Mini Case #2
Rio Claro, Inc.:
Capital Budgeting Decision Analysis

Prepared by:
Michael Thuresson

FIN 526: Financial Management
Lead Instructor: Dr. John Becker-Blease
Section Instructor: Professor Brandon Spaeth
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Introduction

Rio Claro, Inc., a cargo transport company, operates a small dry-cargo vessel called the *Maracas;* the *Maracas* is 25 years old, and in serious need of an overhaul. Three proposals have been presented to Michael John, finance director at Rio Claro, Inc.; these options include a basic overhaul, a basic overhaul plus a brand-new engine and control system, and the purchase of a new vessel to replace the *Maracas* altogether. The book value of the existing vessel is estimated at $100,000, and the book value of any spare parts on hand is estimated at $40,000; market value of the vessel as-is, including all spare parts, is estimated to be $200,000. The overhaul of the vessel would extend the life by 12 years, but would require that the boat be out of service for one year while the overhaul is completed. The vessel would resume commercial service in year 1, while depreciation and operating expenses beginning to accrue during year 2.

The basic overhaul of the *Maracas* would require upfront expenditures of $820,000, plus an opportunity cost of $39,000 after taxes, for a total upfront expense of $859,000. Post-overhaul operating costs for this option would equal $1,181,000 per year, growing with inflation. For a basic overhaul plus a new engine and control system, upfront expenditures include the aforementioned $859,000 for the overhaul and opportunity costs, plus an additional $600,000 for the engine and control system; this option makes the upfront expenditure to be $1,459,000. Post-overhaul operating costs for this option would equal $1,020,000 per year, growing with inflation.

Finally, Rio Claro, Inc. has the option to purchase a new vessel for a fixed price of $3,000,000, payable half immediately and half on delivery in one year. Annual operating costs of the new vessel are estimated to be $885,000; however, this vessel is expected to generate additional revenues of approximately $175,000 in the first year of operation. Operating costs for

all options, as well as revenue generated by the new vessel, will increase at a forecasted 1.25% inflation rate each year, with a depreciation schedule following the 7-year MACRS schedule.

Net Present Value (NPV) of the Maracas

The proposed overhaul of the *Maracas* is the first option that needs to be analyzed before considering the alternative option of purchasing a new ship. There are two overhaul options available; a basic overhaul, as well as a basic overhaul plus a new engine and control system. It is helpful to first establish which overhaul option for the existing vessel has the most attractive NPV, or the lowest amount of cash outflow, since no revenue has been provided. In both cases, the overhauled vessel will continue to operate for the same 12-year period.

The initial cash outlay today for the new engine and control system, at $1,459,000, is significantly greater than that of the basic overhaul, at $859,000, see Figure 1 in the Appendix. In this calculation, we considered both the opportunity cost of forgoing the sale of the *Maracas* at book value with resulting tax benefit, and the initial capital outlay for the actual overhaul. Since it took one year to perform the overhaul, no cash inflows or outflows take place until the beginning of year 2. Starting in year two, depreciation of the overhaul begins to provide a tax credit to overall cash flow. The full depreciation cost is not an actual cost, only an indirect benefit as a tax credit. Operating costs also start in year two and progress through year thirteen (twelve years of operation). Each year, inflation is added to the costs to accurately account for the forecasted cost outflow; inflation for year one was included in the calculation for all subsequent expense cash flows. Operating cash flow was calculated using the tax shield approach. Figure 2 in the Appendix shows a screenshot of the formulas used and the results for the first three years. A full table of years one through thirteen is found in Figure 3 of the Appendix. The resulting NPV for the basic overhaul is $-6,300,849, while the overhaul with the

engine and control system is $-5,985,740. Both NPV's are negative due to the negation of revenue from the analysis; since one project must be selected, the overhaul with the engine and control system should be selected since it has the least indebtedness. An alternative solution to explain the operating cash flows is found in Figure 5 of the Appendix.

We conclude that the extra initial cash outlay for the new engine and control system, which leads to lower post-overhaul operating costs, reduces costs enough to overcome the additional initial cash outlay. Even though the more extensive overhaul would not contribute to incremental revenue in any way, nor extend the life of the *Maracas*, it has a more favorable NPV than that of the basic overhaul.

