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Olympic Dam Mining: Accounting For Capacity Management

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This case concerns the evaluation of a capital investment and provides an opportunity to conduct a sensitivity analysis of outcomes based on alternative project assumptions. Optimum production outputs depend on a reliable fleet of minesite vehicles. Replacement and maintenance alternatives need to be assessed and managed to ensure effective outcomes.

Keywords: investment, capacity, discounted cash flow

Introduction

Smith (2005) and Smith and Tucker (2013) identified six strategies necessary for the conduct of quality investment decision making. Three of these stages are central to the evaluation conducted in the case study of this paper:

(1) How are the cash flows estimated?

(2) What methods and assumptions are employed?

(3) What is the balance between financials/non-financials in decision making?

When the researcher is not directly involved in establishing estimated expenditures and cost savings, we should be aware of both the verification and monitoring processes in existence, as well as any potentially hidden agendas among the case participants. This is particularly pertinent where a subsequent post-audit of decision outcomes might result in "finger-pointing" and the attribution of blame for poor performance.

The essentials of the appraisal of cash flows through the three most prominent methods (payback, net present value (NPV), and internal rate of return (IRR)) are well established and are available from any reputable basic finance text. The two discounted cash flow methods (NPV and IRR) will normally yield consistent decisions; the payback method remains the most commonly used one in practice because of its ease of calculation and the focus on short-term liquidity considerations. In this case study, the "bundling" of projects together for a single evaluation is rightfully a cause for concern. Smith (2006) pointed to an example where such a "bundling" of economic and uneconomic projects took place, because it was the only way for the manager to have his/her preferred (but uneconomic) project passed the evaluation hurdle.

A balance between financial and non-financial outcomes is paramount, and in practice, the latter may be the most prominent in the decision-making process, especially where there are health and safety considerations. This balance is apparent in the following case where the financial implications are clear, but the relative strengths of the non-financial arguments (to do with flexibility, maneuverability, and safety) are less clear.

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The Case Study

Olympic Dam mining operates in the far north of the South Australia, close to the border with the northern territory. Research work has highlighted the potential for the discovery of economic gold and nickel deposits. Coordinated exploration for both minerals has yet to be carried out and will require investment in the vehicles fleet, either by upgrade or replacement.

Cedric Black, operations manager for Olympic Dam, is currently examining a proposal for the expenditure of $200,000 to replace 10 vehicles and items of mobile plant at this operation. The proposal before him evaluates the replacements as a “bundle” rather than assessing each vehicle replacement separately, because each of the items apparently has similar characteristics: excessive age, hard-to-obtain spares, and urgent need of major overhaul. He remains to be convinced that this is an entirely appropriate approach.

The vehicles and plant items are old, and records indicate that they are indeed costly to maintain. In some cases, spare parts are difficult to obtain, and those vehicles and plant items affected are subjected to lengthy periods of downtime. If these vehicles and plant items are to continue in service, they will require major overhauls to improve their deteriorating reliability and existing limitations to effective maintenance.

The plant is critical to successful operations, and as such, the “do nothing” option is not considered as a feasible alternative. The function provided by the plant cannot be lost, and the only reasonable alternatives are overhaul and replacement of the vehicles and plant items.

The proposal for their replacement under consideration is based on Olympic Dam’s approach to problem identification and justification, which comprises:

(1) Comparison of maintenance costs of items under consideration with average maintenance costs for the same vehicle or plant type;

(2) A description of the items under consideration, their use and pattern of utilization, and specific factors which cause them to be troublesome;

(3) An assessment of the salvage value and overhaul cost for each item under consideration, together with a proposed replacement and capital value;

(4) An economic analysis that considers investment, depreciation, and cash flow to calculate NPV and IRR.

Olympic Dam has not considered the option of leasing, since ample cash funds are currently available to finance the capital expenditure required.

The following vehicles/plant items are recommended for replacement (see Table 1).

Table 1

Vehicles for Replacement

Vehicle	Cost
1 × Ford cherry picker	$48,000
2 × Taylor Dunn transporters	$16,000
3 × Toyota 2WD utilities	$30,000
1 × Towmotor forklift	$48,000
1 × Mustang skidsteer loader	$40,000
1 × Platform truck	$10,000
1 × Rob Roy transporter	$8,000
Total proposed expenditure	$200,000

The estimated total salvage cost on disposal of existing equipment is $39,000.

The estimated total overhaul cost of existing equipment is $109,000. This expenditure does not include the purchase of spare parts which are assumed to be either already stocked or readily available from commercial stockists.

