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Shipping Company Decision Analysis

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Abstract: *This article analyzes the current state and trends of the shipping industry, the cost control methods of some large shipping companies, and helps a company consider whether it is more profitable to spend money on repairing an old ship or just operating a new one.*

Keywords: *Shipping Company, Net present Value, Decision Making*

1. Introduction

1.1. Trend

After 2008, China's economy started to rise rapidly and led the world economy forward, quickly becoming the world's second largest economy and surpassing Japan as the world's second largest GDP economy. In this wave of rapid economic development, all domestic enterprises have gained a lot, and the shipping industry has also benefited from this wave. But opportunities often coexist with risks. With the accelerated integration of the world economy, the requirements of trade barriers are getting lower and lower. To adapt to the constantly developing and changing world shipping market. Global shipping companies are facing the problem of how to expand market share and major strategic transformation. And how to complete the strategic transformation and optimization, so that enterprises can obtain long-term and lasting development momentum, is now the most total goal pursued by major enterprises in the industry *[1]*

1.2. Type

The global maritime transport market can be divided into four categories, "international maritime transport" is a service industry that provides maritime passenger or freight transport and is the most important mode of transport in international logistics. Ocean freight can be divided into four categories based on distance, mode of operation and type of vessel and cargo. The more common classifications are cargo type, dry bulk transport, container transport and oil transport.[2]

1.3. Current Status

Marine crude oil transportation was hit hard by the epidemic cause, from 2015 to 2020, the volume of marine crude oil transportation first rose and then fell, reaching a peak in 18 years, after 2019 crude oil prices leveled off and transportation volumes returned to normal, and since 2020 received a heavy setback in crude oil supply and demand received the epidemic. Container shipments are growing steadily, with global container shipments rising year by year from 2017 to 2020. Mainly because of the size of large container ships, which can achieve rapid transportation of goods from the port of origin to the port of destination.[4]

In the shipping market, especially during the market downturn, the cargo owners who control the cargo sources have the absolute initiative and can determine the demand of shipping companies to a large extent. So, the construction of fleet decides the shipping company's transportation capacity and competitiveness and is the core competitiveness of shipping company's operation. Reasonable fleet size and structure is the guarantee of high-quality transportation tasks.[5]

In the past year, the shipping industry is in crisis, and the biggest problem is that the pricing power of global container freight rates has always been in the hands of a small audience of shipping giants, which largely exacerbated the supply chain dilemma under the new crown epidemic and delayed the transoceanic transportation of cargo. A few shippers and shipping companies said that in the past few years a few shipping giants have controlled most of the world's container traffic through giant cargo ships,

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making the world's routes become fewer and smaller ships become scarcer. According to big data provider Alpha liner, the top six large carriers control more than 70 percent of global container capacity, and as small businesses try to replenish their inventories after the lifting of restrictions on the new crown epidemic, they are paying at least four times as much to ship products compared with last year, and it's also taking longer and longer.[3]

1.4. Solutions

So Most shipping companies nowadays are interested in reducing costs by the following options respectively. The first one is waterway transportation software, which is used by shipping companies to improve the efficiency of their business while ensuring the safety of their shipments. It improves the efficiency and productivity of logistics companies, managing and optimizing inbound and/or outbound transportation operations, while helping them to reduce costs. Based on solutions, the waterway transportation software solutions market is segmented into warehousing, vessel tracking, freight security, yard management, auditing and claims, ship brokerage software, maritime software, and others. Based on services, the waterway transportation software solutions market is segmented into managed services, consulting/customization services, and training services. Based on deployment, the waterway transportation software solutions market is segmented into hosted, on-premises, and hybrid. Based on end user, the waterway transportation software solutions market is segmented into consumer & retail, oil & gas, industrial & manufacturing, energy & mining, aerospace & defense, construction, chemical, pharmaceutical & healthcare, food & beverage, and others. Next, I will give a specific analysis of the shipping company I chose.

