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HUGO LÜCKMANN VIDAL

A PARAMETRIC MODEL FOR OPERABILITY OF OFFSHORE SUPPORT VESSELS VIA CONFIGURATION-BASED DESIGN

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Hugo Lückmann Vidal

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Bachelor Thesis submitted to the Naval Engineering Course from the Federal University of Santa Catarina to receive the degree of Naval Engineer.
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This Thesis was judged appropriate to obtainment the title of Naval Engineer, and approved in its final form by the Naval Engineering Course.

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To my friends for the encouragement and support

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"Success consists of going from failure to failure without loss the enthusiasm."

(Winston Churchill)

ABSTRACT

The purpose of Offshore Support Vessels (OSVs) is to support the oil industry for the many activities in sea, such as supply, anchor handling, towing and construction. For the proper performance of each operation, a vessel requires different installed capabilities on board, in which the availability and capacity of these capabilities are directly connected to the operational level of the vessel. The main objective of this thesis is to develop a parametric model of an OSV to take into account the vessel capabilities and its connection to the main operations that these vessels can perform, ranking the designs in some sort of score according to performance and construction cost. The model consists on parametric equations, based on regression analysis from similar vessels, and on a preliminary configuration based approach for specific modules, such as cranes, extra accommodation and larger propulsion. The model will take into account different contexts in which the vessel will operate (e.g. North Sea, Arctic and Brazil). The model will be developed in common engineering tools, such as Excel and JavaScript.

Key Words: Offshore Support Vessels; Parametric Design; Operability.

RESUMO

O propósito das embarcações de apoio offshore (OSV's) é dar suporte a indústria do petróleo para várias atividades no mar, como abastecimento, manuseio de âncora, reboque e construção. Para a adequada realização de cada operação, a embarcação requer diferentes habilidades à bordo, em que a disponibilidade e capacidade destas habilidades estão diretamente associadas ao nível operacional da embarcação. O principal objetivo deste trabalho é desenvolver um modelo paramétrico de um OSV para levar em conta as habilidades da embarcação e sua conexão com as principais operações que estes tipos de navio podem realizar, classificando os projetos através de um sistema de pontuação de acordo com o desempenho e custo de construção. O modelo consiste em equações paramétricas, baseadas em análises de regressão de embarcações semelhantes e em uma abordagem preliminar baseada na configuração de módulos específicos, como guindastes, acomodação extra e maior propulsão. O modelo levará em conta diferentes contextos no qual o navio irá operar (e.g. Mar do norte, Ártico e Brasil) e será desenvolvido em ferramentas comuns de engenharia, como Excel e JavaScript.

Palavras-Chave: Navios de Apoio a Plataforma; Projeto Paramétrico; Operabilidade.

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1 INTRODUCTION

1.1 INTRODUCTION TO OSV

Offshore Support Vessels (OSVs) are vessels specialized in support the offshore industries, as in construction, operation, drilling or extraction. They requires different configurations to accomplish different missions, in which the availability and capacity of these configurations are directly connected to the expected operational level of the vessel. The main function of these vessels is to support the oil industries and each type of OSV has a specific configuration, such as supply, anchor handling, towing, and construction. Given the large number of different type of missions, the specifications of each vessel can vary greatly.

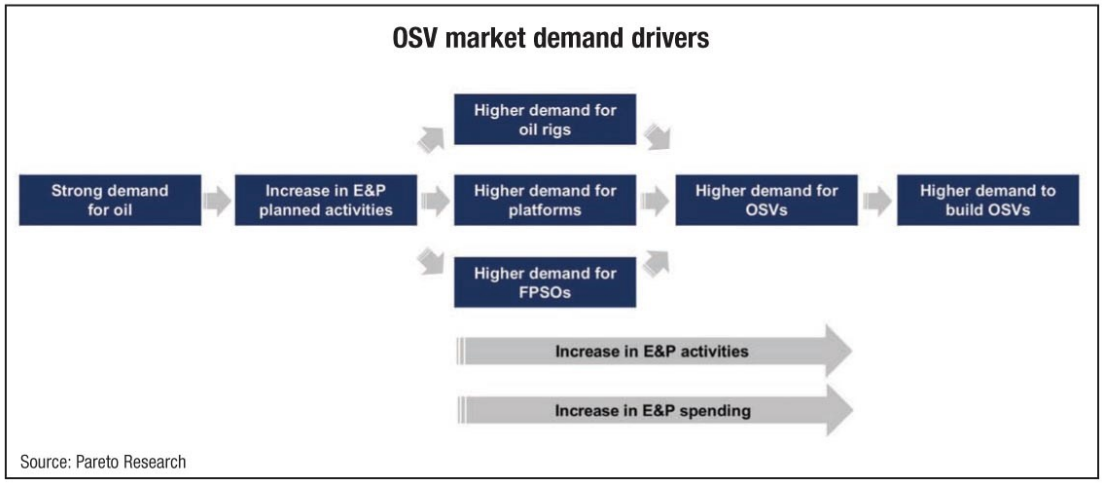

Figure 1. OSV market demand (YEO, 2013)

In addition to manage the mission, the vessel has to be able to sail in diverse sea states, either with ice or with big waves. According to YEO (2013), the operations are complex and there is a low margin for error. Additionally, some of these ships are built with a specialized single purpose, which decreases cost; however increase the number of the assets.

The Organization of the Petroleum Exporting Countries (OPEC) reported that the world oil supply and demand keep increasing. In 2012, the demand was 88.9 million barrels per day and the forecast to the end of 2035 is 108.5 million barrels per day. As seen in Figure 1, the increases of the oil demand coupled with the discovery of new oilfields were the main factor for the increase in demand for oil rigs, platforms and FPSOs (Floating Production, Storage and Offloading), which means higher demand for OSVs. Herewith the increase in OSVs demand, the E&P (Exploration and Production) activities increases as well.

Due to this and the discovery of the pre-salt layer, PETROBRAS, the largest company in Brazil in 2013 (REVISTA EXAME, 2013) expect an increase around 150 OSVs between 2013 and 2020. According to *ANP* (National Agency of Oil, Natural Gas and Biofuels), the oil production in Brazil will double within 10 years and in 2035 the country will be the sixth-largest oil producer (REVISTA VEJA, 2014).

With the OSV demand in high, the shipyards necessitate to save money and time without despising the safety and performance. To make it faster, though, not for OSVs, PARSONS (2004) proposed a parametric design, in which the designer input the primary ship dimensions, and may obtain the hull shape and other output, depending only on the equations that have been informed. These equations will be showed on section 4.1.

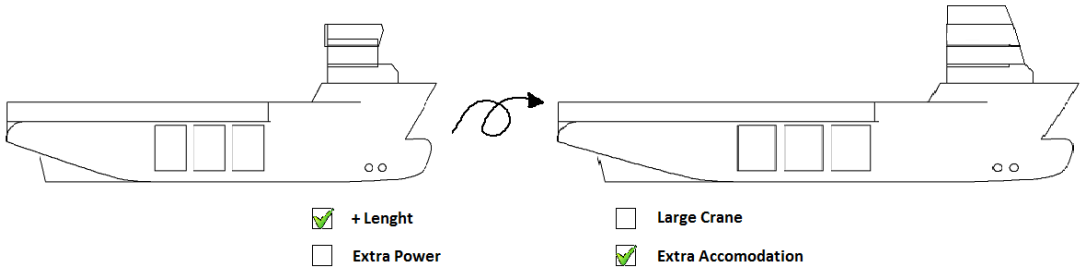

Figure 2. Basic example of Configuration Based Design

The parametric design can be combined with a diverse other methods to design, such as Configuration-Based Design (CBD), where each design may have a specific module, such as cranes, extra accommodation, larger propulsion, or the combination of them. For example in Figure 2, the boxes +Length and Extra Accommodation are selected, then the ship on the right has more accommodation and is longer than the ship on the left. Thus creating a design group and evaluating each design, taking into account the performance, operability and different fields (e.g. North Sea, Arctic and Brazil).

The operability can be associated with the capacity and availability of the vessel, being possible to measure in percentage if the ship will accomplish its mission in any situation, whether on the ice in the Arctic Sea or the hot and tranquil water of Brazil.

1.2 SCOPE AND OBJECTIVE

The main objective of this thesis is to develop a parametric model for operability that show as output the principal attributes of a ship and the decision-making. In addition, add the configuration-based design to the design and compare the results.

This thesis will consider only the three principal offshore support vessels, three field locations, Brazil, North Sea and Arctic. Also three kind of missions, Supply, Towing, and Construction. Some values, although hypothetical, can be used to verify the methodology.

In the selected model, the operability value changes only whether some extra module is added, and the financial return and probability values can change by the user, or the company according to its experience. The company can modify the Parametric Equations and the operability values as well.

1.3 STRUCTURE OF THESIS

This thesis is divided in six sections. The first one is the Introduction that describes the problem, the project's scope and the structure of this thesis. In section two, Literature Review, the main points about ship design, parametric design, offshore support vessels and operability are presented. The Methodology, presented in section 3, describes which are the procedures, what is used and how to accomplish the activities to achieve the objectives. In section 4, the application of the methodology in a real case, with real equations and dimensions are presented. Section 5, Discussion and Analysis makes a comparison of the results to select the best, using the decision tree. Last Section, Concluding Remarks concludes the thesis, returning to the objectives and giving some advices to future works.

2 LITERATURE REVIEW

2.1 INTRODUCTION TO DESIGN METHODS

Firstly, it is necessary to know what does ship design means, LAMB (2003-2004) defines design as the activity involved in producing the drawings, specifications and other data needed to construct an object. To LARSSON (2000) design is an iterative, 'trial and error' procedure where the result has to satisfy certain requirements, specified beforehand. On the other hand, GASPAR (2013) said the design is defined for its function and form, for example, the function of an umbrella is protect someone from the rain, and however the shape can be different.

On the first stages of the ship design, process the designer need to decide which methodology to use and what is the main parameter (e.g. price, volume, bollard pull) to maximize or minimize. To select the methodology correctly is necessary to know how many types are feasible to make the project and which of them is the best choice.

EVANS (1959) proposed the Spiral Design (Figure 3), where every system and subsystem of the ship is included; it gives a general and basic overview of the ship design process, representing sequentially some aspects. This methodology already demanded to have knowledge in technical areas, improving each system at each turn in the spiral, accordingly improving the vessel.

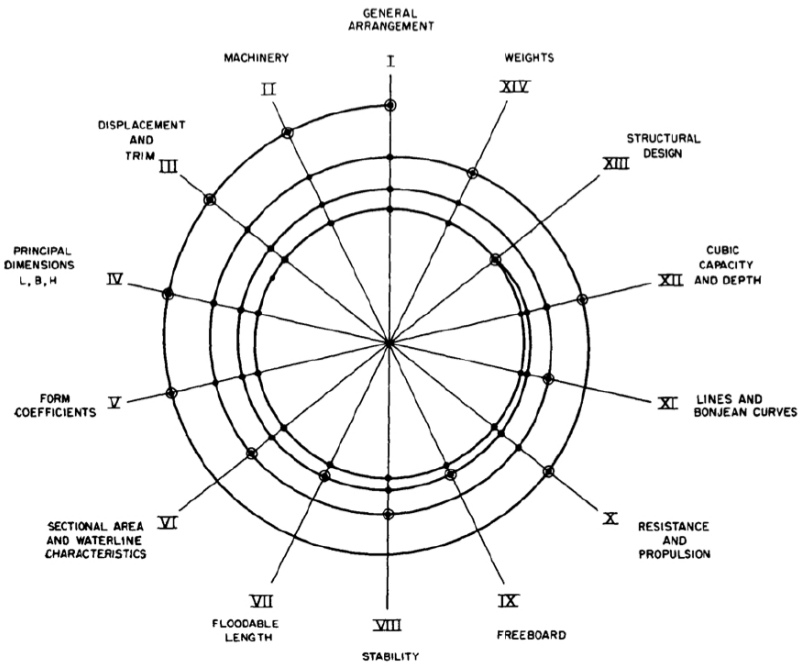

Figure 3. Classic Evan's Spiral of Design (EVANS, 1959)

In 1969, Lamb propounded a flowchart on the beginning of design procedure (Figure 4). With some mathematical equations and an iterative procedure, this method could optimize the ship design on the first steps of the process (LAMB, 1969). The better are the equations to represent the ship functions the better is the design.

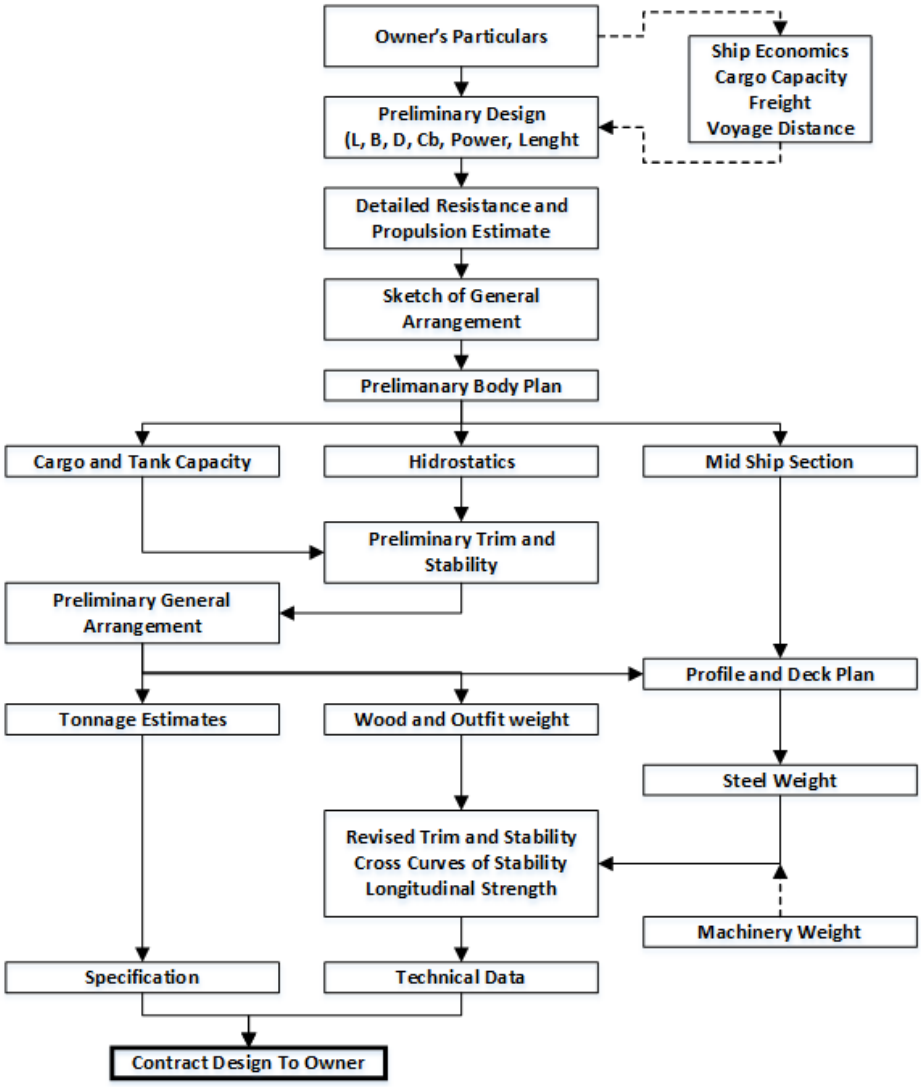

Figure 4. Lamb Flowchart (adapted from LAMB, 1969).

Approximately 25 years later, ERIKSTAD (1996) noticed the design process could be divided in four steps: generate, analyze, evaluate, and decide (Figure 5). The process is an endless cycle and the ship design always may be improved.

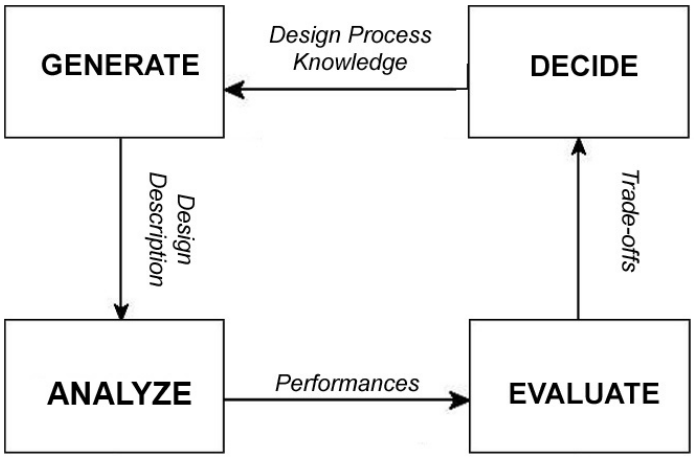

Figure 5. Erikstad Design Process (ERIKSTAD, 1996)

Each ship characteristic should go through the steps with different values and at the last step to choose which is the best.

LEVANDER (2006) verified that the design should be started with its mission and functions, in other words, instead of using the owner requirements as usual, these would be originate from the primary mission and the ship would perform its mission as planned (Figure 6).

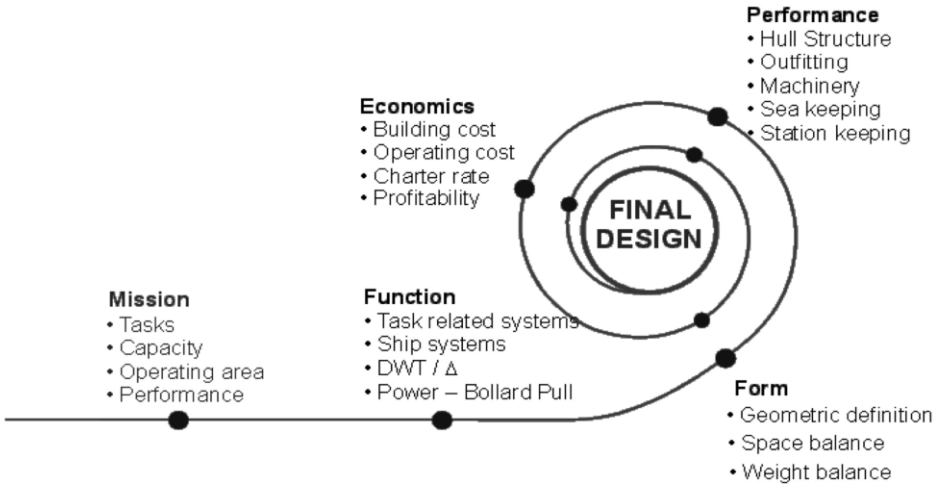

Figure 6. Levander Ship Design Process (LEVANDER, 2006)

GASPAR (2013) summarized the design process growth through the decades 1950s until 2010s. He said the information grows toward of high interactions and less rigid boundaries, mainly due to the advent of the personal computer and the computer-aided design, and nowadays, due to the emergence of new requirements as the environmental performance and risk.