Overhaul costs are based on estimates made by the workshop foreman who has supervised previous overhauls. It is not anticipated that any overhaul will return the item to an "as new" condition, but rather to a best condition appropriate to the age of the item, and to one which would require only minor maintenance attention, at least in the short term. The total overhaul cost for all items represents about 55% of the total capital costs of the proposed replacement items.

Cost savings are estimated on the basis of maintenance costs for the next 10 years, which would not be required if the vehicles and plant items were replaced. These costs are estimated from trends appearing in the maintenance records for vehicles and plant items of similar age in the fleet. However, no allowance has been made for improved productivity or savings in labor costs as a result of replacing the nominated items. There is also no allowance for salvage costs at the end of the useful life of the new plant (For the purposes of project appraisal, cost savings are treated identically to positive cash flows, because they have an identical effect on pre-tax profits).

Olympic Dam considers this approach to assessing the overhaul cost and recurring maintenance costs for existing vehicles and plant items to be reasonable, even conservative, in that there is an implicit assumption that none of the overhauled plant would require anything more than routine maintenance for 10 years, nor is there any allowance made for the cost of hiring substitute plant during the overhaul period. The omission of these factors makes the overhaul option more attractive than it would otherwise be when the analysis is conducted.

The vehicles and plant items are estimated to have a total salvage value of $39,000. However, given the very uncommon nature of some of the vehicles and plant items and the abuse to which they have all been subjected (some for over 20 years), some of these salvage values may be optimistic, unless curiosity or antique value is considered.

Some vehicles and plants are so old or out of date that staff is unwilling to use them. When used, vehicles are not driven with excessive caution, so that body damage is common, a factor which might suggest their replacement with second-hand vehicles. In some instances, notably the Rob Roy transportable, oil leaks which cannot be rectified constitute a potentially serious safety hazard. The layout of the site makes the replacement of some units imperative; it is not possible, for example, to use fixed ladders in place of the platform truck, even if such an option is financially viable.

Table 2 details the various factors relevant to the capability and pattern of usage of the individual vehicles, giving an indication of their priority for replacement.

Cedric Black believes that the economic evaluation prepared for him is heavily biased in favor of vehicle replacement, clearly the option preferred by middle management, but he feels that a combination of maintenance, overhaul, and replacement for particular items may be more financially beneficial to Olympic Dam.

The basis of the assessment produced by the project team is the spreadsheet of Table 3. This spreadsheet lumps all the vehicles together and provides an economic evaluation model presented as a half-yearly investment and depreciation schedule and a schedule of cash flow from operations, including the effects of taxation. Depreciation is taken at 18% (declining balance) and taxation at 39%.

The cash from operations is considered to comprise the amount saved from the major overhaul of existing vehicles and plant items if they were not to be replaced, together with the amount saved for their estimated recurring maintenance costs (netted for estimated maintenance on the replacement plant). This model produces a final NPV and IRR of $98,000 and 38.7% respectively, with discounted payback of 6.5 years.

Table 2

Olympic Dam Vehicle Characteristics

	Age (years)	Salvage cost on disposal ($)	Maintenance cost ($)	Cost over six years (relative to whole fleet)	Major overhaul cost ($)	Replacement cost ($)	Overhaul cost as % of replacement cost	Spare parts availability
Ford cherry picker	20	5,000	8,000	+ 60%	4,000	48,000	8	Difficult
Taylor Dunn (#1)	10	3,000	8,500	+ 70%	5,700	8,000	71	Difficult
Taylor Dunn (#2)	11	4,000	5,000	Average	5,700	8,000	71	Difficult
Toyota (#1)	10	3,000	8,000	= 60%	16,000	10,000	160	No problem
Toyota (#2)	10	3,000	11,000	+ 120%	16,000	10,000	160	No problem
Toyota (#3)	8	5,000	4,000	- 20%	16,000	10,000	160	No problem
Towmotor forklift	20	7,000	6,000	+ 20%	15,000	48,000	31	Long leadtime
Mustang loader	8	4,000	7,500	+ 50%	7,200	40,000	18	No problem
Platform truck	10	0	15,000	+ 150%	15,000	10,000	150	Difficult
Rob Roy transporter	24	5,000	6,000	+ 20%	8,400	8,000	105	Impossible
Total		39,000			109,000	200,000		