2. Model Description

NETCO was faced with the problem of refurbishing its old vessel Vital Spark, but the refurbishment meant taking it out of service for a few months and spending $820,000 on refurbishment and then $1,181,000 a year in operating costs. So NETCO's CFO and Chief Engineer came up with several options, the first being to continue using the Vital Spark after the overhaul or to replace it with a new vessel. The new vessel was manufactured by Cohn and Doyle. The cost of purchasing a new vessel is about $3,000,000 and the annual operating cost is $885,000.

Firstly for this project we can compare two aspects, the first is how to compare the net present value (NPV) of a new vessel and Vital Spark, and the second is the total cost of overhauling and operating Vital Spark compared to the cost of purchasing a new vessel. For both problems we follow the 7 steps in engineering economics, defining the problem, developing alternatives and cash flow tables, and selecting criteria for comparison and selection. In addition to these we perform a sensitivity analysis of certain variables depending on the occasion and explore other relevant information for risk assessment.

3. Question A

3.1. Description

If we compare the net present value (NPV) of Vital Spark with that of a new ship, of course other indicators are also considered. And we use 10,11,12 years of service life as a criterion (Vital Saprk has a maximum life of 12 years after refurbishment and a minimum life of 10 years), Vital Spark is always better than a new ship, and the profit is maximum when Vital Spark can be used for 10 years. However, the value of Vital Spark in the first few years is lower than that of a new vessel, and this will be a consideration in the decision. For the second issue the total annual operating cost of the new vessel is $885,000 and the crew will need to be trained due to the new technology, which will cost $50,000 next year. The new ship will generate an additional annual income of $100,000, so the income of the new ship will be $1500,000 a year, increasing with the inflation rate. The net value of Vital Spark is $100,000 and Vital Spark can also sell the spare parts of the vessel with a book value of $40,000 and Vital Spark can sell it with the spare parts for $200,000. The sale of the Vital Spark will immediately generate $14,000 in taxes. Overhauling the Vital Spark will incur a total cost of $82,000 for equipment such as engines, and after the overhaul the Vital Spark will have a life of no more than 10 years and a maximum of 12 years and will be taxed at 7 years of Mars and several others.

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3.2. General Assumptions

We have made the following assumptions throughout the problem. The after-tax MARR is MARRx=Capital Cost*(1-tax rate). Only real dollars will be taken into account. We do not know which month is year 0 and the inflation base year is considered as the first year.

Sensitivity analysis is performed on three variables: tax rate, inflation rate and cost of capital. The adjustment range and steps are shown in Table 1.

Table 1: Parameters of baseline and sensitivity analysis

Variable	Tax rate	Inflation Rate	Cost of Capital
Baseline	35%	2.5%	11%
Sensitivity Range	20%-50%	1.0%-4.0%	5%-25%
Step	1%	0.1%	1%

3.3. Calculation

Based on what we know about the status of NETCO, we will assume this.

Depreciation includes the cost of the Vital Spark's book value ($100,000) overhaul plus the cost of a new engine. (Spare parts are not included)

The recovery period for depreciation follows a seven-year MACRS rating.

There will be a constant inflationary increase from the second year onwards.

The life of the Vital Spark is 10, 11, 12 years.

We chose to compare the net present value (NPV) and the results, based on the analysis of the spreadsheet, are shown in Table 2.

Table 2: The comparison results

	10 years	11 years	12 years
New ship (NPV)$	430181.38	283151.12	336539.19
Vital Spark (NPV)$	801764.08	548935.31	641572.15

As we can see from the graph, Vital Spark always outperforms New Ship in terms of NPV, regardless of whether the lifetime of Vital Spark is 10, 11 or 12 years. in addition, NETCO will be the most profitable when Vital Spark has a lifetime of 10 years, as shown in Figure 1.