NPV of New Vessel

To ensure the firm captures the most profitable option, NPV of a new vessel is also presented. The initial cash outlay from the fixed cost of $3,000,000 for the new vessel is spread out into two separate periods, one today and one a year later after the vessel is delivered. The cost of training the crew is incurred during year 2, after the vessel has been delivered. From year two onward the vessel will be operational; like the overhaul projects, all asset costs will be depreciated along the same seven year MACRS and all annual expenses will be calculated with inflation. The one difference is the savings the new vessel brings to the annual expenses. This is subtracted out of the annual expenses as a credit due to it being a more efficient vessel that can carry heavier loads.

The new vessel also enjoys a depreciation tax shield, just as the overhaul options do. Figure 4 in the Appendix shows a screenshot of the calculations and results for the first three years of operation. Using NPV analysis alone, the new vessel has a lower NPV value of $-6,740,761 for twenty years of useful life. Therefore, if selecting a project on NPV alone, the

engine and control system overhaul is the best option. However, in addition to NPV, it is necessary to calculate the equivalent annual costs of each vessel to better understand any discrepancies in useful life, and thus determine which option is truly best.

Equivalent Annual Costs (EAC)

EAC is used as an analysis tool because the difference in useful life between the overhaul options and new vessel are substantial; even though an option may have lower costs and a higher NPV, it may need to be replaced sooner than a more expensive option. To ensure an equivalent annual cost, the real discount rate is used to account for inflation rather than the nominal rate. In the case of the *Maracas*, a second 12-year operation and overhaul with inflation was added to each overhaul project to make the comparison with the new vessel more accurate. The NPV of the standard overhaul with an additional 12 years of operations calculates to $-8,952,072, while an overhaul with engine and control system results in $-8,421,681. Both of these are significantly higher than buying the new vessel. However, to ensure the timing of all three proposals are accurately portrayed; EAC standardized the NPV value into an annual cost. Figure 7 in the Appendix shows a screenshot of the calculation needed to add overhauls at year thirteen. Figure 6 in the Appendix shows the EAC calculations and results for all three proposals.

The EAC for each option is obtained by dividing the NPV of the option by the annuity factor, which in the *Maracas* scenario is calculated to be 11.65. Thus, the EAC for the basic overhaul is $-768,245, while the engine and control system overhaul is $-722,728. The new vessel has an EAC of $-644,214, effectively illustrating it to be the best value for Rio Claro, Inc.

Value of EAC

We were able to determine the best financial option by using equivalent annual costs; the EAC allows us to consider how long a company should keep and use an asset before replacing it. The vessel in this case had already undergone significant years of use; with that understanding, it

is imperative to look at long-running financial obligations and the life of the vessel. Additionally, applying the real discount rate to the scenario allows us to calculate the value of future income each vessel option will bring by neutralizing the effects of inflation. Although the equivalent annual cost analysis is the best financial approach, it still cannot account for any accidents or failures each vessel option may experience.

Conclusion

For Mr. John at Rio Claro, Inc. to make the right transport decision, an accurate use of capital budgeting tools NPV and EAC must be presented. NPV alone works very well for both overhaul options. For these two options, the overhaul with the engine and control system change has the best NPV. Initial NPV calculations of the new vessel are far less attractive because of the inaccuracy of the timing scales of useful life between the new vessel and overhaul options. As such, an additional life cycle to include second overhead costs of the *Maracas* was needed to more closely match the new vessel useful life. Though this makes NPV more accurate, the timing of cash flows are still not matched. This is why EAC was used to ensure the most profitable option is selected.

EAC is the cost per year of owning and operating equipment over its entire life. It is primarily used to make capital budgeting decisions when the lifespan is different for various projects. For Rio Claro, the best EAC value is buying the new vessel. This is primarily due to the significant costs of the additional overhauls. Mr. John can sleep easy at night knowing that the most accurate capital budgeting tools were used to ensure the best value for Rio Claro.

Appendix

MARACAS DETAILS			
General Notes: Maracas			
Vessel out of service during overhaul (years)	1		
Useful life post overhaul (years)	12		
Depreciate on 7-year MACRS schedule			
Salvage value (trivial)	0		
Book value - Vessel	100,000.00		
Book value - Spare parts	40,000.00		
Market value - Vessel as-is w/ spare parts	200,000.00		
Year 0: Overhaul work; vessel out of service 1 year			
Year 1: Vessel resumes commerical service			
Year 2: Depreciation & operating costs begin to accrue			
Table 1: Maracas Overhaul One-Time Expenditures			
Overhaul engine and generators	340,000.00		
Replace radar and other electronic equipment	75,000.00		
Repairs to hull and superstructure	310,000.00		
Painting and other repairs	95,000.00		
(must depreciate)	820,000.00	(occurs Year 0)	
Installation of new engine add	600,000.00		
(must depreciate)	1,420,000.00	(occurs Year 0)	
Table 3: Maracas Post-overhaul Operating Costs (Basic Overhaul)			
Fuel	450,000.00		
Labor and benefits	480,000.00		
Maintenance	141,000.00		
Other	110,000.00		
(yearly and grows at inflation rate)	1,181,000.00		
Table 4: Maracas Post-overhaul Operating Costs (Basic overhaul + new engine & control system)			
Fuel	400,000.00		
Labor and benefits	405,000.00		
Maintenance	105,000.00		
Other	110,000.00		
(yearly and grows at inflation rate)	1,020,000.00		

