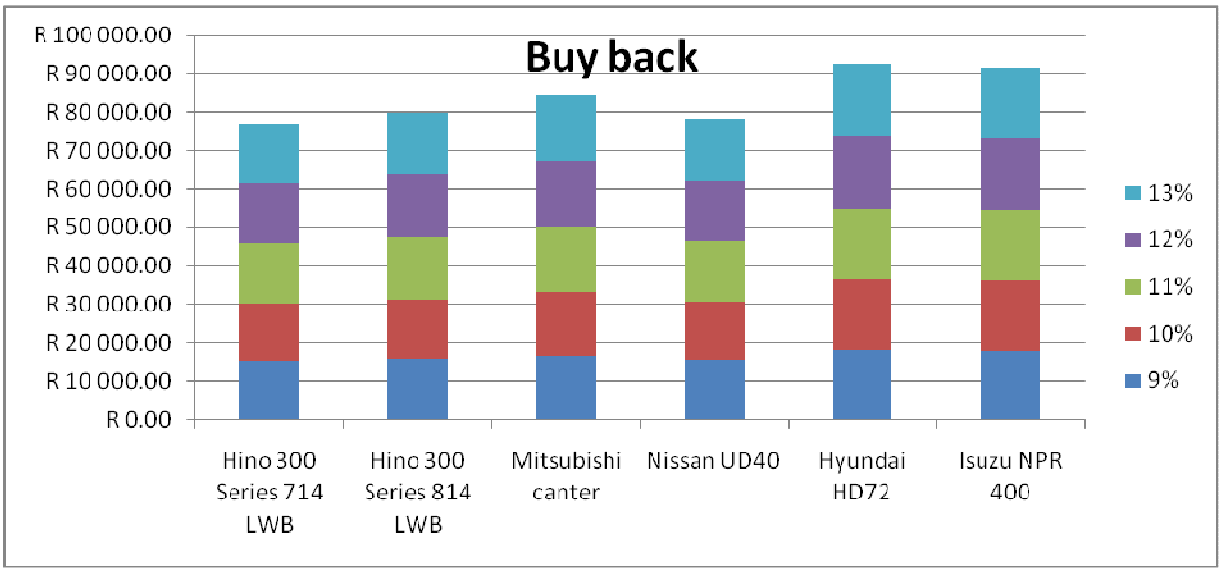
Operating lease						
	Hino 300 Series 714 LWB	Hino 300 Series 814 LWB	Mitsubishi canter	Nissan UD40	Hyundai HD72	Isuzu NPR 400
9%	R 13,736.72	R 14,216.13	R 14,973.91	R 13,761.01	R 16,562.55	R 16,516.70
10%	R 13,899.52	R 14,388.00	R 15,162.86	R 13,944.02	R 16,754.79	R 16,694.03
11%	R 14,063.38	R 14,560.99	R 15,353.03	R 14,128.21	R 16,948.27	R 16,872.51
12%	R 14,228.28	R 14,735.08	R 15,544.42	R 14,313.59	R 17,142.98	R 17,052.12
13%	R 14,394.23	R 14,910.28	R 15,737.02	R 14,500.13	R 17,338.93	R 17,232.88

Buy Back						
	Hino 300 Series 714 LWB	Hino 300 Series 814 LWB	Mitsubishi canter	Nissan UD40	Hyundai HD72	Isuzu NPR 400
9%	R 15,085.41	R 15,639.98	R 16,539.20	R 15,277.11	R 18,155.07	R 17,985.73
10%	R 15,246.25	R 15,809.78	R 16,725.87	R 15,457.91	R 18,344.98	R 18,160.91
11%	R 15,407.88	R 15,980.41	R 16,913.46	R 15,639.60	R 18,535.84	R 18,336.97
12%	R 15,570.30	R 16,151.89	R 17,101.97	R 15,822.19	R 18,727.62	R 18,513.88
13%	R 15,733.52	R 16,324.20	R 17,291.39	R 16,005.66	R 18,920.34	R 18,691.66

This data can be better analyzed by means of graphic illustration:







The graph is drawn in a way that expresses the various monthly expenditures on the different interest rates in an accumulative manner. In other words, the cost of running a particular vehicle in a period where the interest rate is 9% is summed to the cost of running it in a period where the cost of finance is up to 13%. This gives an accurate accumulative figure of the risk inherent to financing a vehicle.

The vehicle with the lowest accumulative costs for each financing option will be chosen as the best candidate.

The best performing vehicle is the Hino 300 series 714 followed by the Nissan UD40, the Hino series 814, the Mitsubishi Canter and the Isuzu NPR 400. The worst performing four-tonner is the Hyundai HD72. The obvious choice for company ABC is to buy only Hino 300 series 714 trucks as it has the lowest operating cost in any economic circumstance.

Now that the issue of the type of truck that must be used has been resolved, one must look at the type of financing option that is going to be the most cost effective option over the next three years.

The same financing options are valid for this analysis as the previous analysis:

- FML (Full maintenance lease)
- Operating lease
- Buy back

All the above financing options will be analyzed using an interest rate of 10%. In this analysis, one must look at all the trucks and one-tonners in the current fleet that meet the criteria of the Economic Service Life analysis. In other words, if trucks have more than 300 000km and one-tonners more than 275 000km on the clock, they are in line to be replaced.