2.2 PARAMETRIC DESIGN

To design is a complex process; however, more practice the designer have, easier is to make an object. Sometimes the process get monotone and repetitive, as for example, when someone have to design a box with a predetermined volume. Instead of make it manually, an algorithm can be done, and the user only has to inform the length of two sides of the box and the desired volume. This way of designing is named of Parametric Design.

In the early stage of the conceptual design is ideal to establish a consistent definition of the design. Speaking in more complex and larger projects, such as ships, many steps or the whole ship can be designed using algorithm. Thinking on it some researchers proposed to use similar vessels to make parametric equations, which depend only on the primary dimensions, such as Length (L), Breadth (B) and Draught (T). This may reduce the time of the design and make easier to fix errors (PARSONS, 2014). An example of a way to find a parametric equation is showed on Figure 7, where to find the Block Coefficient (Cb) the only parameter required is the Froude Number.

The first time, when a parametric design starts, the process can take longer because of the numerous relations that must be established and the parametric equations inserted. After that, make changes or a new project can take few minutes. As the ship is built to attend the owner's requirements, the designer will have to constantly edit the project to satisfy the owner, what justify use the parametric design.

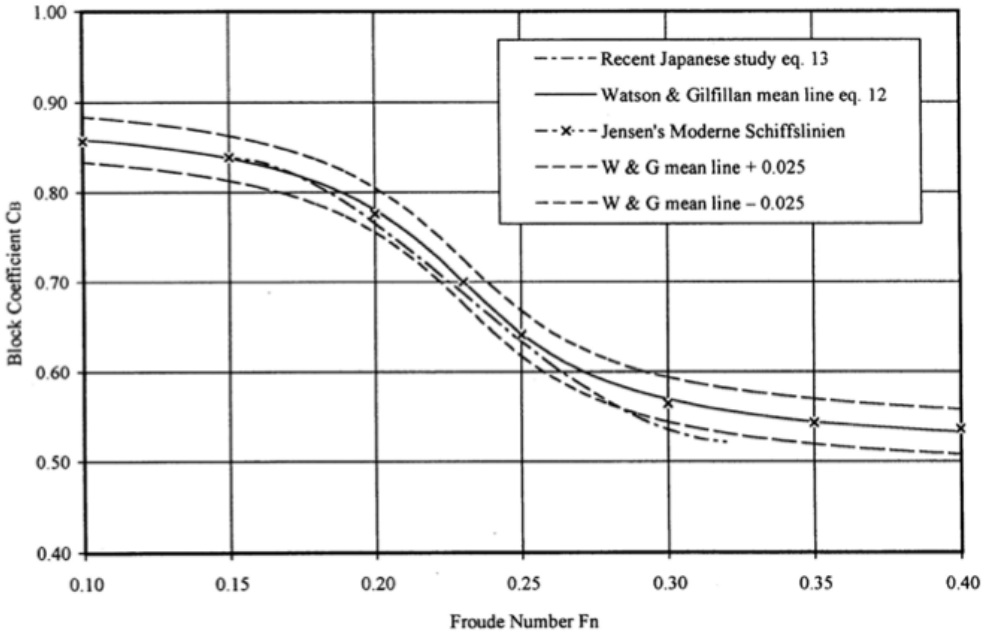

Figure 7. Block Coefficient depending only the Froude Number (PARSONS, 2004)

Although the parametric design is used more to make shapes, it can also be used to calculate some information about the ship, such as price, number of crew and the required power. Table 1 shows what are the considered parameters (variables) and attributes, in other words what will be design input and output, respectively.

Table 1. Parameters vs. Attributes

Parameters	Attributes
Mission GT ...	Power
	Volume
	Cb
	Accomodation
	DWT
	LWT
	Bollard Pull
	⋮

2.3 OFFSHORE VESSELS

According to ABS (American Bureau of Shipping) there are around 16 different types of OSV's, and each of them has a specific characteristic and function. They are made to support any activity on the sea, specially the offshore ones. Due to this, these vessels must have a high technology embedded, for example the dynamic positioning system. In case the local of work is the northern sea, they must contain icebreaker.

This thesis will focus only on the main categories, in other words, those that are most built and existing on the market, namely Platform Supply Vessel (PSV), Anchor Handling Tug Supply (AHTS) and Offshore Subsea Construction Vessel (OSCV). These types are responsible for most and main operations to maintain the offshore industry properly functioning.

The PSV has as main function to carry equipment and supplies necessaries to keep the platform working. Among these are water, food, oil, tools and pulverized cement. As primary characteristic this vessel type must have a big cargo deck area and deadweight tonne. This ships range from 20 to 100 meters in length and the crew can number up to 20.

The AHTS vessels are responsible to handle anchors for oilrigs. They carry out operations for positioning, maintaining and moving platforms. Most of them have a large propulsion and extra bollard pull. They are also fitted with winches for towing, have open

stern and arrangements to facilitate the anchor release. The AHTS vessels can also be used to transport supplies, although it is not the primary function.

The OSCV are equipped with ROVs and some of them have moon pool. Construction Vessels are responsible to connect the oil fields to the oil rigs. These vessels must have a good crane capacity, a large bollard pull and a large open deck. The functions that can be accomplished are installation of the rises, spools, pipeline protection, subsea tree, dome and tie-in of umbilicals. Also make maintenance and repairs. The accommodation facilities are also needed for the construction work force.

Figure 8 summarize the main types of OSV and the main missions of each one.

Type of Vessels		Main Missions
AHTS		• To handle anchors for oil rigs. • Towing and mooring platforms and drilling rigs. • To make deck handling operations.
PSV		• To operate from shore to the platform carrying supplies and personnel. • To be able to stay right next to the platform.
OSCV		• Building and maintaining platforms, well heads and power cables. • Diving support.

Figure 8. Main types of OSV's and their principal missions.

2.4 OPERABILITY

According to Uwohali Incorporated (UWOHALI, 1996), operability may be defined as the ability to operate the system while it is performing its intended function. In case of a ship, it must fulfill the primary mission, in other words, to operate 365 days per year, the

vessel must be able to sail through the high sea conditions and each machine inside of the ship cannot be out of work, otherwise, the operability will not be 100%.

A hundred percent of operability is impossible, at least for a ship during one year, however, the closer the better. To measure the operability some authors use equations that contain information about the sea and the ship, as speed and heading, nevertheless to measure the operability of an offshore vessel is necessary to have information about each machine belonging to the ship.

A simple manner to calculate the operability would be use a database from similar vessels and machinery and make a regression to obtain an equation, though this data collection would require much time, considering every sea in the world and some similar vessels, regardless the difficult to obtain these data.

During the operation, the ship operability may be affected by different characteristics, such as missions, places, environment and regulations.

The mission will affect the operability according to the different tasks, whether one AHTS have to handle an anchor and fasten it on the seafloor and in a right position, the vessel must have a good dynamic positioning system (DPS) and large cranes to guarantee 100% of operability.

Even whether the ship has good facilities and tools, each place has your unique characteristic. In Brazil, the depth may vary from 200m until 2500m and at the North Sea reaches only 700m. To sail in different places the ship must comply with the rules of the maritime organization of each country.

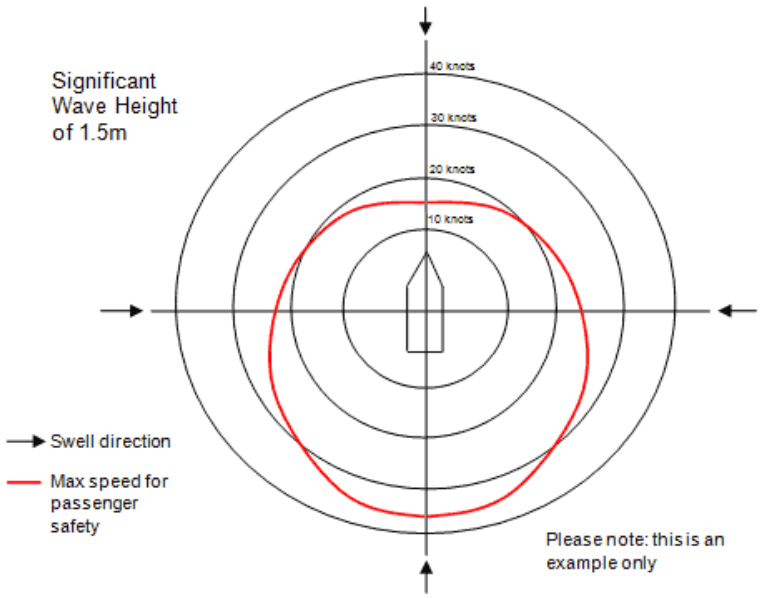

Figure 9. Vessel safety speed vs. swell direction. Source: http://goo.gl/HCF5yL

Different location means different environments, the current, the waves and the wind are, sometimes, unpredictable and the vessel has to handle different requests. Big waves and strong currents change easily the ship position, which may cause severe problems, as shocks between the platform and the towed object.

Figure 9 shows how the maximum vessel speed vary according to the wave direction, as we can see when the vessel sail toward the wave direction, the safety speed decreases.

The regulations, which include taxes, Emission Control Areas (ECAs) and international laws will affect the operability as well. According to International Maritime Organization (IMO), there are four ECAs: North Sea, Baltic Sea, North American Sea and the Caribbean Sea. In these regions, the maximum quantity of sulphur content in fuels shall be of 0.10%.

3 METHODOLOGY

3.1 PARAMETRIC DESIGN METHODOLOGY

Based on ERIKSTAD (1996) and LEVANDER (2006) design theories and combining these with the PARSONS (2004) parametric design, the design process will be define by a mission, with some inputs and the Final Design as output and divided in four steps according to figure 5. The methodology, created and used by the author, was summarized on Figure 10.

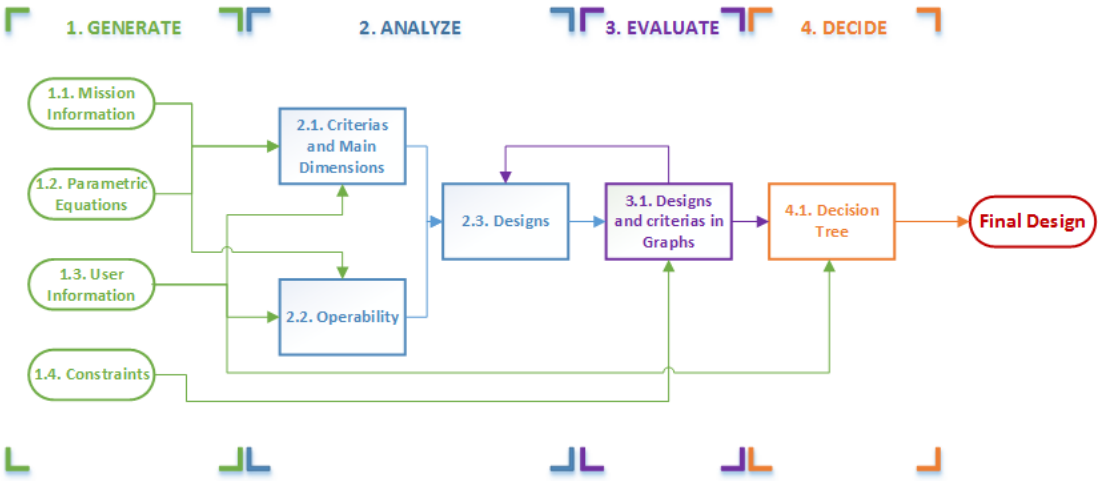

Figure 10. Parametric Design Methodology

The first step is dominated Generate, where the information about the mission and the ship are informed by the user. The Mission Information contains data about the tasks to perform. The Parametric Equations Box contains all the information to calculate the attributes with the parameters. The box *1.3* is the user interface where the main dimensions, the work local and other information will be modified; here is where the user may create different designs. Constraints has data about the taxes, ECAs and environment.

Analyze is the parametric equation stage, where each input will be used to calculate the ship characteristics as in equation 1.

$$C_b = \frac{Volume}{L \times B \times T} \tag{1}$$

With these equations is possible to calculate the attributes and every data, when available, to have a simplified ship design. Criteria and Main Dimensions and Operability contain attributes about the ship, and joining them, the Designs box is created.

Evaluate consists in obtain the values of each determined criteria. The user should input the constraints and the task values, satisfying the mission requirements and verifying the designs. Here the design and criteria are placed side by side in graphs to facilitate the understanding and comparison of the designs.

The last stage consists in decide which design is the best to attend the criteria, the principal one, operability. However, the user can select a weight to decide between price and operability. The decision-making is not easy; it requires information, experience, and good judgment. To help the user to achieve the best design will be used the Decision Tree method (INCOSE, 2006).

This method is a powerful tool to facilitate the user to make a decision. It take in account the probability of some event occurrence, in this case the operability, may contain information on the environment as well. Figure 11 has an example with the decision tree method.

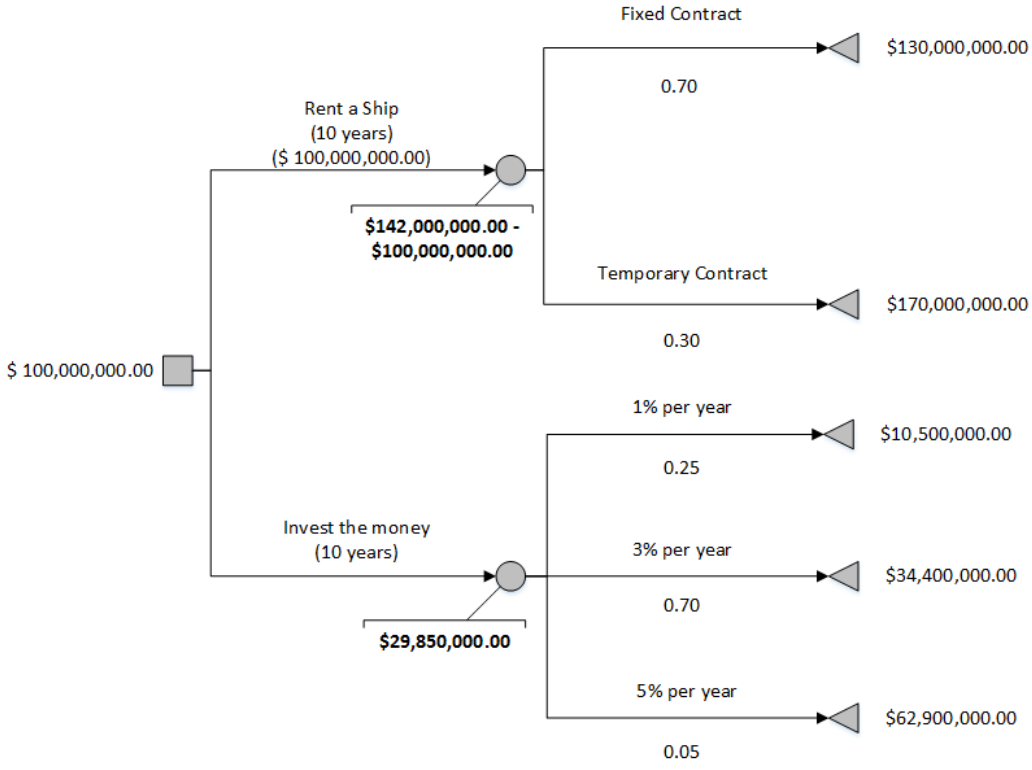

Figure 11. Basic Decision Tree

Figure 11 illustrates a situation where the entrepreneur needs to decide on invest (open a savings account) or rent a ship. To rent a ship the financial return should be better than to invest the money, otherwise it is not worth it. The cost of decision for rent a ship must be

greater than invest the money, otherwise, the entrepreneur does not need to rent. Using the compound interest equation, the return for invest money with rates of 1%, 3% and 5% will be $10,500,000.00, $34,000,000.00 and $62,900,000.00 respectively for ten years.

The return values to rent a ship will be $130,000,000.00 for a fixed contract and $170,000,000.00 for a temporary contract. Looking at the Figure 12, someone could say that the best option is to rent a ship in a temporary contract. However, there are the probabilities of occurrence of each outcome, which change the cost of decision, the entrepreneur will decide for rent a ship with a fixed contract, 70% of chance to earn $130,000,000.00.