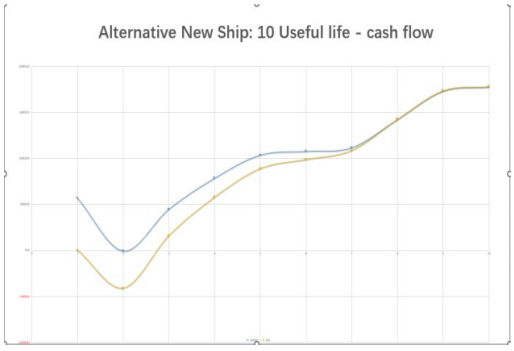

Figure 1: 10 use of life for Vital Spark

With brand-new engine and control system (Useful life = 10)											
Year	0	1	2	3	4	5	6	7	8	9	10
Initial Outlay	-1520000.00										
Revenue		1400000.00	1435000.00	1470875.00	1507646.88	1545338.05	1583971.50	1623570.79	1664160.06	1705764.06	1748408.16
Operating Costs		-1020000.00	-1045500.00	-1071637.50	-1098428.44	-1125889.15	-1154036.38	-1182887.29	-1212459.47	-1242770.96	-1273840.23
Depreciation		217208.00	372248.00	265848.00	189848.00	135736.00	135584.00	135736.00	67792.00	0.00	0.00
Taxable Income		162792.00	17252.00	133389.50	219370.44	283712.90	294351.12	304947.50	383908.59	462993.10	474567.93
Taxes		56977.20	6038.20	46686.32	76779.65	99299.51	103022.89	106731.62	134368.01	162047.59	166098.78
ATCF		323022.80	383461.80	352551.18	332428.78	320149.38	326912.23	333951.87	317332.58	300845.52	308469.15
NOPAT		105814.80	11213.80	86703.17	142590.78	184413.38	191328.23	198215.87	249540.58	300845.52	308469.15
IRR (ATCF)		0.1785485									
Book Value		1302792.00	930544.00	664696.00	474848.00	339112.00	203528.00	67792.00	0.00	0.00	0.00
EVA		12665.17	-55320.10	39177.41	108639.15	160166.88	176775.98	193368.75	249540.58	300845.52	308469.15
Present Value for Each year (11%)	-1520000.00	301467.85	333993.30	286579.84	252198.78	226668.83	216012.12	205939.03	182632.16	161643.52	154628.66
NPV of the overhaul without brand-new engine and control system	801764.08										

Figure 2: Spread sheets for 11 useful life New ship

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With brand-new engine and control system (Useful life = 11)												
Year	0	1	2	3	4	5	6	7	8	9	10	11
Initial Outlay	-1520000.00											
Revenue		1400000.00	1435000.00	1470875.00	1507646.88	1545338.05	1583971.50	1623570.79	1664160.06	1705764.06	1748408.16	1792118.36
Operating Costs		-1020000.00	-1045800.00	-1071637.50	-1098428.44	-1125889.15	-1154036.38	-1182887.29	-1212459.47	-1242770.96	-1273840.23	-1305686.24
Depreciation		217208.00	372248.00	265848.00	189848.00	135736.00	135584.00	135736.00	67792.00	0.00	0.00	0.00
Taxable Income		162792.00	17252.00	133389.50	219370.44	283712.90	294351.12	304947.50	383908.59	462993.10	474567.93	486432.13
Taxes		56977.20	6038.20	46686.32	76779.65	99299.51	103022.89	106731.62	134368.01	162047.59	166098.78	170251.24
ATCF		323022.80	383461.80	352551.18	332438.78	320149.38	326912.23	333951.87	317332.58	300945.52	308469.15	316180.88
NOPAT		105814.80	11213.80	86703.17	142590.78	184413.38	191308.23	198215.87	249540.58	300945.52	308469.15	316180.88
IRR (ATCF)		0.1877494										
Book Value		1302792.00	930544.00	664696.00	474848.00	339112.00	203528.00	67792.00	0.00	0.00	0.00	0.00
EVA		12665.17	-55320.10	39177.41	108639.15	160166.88	176775.98	193368.75	249540.58	300945.52	308469.15	316180.88
Present Value for Each year (11%)	-1520000.00	291011.53	311226.20	257782.38	218987.72	189993.08	174780.63	160850.73	137699.02	117647.06	108638.05	100318.92
NPV of the overhaul without brand-new engine and control system	548935.31											