Table 3

Spreadsheet for Project Evaluation

Period	Base 0	Y1H1 1	Y1H2 2	Y2H1 3	Y2H2 4	Y3H1 5	Y3H2 6	Y4H1 7	Y4H2 8	Y5H1 9	Y5H2 10
Investment and depreciation schedule 18.0% declining balance											
Investment	200.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Depreciation	0.0	18.0	18.0	14.8	14.8	12.1	12.1	9.9	9.9	8.1	8.1
Depreciated value	200.0	182.0	164.0	149.2	134.5	122.4	110.3	100.3	90.4	82.3	74.1
Working capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Salvage	0.0	39.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cash flow from ops	109.0	8.3	8.3	10.0	10.0	13.0	13.0	16.8	16.8	22.3	22.3
+ salvage	0.0	39.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
− depreciation	0.0	18.0	18.0	14.8	14.8	12.1	12.1	9.9	9.9	8.1	8.1
Taxable income	109.0	29.3	(9.8)	(4.8)	(4.8)	0.9	0.9	6.9	6.9	14.1	14.1
− tax paid (1-year lag)	0.0	0.0	0.0	7.6	0.0	(3.7)	0.0	0.7	0.0	5.4	0.0
After-tax cash from ops	109.0	29.3	(9.8)	(12.4)	(4.8)	4.6	0.9	6.2	6.9	8.7	14.1
Less working capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Less investment	200.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Add depreciation	0.0	18.0	18.0	14.8	14.8	12.1	12.1	9.9	9.9	8.1	8.1
Net cash flow	(91.0)	47.3	8.3	2.4	10.0	16.7	13.0	16.1	16.8	16.9	22.3
Discounted cash flow 13.0% discount factor											
NPV	(91.0)	(46.6)	(39.4)	(37.4)	(29.6)	(17.4)	(8.5)	1.9	12.0	21.6	33.4
End-year IRR (%)	NA	NA	NA	NA	NA	NA	5.2	14.4	20.9	25.4	29.6

(Table 3 continued)

Period	Base 0	Y6H1 11	Y6H2 12	Y7H1 13	Y7H2 14	Y8H1 15	Y8H2 16	Y9H1 17	Y9H2 18	Y10H1 19	Y10H2 20
Investment and depreciation schedule 18.0% declining balance											
Investment	200.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Depreciation	0.0	6.7	6.7	5.5	5.5	4.5	4.5	3.7	3.7	3.0	3.0
Depreciated value	200.0	67.5	60.8	55.3	49.9	45.4	40.9	37.2	33.5	30.5	27.5
Working capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Salvage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cash flow from ops	109.0	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3
+ salvage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
− depreciation	0.0	6.7	6.7	5.5	5.5	4.5	4.5	3.7	3.7	3.0	3.0
Taxable income	109.0	15.6	15.6	16.8	16.8	17.8	17.8	18.6	18.6	19.2	19.2
− tax paid (1-year lag)	0.0	11.0	0.0	12.1	0.0	13.1	0.0	13.9	0.0		
After-tax cash from ops	109.0	4.6	15.6	4.6	16.8	4.7	17.8	4.7	18.6	19.2	19.2
Less working capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Less investment	200.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Add depreciation	0.0	6.7	6.7	5.5	5.5	4.5	4.5	3.7	3.7	3.0	3.0
Net cash flow	(91.0)	11.2	22.3	10.1	22.3	9.2	22.3	8.4	22.3	22.3	22.3
Discounted cash flow 13.0% discount factor											
NPV	(91.0)	39.1	49.5	54.0	63.2	66.8	74.9	77.8	84.9	91.6	98.0
End-year IRR (%)	NA	31.2	33.5	34.3	35.7	36.2	37.0	37.3	37.9	38.3	38.7

Depreciation is deducted, as it occurs each half year to calculate taxable income, from which tax is deducted at the rate of 39% (assuming a 12-month lag) to give the after-tax cash position from operations. This value is adjusted for working capital, investment, and depreciation to obtain the net cash flow for each half-year interval. A discount factor of 13% per annum is applied to calculate a NPV for each half-year interval. This is the standard rate used by Olympic Dam for expenditure proposals.

Cedric Black has a number of doubts about the analysis, apart from his fundamental concern about the "bundling" together of the projects:

(1) More conservative assumptions regarding the timing of maintenance savings might generate negative net cash flows more than once in the spreadsheet analysis, which would cast doubt over the interpretation of the IRR;

(2) The size of the salvage value and its realization in the first half of Year 1 of the appraisal raises concerns about the sensitivity of the analysis to alternative assumptions.