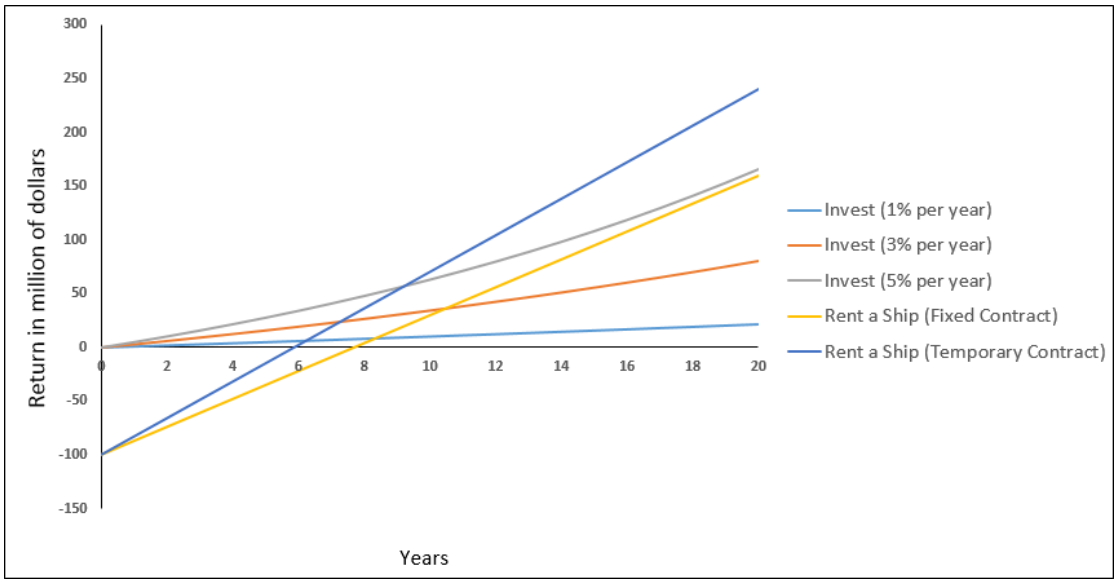

Figure 12. Rent a Ship vs. Different invest rates

Multiplying the outcome values with the probabilities and summing, the cost of decision for each choice, rent a ship or invest money, is calculated. For rent a ship, is necessary to deduct the amount of the rent, and then, comparing the two possibilities, rent a ship is worthier than invest the money. Changing the values of the probability and the return money, the cost of decision will change as well.

3.2 OPERABILITY AND CBD APPLIED TO THE CASE

To improve the operability, the configured to order, a method of manufacturing, which allows the customer to select a base ship (PSV, OSCV, AHTS) and configure some items inside of it according to the mission or the place of sail, will be applied.

An AHTS vessel has as principal missions to anchor handling, to supply and to tow. For an anchor handling vessel manage to complete a construction mission, the vessel have to have new facilities or configurations, such as new cranes, extra accommodation and moon pools with ROVS, as showed in Figure 13, step number 1. To manage the step number 2, in other words, to be able to navigate both in Brazil and in Arctic the ship must have better seakeeping (e.g. X-bow), Ice Class configuration and other.

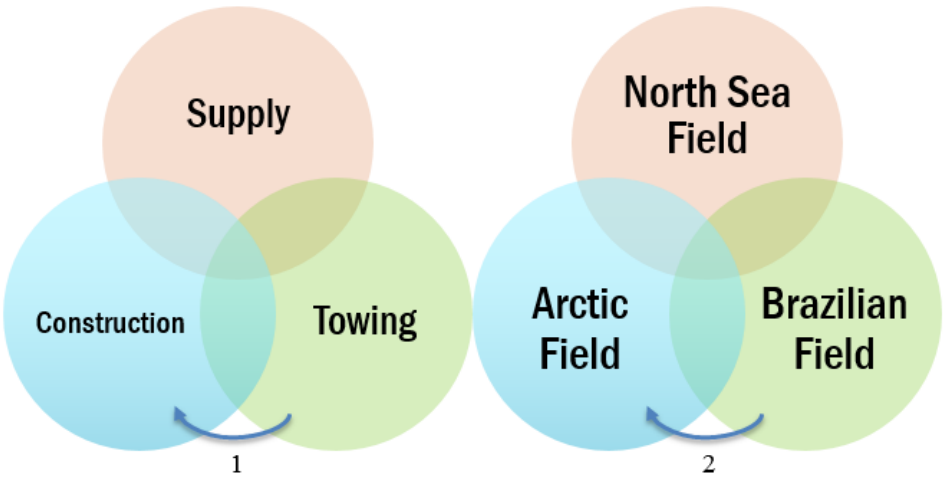

Figure 13. Different missions and fields. Each one requires ship facilities

The operability is directly connected with the mission, place and type of the vessel, as well as the configuration-based. Each change on the vessel, mission and place can modify significantly the ship operability, for example a simple PSV with the mission construction, whether the ship there is no construction facilities, the operability will be nearly 0%. Figure 14 shows what is connected with operability and which are the facilities and extra modules that the ship has to have to improve the operability.

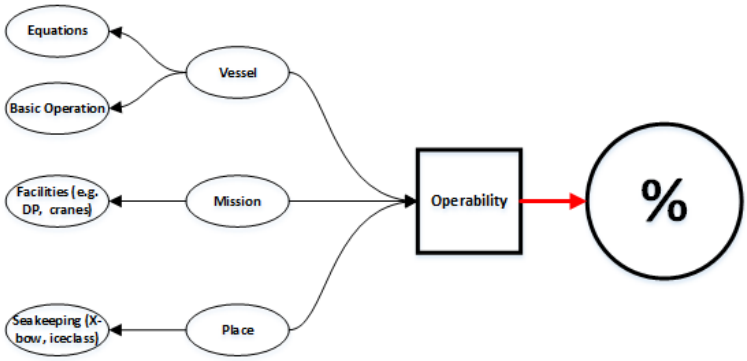

Figure 14. Relationship between operability, vessel, mission and place

3.3 BASIC CASE IN EXCEL

To explain the methodology, a basic case using MS Excel is presented. The purpose is to evaluate which design is most rentable considering three different fields: Brazilian, Norwegian and US. Each one has different levels of sea states and environmental conditions.

In Table 2, each distinct characteristic of these three different fields, are presented. Sea Level is the maximum state of the sea on that region, in other words, the size of the waves, usually defined by Beaufort scale. Distance work loc. is the distance between the shore and the platform. Revenue per trip is how much money the owner receive per trip. Cost per trip is the spending to navigate in that region. The availability determines how many months per year is possible to navigate in each region and the operation time is how many days is necessary to accomplish the mission beside the platform.

Table 2. Different cases defined by the user.

Cases	Sea States	Distance work loc.	Ice	Revenue per trip	Cost per trip	Availability (m/y)	Operation Time
Brazilian Fields	6	300	No	100	15	12	4
Norwegian Fields	8	700	Yes	93	17	12	4
US Fields	7	500	No	80	10	12	4

Table 3 shows four different designs, two of them are Ice Class. Each design has different lengths, beam and draught. The Capital Expenditure (CAPEX), money spent to build the ship, is calculated by the equation 2, this is an assumed equation and hereafter can be replaced for a real equation given by the company. The Speed given in knot. The Ice Breaker cell informs whether the design has icebreaker. The consumption gives the consumption of fuel in tons per day. The cell called *Sea State* contains a value that determines the maximum sea state level that each design can sail. When the sea state level is greater than the vessel may to support, it cannot sail and its operability will be less than 100% and the Bollard Pull informs how many tons of bollard pull the ship can tow.

Table 3. Different designs defined by the user.

Designs	L	B	T	CAPEX	Speed [knot]	Ice Breaker	Consumption [t/day]	Sea State	Bollard Pull (tons)
Design 1	90	18	7	1236	14	yes	15	8	100
Design 2	100	20	8	1152	15	no	14	7	110
Design 3	110	21	9	1462	13	yes	16	5	120
Design 4	120	24	10	1384	14	no	17	6	130

$$CAPEX = 10 * Length + 6 * Breadth + 4 * Draught + 200 \quad (2)$$

The value 200 in equation 2 is due to the ship have icebreaker, and it is considered only whether the ship is Ice Class. The tables 2 and 3 were the generate step. Following Erikstad proposal, the next step is to analyze.

The Table 4 presents the time in days for each design, adding the time to arrive at the platform and the operation time. How many tons of fuel was spent during the trip, the cost of trip and fuel. The last column, Operational Expenditure (OPEX) plus Voyage Expenditure (VOYEX), are the sum between Cost trip and Cost Fuel.

Table 4. Analyzing the designs in Norwegian Fields.

Norwegian Fields	Time	Fuel	Cost Trip	Cost Fuel	OPEX/ VOYEX
Design 1	6.25	93.78	17	65.64	82.64
Design 2	6.10	85.42	17	59.80	76.80
Design 3	6.42	102.80	17	71.96	88.96
Design 4	6.25	106.28	17	74.40	91.40

Different hypothetical scenarios were created, one of them is on the Table 5. To sail one year on Norwegian Sea, being two months in sea states level 8, three months in sea states level 7 and seven months in sea states level 5. The number of trip would be approximately 72 for all of the designs, however, two designs has no Ice Breaker that reduces the operability, or the number of trips. The other scenarios are presented on the Appendix 1, they take into account Brazil and US fields.

To calculate the operability, the environmental and the sea condition were taken into account. For Example, if the vessel has not icebreaker, its operability will be only 66.66%, because the Northern Sea is frozen during four months (supposed value). Whether the Sea State Level is eight during three months and the vessel support only Sea State Level 7, its operability will be 75%.

The Yearly Cost and Revenue are calculated using the equation 3 and 4 respectively.

$$Yearly\ Cost = (OPEX/VOYEX) * (Trips) * (Operability) \quad (3)$$

$$Yearly\ Revenue = (Revenue\ per\ Trip) * (Trips) * (Operability) \quad (4)$$

Table 5. Norwegian Field plus different Sea States.

Scenario 4	Norway: 2 months Sea States 8 + 3 months SS 7 + 7 months SS 5			
	Trips	Operability	Yearly Cost	Yearly Reveneu
Design 1	73	1	6033	6789
Design 2	73	0.55	3114	3771
Design 3	71	0.58	3685	3852
Design 4	73	0.38	2595	2640

In distinct scenarios, the vessel operability will be different and the profit will be positive or negative, and the better design for each scenario will change. The profit is calculated by subtracting Yearly Revenue and Yearly Cost, after deducing the CAPEX. On Table 6, for each design in each scenario, the profit is presented for ten years of work.

Table 6. Evaluating Profit in 10 years in each scenario.

Evaluating PROFIT	Design 1	Design 2	Design 3	Design 4
10 Years S1	22754	25838	18818	17536
10 Years S2	4764	5214.342	798	-767.596
10 Years S3	5874	9308	2188	696
10 Years S4	6324	5418	208	-934

In this basic case, to make the decision, is not necessary to use the Decision Tree method. The best design for each scenario is that which have better profit. For the scenario 4, for example, the best design is the number one. However, whether the ship designed not achieves the criteria, the user may easily change the attributes with the Configuration-Based design and each variation will change the price as well, as we can see in Table 7. Changing the attribute Power from 1 to 1.2 (plus 20%), the price will change as well.

Table 7. Simple CBD applied to this case.

Configuration Based			
Attribute	Power	BP	Accommodation
change attribute	1,2	1,4	10
change Price	1,2	1,175	1,05

To use excel to solve issues and to make a design, is difficult to automatize. In other words, in case the user need to insert a new design, the algorithm should be set up again for

the new ship. To work around of this disadvantage and propose a better interface with the user, use a computer language is more appropriate.

3.4 BASIC CASE IN JAVASCRIPT

The way to solve the problem on JavaScript is the same in excel, nevertheless this one needs to create functions and objects to store information. This information will be saves in different locations (Design ID), posteriorly processed and showed as graphs to the user. Complying the initial methodology, the decision tree will be into the algorithm to select which one is the best design. The Figure 15 contains the steps of the algorithm.

As did on Excel, the same steps will be created on the JavaScript. Though, in case of need to create a new design, in this case, there is a function to add a new one and calculate everything easily. This function is called .push.

The user will inform the ship type, mission and place to sail, when the mission is selected the user have to inform a value to DWT, Bollar Pull or Cargo Deck Area. This information is the input of the function. After this, the information about extras modules is necessary. Then, the user may add the design. Clicking on add button, the design will be stored. A set of designs can be created. After, clicking on calculate button, the attributes will be calculate and showed to the user, and the decision can be made only clicking on button decision, informing the weight to operability or price.

A basic example in JavaScript is on Appendix 2. However, this example has no user interface, the user necessitates a software to read the program. To make it possible is necessary to combine the JavaScript with HTML, and everyone with internet access may use the algorithm in a web page.

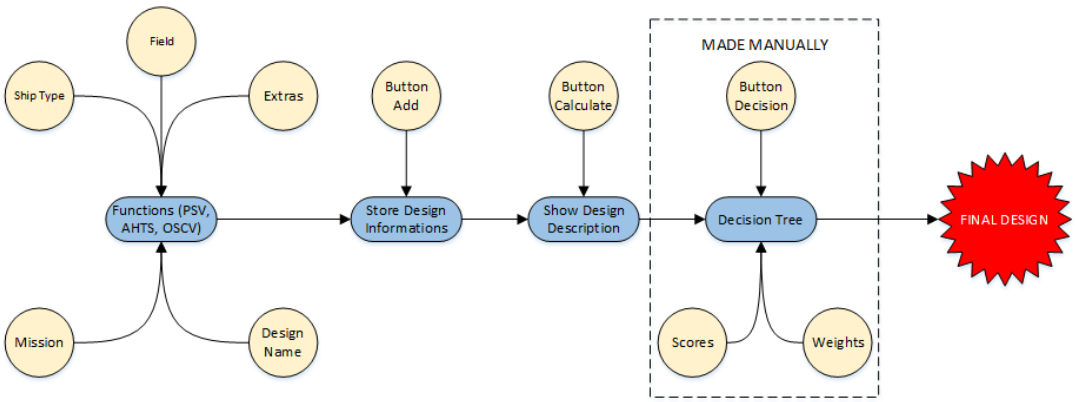

Figure 15. The algorithm steps

3.5 BASIC CASE IN HTML + JAVASCRIPT

The best advantage to use HTML plus JavaScript is the web application possibility. In few seconds, several users may have access to the algorithm and make their own design. One difference is that the user do not need a file or have knowledge about the algorithm, only a web link.

An example of user interface is presented on Figure 16, where, sliding the bars is possible to change the design characteristics and posteriorly the criteria. After input the main dimensions, the user can receive the design set, and some graphs comparing them (Figure 17).

Parameters	Value	Range
Length [m]	100	
Breadth/Length	0.22	
Breadth [m]	22	
Depth/Breadth	0.45	
Depth [m]	9.9	
Draft/Depth	0.7	
$Draft_{Design}$ [m]	6.9	
C_B	0.75	
Powering [kW]	20689	
Price / GT [kNOK/GT]	50	

Figure 16. Example of set the main parameters in a webpage (GASPAR, 2013b).

To change the attributes value the user only need to click one button and set the new value. At the final, the decision tree could be presented, where the user will be able to compare, put weights for each attribute (operability is worthier than price) and make the decision, however the decision tree will be made manually due to the difficulty to implement this. The complete algorithm (Appendix 3) and equations in JavaScript + HTML will be showed on the following section.

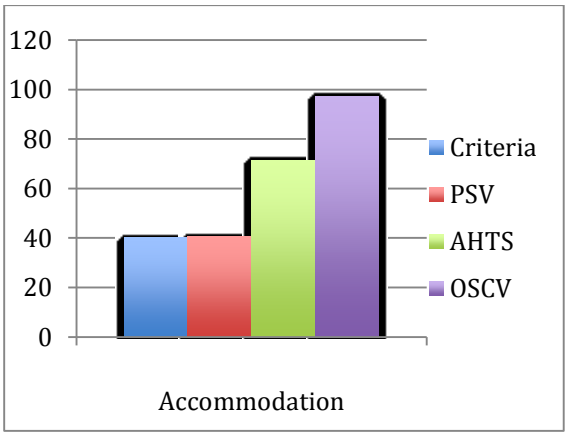

Figure 17. Number of bedroom in each type of vessel vs. the criteria.

4 CASE STUDY

4.1 PARAMETRIC EQUATIONS

To make a parametric model, the principal information needed is the parametric equations. The equations must take into account the vessel type; it means that, one equation made for Platform Supply Vessel does not work for Anchor Handling Tug Supply Vessel. ERIKSTAD and LEVANDER (2012) did a survey of data for the main types of OSV, containing graphs where was possible to make a linear regression and have some equations, as presented in Table 8.

Table 8. Principal parametric equations for OSVs (ERIKSTAD and LEVANDER, 2012).

Attribute	PSV	AHTS	OSCV
Deck Cargo Weight	0,0004*GT^1,9111	0,1988*GT^1,0797	0,0162*GT^1,3414
Accomodation	1,0755*GT^0,3832	(-5*10^-7)*GT^2+0,0129*GT	1,9532*GT^0,4343
Installed Power	28,41*GT^0,6773	34,751*GT^0,7294	5,0811*GT^0,8628
Bollard Pull	1,8623*GT^0,5017	0,4934*GT^0,7248	0,023*GT^0,9346
DWT	(-5*10^-5)*GT^2+1,427*GT	(-8*10^-5)*GT^2+1,2246*GT	3,0942*GT^0,84
Price	(1*10^-7)*GT^2+GT*0,0071	0,0011*GT^1,2733	(3*10^-6)*GT^1,931

As showed on Table 8, to obtain the results the only information necessary is the Gross Tonnage (GT). As defined in 1969 tonnage convention (LAMB, 2004), the GT is calculated as following

$$GT = K_I \times V \tag{5}$$

Where,

V = Volume of enclosed places (m^3)

$K_I = 0.2 + 0.02 \times \log_{10} V$

To find the enclosed volume, the data about the superstructure and the volume in each deck is necessary, and on preliminary design is difficulty to obtain this value. Then, GT will be found from the inverse parametric equation. As showed on section 3.1 the design starts from the mission (supply, towing or construction), and the user will define what is the ship mission and the necessary value for the attribute directly connected with the mission.

Whether the mission is supply, the principal characteristic needed for accomplish this is DWT. Given the mission, the user will inform the value of the attribute, and from this value

is possible to find the Gross Tonnage. Table 9 shows the mission related to the main attribute and the inverse parametric equation.

Table 9. Inverse Parametric Equation for each type of vessel (ERIKSTAD and LEVANDER, 2012).