Figure 1: Maracas Overhaul Expenses

Maracas Basic Overhaul: NPV

Year	0	1	2	3	4
Overall Costs =	820,000.00				
Opportunity Cost = (Market Value-Book Value)*(1-Tax rate) =	39,000.00				
Sales revenues =	0.00	0.00	0.00	0.00	
Cash costs = operating costs*(1+inflation rate)^year =			1,210,709.53	1,225,843.40	1,241,16
Depreciation = overhaul expense*MACRS =			117,178.00	200,818.00	143,41
OCF = (Sales-Cash costs)*(1-tax rate)+Depreciation*tax rate =	-859,000.00	0.00	-745,948.90	-726,511.91	-756,56
	NPV (first overhaul)	**-6,300,849.33**	$NPV = \sum_{t=0}^{n} \frac{CF_t}{(1+r)^t}$		

Maracas Basic Overhaul + New E&C: NPV

Year	0	1	2	3	4
Overall Costs =	1,420,000.00				
Opportunity Cost = (Market Value-Book Value)*(1-Tax rate) =	39,000.00				
Sales revenues =	0.00	0.00	0.00	0.00	
Cash costs = operating costs*(1+inflation rate)^year =			1,045,659.38	1,058,730.12	1,071,96
Depreciation = overhaul expense*MACRS =			202,918.00	347,758.00	248,35
OCF = (Sales-Cash costs)*(1-tax rate)+Depreciation*tax rate =	-1,459,000.00	0.00	-608,657.29	-566,459.28	-609,85
	NPV (first overhaul)	**-5,985,740.88**	$NPV = \sum_{t=0}^{n} \frac{CF_t}{(1+r)^t}$		

Figure 2: NPV Analysis of Maracas Overhaul Options

0	1	2	3	4	5	6	7	8	9	10	11	12	13
820,000.00													
39,000.00													
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		1,210,709.53	1,225,843.40	1,241,166.44	1,256,681.02	1,272,389.54	1,288,294.41	1,304,398.09	1,320,703.06	1,337,211.85	1,353,927.00	1,370,851.09	1,387,986.72
		117,178.00	200,818.00	143,418.00	102,418.00	73,226.00	73,226.00	73,226.00	36,490.00				
-859,000.00	0.00	-745,948.90	-726,511.91	-756,561.89	-780,996.37	-801,424.10	-811,762.26	-822,229.66	-845,685.49	-869,187.70	-880,052.55	-891,053.21	-902,191.37
NPV (first overhaul)	**-6,300,849.33**	$NPV = \sum_{t=0}^{n} \frac{CF_t}{(1+r)^t}$											

0	1	2	3	4	5	6	7	8	9	10	11	12	13
1,420,000.00													
39,000.00													
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		1,045,659.38	1,058,730.12	1,071,964.24	1,085,363.80	1,098,930.84	1,112,667.48	1,126,575.82	1,140,658.02	1,154,916.25	1,169,352.70	1,183,969.61	1,198,769.23
		202,918.00	347,758.00	248,358.00	177,358.00	126,806.00	126,806.00	126,806.00	63,190.00				
-1,459,000.00	0.00	-608,657.29	-566,459.28	-609,851.46	-643,411.17	-669,922.95	-678,851.76	-687,892.19	-719,311.21	-750,695.56	-760,079.25	-769,580.25	-779,200.00
NPV (first overhaul)	**-5,985,740.88**	$NPV = \sum_{t=0}^{n} \frac{CF_t}{(1+r)^t}$											