Figure 3: Spread sheets for 11 use of life Vital Spark

No brand-new engine and control system (Useful life = 12)													
Year	0	1	2	3	4	5	6	7	8	9	10	11	12
Initial Outlay	-920000.00												
Revenue		1400000.00	1435000.00	1470875.00	1507646.88	1545338.05	1583971.50	1623570.79	1664160.06	1705764.06	1748408.16	1792118.36	1836921.32
Operating Costs		-1181000.00	-1210525.00	-1240788.13	-1271807.83	-1303603.02	-1336193.10	-1369597.93	-1403837.88	-1438933.82	-1474907.17	-1511779.85	-1549574.34
Depreciation		131468.00	225308.00	160908.00	114908.00	82156.00	82064.00	82156.00	41032.00	0.00	0.00	0.00	0.00
Taxable Income		87532.00	-833.00	69178.87	120931.05	159679.02	165714.40	171816.86	219290.18	266830.23	273500.99	280338.52	287346.98
Taxes		30636.20	-291.55	24212.61	42325.87	55882.66	58000.04	60135.90	76751.56	93390.58	95725.35	98118.48	100571.44
ATCF		188363.80	224766.55	205874.27	193513.18	185882.36	189778.36	193836.96	183570.62	173439.65	177775.64	182220.03	186775.54
NOPAT		56895.80	-541.45	44966.27	78605.18	103726.36	107714.36	111680.96	142538.62	173439.65	177775.64	182220.03	186775.54
IRR (ATCF)		0.1844175											
Book Value		788532.00	563224.00	402316.00	287408.00	205252.00	123188.00	41032.00	0.00	0.00	0.00	0.00	0.00
EVA		515.76	-40811.97	16200.67	58095.51	89050.89	98906.42	108747.17	142538.62	173439.65	177775.64	182220.03	186775.54
Present Value for Each year (11%)	-920000.00	169697.12	182425.57	150533.49	127473.13	110312.14	101463.26	93363.20	79656.15	67801.86	62609.82	57815.38	53388.07
NPV of the overhaul without brand-new engine and control system	336539.19												

Figure 4: Spread Sheets for 12 use of life Vital Spark

Vital Spark always outperforms New Ship when the three variables (tax rate, inflation rate, and cost of capital) vary within our assumptions, but both Vital Spark and New ship become negative when one of the variables (cost of capital) is above 28%. (See Figure 2-4)

4. Question B

4.1. Description

For the second question, we need to compare overhauling and keeping Vital Spark in operation for 12 years with buying a new ship (which can run for 20 years or more).in the title, as shown in Table 3-4.

Table 3: The comparison results (cost only)

Category	Total cost	Annual Cost
Overhauling the Vital Spark	-6985596.030	-1125526.268
Buying a new vessel	-9133008.757	-1471519.569

Table 4: ACTF comparison result between (V) and (N) cost only

Years	1	2	3	4	5	6	7
ATCF in (V)	-820000	-738950	-735181	-765184	-793613	-820881	-847374
ATCF in (N)	-477750	-400631	-453172	-498521	-538158	-573458	-598339
Years	8	9	10	11	12	13	14
ATCF in (V)	-871440	-893696	-916480	-939891	-973243	NULL	NULL
ATCF in (N)	-615016	-632006	-649633	-701929	-754778	-773647	-792988
Years	15	16	17	18	19	20	21
ATCF in (V)	NULL	NULL	NULL	NULL	NULL	NULL	NULL
ATCF in (N)	-812813	-833134	-853962	-875311	-897194	-919624	-942614

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4.2. Conditions

Since we only consider cost, we only consider ATCF and annual cost in this issue. The ACTF of replacing a new ship every year except the first year is always lower than the ACTF of overhauling and operating Vital Spark.

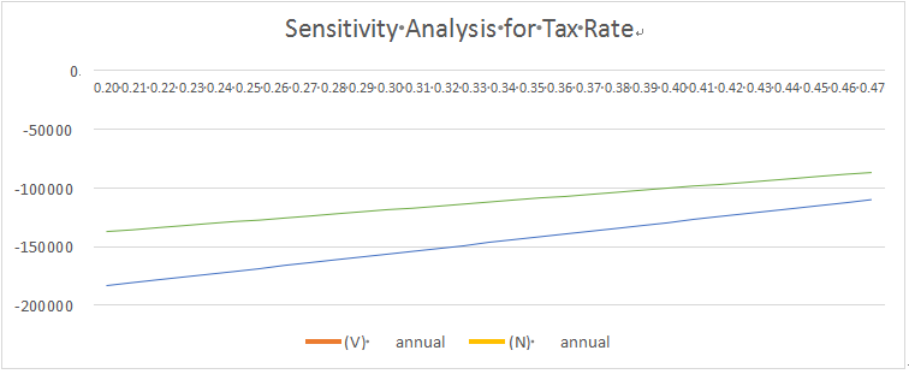

Figure 5: Sensitivity Analysis for tax rate (considering revenue)