		Equation/Vessel Type		
Mission	Attribute	PSV	AHTS	OSCV
Supply	DWT	Equation 6	Equation 7	GT = (DWT/3,0942)^1,1905
Towing	Bollard Pull (BP)	GT =(BP/1,8623)^1,9932	GT = (BP/0,4934)^1,3797	GT = (BP/0,023)^1,07
Construction	Deck Cargo Weight (DCW)	GT = (DCW/0,0004)^(0,5233)	GT = (DCW/0,1988)^0,9262	GT = (DCW/0,0162)^0,7455

The equations 6 and 7 are part of the Table 9,

$$GT = \frac{\sqrt{-2*10^{-4}*DWT+2,0363}}{-1*10^{-4}} + 14270 \quad (6)$$

$$GT = \frac{\sqrt{-3,2*10^{-4}*DWT+1,4996}}{-1,6*10^{-4}} + 7654 \quad (7)$$

Hereafter the gross tonnage value can be changed, and naturally every attribute, simply modifying the mission value showed on Table 9. The Length, Breadth and Draught can be calculate using the inverse of the equations showed on Table 10.

Table 10. Relationship between GT and L, B, T for each vessel type (ERIKSTAD and LEVANDER, 2012).

PARAMETER	PSV	AHTS	OSCV
Length	$GT = 0{,}7604 * L^2 - 28{,}287 * L + 384{,}83$	$GT = 0{,}0036 * L^{3{,}1603}$	$GT = 0{,}02 * L^{2{,}7306}$
Breadth	$GT = 23{,}52 * B^2 - 321{,}67 * B + 1142{,}9$	$GT = 0{,}272 * B^{3{,}2457}$	$GT = 0{,}002 * B^{4{,}8411}$
Draught	$GT = 3{,}598 * T^{3{,}7204}$	$GT = 4{,}9059 * T^{3{,}437}$	$GT = 22{,}225 * T^{3{,}0387}$

4.2 ADD CONFIGURATION MODULES

One of the objectives of this thesis is the possibility to add different modules on the design; each module will affect the results and the final decision. The user can choose all options or only one, obviously to check all options will increase the price, however will improve the operability. The options, which may be chosen, are therefore listed.

- Extra Accommodation;
- Extra Bollard Pull;
- Extra Power;
- Extra Crane;
- Dynamic Positioning (DP) - Class II or III;
- Ice Class;
- X-Bow;
- Extra Moon Pool
- Extra ROV;
- Helipad;

The Table 11 shows how each configuration affect the attributes (price, DWT, Power).

Table 11. How the modules affect each attribute.

Attribute / Module	Price	Power	Accomodation	DWT	Bollard Pull	Deck Cargo Weight	Light Weight Tonnage	Operability
Extra Accommodation (1)	plus 0.5%	*	plus 1	less 0.5%	*	Less 0.2%	plus 0.5%	
Extra Bollard Pull (1%)	plus 0.125%	*	*	*	plus 1%	*	*	
Extra Power (1%)	plus 0.25%	plus 1%	*	less 0.04%	*	*	plus 0.25%	
Extra Crane (1 ton)	plus 0.5%	*	*	less 0.04%	*	Less 0.03%	plus 0.05%	
DP II (yes)	5%	*	*	less 0.2%	*	*	plus 0.2%	
DP III (yes)	10%	*	*	less 0.3%	*	*	plus 0.3%	
Ice Class (yes)	plus 0.5%	*	*	less 0.01%	*	*	*	
Xbow (yes)	plus 0.5%	*	*	*	*	*	*	
Moon Pool (yes)	plus 1%	*	*	Less 3%	*	Less 5%	plus 3%	
Extra ROV (yes)	plus 1%	*	*	Less 2%	*	Less 0.8%	plus 5%	
Helipad (yes)	plus 1%	*	Less 5	Less 2%	*	Less 0.5%	plus 2%	

* Attribute not affected.

When the user decide to add a new accommodation the price will increase in 0.5%, the Accommodation will increase in one more cabin and the DWT will decrease in 0.5%. One percent in extra power changes the price in plus 0.25% and decreases the DWT in 0.04%. When DP II yes, the price increase 5%.

As well as the main attributes are affected due to the configuration modules, the operability also will be affected. However, the operability improves whereas each module is added.

Every set of type, mission and place of sail, will give a different value for operability. For example, to navigate through the arctic sea, is necessary to be Ice Class, otherwise the operability will be low. The Table 12 shows whether is good, neutral or bad to add a module for the operability value according to the mission, ship type, place and extra modules.

Table 12. Changing on operability according to the ship type, mission, field and extra modules.

			Accommodation	BP	Power	Crane	DP II	DP III	Ice Class	X-Bow	Moon Pool	ROV	Helipad
PSV	Supply (best operability)	Brazil	Bad	Bad	Bad	Bad	Good	Good	Bad	Good	Bad	Bad	Bad
		North Sea	Bad	Neutral	Neutral	Bad	Good	Good	Bad	Good	Bad	Bad	Bad
		Arctic	Bad	Neutral	Neutral	Bad	Good	Good	Good	Good	Bad	Bad	Bad
	Towing	Brazil	Neutral	Good	Good	Good	Good	Good	Bad	Good	Bad	Bad	Bad
		North Sea	Neutral	Good	Good	Good	Good	Good	Bad	Good	Bad	Bad	Bad
		Arctic	Neutral	Good	Good	Good	Good	Good	Good	Good	Bad	Bad	Bad
	Construction	Brazil	Good	Good	Good	Good	Good	Good	Bad	Good	Good	Good	Good
		North Sea	Good	Good	Good	Good	Good	Good	Bad	Good	Good	Good	Good
		Arctic	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
AHTS	Supply	Brazil	Bad	Bad	Bad	Bad	Good	Good	Bad	Good	Bad	Bad	Bad
		North Sea	Bad	Bad	Bad	Bad	Good	Good	Bad	Good	Bad	Bad	Bad
		Arctic	Bad	Bad	Bad	Bad	Good	Good	Good	Good	Bad	Bad	Bad
	Towing (best operability)	Brazil	Neutral	Good	Good	Bad	Good	Good	Bad	Good	Bad	Bad	Bad
		North Sea	Neutral	Good	Good	Bad	Good	Good	Bad	Good	Bad	Bad	Bad
		Arctic	Neutral	Good	Good	Bad	Good	Good	Good	Good	Bad	Bad	Bad
	Construction	Brazil	Good	Bad	Bad	Neutral	Good	Good	Bad	Good	Good	Good	Good
		North Sea	Good	Bad	Bad	Neutral	Good	Good	Bad	Good	Good	Good	Good
		Arctic	Good	Bad	Bad	Neutral	Good	Good	Good	Good	Good	Good	Good
OSCV	Supply	Brazil	Bad	Neutral	Neutral	Bad	Good	Good	Bad	Good	Bad	Bad	Bad
		North Sea	Bad	Neutral	Neutral	Bad	Good	Good	Bad	Good	Bad	Bad	Bad
		Arctic	Bad	Neutral	Neutral	Bad	Good	Good	Good	Good	Bad	Bad	Bad
	Towing	Brazil	Bad	Good	Good	Bad	Good	Good	Bad	Good	Bad	Bad	Bad
		North Sea	Bad	Good	Good	Bad	Good	Good	Bad	Good	Bad	Bad	Bad
		Arctic	Bad	Good	Good	Bad	Good	Good	Good	Good	Bad	Bad	Bad
	Construction (best operability)	Brazil	Bad	Bad	Bad	Neutral	Good	Good	Bad	Good	Neutral	Neutral	Neutral
		North Sea	Bad	Bad	Bad	Neutral	Good	Good	Bad	Good	Neutral	Neutral	Neutral
		Arctic	Bad	Bad	Bad	Neutral	Good	Good	Good	Good	Neutral	Neutral	Neutral

TVEDT (2012) divided the ship as we can see in Figure 18. On this thesis, the extra modules are only modifying the attributes values; however, Tvedt showed that the ship could be divided in modules and added separately. He said it has a several benefits in a flexible parametric ship design, including the task related modules can be implemented on selection, same principle of CBD, discussed on this thesis. Nevertheless, the 3D model will not be a result of this thesis.

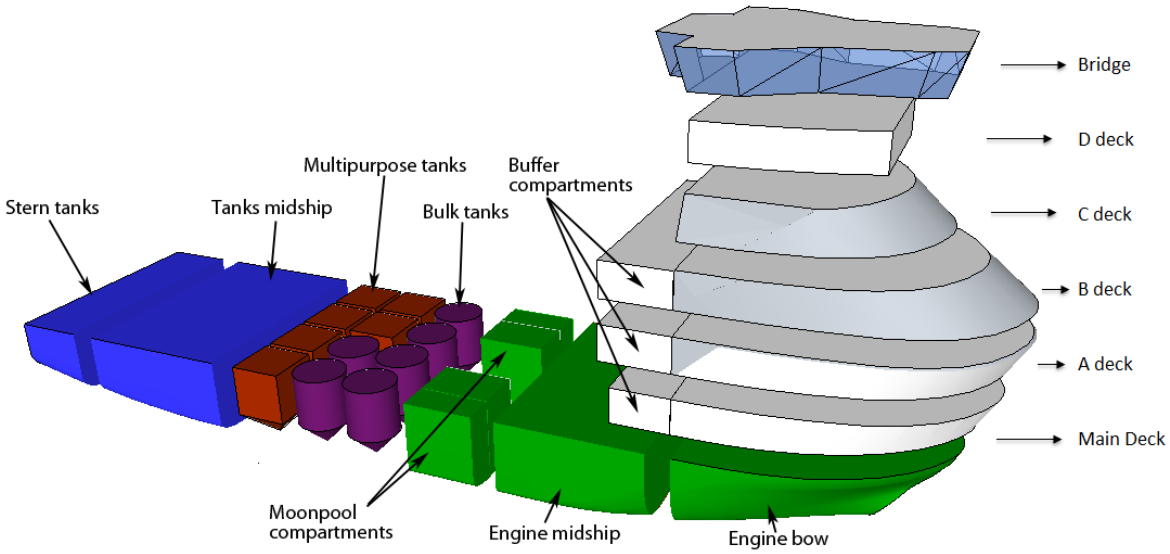

Figure 18. Ship divided into modules (TVEDT, 2012)

4.3 EXPLAINING THE ALGORITHM

The model, as commented, was made by JavaScript plus HTML, which permits the creation of the Graphical User Interface (GUI) and the upload of the algorithm in a webpage. The GUI is a type of user interface that use graphical icons and indicators to allow the user to interact with electronic devices or computer programs, using mouse and the keyboard to manipulate texts and images (DICTIONARY, 2014).

The figure 19 presents how each box communicates with the algorithm and gives to the user the results. The first box to select is the type of the ship, the user can choose between PSV, OSCV and AHTS. When selected, the algorithm stores the option, and from now, the equations inside of the program are those showed on table 8 column 2, 3 or 4.

The second step is to select the mission, supply, towing or construction. Each choice determinates, with user information, a value of DWT, Bollard Pull or Deck Cargo Weight, respectively. These values, on the other hand, will calculate the GT value with the inverse

equations. The GT value is the input for the parametric equations. This returns every attribute value. Nevertheless, in case the user is not satisfy with the results, a new design can be created to modifying the ship length, breadth or draught.

The mission also change the operability, for example, the selected ship type is PSV and the selected mission is construction, the ship has no facilities to accomplish the construction mission. The operability may be modified with the extra boxes.

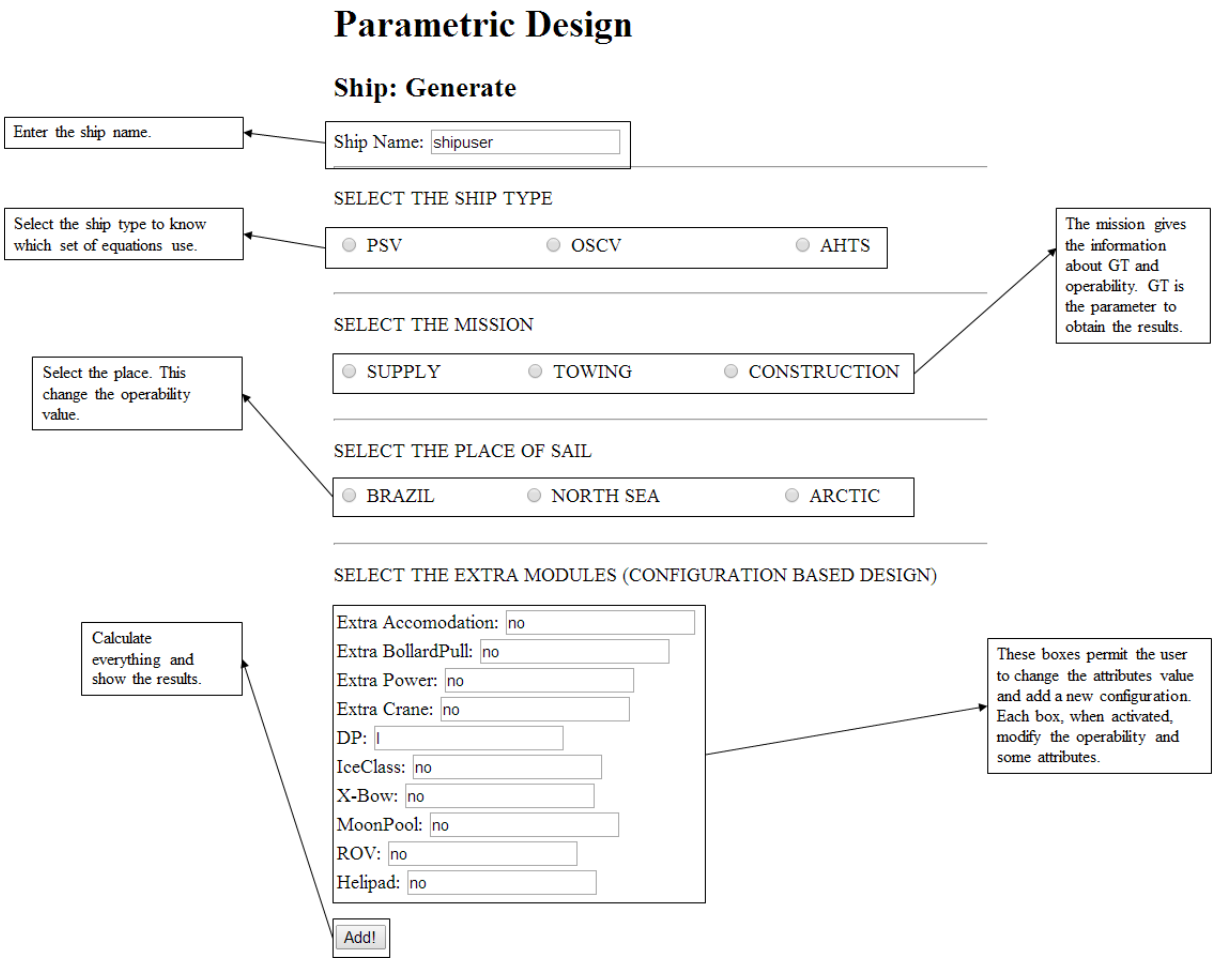

Figure 19. Graphical User Interface X Algorithm

The extra boxes, when selected, will increase the attribute values, as showed on Table 11, however, they do not change the GT value. Also, will improve the operability, which is important to make the final decision.

The place of sail box will change only the operability. To sail in Brazil is different to sail in Arctic. In the last, the ship needs, at least, to be Ice Class and has X-Bow to guarantee the safety of the crew. Finally, the button add will store the design.

After generate the designs, they will be showed on analyzes' place, showed on Figure 20. The users may create how many designs they want. With all the designs stored, is possible to calculate the results (attributes), every attribute for each design will show automatically when the button calculate is pressed.

Moreover, the decision can be made simply clicking on decision button, nevertheless on this thesis the decision will be made manually.

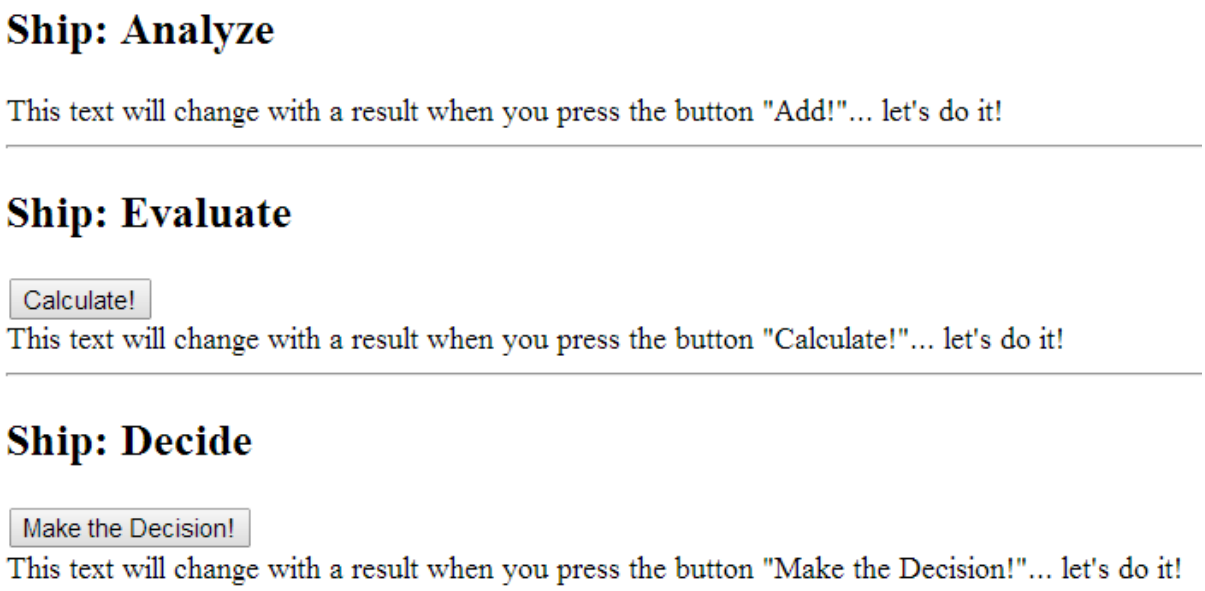

Figure 20. Analyze, Evaluate and Decide on HTML.

4.4 DESCRIBING THE CASE

The case will take into account the three types of vessels. Each type will have different places and missions, in other words, different operability. Then each design will have a set of nine scenarios. In each scenario, the financial return will be different and the value will be hypothetic.