You are required to allay Cedric's fears, or otherwise, by conducting a sensitivity analysis of the existing proposal and then by exploring alternative strategies for vehicle replacement.

Teaching Note

Olympic Dam's vehicle fleet is old; average age 13.1 years and with ages ranging from eight to 24 years. With age has come inefficiency of operation and high maintenance costs; for some vehicles maintenance costs are twice that of the fleet average and are clearly financially uneconomic. Besides, in many instances spare parts are scarce and difficult to obtain, creating process bottlenecks and impacting negatively output. Some of the vehicles are likely not to "fit for purpose" in that they pose a safety hazard.

"Do nothing" does not appear to be a feasible alternative, and Olympic Dam must replace all or part of its fleet, with purchased or leased vehicles. Four options are considered here.

The two extremes:

(1) Replace all vehicles;

(2) Overhaul all vehicles.

The two intermediary stages:

(3) Do nothing if possible, otherwise overhaul where overhaul appears unwise then replace;

(4) Replace where absolutely essential, otherwise overhaul.

In terms of an "economy" measure, #1 is the most expensive, and #2 is the cheapest strategy in the short term.

Replacement

This is the most radical option which requires an expenditure of $200,000 to replace all the vehicles and items at the plant. Although it requires the largest outlay, subsequent maintenance cost in the foreseeable future would be reduced. Hence, the initial outlay could be recouped in later years as cost savings. In addition, there are fewer risks involved, as all vehicles are new, and there is a lesser likelihood of potential breakdown. New vehicles are also safer, which enables the employees to work in a better and safer environment, which is likely to promote morale. However, this option requires the greatest initial outlay which could limit the firm's investment opportunities. Other potential investment opportunities may have to be forgone due to lack of reserves. On the other hand, this is the preferred option by middle management because of greater cash inflows in terms of cost savings in years to come. Moreover, this option provides a long-term solution, reducing the need for unnecessary expenses in later years.

Overhaul

This option has the cost advantage over replacement, because it costs 55% of the replacement cost. It is not anticipated that the overhaul will return the items to "as new" condition but rather to a best condition appropriate to the age of the item and to one which would require only minor maintenance at least in the short term. In other words, this option is viewed as being only a short-term solution. Consequently, cash outflows for maintenance and other possible repairs may increase at a higher rate due to the higher possibility of malfunction, thus offsetting the initially low outlay. Taking into consideration that there is a greater possibility of the overhauled vehicles breaking down and disrupting production, the firm should probably set aside a contingency amount for repairs and hire during the breakdown period. In this case, the firm would have lower funds for the other purposes due to the uncertainty involved.

Nevertheless, because some of the vehicles are so old, overhaul may not improve their condition significantly. Moreover, the expenditure does not include the purchase of spare parts. Hence, though this option may seem to be financially attractive due to lower costs, there are hidden costs involved which are not included in the analysis. However, the firm would have more funds to invest in other operations or interest-bearing investment which could generate more income.

Selective Replacement

This policy is based on #1 being too radical, resulting in the replacement of vehicles which still have a good number of years of satisfactory service left in them. This results in some savings in the initial outlay.

Replacement as a Last Resort

This is a “do nothing if possible” option. But some vehicles need to be overhauled, and in some cases, overhaul is so prohibitively expensive that replacement is advisable. This is the option that requires the lowest initial outlay. Those vehicles not requiring immediate attention would need to be re-examined annually to determine their continuing condition. Future costs will be likely to increase at escalating rates, with unexpected breakdowns occurred.

For each option, depreciation is taken at 18% declining balance and is deducted as it occurs each half year to calculate taxable income from which tax is deducted at the rate of 39% to give the after-tax cash position. The discount factor is taken to be 13% per annum to calculate a NPV for each half-year interval which is the standard rate used by Olympic Dam for expenditure proposals.

Cost savings are estimated on the basis of maintenance costs for the next 10 years, which would not be required if the vehicles and plant items were replaced. No allowance has been made for improved productivity or savings in labor costs as a result of replacing the nominated items. Furthermore, no allowance is made for the cost of hiring substitute plant during the overhaul period. The appropriate method of allocation of the maintenance cost savings is not provided in the case study, so realistic assumptions are made throughout.