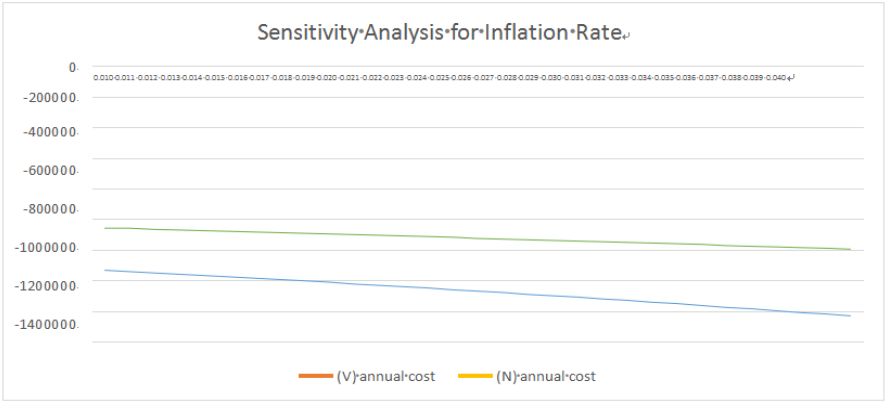

Figure 6: Sensitivity Analysis for inflation rate (considering revenue)

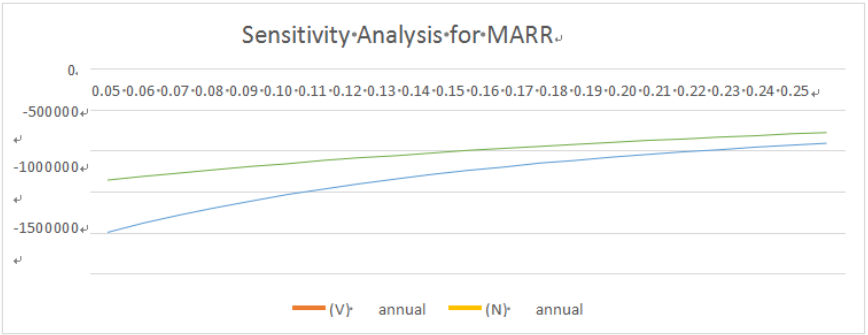

Figure 7: Sensitivity Analysis for MARR(considering revenue)

We analyze tax rate inflation and cost of capital within our assumptions, and for tax rate and MARR we find that annual cost increases negatively with tax rate. The annual cost of inflation also tends to grow negatively. However, the total annual cost of purchasing a new vessel is always lower than the total cost of overhauling a Vital Spark as we can see in Figure5-7.

According to our information and assumptions above, the ATCF of a new replacement ship is always less than that of an overhauled Vital Spark. However, new ships are more profitable so we cannot draw a direct conclusion yet. We need to add the revenue to the annual ATCF calculation. As you can see from the graph below a new ship is a better choice when considering the revenue, as shown in Table 5.

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Table 5: The Comparison results

Operation	Annual ATCF
Overhauling the Vital Spark	80243
Buying a new vessel	301936

4.3. Calculations

We have also analyzed this part, based on the same values with the same range, as shown in the figure below, in the current year ATCF grows negatively with the cost of capital and the tax rate, and positively with inflation. Because the increase in revenue is only related to the inflation rate, and we only consider the real revenue. Figure 8 also show that replacing a new ship is a better choice when the value varies within a given range.