Each mission and place will have a probability to happen according to the ship type. For example, a supply mission for a PSV is more often than a towing mission. Then the probability for supply is bigger. The probability values are hypothetic and can be changed by the user hereafter. The financial return combined with the operability, probability and the CAPEX, will give the weight of the decision.

The first design is a Basic PSV, the term basic means that every extra configuration is filled with "no". The information about the design in each scenario is showed on table 13. For one design, nine scenarios are created and analyzed. The earned money is presented on the

last column of the table 13. The CAPEX will be showed on the next section. The value of the mission for each scenario is showed on the DWT, BP and CDW columns.

Table 13. Scenarios for the PSV design.

Name	Ship Type	Mission	Place	DWT(tons)	BP(tons)	CDW(tons)	Financial Return (M)
Scenario 1	PSV	Supply	Brazil	4000	-	-	50
Scenario 2	PSV	Supply	North Sea	4000	-	-	60
Scenario 3	PSV	Supply	Arctic	4000	-	-	70
Scenario 4	PSV	Towing	Brazil	-	105,9859	-	90
Scenario 5	PSV	Towing	North Sea	-	105,9859	-	110
Scenario 6	PSV	Towing	Arctic	-	105,9859	-	130
Scenario 7	PSV	Construction	Brazil	-	-	1938,4056	150
Scenario 8	PSV	Construction	North Sea	-	-	1938,4056	170
Scenario 9	PSV	Construction	Arctic	-	-	1938,4056	190

For the two next designs, AHTS and OSCV, the GT value has to be the same for each mission to do not change the attribute values. However it cannot be made due to the comparison of the mission, then the calculated GT will be the arithmetic mean for each mission and the mission values will be different from PSV design, however the attributes will be the same for each scenarios. The probability value for the scenarios will be showed on the decision tree on the next section.

The new mission values for the AHTS and OSCV designs are showed on table 14 and 15 and the screenshot of the HTML for the first scenario of the first design is presented on Figure 21.

The user can change everything, evaluate different designs in different scenarios, and hereafter make the decision, being sure of what design is the best to invest and profit money.

Table 14. Scenarios for the AHTS design.

Name	Ship Type	Mission	Place	DWT(tons)	BP(tons)	CDW(tons)	Financial Return (M)
Scenario 1	AHTS	Supply	Brazil	3482,9575	-	-	50
Scenario 2	AHTS	Supply	North Sea	3482,9575	-	-	60
Scenario 3	AHTS	Supply	Arctic	3482,9575	-	-	70
Scenario 4	AHTS	Towing	Brazil	-	193,0935	-	90
Scenario 5	AHTS	Towing	North Sea	-	193,0935	-	110
Scenario 6	AHTS	Towing	Arctic	-	193,0935	-	130
Scenario 7	AHTS	Construction	Brazil	-	-	1446,9122	150
Scenario 8	AHTS	Construction	North Sea	-	-	1446,9122	170
Scenario 9	AHTS	Construction	Arctic	-	-	1446,9122	190

Table 15. Scenarios for the OSCV design.

Name	Ship Type	Mission	Place	DWT(tons)	BP(tons)	CDW(tons)	Financial Return (M)
Scenario 1	OSCV	Supply	Brazil	4932,3919	-	-	50
Scenario 2	OSCV	Supply	North Sea	4932,3919	-	-	60
Scenario 3	OSCV	Supply	Arctic	4932,3919	-	-	70
Scenario 4	OSCV	Towing	Brazil	-	84,1202	-	90
Scenario 5	OSCV	Towing	North Sea	-	84,1202	-	110
Scenario 6	OSCV	Towing	Arctic	-	84,1202	-	130
Scenario 7	OSCV	Construction	Brazil	-	-	2016,7703	150
Scenario 8	OSCV	Construction	North Sea	-	-	2016,7703	170
Scenario 9	OSCV	Construction	Arctic	-	-	2016,7703	190

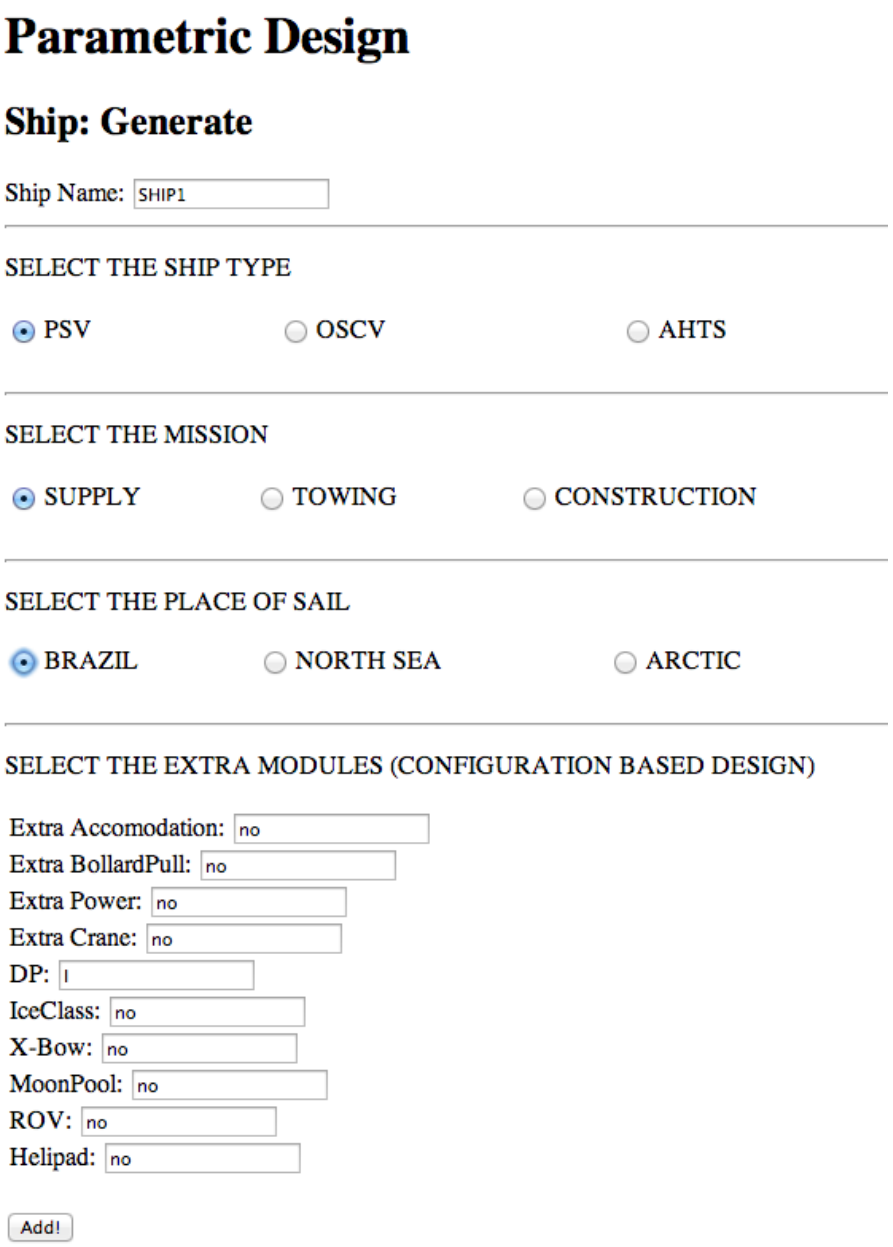

Figure 21. HTML Screenshot of the Scenario 1 (PSV design).

5 RESULTS AND ANALYSIS

5.1 THE CALCULATED ATTRIBUTES FOR EACH DESIGN.

The Results and Analysis section presents the results, including the decision tree and a discussion about the results. The calculated attributes for each ship will be presented as well. The calculated attributes for each design are showed on figure 22.

DESIGN 1:	**DESIGN 2:**	**DESIGN 3:**
Type: PSV, Mission: SUPPLY, Place: BRAZIL Length: 84.8538497820878 m Breadth: 18.746318198793265 m Draught: 6.176773038781632 m LWT: 2324.700139860131 ton DWT: 4000.145 ton Volume: 6170.5806242537865 m3 Cb: 0.6280248841393262 Installed Power: 6652.416139434055 kW Bollard Pull: 105.98097890303707 ton Deck Cargo Weight: 1940.7532884805833 ton Accommodation: 23.562478711165497 Persons CAPEX: 23.36573129418105 Million of Dollars Operability: 0.9	Type: AHTS, Mission: SUPPLY, Place: BRAZIL Length: 80.20442361635772 m Breadth: 18.88858606666629 m Draught: 6.913715311172526 m LWT: 3693.048875303807 ton DWT: 3483.2537517182263 ton Volume: 7001.270855631253 m3 Cb: 0.668447980272664 Installed Power: 14126.346649529778 kW Bollard Pull: 193.11121925565786 ton Deck Cargo Weight: 1447.1096312397958 ton Accommodation: 41.57863902955488 Persons CAPEX: 39.44433222598788 Million of Dollars Operability: 0.8	Type: OSCV, Mission: SUPPLY, Place: BRAZIL Length: 104.24222038377225 m Breadth: 22.114346196809993 m Draught: 6.478691937088059 m LWT: 4671.672781787438 ton DWT: 4933.119387726932 ton Volume: 9370.52894586768 m3 Cb: 0.6274209549232329 Installed Power: 9895.960988879167 kW Bollard Pull: 84.13405653588498 ton Deck Cargo Weight: 2107.266575714609 ton Accommodation: 88.4205749684397 Persons CAPEX: 69.06008830864347 Million of Dollars Operability: 0.8

Figure 22. Calculated Attributes for each design.

As we can see on figure 22, the OSCV design is more expensive than the other is and the ship is bigger. However, the AHTS design has more bollard pull and installed power. The PSV design is the smallest one, nevertheless its operability is greatest for a mission supply in Brazil. For other scenarios, the only attribute that will change is the operability.

The calculated attributes is presented on the webpage simply clicking on calculate button and they can change with another mission value.

5.2 DECISION TREE

To make the decision, the decision tree will be utilized and will facilitate the decision. Is important to know the probabilities to occurrence each scenario, for example, one PSV has 70% of the time a supply mission, 20% towing mission and 10% construction mission. An experienced team should make the expected financial return and the probabilities, however on this thesis theses values are hypothetic. The model is very susceptible to the return money and the economic parameters, as CAPEX.

The decision make will be between the three types of vessel and hereafter between build a ship or invest money in an account.

The decision tree for the PSV design is presented on Figure 23, the probability values can be found on this figure and the financial return for each scenario is presented on Table 13.

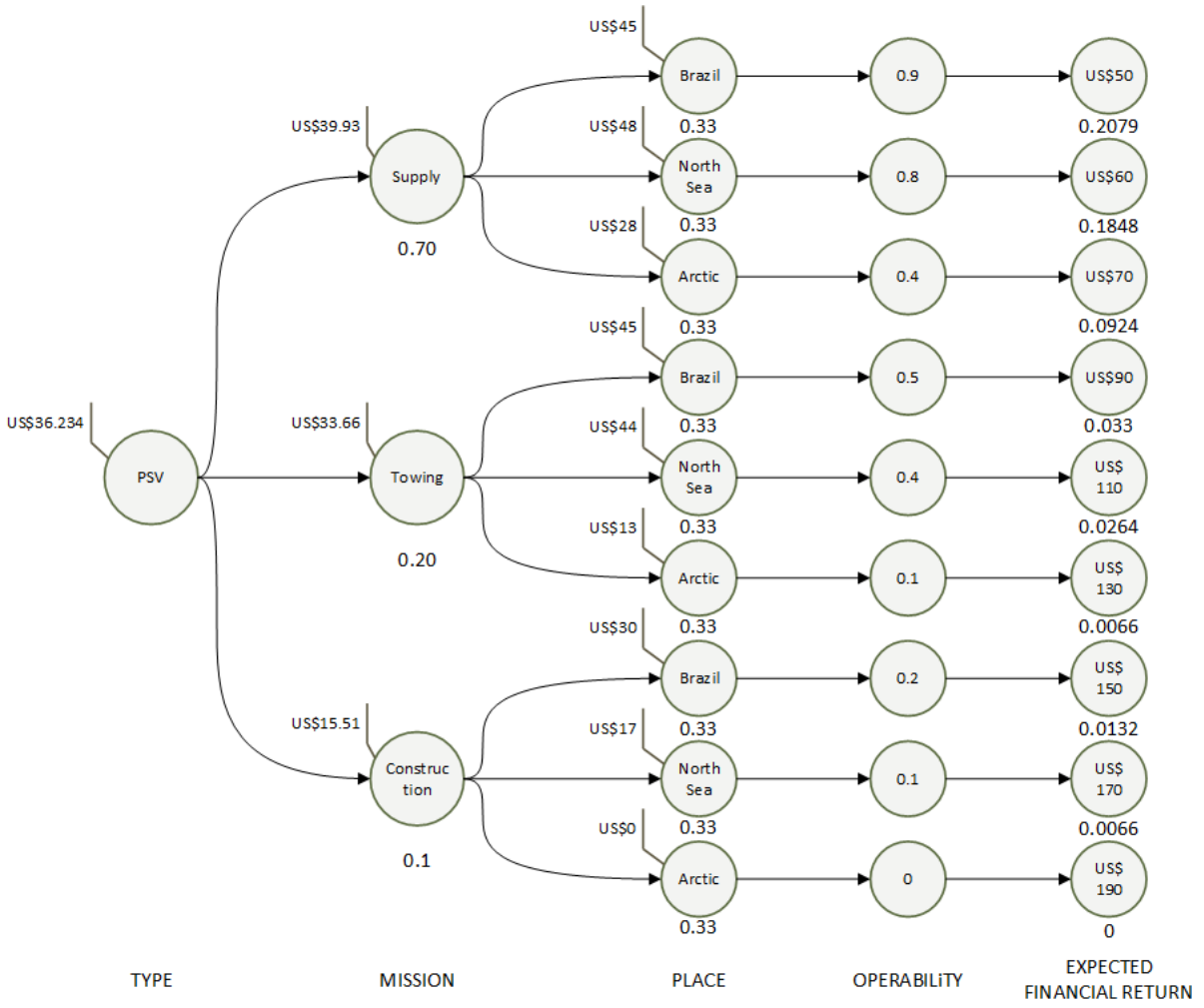

Figure 23. Decision Tree for a PSV Design.

As we can see on Figure 23, the best scenario for a PSV design is navigate on North Sea with a supply mission, the cost of decision on this case will be US$48 million without deduct the CAPEX value. Whether the user wants the place of sailing in Brazil, there are two possible scenarios, with a mission supply or a mission towing. Changing the operability, expected financial return and the probabilities values, the best scenario will change. The user can decide for a construction mission on the arctic, however the probability of earn money is zero. The equation 8 shows how to calculate the cost of decision for the mission supply.

$$Expected\ Money\ for\ Supply = US\$50 \times 0.9 \times 0.33 + US\$60 \times 0.8 \times 0.33 + US\$70 \times 0.4 \times 0.33 \quad (8)$$

Although, in this case the result is to choice the best design, is possible to see which scenario is better for each design. As made with the PSV design, the same will be made with the AHTS design and the OSCV design. Both are describe on following.

For the AHTS, the probability for each mission will be 30% supply, 60% towing and 10% construction. In addition, the decision tree is showed on Figure 24.

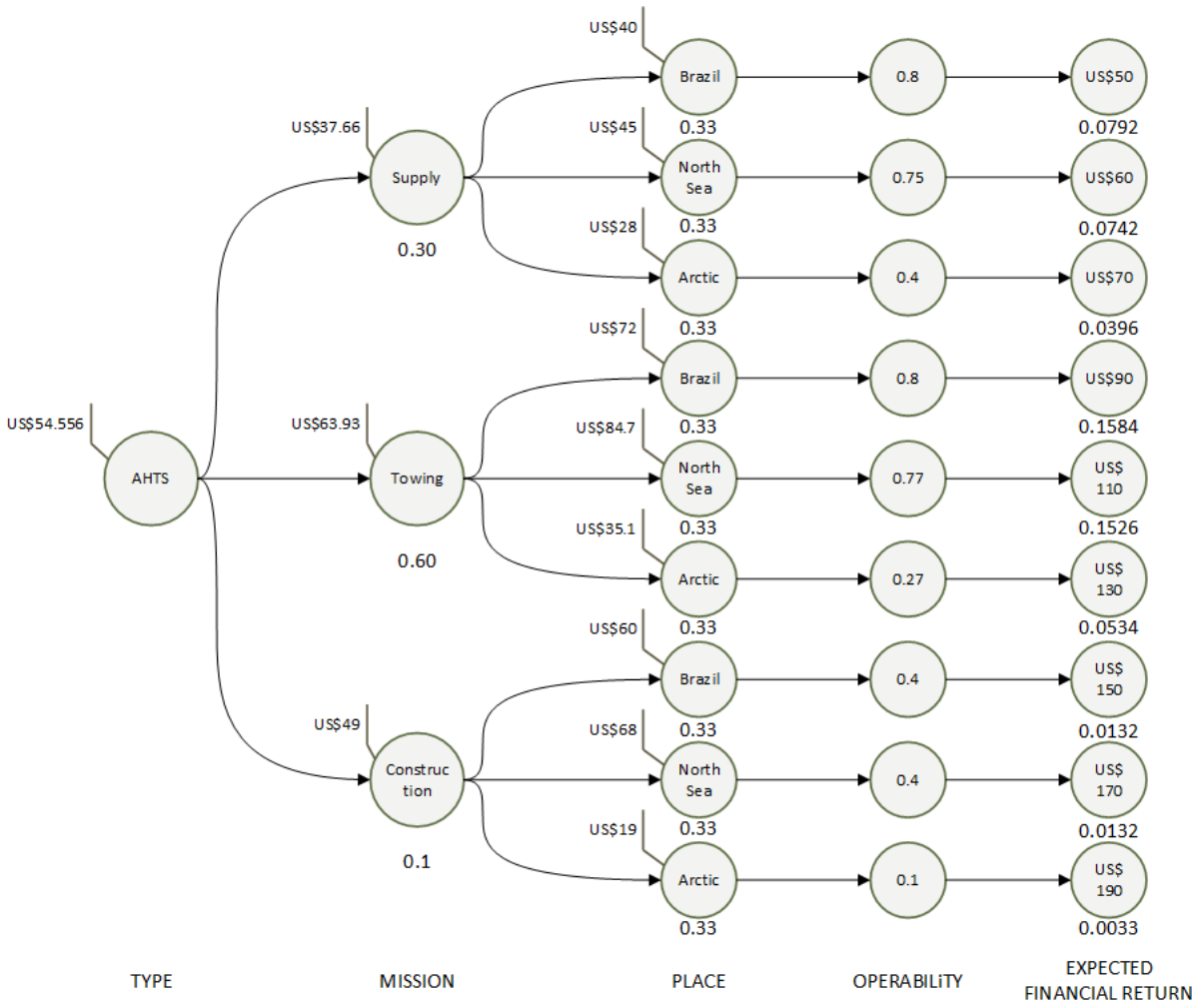

Figure 24. Decision Tree for an AHTS design

As we can see on Figure 24, the best scenario for the AHTS design is sailing on North Sea with a mission towing, even though the operability is less. The best mission, as expected, is towing regardless of the place. However, for this type of vessel the construction mission profit more money than the supply mission does, even with low probabilities. The Equation 9 shows how to calculate the cost of decision for the AHTS vessel.

$$Expected\ money\ for\ AHTS = US\$37.66 \times 0.30 + US\$63.93 \times 0.60 + US\$49 \times 0.1 = US\$\ 54.556 \quad (9)$$

The same was made to calculate the expected money for PSV and will be made to calculate the expected money for OSCV.