Analysis

Option 1: Replacement

The strengths of replacement are as follows:

(1) Highest NPV ($98,000) and IRR (38.7%);

(2) Cost savings in terms of maintenance cost and possible breakdown, as most suppliers would provide loan vehicles and new vehicles, are covered by warranty, at least for the short term;

(3) Reliability of vehicles;

(4) Reduced downtime, bottlenecks, and waste;

(5) Increased productivity and efficiency;

(6) Improved working and environmental conditions in terms of safety and employee satisfaction;

(7) Perception of the firm as a “caring” organization.

The weaknesses of replacement are as follows:

(1) High initial outlay;

(2) No allowance made for improved productivity or savings in labor costs;

(3) Not all items under consideration need to be replaced, hence a potential waste of resources;

(4) The loss opportunity of investing in other potential revenue-generating investments, such as the search for and evaluation of other possible mineral deposits.

The analysis in Table 2 is based on Olympic Dam’s original study where the replacements are evaluated as a bundle rather than assessing each vehicle separately based on similar characteristics. In the original proposal, the vehicles and plant items are estimated to have a total salvage value of $39,000. However, given the very uncommon nature of some of the vehicles and plant items and the abuse to which they have been subjected, some of these salvage values may be optimistic. It may be unrealistic to recognize the entire amount of salvage value in the first year and the entire amount of the savings in terms of overhaul cost of $109,000 in the base year.

The impact of including the entire amount of the salvage value in the proposals would overstate the outcome of the proposal, and it would be unrealistic to recognize the whole amount of the salvage and the savings of cash outflow in the first year of the proposal. It appears that management strongly favors this option and may have designed an appraisal where it appears more attractive than it would otherwise be.

To provide a more realistic analysis, the salvage values are recognized on the basis of the condition of the vehicles, which reflects the ease of their sale. The vehicles which have fewer problems are assumed to be sold first. Sensitivity analysis is conducted to assess the impact of the difference between expected and actual salvage value, with a most conservative option of $10,000 salvage rather than $39,000.

This modified option produces a NPV of $40,800 and IRR of 19% with a discounted payback period of six years. From a financial point of view, this proposal seems to be less attractive (lower NPV and IRR) than the original proposal, but it adopts a very pessimistic outlook which provides a "worst-case" assessment of the "replacement" option.

Option 2: Overhaul

The strengths of the overhaul option are as follows:

(1) Lower initial outlay, hence more costs savings;

(2) Require only minor maintenance at least in the short term;

(3) Some vehicles may be old, but it could be the industry average or the norm for the vehicles, hence, overhaul rather than replacement may be appropriate.

The weaknesses of the overhaul option are as follows:

(1) No allowance is made for improved productivity or savings in labor costs;

(2) A short-term solution; NPV ($49,600); IRR (26.2%); discounted payback period (12 years);

(3) Overhauling may not improve conditions vastly, hence a potential waste of resources;

(4) Potential problems;

(5) Breakdowns, increased downtime, and lower turnover rate, productivity, and waste;

(6) Potential safety hazard to the employees, hence possible union and legal action.

Over time, more expenditure would need to be undertaken possibly at a higher cost due to the neglect of the condition and the obsolescence of the vehicles which cannot be rectified through overhaul.

In this option, all vehicles are overhauled regardless of condition. Cash flow from operations is calculated based on the sum of the savings in outflows from replacing the vehicles and the expected reduction in maintenance cost for the vehicles. The expected reduction in maintenance cost is determined by calculating the total costs of overhaul as a percentage of the total replacement costs. The overhaul cost is 55% of the total replacement costs. This figure would then be multiplied by the expected savings in maintenance cost for the next 10 years, were the vehicles to be replaced, resulting in the expected savings in maintenance for the overhaul cost. Subsequently, the overhaul cost for each vehicle is calculated as a percentage of the total overhaul costs to derive savings in overhaul costs for each vehicle.

The NPV and IRR for this option are $49,600 and 26.2% respectively with a payback period of approximately 12 years which is almost double the length of Option 1. Aside from the lower capital outlay, overhaul would result in a lower subsequent maintenance cost, which stems from the marginally improved working condition of the vehicles. However, this option is only a short-term solution. It would be detrimental to the firm, if the overhauled vehicles breakdown halfway through the operations affecting exploration and output. This would only be an appropriate option, if the firm is in a tight financial position where "economy" is a vital feature of the appraisal.

Option 3: Replace Where Essential

The strength of this option is the identification of vehicles that need to be replaced, hence lower initial outlay when compared with replacement. While the weaknesses are as follows:

(1) No allowance made for improved productivity or savings in labor costs;

(2) Uncertainty in the choice of vehicles for replacement/overhaul;

(3) May only be a short-term solution for vehicles overhauled, hence a waste of resources;

(4) NPV $32,200; IRR 17.4%.

