MEC-E1004 Principles of Naval Architecture

Measures of merit

Aalto University
School of Engineering

Modelling hull surface

Tips before modelling

- The annual revenues and costs must be estimated before calculations
- The required freight rate should be ready as well.
- The required interest rate must be estimated as an owner requirement.
- Finally, the ship's life is to be estimated (20-30 years)

Net Present Value (NPV)

- **To make sure that your project is feasible, NPV as an economic KPI must be positive.**

- **In this example, the effect of fuel savings (2 tons/day) on the project is to be investigated.**

Initial investment	2,000,000	EUR
Saving in daily fuel consumption	2	ton/day
Fuel price	700	EUR/ton
Annual operating days	230	
Annual saving in fuel costs	322,000	EUR
Annul maintenance costs	20,000	EUR
Annual savings	302,000	EUR
Interest rate	12.0 %	

Net Present Value (NPV)

- **The initial investment is the amount paid at year zero.**
- **The annual maintenance costs are subtracted from the fuel savings costs.**

Initial investment	2,000,000	EUR
Saving in daily fuel consumption	2	ton/day
Fuel price	700	EUR/ton
Annual operating days	230	
Annual saving in fuel costs	322,000	EUR
Annul maintenance costs	20,000	EUR
Annual savings	302,000	EUR
Interest rate	12.0 %	

Net Present Value (NPV)

- **NPV is to be calculated at each year by returing the annual net savings at each year to the year zero using the following formula and subtract the initial investment from it.**

$$NPV_i = \frac{F}{(1+i)^n} - P$$

- **Where F is the annual net savings at each year and P is the remainder of the initial investment.**

Net Present Value (NPV)

- **Although NPV after 10 years is negative, this example is to study the effect of the fuel savings on the feasibility of the project and other revenues are not yet considered.**

Year	NPV, annual cash flow	NPV
0	-2,000,000 €	-2,000,000 €
1	269,643 €	-1,730,357 €
2	240,753 €	-1,489,605 €
3	214,958 €	-1,274,647 €
4	191,926 €	-1,082,720 €
5	171,363 €	-911,358 €
6	153,003 €	-758,355 €
7	136,609 €	-621,746 €
8	121,973 €	-499,773 €
9	108,904 €	-390,869 €
10	97,236 €	-293,633 €

Net Present Value (NPV) & RFR

- This example is the same as the previous one, but it is more general to study the feasibility of the project.

- From the estimated transport capacity and the required freight rate, annual revenues can be obaitned ($Annual\ revenues = Transport\ capacity \times Freight\ rate$)

- The estimated annual costs are subtracted from the revenues result in the annual cash flow.

Initial investment	200,000,000	EUR
Transport capacity	450,000	ton/year
Freight rate	102.30	EUR/ton
Annual revenues	46,035,000	EUR
Annual costs	10,000,000	EUR
Annual cash flow	36,035,000	
Interest rate	12.0 %	

Net Present Value (NPV) & RFR

- **NPV is to be calculated at each year by returing the annual net savings at each year to the year zero using the following formula and subtract the initial investment from it.**

$$NPV_i = \frac{F}{(1+i)^n} - P$$

- **Where F is the annaul net savings at each year and P is the remainder of the initial investment.**

Year	NPV, annual cash flow	NPV
0	-200,000,000 €	-200,000,000 €
1	32,174,107 €	-167,825,893 €
2	28,726,881 €	-139,099,011 €
6	18,256,452 €	-120,842,559 €
7	16,300,404 €	-104,542,155 €
8	14,553,932 €	-89,988,223 €
9	12,994,582 €	-76,993,641 €
10	11,602,306 €	-65,391,335 €
11	10,359,201 €	-55,032,134 €
12	9,249,287 €	-45,782,847 €
13	8,258,292 €	-37,524,555 €
14	7,373,475 €	-30,151,080 €
15	6,583,460 €	-23,567,620 €
16	5,878,089 €	-17,689,531 €
17	5,248,294 €	-12,441,237 €
18	4,685,977 €	-7,755,261 €
19	4,183,908 €	-3,571,353 €
20	3,735,632 €	164,279 €

Net Present Value (NPV) & RFR

- **Noted that NPV when all the annual cash flows returned to zero is positive; hence, the project is accepted.**

Year	NPV, annual cash flow	NPV
0	-200,000,000 €	-200,000,000 €
1	32,174,107 €	-167,825,893 €
2	28,726,881 €	-139,099,011 €
6	18,256,452 €	-120,842,559 €
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Comparing Alternatives

- **After making sure that the project is feasible, it is important at preliminary stages of design to choose the best project among different alternatives.**

- **This can be done using different KPIs, but we will use NPV to differentiate them.**

- **The higher the NPV the better is the project.**

Comparing Alternatives

- **In this example, there are two ships; the best among them is to be chosen.**
- **They have different revenues and costs but the same ship's life.**
- **In addition to annual cash flow and the initial price of the ship, Ship 1 has an advantage of resale value after the estimated life of the project.**

Interest rate 12 %

		Ship 1				Ship 2			
Year	PW_j (i,n)	Income M €	Costs M €	Net M €	Present value M €	Income M €	Costs M €	Net M €	Present value M €
1	0.8929	10	10	0	0.00	50	30	20	17.86
2	0.7972	15	10	5	3.99	50	30	20	15.94
3	0.7118	20	10	10	7.12	50	30	20	14.24
4	0.6355	25	15	10	6.36	60	40	20	12.71
5	0.5674	30	15	15	8.51	60	40	20	11.35
6	0.5066	35	15	20	10.13	60	40	20	10.13
7	0.4523	40	20	20	9.05	80	50	30	13.57
8	0.4039	45	20	25	10.10	80	50	30	12.12
9	0.3606	50	20	30	10.82	80	50	30	10.82
10	0.3220	55	20	35	11.27	80	50	30	9.66
				Σ(M €)	77.33	(1)		Σ(M €)	128.39
			year 0	Price (M €)	-30	(2)		Price (M €)	-30
								NPV (M €)	98.39

Resales share of the price (%)	80	
Resales value (M €)	24	
Relales value today (M €)	7.73	(3)
Total NPV for Ship 1 (M €)	55.06	(1)+(2)+(3)

Comparing Alternatives

- The same procedure discussed previously is followed to obtain the NPV value for each project.
- The only difference is that Ship 1 has a resales value of the ship.
- The share of the resales price is estimated to be 80%.
- The share value of the resales price is returned to the year zero and added to the annual cash flow already returned to the year zero.
- The total $NPV = the\ annual\ cash\ flow\ of\ today + the\ resales\ value\ of\ today - the\ initial\ investment$
- Finally, ship 2 has higher NPV, so it is the best alternative

	Σ(M €)	77.33	(1)
year 0	Price (M €)	-30	(2)

Resales share of the price (%)	80
Resales value (M €)	24
Relales value today (M €)	7.73
Total NPV for Ship 1 (M €)	55.06

(3)

(1)+(2)+(3)

Σ(M €)	128.39
Price (M €)	-30
NPV (M €)	98.39