For the OSCV design the probability values for each mission is 20%, 10% and 70% respectively. The Decision Tree for this design is presented on figure 25.

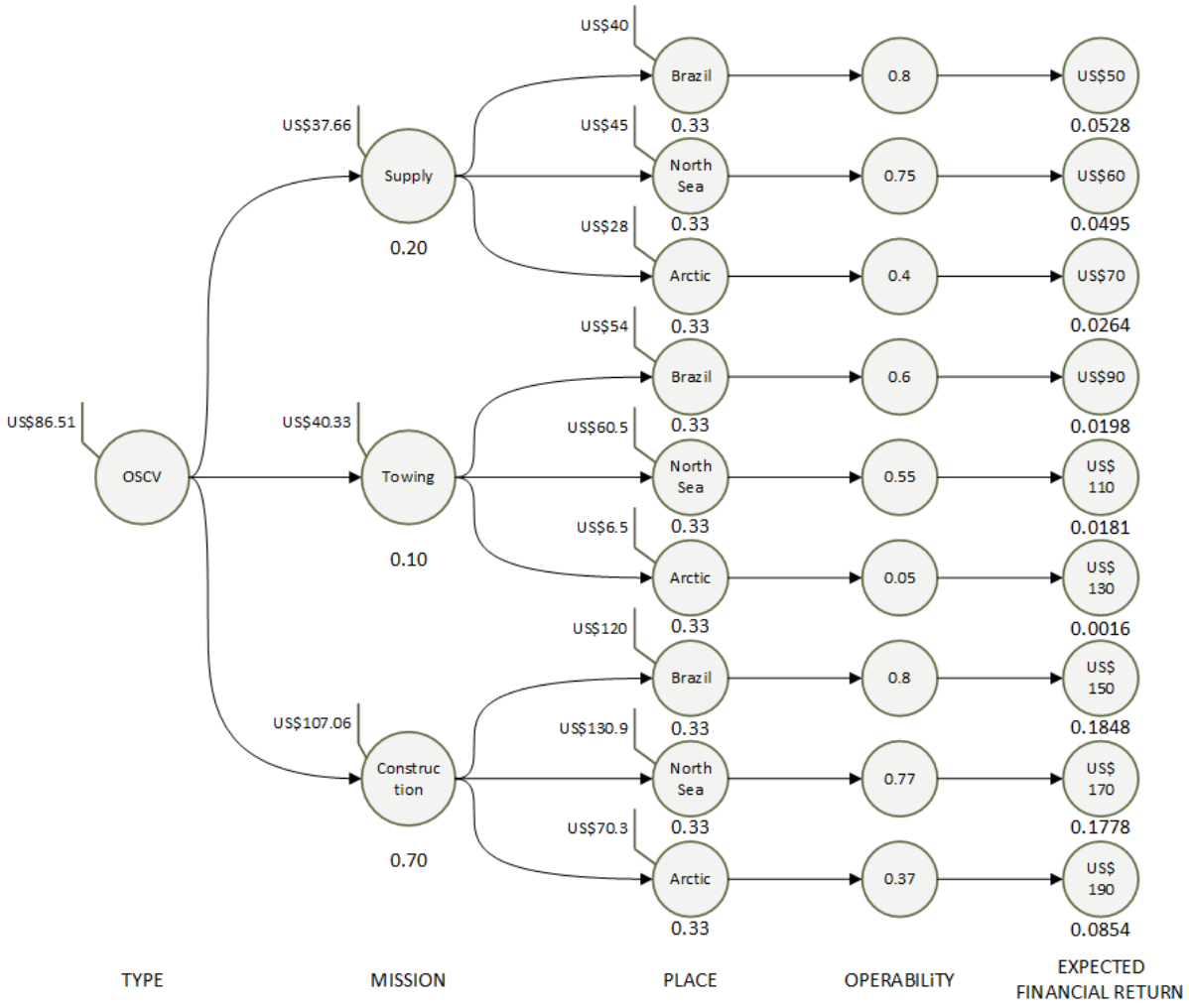

Figure 25. Decision Tree for the OSCV design.

Comparing the missions supply and towing, we can see that towing is better whether the place of sail is Brazil or North Sea, however whether the place is Arctic, the best mission between these two is supply.

The figure 25 shows that the OSCV design profit more money, however to make the decision is necessary to deduct the CAPEX of each design. Then, the decision can be made. In addition, the decision can be extended to build a ship or invest the money in a bank account.

The figure 26 shows the final decision, deducting the CAPEX and comparing the ships with the invested money.

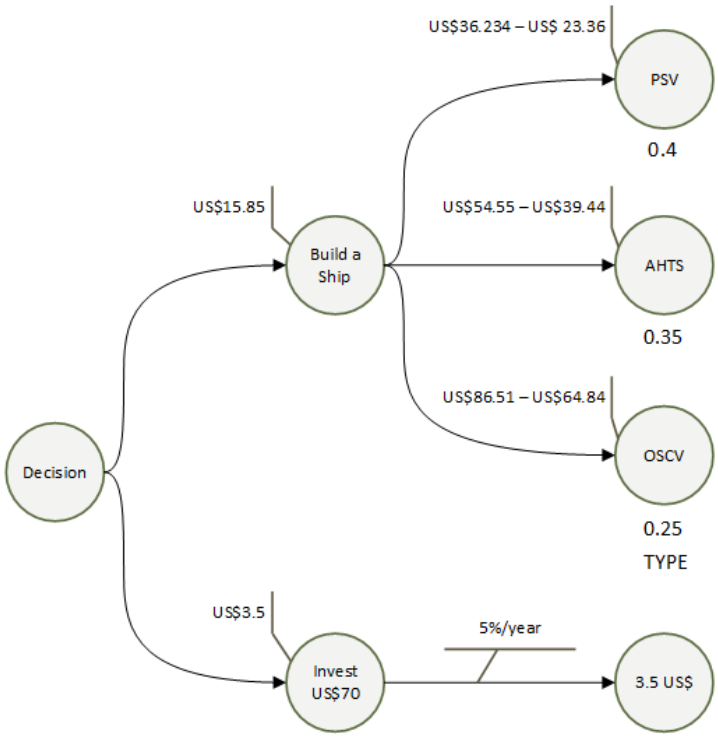

Figure 26. Decision Making.

The figure 26 shows that is better to build a ship, the cost of decision does not mean the same as the amount of money, of course that within one year the amount of money for invest money is greater, however extending the time line for 3 years, build a ship is better. Every different scenario can change the results, including the taxes from the bank. Within 3 years, building an AHTS, the amount of money can be US$ 124.210.000,00 and investing can be US$ 81.033.750,00. As showed, the decision tree aims always the best decision, according to the probabilities and the expected financial return.

On this figure is possible to see that the best ship to build is an AHTS, after an OSCV and finally the PSV, regardless the time line. These results can change considering real values for the probability, operability and the financial return at the end of each scenario. Each company can include its own values and equations, and delivery to the customer the best choice to profit.

6 CONCLUDING REMARKS AND FUTURE WORKS

6.1 CONCLUSION

This thesis has presented the adaptation of the Configuration-Based design to the Parametric Design, by means of an algorithm to measure the operability and show the principal attributes of the Offshore Support Vessels in different scenarios and missions, having as input the mission of the vessel as described by LEVANDER (2006), and posteriorly showing the decision-make.

To achieve the objective of develop a parametric model common tools were used as, Excel, JavaScript and HTML. Herewith the parametric equations obtained and some acquired knowledge about the operability, was possible to quantify the operability value for every scenario. Moreover, gradually the algorithm was improving.

The addressed methodology helped to achieve the result and to organize the steps to make the parametric model. The Decision Tree method proved that it could be extended to include multiple decisions points and multiple outcomes as long as the outcome has the probability to occurrence and a value.

During the development of the thesis, some difficulties appeared. The principal one was how to measure the operability. As this attribute depend of several parameters, and there is no data or equation about how the ship configuration affect the operability, this attribute improved according to the table 12. Another difficulty was the information about the financial return and the probabilities, data hided by the companies.

To implement the decision tree method on the algorithm was a difficulty as well. The diversity of inputs and designs, herewith the set of scenarios precluded the use of it inside of the model. However, it does not prevent to apply the method, even manually.

As showed, some parametric equations was obtained from the research of ERIKSTAD and LEVANDER (2012). Other attributes could be calculated, nevertheless the data (equations) about new attributes have not been found. Possibly other researches or company information would be needed to make a whole ship design.

The outcomes of the thesis proved and showed that the companies with their own equations, values, and scenarios can use this algorithm, simply modifying values inside of the program. The model also proved that is possible to have a ship design only with simple parameters, in this case, a gross tonnage value given by the mission of interest.

The decision tree method provides a clearly lay out of the case, enabling to contest all the results and analyze the consequences of a decision. Also, provide a good framework to

quantify the values of the outcomes and probabilities, facilitating the decision-making based on the existing information. However, this method should be always used in conjunction with common sense of an experienced group.

The model also proved that the quick exchanging information between a possible customer and a company is possible, however the GUI were not polish enough. The Graphical User Interface could be improved using JQuery User Interface, though this tool was not used.

The developed algorithm were not polish enough and can be improved, it can waste more computational effort than necessary and some users cannot understand the code. Maybe creating some functions for the repeated parts, the algorithm could be cleaner and more understandable.

The excel showed that it is a good tool to start understanding the problem, however, on the latest stages of the work, use excel can be toilsome, may cause the user to become frustrated every time that he needs to change or add a new design. In addition, the JavaScript, even though on the latest stages is a good tool, on the earlier stages takes time and mental effort, more when an error occurs.

6.2 FUTURE WORKS

For future works, a communication with the HTML + JavaScript algorithm and a 3D software can be made, and the customer can have a preliminary 3D design as output. As made by TVEDT (2012).

Also the improving of the GUI, using JQuery or another tool. This would facilitate the access and the view of the user. Could be added as well, the possibility to edit the design after create it.

The model could be used with real values, applying a real case and the results would be more reliable. However, the model need to be improved to make easier the change of the values inside of the computer program.

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8 APPENDIX

8.1 APPENDIX 1

Table 16. Scenario 1 for a basic case in Excel

Scenario 1	1 year Brazil calm sea conditions			
	Trips	Operability	Yearly Cost	Yearly Revenue
Design 1	73	1	4901	7300
Design 2	73	1	4601	7300
Design 3	71	1	5072	7100
Design 4	73	1	5408	7300

Table 17. Scenario 2 for a basic case in Excel

Scenario 2	1 year Norway calm Sea Conditions			
	Trips	Operability	Yearly Cost	Yearly Revenue
Design 1	58	1	4794	5394
Design 2	59	0.6666	3021	3657.6342
Design 3	56	1	4982	5208
Design 4	58	0.6666	3534	3595.6404

Table 18. Scenario 3 for a basic case in Excel

Scenario 3	1 year US calm Sea Conditions			
	Trips	Operability	Yearly Cost	Yearly Revenue
Design 1	64	1	4409	5120
Design 2	65	1	4154	5200
Design 3	63	1	4675	5040
Design 4	64	1	4912	5120

8.2 APPENDIX 2

```
//Simple Parametric Design
   function log10(arg){
      return Math.log(arg) / 2.302585092994046;
   }

   //Designs
   var Ship1 = {name: "Design 1", L: 100, B: 22, D: 10, To: 7, Cb: 0.7, extraP: "yes",
extraBP: "no", extraAcc: "yes"};
   var Ship2 = {name: "Design 2", L: 110, B: 23, D: 10.5, To: 7.5, Cb: 0.71, extraP:
"no", extraBP: "yes", extraAcc: "yes"};
   var ships = [Ship1, Ship2];

   //Volume and GT
   var Volume = [];
   var GT = [];
```

```
   for (var i = 0; i < ships.length; i++)
   {
      Volume[i] = (ships[i].L * ships[i].B * ships[i].D);
      GT[i] = (0.2 + 0.02 * log10(Volume[i]))*Volume[i];
   }



   //PSV

   var PSV = [];
   function PSVf(GTonnage) {
      this.DeckCargoWeight = (0.0004)*(Math.pow(GTonnage,1.9111));
      this.Accomodation = 1.0755 * (Math.pow(GTonnage,0.3832));
      this.InstalledPower = 28.41 * (Math.pow(GTonnage,0.6773));
      this.BollardPull = 1.8623 * (Math.pow(GTonnage,0.5017));
      this.DWT = -5 * (Math.pow(10,-5)) * (Math.pow(GTonnage,2))+ 1.427 *
GTonnage;
      this.Price = (Math.pow(10,-7)) * (Math.pow(GTonnage,2)) + 0.0071 *
GTonnage;
   }

   for (var i = 0; i < ships.length; i++){
      PSV[i] = new PSVf(GT[i]);
   }
```