For the initial analysis, all the current trucks and one-tonners will be replaced by Hino 300's. The current fleet data is analyzed in an Excel spreadsheet that considers the following for every vehicle in the ABC fleet:

- The date the vehicle was purchased whether truck or one-tonner
- The kilometers the vehicle has travelled
- The vehicle class description

In this analysis, 361 vehicles are going to be analyzed over the period of three years. If a one-tonner vehicle has done more than 275 000km or is older than 4 years, the model will replace it with a truck. Similarly, if the four-tonner has done more than 300 000km, the model will replace it with a new four-tonner.

The following assumptions must be made in the model:

- A vehicle will be sold at the end of the month it has reached its Economic Service Life
- All the privately owned vehicles will be sold

- After the lease is paid off, a monthly operational cost of R41,73 is incurred
- When the vehicle is sold, the outstanding balance is paid in full
- Operating expenditures for the current fleet and new fleet is ignored.

If a vehicle has reached or exceeded its economic service life (ESL), the model will automatically replace it with a new model. It will replace it the month following the month that it has reached its ESL.

The model will calculate how many vehicles are bought in a particular month and from there on hence, lease payments will be incurred for 36, 48 or 60 months, depending on the finance option. During the next three years, fuel and operating expenses must also be inflated to build realistic model. Fuel will be inflated by 12% yearly and operating initial vehicle expenses by 6.5% yearly. Fuel will thus be inflated 1% monthly and operational expenses by 0.542% monthly. For example, if a Hino 300 costs R278 640 now, it would cost R278 640 x 1.065^3 in three years' time. That is equal to R336 583. Vehicle prices usually escalate in December. All the costs are summed together for each month of the year. A NPV value is then calculated for all month totals and is summed to get a total NPV for each finance option. The following results were obtained:

	Monthly Installment				
Year	2010	2011	2012	2013	Total NPV
Full Maintenance Lease (FML)	5920	6305	6715	7151	23972076.5
Operating Lease (OL)	5643	6010	6400	6816	23830282.2
Buy Back	6990	7444	7928	8444	24771857.8

As seen from the above table, the operating lease is the option that with the lowest Net Present Value (NPV) for operating this fleet over the next period of three years.

Another interesting deliverable of this analysis is that if the vehicles are replaced in this manner over the next three years, the new one-tonner to four-tonner split is 13.76% to 86.24%. This is very close to the aimed percentage of 10 to 90 for the fleet ratio. The following table presents a vehicle split per year:

Vehicle ratio by year					
Year	2009	2010	2011	2012	2013
One-tonner	72.11%	72.00%	52.60%	33.00%	13.76%
Four-tonner	27.89%	28.00%	47.00%	66.80%	86.24%

9) Potential cost savings by implementing this Fleet Replacement Strategy

A simple way to calculate the potential savings is to use the model that was built in chapter seven of this paper. The fleet vehicle ratio can be entered into the model.

The first step in this analysis is to determine the cost of running the current fleet with an unchahged ratio:

Vehicle operating Cost	2010	2011	2012	2013	2014	2015
Vehicle split (4Ton vs. 1Ton)		28%	28%	28%	28%	28%
Number of 1Ton required		370	400	435	470	501
		13	14	15	16	17
Number of 4Ton required		76	82	89	96	102
		4	4	5	5	6
Total Vehicles required		*463*	*500*	*544*	*587*	*626*

The cost of running this fleet is the following:

	FY2011	FY2012	FY2013	FY2014	FY2015	
Total operating costs (R 000)	R 158,025	R 185,233	R 219,058	R 257,305	R 295,360	R 1,114,982

The proposed ratio is the following:

Vehicle operating Cost	2010	2011	2012	2013	2014	2015
Vehicle split (4Ton vs. 1Ton)		47%	67%	86%	90%	90%
Number of 1Ton required		272	183	85	65	70
		9	6	3	2	2
Number of 4Ton required		127	195	273	309	329
		7	11	15	17	18
Total Vehicles required		*415*	*395*	*376*	*393*	*419*

The fleet will cost the following to run:

	FY2011	FY2012	FY2013	FY2014	FY2015	
Total operating costs (R 000)	R 150,634	R 167,244	R 187,478	R 216,842	R 248,588	R 970,785

This amounts to a saving of R144 197 000 over the next five years.

10) Conclusion

In this document, a study was performed to establish the optimal service life of the vehicles in the ABC fleet. The result of this study showed that is to optimal to replace all one-tonner vehicles if they have done 275 000km or more.

Secondly, a study was performed to establish the optimal fleet mix in the new supply-chain network. It is clear that the current vehicle ratio of one-tonner to four-tonner vehicles will not be optimal. The study made it clear that company ABC should aim to acquire a 10% one-tonner to 90% four-tonner fleet vehicle split.

Lastly, a study was done on the current fleet to establish how the fleet will be transformed in the most cost effective way. The results of the ESL and fleet mix study were used as inputs for this calculation.

This study yielded the following results that company ABC must implement:

- To buy Hino 300 Series 714 Four-Tonners
- Sell the specific fleet vehicles as indicated (data not included in this report)
- To buy all vehicles on the operating lease

This document concludes with a summary of the cost savings, should the abovementioned results be employed.

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