Vehicles not overhauled may cause the following problems:

(1) Breakdowns, increased downtime, and lower turnover rate, productivity, and waste;

(2) Potential safety hazard to the employees, hence possible union and legal action.

This model allows greater flexibility in the selection of vehicles for replacement. In this analysis, vehicles deemed unfit for operations would be replaced, while those with fewer problems are overhauled. The model here highlights the priorities for vehicle replacement; under this option, Priorities 1 and 2 are replaced, and 3 and 4 are overhauled. The cash flow from operations is calculated on the expected reduction in maintenance cost determined by calculating the total costs of overhaul as a percentage of the total replacement costs.

Salvage costs are once again based on pessimistic estimates, and vehicles in better condition are expected to be sold first.

Since the vehicles are either replaced or overhauled based on a needs basis, it would provide greater savings compared with Option 1 and better guard against uncertainties and possible risks of overhaul. However, the difference in the cost of this option ($185,200) and the cost of total replacement ($200,000) is minor, and there may be greater benefits in replacing all the vehicles as this would ensure a smoother flow of operation. Moreover, with some vehicles in a fairly good condition, the sale of these vehicles now could result in a better price. Nevertheless, this option would allow Olympic Dam to ensure that its vital operations would function efficiently and at the same time provide more reserves for investment in other potential income-generating opportunities.

Option 4: Selective Replacement

The strengths of selective replacement are as follows:

(1) Lowest initial outlay;

(2) NPV ($45,000); IRR (22.1%);

(3) Flexibility;

(4) No waste of resources, reducing unnecessary expenses as only those vehicles which need to be replaced or overhauled are acted upon.

Admittedly, this option would also have weaknesses as follows:

The wrong vehicles may be selected for replacement/overhaul and those vehicles not selected may cause problems—incurring higher costs, disrupting production, and reducing efficiency, productivity, safety, and environmental impact:

(1) Breakdowns, increased downtime, and lower turnover rate, productivity, and waste;

(2) Potential safety hazard to the employees, hence possible union and legal action.

Option 4 is similar to Option 3 where vehicles are either replaced or overhauled, but in this case, vehicles are not compelled to be either. Using the same priorities as earlier, Priorities 1, 2, and 3 are selected for replacement, none for overhaul and Priority 4 for "do nothing". From a financial point of view, this option is the most conservative of all and requires the least outlay. The decision to either overhaul or replace is based on the age and the amount of overhaul cost involved. For instance, although the towmotor forklift could be overhauled, it is replaced because of a long leadtime for the spare parts which cannot be rectified through overhaul. Furthermore, it is 20 years old and would cost $15,000 to overhaul. The vehicles replaced are expected to have a lower maintenance cost generating savings in cash outflows. Vehicles overhauled are expected to generate cost savings in terms of reduction in maintenance cost and savings in terms of lower outlay required for overhaul.

The attractiveness of this option is the flexibility it offers compared with all of the above options, as detailed in Table 4.

Table 4

Options for Change

	Investment ($000)	NPV ($000)	IRR (%)	Discounted pay back (years)
Option 1: Replacement	200	93.8	38.5	6.5
Option 1: (Pessimistic assumptions)	200	40.8	19.0	6.0
Option 2: Overhaul	109	49.6	26.2	12.0
Option 3: Replace where essential	185.2	32.2	17.4	6.5
Option 4: Selective replacement	130	45.0	22.1	10.0

Recommendations

In terms of an "effectiveness" measure, only Option 2, overhaul, can be disregarded. Without vehicle replacement, the fleet will be unreliable and remain unfit for purpose. In terms of "economy", Option 4 is the next best one and may provide a suitable short-term solution, if budget pressures are great or if cost savings in this year are high on the agenda.

Option 3 scores high on flexibility, but the cost savings compared with full replacement are miniscule. The financial returns do not compare with those of Option 1, full replacement. Even with very (even overly) pessimistic estimates for salvage values and income recognition, Option 1 is outstanding. It appears that Cedric Black should have few fears that this is the optimum course of action.

Conclusions

The project analysis reveals outcomes largely as anticipated. The case participants clearly favour the investment in new vehicles, and cost saving estimates might therefore have been biased in that direction. However, sensitivity analysis of the assumptions substantially allays these fears. The arguments provided by the non-financial factors, particularly those associated with safety and driver preferences, are key factors in the decision to replace the aging fleet.

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