8.3 APPENDIX 3

```
<html>
<body>
   <h1>Parametric Design</h1>
   <h2>Ship: Generate</h2>

   Ship Name: <input type="text" id="name" value="shipuser" title="Ship
Name"><br><hr>

   <table style="width:600px">
      <tr><p>SELECT THE SHIP TYPE</p></tr>
      <tr><form id="formBuzType" method="post" action="#">
         <td><input type="radio" id='r1' name="buztype" value="PSV">
PSV<br></td>
         <td><input type="radio" id='r2' name="buztype" value="OSCV">
OSCV<br></td>
         <td><input type="radio" id='r3' name="buztype" value="AHTS">
AHTS<br></td></form>

      </tr></table><br><hr>
```

```
      <table style="width:600px"><tr>
      <p>SELECT THE MISSION</p></tr>

         <tr><form id="formMission" method="post" action="#">
            <td><input type="radio" id='r1' name="mission" value="SUPPLY">
SUPPLY<br></td>
            <td><input type="radio" id='r2' name="mission" value="TOWING">
TOWING<br></td>
            <td><input type="radio" id='r3' name="mission"
value="CONSTRUCTION"> CONSTRUCTION<br></td>
         </form>
         </tr>
   </table><br><hr>

      <table style="width:540px">
         <p>SELECT THE PLACE OF SAIL</p></tr>
         <tr><form id="formPlace" method="post" action="#">
            <td><input type="radio" id='r1' name="place" value="BRAZIL">
BRAZIL<br></td>
            <td><input type="radio" id='r2' name="place" value="NORTHSEA">
NORTH SEA<br></td>
            <td><input type="radio" id='r3' name="place" value="ARCTIC">
ARCTIC<br></td>
         </form>
         </tr>

      </table><br><hr>

<table>

  <tr>
     <p>SELECT THE EXTRA MODULES (CONFIGURATION BASED
DESIGN)</p>

  <td>
     Extra Accomodation: <input type="text" id="ExtraAcc" value="no" title="yes or
no" ><br>
     Extra BollardPull: <input type="text" id="ExtraBP" value="no" title="yes or no"
><br>
     Extra Power: <input type="text" id="ExtraP" value="no" title="yes or no" ><br>
     Extra Crane: <input type="text" id="ExtraCrane" value="no" title="yes or no"
><br>
     DP: <input type="text" id="DP" value="I" title="I or II or III" ><br>
     IceClass: <input type="text" id="IC" value="no" title="yes or no" ><br>
     X-Bow: <input type="text" id="Xbow" value="no" title="yes or no" ><br>
     MoonPool: <input type="text" id="Moonpool" value="no" title="yes or no"
><br>
     ROV: <input type="text" id="ROV" value="no" title="yes or no" ><br>
     Helipad: <input type="text" id="Helipad" value="no" title="yes or no"
><br></td>
```

```
  </tr>

</table><br>

<button type="button" onclick="updateCalc()">Add!</button><br>
  <hr>



  <h2>Ship: Analyze</h2>

  <div id="shipadd">
  This text will change with a result when you press the button "Add!"... let's do it!
  </div>

  <hr>

   <h2>Ship: Evaluate</h2>

  <button type="button" onclick="calculating()">Calculate! </button><br>

  <div id="div_result">
  This text will change with a result when you press the button "Calculate!"... let's do
it!
</div>

<hr>

<h2>Ship: Decide</h2>

<div id = "decision">
   <button type="button" onclick="decisionTree()">Make the Decision!
</button><br>
   This text will change with a result when you press the button "Make the
Decision!"... let's do it!
</div>

<script>

var ships =[];
count = 1;
var Operability = [];
var Results = [];
var Volume = [];
var CB = [];
var decideship = [];
var bestship = 0;
var results_str = "";
var bestship_str = "";
```

```
function updateCalc (){
   //Simple Parametric Design
   function log10(arg){
      return Math.log(arg) / 2.302585092994046;
   }

var form = document.getElementById('formBuzType'); // if you passed the form, you
wouldn't need this line.
    for(var i = 0; i < form.buztype.length; i++)
    {
        if(form.buztype[i].checked)
        {
        var type = form.buztype[i].value;
        }

    }
    var form = document.getElementById('formMission'); // if you passed the form,
you wouldn't need this line.
    for(var i = 0; i < form.mission.length; i++)
    {
       if(form.mission[i].checked)
       {
          var Mission = form.mission[i].value;
       }

    }
    var form = document.getElementById('formPlace'); // if you passed the form, you
wouldn't need this line.
    for(var i = 0; i < form.place.length; i++)
    {
       if(form.place[i].checked)
       {
          var Place = form.place[i].value;
       }

    }
    if (type=="PSV"){
            if (Mission=="SUPPLY"){
                  var DWT = prompt("The mission is Supply. Define a value for DWT
in tons");
                  var BP  = "definido depois";
                  var DCW = "definido depois";
            }

            if (Mission=="TOWING"){
                  var BP = prompt("The mission is Towing. Define a value for BP in
tons")
                  var DWT = "definido depois";
                  var DCW = "definido depois";
            }
```

```
            if (Mission=="CONSTRUCTION"){
                var DCW = prompt("The mission is Construction. Define a value for
Deck Cargo Weight in tons")
                var DWT = "definido depois";
                var BP  = "definido depois";
            }

    }

    if (type=="AHTS"){
        if (Mission=="SUPPLY"){
            var DWT = prompt("The mission is Supply. Define a value for DWT in
tons");
            var BP  = "definido depois";
            var DCW = "definido depois";
        }

        if (Mission=="TOWING"){
            var BP = prompt("The mission is Towing. Define a value for BP in tons")
            var DWT = "definido depois";
            var DCW = "definido depois";
        }

        if (Mission=="CONSTRUCTION"){
            var DCW = prompt("The mission is Construction. Define a value for Deck
Cargo Weight in tons")
            var DWT = "definido depois";
            var BP  = "definido depois";
        }

    }

    if (type=="OSCV"){
        if (Mission=="SUPPLY"){
            var DWT = prompt("The mission is Supply. Define a value for DWT in
tons");
            var BP  = "definido depois";
            var DCW = "definido depois";
        }

        if (Mission=="TOWING"){
            var BP = prompt("The mission is Towing. Define a value for BP in tons")
            var DWT = "definido depois";
            var DCW = "definido depois";
        }

        if (Mission=="CONSTRUCTION"){
            var DCW = prompt("The mission is Construction. Define a value for Deck
Cargo Weight in tons")
```

```
            var DWT = "definido depois";
            var BP  = "definido depois";
        }

    }


    //adding designs

    var Ship1 = {
        id: count,
        shiptype: type,
        shipmission: Mission,
        shipplace: Place,
        DWT: DWT,
        BP: BP,
        DCW: DCW,
        name: document.getElementById("name").value,
        extraP: document.getElementById("ExtraP").value,
        extraBP: document.getElementById("ExtraBP").value,
        extraAcc: document.getElementById("ExtraAcc").value,
        ExtraCrane: document.getElementById("ExtraCrane").value,
        DP: document.getElementById("DP").value,
        IceClass: document.getElementById("IC").value,
        XBow: document.getElementById("Xbow").value,
        MoonPool: document.getElementById("Moonpool").value,
        ROV: document.getElementById("ROV").value,
        Helipad: document.getElementById("Helipad").value,
            PowerM: 0,
            BPM: 0,
            AccM: 0,
            CraneM: 0};

            if (Ship1.extraP == "yes"){
                    var PowerM = prompt("In how many percent do you want to improve
the ship power? put values between 0 and 0.1. For Example: 0.05");
                    Ship1.PowerM = PowerM;
            }

            if (Ship1.extraBP == "yes"){
            var BPM = prompt("In how many percent do you want to improve the Bollard
Pull? put values between 0 and 0.1. For Example: 0.05");
                    Ship1.BPM = BPM;
            }

            if (Ship1.extraAcc == "yes"){
            var AccM = prompt("In how many people do you want to improve the ship
accomodation? put values between 0 and 20. For Example: 15");
                    Ship1.AccM = AccM;
            }
```

```
        if (Ship1.ExtraCrane == "yes"){
        var CraneM = prompt("how many tons the crane must have? put values
between 50 and 250. For Example: 70");
                Ship1.CraneM = CraneM;
        }


   ships.push(Ship1);
   document.getElementById("shipadd").innerHTML = JSON.stringify(ships);
   count = count + 1;
}


//Calculating Everything

function calculating(){

for (var i = 0; i < ships.length; i++){


   //PSV


   if (ships[i].shiptype=="PSV"){

   if (ships[i].shipmission=="SUPPLY"){
      var ajuda = ((-2)*(Math.pow(10,-4))*ships[i].DWT) + 2.0363;
      var GT = (Math.pow(ajuda,0.5))/(-1*(Math.pow(10,-4)))+14270;
   }

   if (ships[i].shipmission=="TOWING"){
      var GT = Math.pow((ships[i].BP/1.8623),1.9932);
   }

   if (ships[i].shipmission=="CONSTRUCTION"){
      var GT = Math.pow((ships[i].DCW/0.0004),0.5233);
   }

   function PSVf(GTonnage) {
      this.DCW = ((0.0004)*(Math.pow(GTonnage,1.9111)));
      this.Accomodation = (1.0755 * (Math.pow(GTonnage,0.3832)));
      this.InstalledPower = (28.41 * (Math.pow(GTonnage,0.6773)));
      this.BollardPull = (1.8623 * (Math.pow(GTonnage,0.5017)));
      this.DWT = (-5 * (Math.pow(10,-5)) * (Math.pow(GTonnage,2))+ 1.427 *
GTonnage);
      this.Price = ((Math.pow(10,-7)) * (Math.pow(GTonnage,2)) + 0.0071 *
GTonnage);
      this.IPrice = ((Math.pow(10,-7)) * (Math.pow(GTonnage,2)) + 0.0071 *
GTonnage);
```

```
        this.Length = (2.4138*Math.pow(GTonnage,0.4419));
        this.Breadth = (1.613*Math.pow(GTonnage,0.3045));
        this.Draugth = (0.7097*Math.pow(GTonnage,0.2686));
        this.LWT = (0.7157*Math.pow(GTonnage,-
0.154))*(4.7096*Math.pow(GTonnage,0.9654));
    }


        Results[i] = new PSVf(GT);

        //EXTRA POWER PSV

        if (ships[i].extraP == "yes"){
            Results[i].InstalledPower += Results[i].InstalledPower * (ships[i].PowerM);
            Results[i].Price += Results[i].Price*(ships[i].PowerM/4);
            Results[i].DWT -= Results[i].DWT*(ships[i].PowerM*0.04);
            Results[i].LWT += Results[i].LWT*(ships[i].PowerM*0.25);

        }

        //EXTRA BOLLARD PULL PSV

        if (ships[i].extraBP == "yes"){
            Results[i].BollardPull += Results[i].BollardPull * (ships[i].BPM);
            Results[i].Price += Results[i].Price*(ships[i].BPM/8);
        }

        //EXTRA ACCOMMODATION PSV

        if (ships[i].extraAcc == "yes"){
            Results[i].Accomodation += (ships[i].AccM*1);
            Results[i].Price += Results[i].Price*0.005*ships[i].AccM;
            Results[i].DWT -= Results[i].DWT*(ships[i].AccM*0.005);
            Results[i].DCW -= Results[i].DCW*(ships[i].AccM*0.002);
            Results[i].LWT += Results[i].LWT*(ships[i].AccM*0.005);
        }

        //EXTRA CRANE PSV

        if (ships[i].ExtraCrane == "yes"){
            Results[i].DWT -= Results[i].DWT*(ships[i].CraneM*0.0004);
            Results[i].Price += (Results[i].Price*0.0005*ships[i].CraneM);
            Results[i].DCW -= Results[i].DCW*(ships[i].CraneM*0.0003);
            Results[i].LWT += Results[i].LWT*(ships[i].CraneM*0.0005);
        }

        //EXTRA DP PSV

        if (ships[i].DP == "II"){
            Results[i].Price += (Results[i].Price*0.05);
```

```
    Results[i].DWT -= Results[i].DWT*(0.002);
    Results[i].LWT += Results[i].LWT*(0.002);
}
if (ships[i].DP == "III"){
    Results[i].Price += Results[i].Price*0.1;
    Results[i].DCW -= Results[i].DCW*(0.003);
    Results[i].LWT += Results[i].LWT*(0.003);
}

//EXTRA ICE CLASS PSV

if (ships[i].IceClass == "yes"){
    Results[i].DWT -= Results[i].DWT*0.0001;
    Results[i].Price += Results[i].Price*0.005;
}

//EXTRA XBOW PSV

if (ships[i].XBow == "yes"){
    Results[i].Price += Results[i].Price*0.005;
}

//MOON POOL PSV

if (ships[i].MoonPool == "yes"){
    Results[i].Price += Results[i].Price*0.01;
    Results[i].DWT -= Results[i].DWT*0.03;
    Results[i].DCW -= Results[i].DCW*0.05;
    Results[i].LWT += Results[i].LWT*(0.03);
}

//EXTRA ROV PSV

if (ships[i].ROV == "yes"){
    Results[i].Price += Results[i].Price*0.01;
    Results[i].DWT -= Results[i].DWT*0.02;
    Results[i].DCW -= Results[i].DCW*0.008;
    Results[i].LWT += Results[i].LWT*(0.05);
}

//EXTRA HELIPAD PSV

if (ships[i].MoonPool == "yes"){
    Results[i].Price += Results[i].Price*0.01;
    Results[i].DWT -= Results[i].DWT*0.02;
    Results[i].DCW -= Results[i].DCW*0.005;
    Results[i].Accomodation -= 5;
    Results[i].LWT += Results[i].LWT*(0.02);
}
```

```
      //OPERABILITY FOR PSV

      if (ships[i].shipmission == "SUPPLY" && ships[i].shipplace =="BRAZIL"){
         Operability[i] = 0.9;
         if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.93;
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
               Operability[i] = 0.95;
            }
         }
         if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.97;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
               Operability[i] = 0.99;
            }
         }
      }
      if (ships[i].shipmission == "SUPPLY" && ships[i].shipplace
=="NORTHSEA"){
         Operability[i] = 0.8;
         if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.85;
            if(ships.extraP == "yes"){
               Operability[i] = 0.88;
            }
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
               Operability[i] = 0.90;
               if(ships[i].extraP == "yes"){
                  Operability[i] = 0.93;
               }
            }
         }
         if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.90;
            if(ships.extraP == "yes"){
               Operability[i] = 0.93;
            }
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
               Operability[i] = 0.95;
               if(ships[i].extraP == "yes"){
                  Operability[i] = 0.98;
               }
            }
         }
      }
      if (ships[i].shipmission == "SUPPLY" && ships[i].shipplace =="ARCTIC"){
         Operability[i] = 0.4;
         if(ships[i].IceClass == "yes"){
            Operability[i] = 0.8;
```

```
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.83;
            if(ships[i].extraP == "yes"){
                Operability[i] = 0.86;
            }
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.88;
                if(ships[i].extraP == "yes"){
                    Operability[i] = 0.91;
                }
            }
        }
        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.88;
            if(ships[i].extraP == "yes"){
                Operability[i] = 0.91;
            }
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.93;
                if(ships[i].extraP == "yes"){
                    Operability[i] = 0.96;
                }
            }
        }
    }
}

if (ships[i].shipmission == "TOWING" && ships[i].shipplace =="BRAZIL"){
    Operability[i] = 0.5;
    if(ships[i].DP == "II" || ships[i].XBow == "yes"){
        Operability[i] = 0.55;
        if(ships[i].DP == "II" && ships[i].XBow == "yes"){
            Operability[i] = 0.6;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.63;
            }
        }
    }
    if(ships[i].ExtraCrane == "yes" || ships[i].extraP == "yes"){
        Operability[i] = 0.6;
        if(ships[i].extraBP == "yes"){
            Operability[i] = 0.7;
            if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                Operability[i] = 0.75;
                if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                    Operability[i] = 0.8;
                    if(ships[i].Accomodation == "yes"){
                        Operability[i] = 0.83;
                    }
                }
```

```
        }
    }
    if(ships[i].ExtraCrane == "yes" && ships[i].extraP == "yes"){
        Operability[i] = 0.7;
        if(ships[i].extraBP == "yes"){
            Operability[i] = 0.8;
            if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                Operability[i] = 0.85;
                if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                    Operability[i] = 0.9;
                    if(ships[i].Accomodation == "yes"){
                        Operability[i] = 0.93;
                    }
                }
            }
        }
    }
}
if(ships[i].DP == "III" || ships[i].XBow == "yes"){
    Operability[i] = 0.57;
    if(ships[i].DP == "III" && ships[i].XBow == "yes"){
        Operability[i] = 0.62;
        if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.65;
        }
    }
}
if(ships[i].ExtraCrane == "yes" || ships[i].extraP == "yes"){
    Operability[i] = 0.6;
    if(ships[i].extraBP == "yes"){
        Operability[i] = 0.7;
        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.77;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.82;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.85;
                }
            }
        }
    }
    if(ships[i].ExtraCrane == "yes" && ships[i].extraP == "yes"){
        Operability[i] = 0.7;
        if(ships[i].extraBP == "yes"){
            Operability[i] = 0.8;
            if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                Operability[i] = 0.87;
                if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                    Operability[i] = 0.92;
                    if(ships[i].Accomodation == "yes"){
```

```
                        Operability[i] = 0.95;
                    }
                }
            }
        }
    }
    if (ships[i].shipmission == "TOWING" && ships[i].shipplace
=="NORTHSEA"){
        Operability[i] = 0.4;
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.45;
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.5;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.53;
                }
            }
        }
        if(ships[i].ExtraCrane == "yes" || ships[i].extraP == "yes"){
            Operability[i] = 0.5;
            if(ships[i].extraBP == "yes"){
                Operability[i] = 0.6;
                if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                    Operability[i] = 0.65;
                    if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                        Operability[i] = 0.7;
                        if(ships[i].Accomodation == "yes"){
                            Operability[i] = 0.73;
                        }
                    }
                }
            }
            if(ships[i].ExtraCrane == "yes" && ships[i].extraP == "yes"){
                Operability[i] = 0.6;
                if(ships[i].extraBP == "yes"){
                    Operability[i] = 0.7;
                    if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                        Operability[i] = 0.75;
                        if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                            Operability[i] = 0.8;
                            if(ships[i].Accomodation == "yes"){
                                Operability[i] = 0.83;
                            }
                        }
                    }
                }
            }
        }
```

```
    if(ships[i].DP == "III" || ships[i].XBow == "yes"){
      Operability[i] = 0.47;
      if(ships[i].DP == "III" && ships[i].XBow == "yes"){
        Operability[i] = 0.52;
        if(ships[i].Accomodation == "yes"){
          Operability[i] = 0.55;
        }
      }
    }
    if(ships[i].ExtraCrane == "yes" || ships[i].extraP == "yes"){
      Operability[i] = 0.5;
      if(ships[i].extraBP == "yes"){
        Operability[i] = 0.6;
        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
          Operability[i] = 0.67;
          if(ships[i].DP == "III" && ships[i].XBow == "yes"){
            Operability[i] = 0.62;
            if(ships[i].Accomodation == "yes"){
              Operability[i] = 0.65;
            }
          }
        }
      }
      if(ships[i].ExtraCrane == "yes" && ships[i].extraP == "yes"){
        Operability[i] = 0.6;
        if(ships[i].extraBP == "yes"){
          Operability[i] = 0.7;
          if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.77;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
              Operability[i] = 0.82;
              if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.85;
              }
            }
          }
        }
      }
    }
  }
  if (ships[i].shipmission == "TOWING" && ships[i].shipplace =="ARCTIC"){
    Operability[i] = 0.1;
    if(ships[i].DP == "II" || ships[i].XBow == "yes"){
      Operability[i] = 0.15;
      if(ships[i].DP == "II" && ships[i].XBow == "yes"){
        Operability[i] = 0.2;
        if(ships[i].Accomodation == "yes"){
          Operability[i] = 0.23;
        }
      }
```

```
}
if(ships[i].ExtraCrane == "yes" || ships[i].extraP == "yes"){
   Operability[i] = 0.15;
   if(ships[i].extraBP == "yes"){
      Operability[i] = 0.25;
      if(ships[i].DP == "II" || ships[i].XBow == "yes"){
         Operability[i] = 0.3;
         if(ships[i].DP == "II" && ships[i].XBow == "yes"){
            Operability[i] = 0.35;
            if(ships[i].Accomodation == "yes"){
               Operability[i] = 0.38;
            }
         }
      }
   }
   if(ships[i].ExtraCrane == "yes" && ships[i].extraP == "yes"){
      Operability[i] = 0.25;
      if(ships[i].extraBP == "yes"){
         Operability[i] = 0.35;
         if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.40;
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
               Operability[i] = 0.45;
               if(ships[i].Accomodation == "yes"){
                  Operability[i] = 0.48;
               }
            }
         }
      }
   }
}
if(ships[i].DP == "III" || ships[i].XBow == "yes"){
   Operability[i] = 0.2;
   if(ships[i].DP == "III" && ships[i].XBow == "yes"){
      Operability[i] = 0.22;
      if(ships[i].Accomodation == "yes"){
         Operability[i] = 0.25;
      }
   }
}
if(ships[i].ExtraCrane == "yes" || ships[i].extraP == "yes"){
   Operability[i] = 0.2;
   if(ships[i].extraBP == "yes"){
      Operability[i] = 0.3;
      if(ships[i].DP == "III" || ships[i].XBow == "yes"){
         Operability[i] = 0.35;
         if(ships[i].DP == "III" && ships[i].XBow == "yes"){
            Operability[i] = 0.4;
            if(ships[i].Accomodation == "yes"){
               Operability[i] = 0.43;
```

```
            }
        }
    }
}
if(ships[i].ExtraCrane == "yes" && ships[i].extraP == "yes"){
    Operability[i] = 0.3;
    if(ships[i].extraBP == "yes"){
        Operability[i] = 0.4;
        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.45;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.5;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.53;
                }
            }
        }
    }
}
}
if(ships[i].IceClass == "yes"){
    Operability[i] = 0.4;
    if(ships[i].DP == "II" || ships[i].XBow == "yes"){
        Operability[i] = 0.45;
        if(ships[i].DP == "II" && ships[i].XBow == "yes"){
            Operability[i] = 0.5;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.53;
            }
        }
    }
    if(ships[i].ExtraCrane == "yes" || ships[i].extraP == "yes"){
        Operability[i] = 0.5;
        if(ships[i].extraBP == "yes"){
            Operability[i] = 0.6;
            if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                Operability[i] = 0.65;
                if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                    Operability[i] = 0.7;
                    if(ships[i].Accomodation == "yes"){
                        Operability[i] = 0.73;
                    }
                }
            }
        }
        if(ships[i].ExtraCrane == "yes" && ships[i].extraP == "yes"){
            Operability[i] = 0.6;
            if(ships[i].extraBP == "yes"){
                Operability[i] = 0.7;
                if(ships[i].DP == "II" || ships[i].XBow == "yes"){
```

```
                Operability[i] = 0.75;
                if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                    Operability[i] = 0.8;
                    if(ships[i].Accomodation == "yes"){
                        Operability[i] = 0.83;
                    }
                }
            }
        }
    }
}
if(ships[i].DP == "III" || ships[i].XBow == "yes"){
    Operability[i] = 0.47;
    if(ships[i].DP == "III" && ships[i].XBow == "yes"){
        Operability[i] = 0.52;
        if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.55;
        }
    }
}
if(ships[i].ExtraCrane == "yes" || ships[i].extraP == "yes"){
    Operability[i] = 0.5;
    if(ships[i].extraBP == "yes"){
        Operability[i] = 0.6;