Figure 3: NPV and Calculations for Basic and Engine/Control System Overhauls

New Vessel: NPV					
Year	0	1	2	3	4
Overall Costs =	1,500,000.00	1,500,000.00	50,000.00		
Opportunity Cost = (Market Value-Book Value)*(1-Tax rate) =	39,000.00				
Sales revenues =	0.00	0.00	175,000.00	177,187.50	179,40
Cash costs = operating costs*(1+inflation rate)^year =			958,521.09	918,604.07	930,08
Depreciation = overhaul expense*MACRS =			435,845.00	746,945.00	533,44
OCF = (Sales-Cash costs)*(1-tax rate)+Depreciation*tax rate =	-1,539,000.00	-1,500,000.00	-356,742.96	-220,490.02	-301,23
	NPV	**-6,740,761.77**	$NPV = \sum_{t=0}^{n} \frac{CF_t}{(1+r)^t}$		

Figure 4: NPV of New Vessel

Secondary Explanation

Pre-tax operating costs	-1,210,709.53	
After tax operating costs	-786,961.20	=operating costs*(1-tax)
Depreciation tax benefit	41,012.30	=depreciation*tax
Operating cash flows	-745,948.90	=after tax OP+depreciation tax benefit

Figure 5: Secondary Explanation of Calculations, Year 2 shown

Maracas Basic Overhaul: EAC with another overhaul and additional 12 years of operation			
Real interest rate = ((1+nominal interest rate)/(1+inflation rate))-1 =	7.16%		
Number of years (n) =	26		
Annuity Factor = ((1-(1/(1+r)^n))/r) =	11.65		
NPV with second overall and additional 12 years of operation =	-8,952,072.58		
EAC = NPV / Annuity Factor	**EAC**	**-768,244.89**	
Maracas Basic Overhaul + New E&C: EAC with another overhaul and additional 12 years of operation			
Real interest rate = ((1+nominal interest rate)/(1+inflation rate))-1 =	7.16%		
Number of years (n) =	26		
Annuity Factor = ((1-(1/(1+r)^n))/r) =	11.65		
NPV with second overall and additional 12 years of operation =	-8,421,681.69		
EAC = NPV / Annuity Factor	**EAC**	**-722,728.04**	
New Vessel: EAC			
Real interest rate = ((1+nominal interest rate)/(1+inflation rate))-1 =	7.16%		
Number of years (n) =	20		
Annuity Factor = ((1-(1/(1+r)^n))/r) =	10.46		
EAC = NPV / Annuity Factor	**EAC**	**-644,214.33**	

Figure 6: EAC for all three Proposals

Basic Overhaul: NPV									
	Year 0 to……	10	11	12	13	14	15	16	**……to year 26**
Overall Costs =									
Opportunity Cost = (Market Value-Book Value)*(1-Tax rate) =									
Sales revenues =	……	0.00	0.00	0.00	0.00				
Cash costs = operating costs*(1+inflation rate)^year =	……	1,337,211.85	1,353,927.00	1,370,851.09	1,387,986.72				
Depreciation = overhaul expense*MACRS =	……								
OCF = (Sales-Cash costs)*(1-tax rate)+Depreciation*tax rate =	……	-869,187.70	-880,052.55	-891,053.21	-902,191.37				
				Overall Costs with inflation =	963,716.44				
				Opportunity Cost with inflation=	45,835.29				
				Sales revenues =	0	0	0	0	……
				Cash costs =			1,422,903.27	1,440,689.56	……
				Depreciation =			137,715.08	236,014.16	……
				OCF =	-1,911,743.10	0	-876,686.84	-853,843.26	……
Basic Overhaul + New E&C: NPV									
	Year 0 to……	10	11	12	13	14	15	16	**……to year 26**
Overall Costs =									
Opportunity Cost = (Market Value-Book Value)*(1-Tax rate) =									
Sales revenues =	……	0.00	0.00	0.00	0.00				
Cash costs = operating costs*(1+inflation rate)^year =	……	1,154,916.25	1,169,352.70	1,183,969.61	1,198,769.23				
Depreciation = overhaul expense*MACRS =	……								
OCF = (Sales-Cash costs)*(1-tax rate)+Depreciation*tax rate =	……	-750,695.56	-760,079.25	-769,580.25	-779,200.00				
				Overall Costs with inflation =	1,668,874.81				
				Opportunity Cost with inflation=	45,835.29				
				Sales revenues =	0	0	0	0	……
				Cash costs =			1,228,925.77	1,244,287.34	……
				Depreciation =			238,482.21	408,707.44	……
				OCF =	-2,493,910.10	0	-715,332.97	-665,739.17	……

Figure 7: Screenshot of transitions of new overhauls at year 13

References

Ross, S. A., Westerfield, R. W., & Jaffe, J. F. (2013). Corporate Finance (10th ed.). New York, NY: McGraw-Hill.