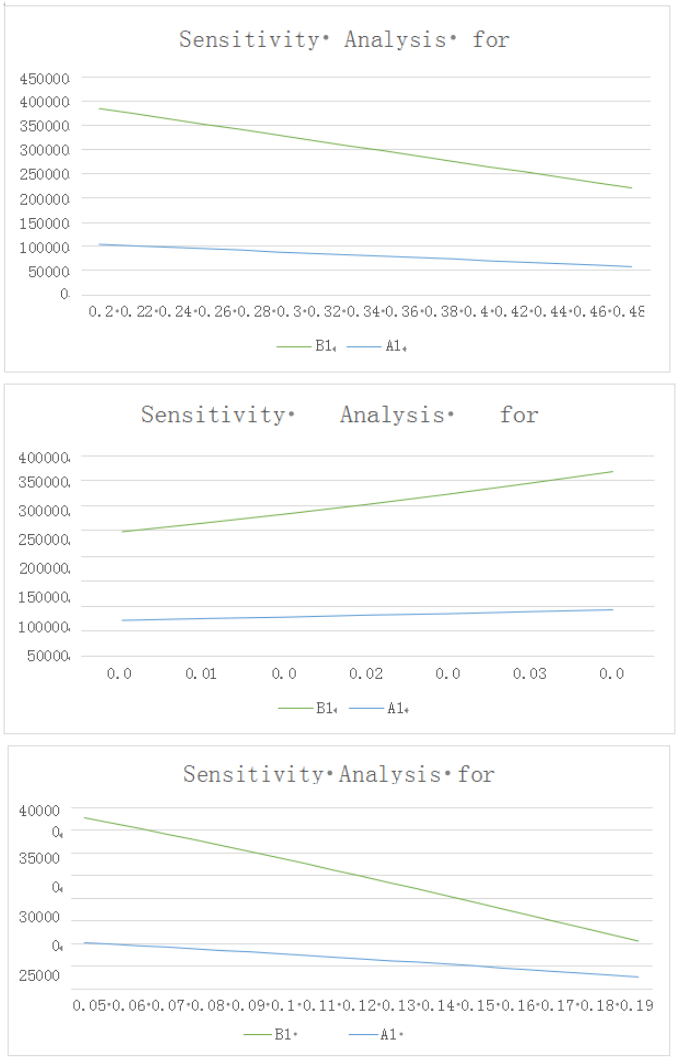

Figure 8: Sensitivity Analysis

4.4. Conclusion

In a normal life without assumptions, NETCO would have more options, for example it could repair the old ship and replace it after 5 to 10 years. Both are calculated to be less valuable than replacing a new vessel, so it is recommended to replace it now.

As mentioned above, it is more profitable to buy a new ship outright now, but should we retire Vital Spark now or keep it running until the new ship is ready? Here's the problem: Keeping Vital Spark running will generate profits, but the depreciation will increase over time. And the crux of the matter

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depends on how many months are left in the year and the approximate revenue, considering inflation this year's operating expenses and revenue are.

Rm = 1,400,000/(1.025 × 12) = 113,821\$, Em = 1,181,000/(1.025 × 12) = 96,016\$.

If we estimate the monthly depreciation, Vital Spark is 25 years old and has a book value of \$100,000, if the company uses the SL method, the monthly depreciation would be \$5,061 and if the Vital Spark is scrapped now, the ATCF would be \$179,000. But considering that there are still a few months left in the year, the total after-tax cash flow is shown in the Table 6.

Table 6: The total after tax cash flow

Months left	Total ATCF	Months left	Total ATCF
1	108,283.60	7	157,985.20
2	116,567.20	8	166,268.80
3	124,850.80	9	174,552.40
4	133,134.40	10	182,836
5	141,418	11	191,119.60
6	149,701.60	12	199,403.20

We can conclude that only when there is more than 10 months left this year is it wise to keep the Vital Spark running.

5. Conclusion

1). For question A it is recommended to replace the Vital Spark with new equipment so that it can be the most profitable.

2). For question B if we only consider the cost, we should overhaul Vital Spark, but if we want to be profitable, we'd better buy a new ship. In short, it is wise to place an order for a new ship now, and we should only let Vital Spark run if there are more than 10 months left and its shrinkage factor is not less than 0.85.

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