ICA 10: Project Justification

ISE 453: Design of PLS Systems Spring 2020

A firm is currently considering constructing a widget factory for a total initial investment cost of $1 million. The factory is expected to operate for 20 years and is estimated to have an annual demand of around 250,000 units. Operating costs will $1.95 per unit. Unless noted, each question builds upon the results from the previous questions. The answers for this ICA do not need to be submitted.

1. Why is it not possible to make a decision whether or not the factory should be constructed?

2. If it is estimated that the sales price will be $2.50 per unit, what is the payback period for the project?

3. If the salvage value of the factory at the end of economic life is expected to be 50% of its initial investment cost and the real cost of capital is 10% compounded annually, what are the NPV and the NAV of the project?

4. What will be the expected average cost of producing each widget?

5. (a) What is the present value of all of costs divided by 20 times the annual widget demand? (b) Why is this not the correct way to calculate the average cost?

6. Since the actual demand might be less than the estimate, what is the minimum number of units per year that would make the project acceptable (i.e., what is the break-even demand)? Determine your answer using both Solver and Equation 3.5 in the notes.

$$q_B = \frac{F}{P - V}$$

7. Assume that a more automated widget factory can be constructed for $3 million and is otherwise identical to the original (manual) factory design except that its operating costs are only $1.10 per unit due to a reduction in labor costs. Which design should the firm choose?

8. Now, instead of having both the manual and automated designs to select between, assume that only the manual design was available and the factory has just been built. If the automated design now becomes available as an alternative, why (in words) is it now not necessary to know the sale price per unit to make the decision about whether or not to replace the manual factory with the automated factory? (The existing manual factory can be sold today for $1 million so that the net additional investment for the new automated factory is $2 million, and the net salvage value of the new factory will be $1 million instead of $1.5 million because the $500,000 salvage value of the existing factory will now not be realized.)

9. What is the annual demand that would make both projects have the same costs (i.e., what is the cost indifference demand)? Determine your answer using both Solver and Equation 3.6 in the notes.

Common				
Cost of Capital	(i)	10%	10%	
Economic Life	(N, yr)	20	20	
Annual Demand	(q/yr)	250,000	250,000	
Sale Price	($/q)	2.50	2.50	
Project		**Manual**	**Automated**	**Net**
Investment Cost	(IV, $)	1,000,000	3,000,000	2,000,000
Salvage Percentage		50%	50%	
Salvage Value	(SV, $)	500,000	1,500,000	1,000,000
Eff. Investment Cost	(IV^{eff}, $)	925,678	2,777,035	1,851,356
Cost Cap Recovery	(K, $/yr)	108,730	326,189	217,460
Oper Cost per Unit	($/q)	1.95	1.10	(0.85)
Operating Cost	(OC, $/yr)	487,500	275,000	(212,500)
Operating Revenue	(OR, $/yr)	625,000	625,000	0
Operating Profit (OR - OC)	(OP, $/yr)	137,500	350,000	212,500
Analysis				
Payback Period (IV/OP)	(yr)	7.27		9.41
PV of OP	($)	1,170,615	2,979,747	1,809,132
NPV (PV of OP - IV^{eff})	($)	244,937	202,713	(42,224)
NAV (OP - K)	($/yr)	28,770	23,811	(4,960)
Average Cost ((K + OC)/q)	($/$q$)	2.38		
(IV^{eff} + PV of OC) / (N x q)	($/$q$)	1.02	← (*Incorrect avg cost !!!*)	
Fixed Cost	(F, $/yr)	108,730	326,189	
Variable Cost	(V, $/q)	1.95	1.10	
Revenue per Unit	(P, $/q)	2.50		
Break-Even & Indiff Points	(q/yr)	197,691	255,835	
		(q_B)	(q_I)	

$$q_{I1\&2} = \frac{F_1 - F_2}{V_2 - V_1}$$