        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.67;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.62;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.65;
                }
            }
        }
    }
    if(ships[i].ExtraCrane == "yes" && ships[i].extraP == "yes"){
        Operability[i] = 0.6;
        if(ships[i].extraBP == "yes"){
            Operability[i] = 0.7;
            if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                Operability[i] = 0.77;
                if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                    Operability[i] = 0.82;
                    if(ships[i].Accomodation == "yes"){
                        Operability[i] = 0.85;
                    }
                }
            }
        }
    }
}
```

```
        }
      }

      if (ships[i].shipmission == "CONSTRUCTION" && ships[i].shipplace
=="BRAZIL"){
         Operability[i] = 0.2;
         if(ships[i].ExtraCrane == "yes" || ships[i].MoonPool == "yes" || ships[i].ROV
== "yes"){
            Operability[i] = 0.25;
            if(ships[i].DP == "II" || ships[i].XBow == "yes"){
               Operability[i] = 0.27;
               if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                  Operability[i] = 0.29;
                  if(ships[i].Accomodation == "yes"){
                     Operability[i] = 0.35;
                  }
               }
            }
            if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
               Operability[i] = 0.27;
               if(ships[i].Helipad == "yes"){
                  Operability[i] = 0.3;
                  if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                     Operability[i] = 0.32;
                     if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                        Operability[i] = 0.35;
                        if(ships[i].Accomodation == "yes"){
                           Operability[i] = 0.4;
                        }
                     }
                  }
               }
               if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
                  Operability[i] = 0.3;
                  if(ships[i].Helipad == "yes"){
                     Operability[i] = 0.33;
                     if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                        Operability[i] = 0.35;
                        if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                           Operability[i] = 0.38;
                           if(ships[i].Accomodation == "yes"){
                              Operability[i] = 0.43;
                           }
                        }
                     }
                  }
               }
            }
            if(ships[i].DP == "III" || ships[i].XBow == "yes"){
               Operability[i] = 0.29;
```

```
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
               Operability[i] = 0.31;
               if(ships[i].Accomodation == "yes"){
                  Operability[i] = 0.37;
               }
            }
         }
         if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
            Operability[i] = 0.29;
            if(ships[i].Helipad == "yes"){
               Operability[i] = 0.32;
               if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                  Operability[i] = 0.34;
                  if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                     Operability[i] = 0.37;
                     if(ships[i].Accomodation == "yes"){
                        Operability[i] = 0.42;
                     }
                  }
               }
            }
            if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
               Operability[i] = 0.32;
               if(ships[i].Helipad == "yes"){
                  Operability[i] = 0.35;
                  if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                     Operability[i] = 0.37;
                     if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                        Operability[i] = 0.40;
                        if(ships[i].Accomodation == "yes"){
                           Operability[i] = 0.45;
                        }
                     }
                  }
               }
            }
         }
      }

      if((ships[i].ExtraCrane == "yes" && ships[i].MoonPool == "yes") ||
ships[i].ROV == "yes"){
         Operability[i] = 0.3
         if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.32
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
               Operability[i] = 0.34;
               if(ships[i].Accomodation == "yes"){
                  Operability[i] = 0.4;
               }
            }
```

```
}
if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
   Operability[i] = 0.32;
   if(ships[i].Helipad == "yes"){
      Operability[i] = 0.35;
      if(ships[i].DP == "II" || ships[i].XBow == "yes"){
         Operability[i] = 0.37;
         if(ships[i].DP == "II" && ships[i].XBow == "yes"){
            Operability[i] = 0.4;
            if(ships[i].Accomodation == "yes"){
               Operability[i] = 0.45;
            }
         }
      }
   }
   if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
      Operability[i] = 0.35;
      if(ships[i].Helipad == "yes"){
         Operability[i] = 0.38;
         if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.4;
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
               Operability[i] = 0.43;
               if(ships[i].Accomodation == "yes"){
                  Operability[i] = 0.48;
               }
            }
         }
      }
   }
}
if(ships[i].DP == "III" || ships[i].XBow == "yes"){
   Operability[i] = 0.34;
   if(ships[i].DP == "III" && ships[i].XBow == "yes"){
      Operability[i] = 0.36;
      if(ships[i].Accomodation == "yes"){
         Operability[i] = 0.42;
      }
   }
}
if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
   Operability[i] = 0.34;
   if(ships[i].Helipad == "yes"){
      Operability[i] = 0.37;
      if(ships[i].DP == "III" || ships[i].XBow == "yes"){
         Operability[i] = 0.39;
         if(ships[i].DP == "III" && ships[i].XBow == "yes"){
            Operability[i] = 0.42;
            if(ships[i].Accomodation == "yes"){
               Operability[i] = 0.47;
```

```
                    }
                }
            }
        }
        if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
            Operability[i] = 0.37;
            if(ships[i].Helipad == "yes"){
                Operability[i] = 0.4;
                if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                    Operability[i] = 0.42;
                    if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                        Operability[i] = 0.45;
                        if(ships[i].Accomodation == "yes"){
                            Operability[i] = 0.5;
                        }
                    }
                }
            }
        }
    }
}

    if(ships[i].ExtraCrane == "yes" || (ships[i].MoonPool == "yes" &&
ships[i].ROV == "yes")){
        Operability[i] = 0.3
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.32
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.34;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.4;
                }
            }
        }
        if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
            Operability[i] = 0.32;
            if(ships[i].Helipad == "yes"){
                Operability[i] = 0.35;
                if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                    Operability[i] = 0.37;
                    if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                        Operability[i] = 0.4;
                        if(ships[i].Accomodation == "yes"){
                            Operability[i] = 0.45;
                        }
                    }
                }
            }
        }
        if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
            Operability[i] = 0.35;
```

```
        if(ships[i].Helipad == "yes"){
            Operability[i] = 0.38;
            if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                Operability[i] = 0.4;
                if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                    Operability[i] = 0.43;
                    if(ships[i].Accomodation == "yes"){
                        Operability[i] = 0.48;
                    }
                }
            }
        }
    }
}
if(ships[i].DP == "III" || ships[i].XBow == "yes"){
    Operability[i] = 0.34;
    if(ships[i].DP == "III" && ships[i].XBow == "yes"){
        Operability[i] = 0.36;
        if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.42;
        }
    }
}
if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
    Operability[i] = 0.34;
    if(ships[i].Helipad == "yes"){
        Operability[i] = 0.37;
        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.39;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.42;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.47;
                }
            }
        }
    }
    if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
        Operability[i] = 0.37;
        if(ships[i].Helipad == "yes"){
            Operability[i] = 0.4;
            if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                Operability[i] = 0.42;
                if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                    Operability[i] = 0.45;
                    if(ships[i].Accomodation == "yes"){
                        Operability[i] = 0.5;
                    }
                }
            }
```

```
                }
            }
        }
    }

    if(ships[i].ExtraCrane == "yes" && ships[i].MoonPool == "yes" &&
ships[i].ROV == "yes"){
        Operability[i] = 0.5;
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.55;
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.6;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.63;
                }
            }
        }
        if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
            Operability[i] = 0.6;
            if(ships[i].Helipad == "yes"){
                Operability[i] = 0.7;
                if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                    Operability[i] = 0.75;
                    if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                        Operability[i] = 0.8;
                        if(ships[i].Accomodation == "yes"){
                            Operability[i] = 0.83;
                        }
                    }
                }
            }
            if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
                Operability[i] = 0.7;
                if(ships[i].Helipad == "yes"){
                    Operability[i] = 0.8;
                    if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                        Operability[i] = 0.85;
                        if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                            Operability[i] = 0.9;
                            if(ships[i].Accomodation == "yes"){
                                Operability[i] = 0.93;
                            }
                        }
                    }
                }
            }
        }
        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.57;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
```

```
                Operability[i] = 0.62;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.65;
                }
            }
        }
        if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
            Operability[i] = 0.6;
            if(ships[i].Helipad == "yes"){
                Operability[i] = 0.7;
                if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                    Operability[i] = 0.77;
                    if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                        Operability[i] = 0.82;
                        if(ships[i].Accomodation == "yes"){
                            Operability[i] = 0.85;
                        }
                    }
                }
            }
            if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
                Operability[i] = 0.7;
                if(ships[i].Helipad == "yes"){
                    Operability[i] = 0.8;
                    if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                        Operability[i] = 0.87;
                        if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                            Operability[i] = 0.92;
                            if(ships[i].Accomodation == "yes"){
                                Operability[i] = 0.95;
                            }
                        }
                    }
                }
            }
        }
    }

    if (ships[i].shipmission == "CONSTRUCTION" && ships[i].shipplace
=="NORTHSEA"){
        Operability[i] = 0.1;
        if(ships[i].ExtraCrane == "yes" || ships[i].MoonPool == "yes" || ships[i].ROV
== "yes"){
            Operability[i] = 0.15;
            if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                Operability[i] = 0.17;
                if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                    Operability[i] = 0.19;
                    if(ships[i].Accomodation == "yes"){
```

```
            Operability[i] = 0.25;
        }
    }
}
if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
    Operability[i] = 0.17;
    if(ships[i].Helipad == "yes"){
        Operability[i] = 0.2;
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.22;
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.25;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.3;
                }
            }
        }
    }
    if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
        Operability[i] = 0.2;
        if(ships[i].Helipad == "yes"){
            Operability[i] = 0.23;
            if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                Operability[i] = 0.25;
                if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                    Operability[i] = 0.28;
                    if(ships[i].Accomodation == "yes"){
                        Operability[i] = 0.33;
                    }
                }
            }
        }
    }
}
if(ships[i].DP == "III" || ships[i].XBow == "yes"){
    Operability[i] = 0.19;
    if(ships[i].DP == "III" && ships[i].XBow == "yes"){
        Operability[i] = 0.21;
        if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.27;
        }
    }
}
if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
    Operability[i] = 0.19;
    if(ships[i].Helipad == "yes"){
        Operability[i] = 0.22;
        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.24;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
```

```
                    Operability[i] = 0.27;
                    if(ships[i].Accomodation == "yes"){
                        Operability[i] = 0.32;
                    }
                }
            }
        }
        if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
            Operability[i] = 0.22;
            if(ships[i].Helipad == "yes"){
                Operability[i] = 0.25;
                if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                    Operability[i] = 0.27;
                    if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                        Operability[i] = 0.30;
                        if(ships[i].Accomodation == "yes"){
                            Operability[i] = 0.35;
                        }
                    }
                }
            }
        }
    }
}

    if((ships[i].ExtraCrane == "yes" && ships[i].MoonPool == "yes") ||
ships[i].ROV == "yes"){
        Operability[i] = 0.2
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.22
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.24;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.3;
                }
            }
        }
        if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
            Operability[i] = 0.22;
            if(ships[i].Helipad == "yes"){
                Operability[i] = 0.25;
                if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                    Operability[i] = 0.27;
                    if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                        Operability[i] = 0.3;
                        if(ships[i].Accomodation == "yes"){
                            Operability[i] = 0.35;
                        }
                    }
                }
```

```
    }
    if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
        Operability[i] = 0.25;
        if(ships[i].Helipad == "yes"){
            Operability[i] = 0.28;
            if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                Operability[i] = 0.3;
                if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                    Operability[i] = 0.33;
                    if(ships[i].Accomodation == "yes"){
                        Operability[i] = 0.38;
                    }
                }
            }
        }
    }
}
if(ships[i].DP == "III" || ships[i].XBow == "yes"){
    Operability[i] = 0.24;
    if(ships[i].DP == "III" && ships[i].XBow == "yes"){
        Operability[i] = 0.26;
        if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.32;
        }
    }
}
if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
    Operability[i] = 0.24;
    if(ships[i].Helipad == "yes"){
        Operability[i] = 0.27;
        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.29;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.32;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.37;
                }
            }
        }
    }
    if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
        Operability[i] = 0.27;
        if(ships[i].Helipad == "yes"){
            Operability[i] = 0.3;
            if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                Operability[i] = 0.32;
                if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                    Operability[i] = 0.35;
                    if(ships[i].Accomodation == "yes"){
                        Operability[i] = 0.4;
```

```
                    }
                }
            }
        }
    }
}

    if(ships[i].ExtraCrane == "yes" || (ships[i].MoonPool == "yes" &&
ships[i].ROV == "yes")){
        Operability[i] = 0.2
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.22
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.24;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.3;
                }
            }
        }
        if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
            Operability[i] = 0.22;
            if(ships[i].Helipad == "yes"){
                Operability[i] = 0.25;
                if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                    Operability[i] = 0.27;
                    if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                        Operability[i] = 0.3;
                        if(ships[i].Accomodation == "yes"){
                            Operability[i] = 0.35;
                        }
                    }
                }
            }
            if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
                Operability[i] = 0.25;
                if(ships[i].Helipad == "yes"){
                    Operability[i] = 0.28;
                    if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                        Operability[i] = 0.3;
                        if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                            Operability[i] = 0.33;
                            if(ships[i].Accomodation == "yes"){
                                Operability[i] = 0.38;
                            }
                        }
                    }
                }
            }
        }
```

```
            if(ships[i].DP == "III" || ships[i].XBow == "yes"){
               Operability[i] = 0.24;
               if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                  Operability[i] = 0.26;
                  if(ships[i].Accomodation == "yes"){
                     Operability[i] = 0.32;
                  }
               }
            }
            if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
               Operability[i] = 0.24;
               if(ships[i].Helipad == "yes"){
                  Operability[i] = 0.27;
                  if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                     Operability[i] = 0.29;
                     if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                        Operability[i] = 0.32;
                        if(ships[i].Accomodation == "yes"){
                           Operability[i] = 0.37;
                        }
                     }
                  }
               }
               if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
                  Operability[i] = 0.27;
                  if(ships[i].Helipad == "yes"){
                     Operability[i] = 0.3;
                     if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                        Operability[i] = 0.32;
                        if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                           Operability[i] = 0.35;
                           if(ships[i].Accomodation == "yes"){
                              Operability[i] = 0.4;
                           }
                        }
                     }
                  }
               }
            }
         }

         if(ships[i].ExtraCrane == "yes" && ships[i].MoonPool == "yes" &&
ships[i].ROV == "yes"){
            Operability[i] = 0.4;
            if(ships[i].DP == "II" || ships[i].XBow == "yes"){
               Operability[i] = 0.45;
               if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                  Operability[i] = 0.5;
                  if(ships[i].Accomodation == "yes"){
                     Operability[i] = 0.53;
```

```
        }
    }
}
if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
    Operability[i] = 0.5;
    if(ships[i].Helipad == "yes"){
        Operability[i] = 0.6;
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.65;
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.7;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.73;
                }
            }
        }
    }
    if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
        Operability[i] = 0.6;
        if(ships[i].Helipad == "yes"){
            Operability[i] = 0.7;
            if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                Operability[i] = 0.75;
                if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                    Operability[i] = 0.8;
                    if(ships[i].Accomodation == "yes"){
                        Operability[i] = 0.83;
                    }
                }
            }
        }
    }
}
if(ships[i].DP == "III" || ships[i].XBow == "yes"){
    Operability[i] = 0.47;
    if(ships[i].DP == "III" && ships[i].XBow == "yes"){
        Operability[i] = 0.52;
        if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.55;
        }
    }
}
if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
    Operability[i] = 0.5;
    if(ships[i].Helipad == "yes"){
        Operability[i] = 0.6;
        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.67;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.72;
```

```
                    if(ships[i].Accomodation == "yes"){
                        Operability[i] = 0.75;
                    }
                }
            }
            if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
                Operability[i] = 0.6;
                if(ships[i].Helipad == "yes"){
                    Operability[i] = 0.7;
                    if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                        Operability[i] = 0.77;
                        if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                            Operability[i] = 0.82;
                            if(ships[i].Accomodation == "yes"){
                                Operability[i] = 0.85;
                            }
                        }
                    }
                }
            }
        }
    }


    if (ships[i].shipmission == "CONSTRUCTION" && ships[i].shipplace
=="ARCTIC"){
        Operability[i] = 0;
        if(ships[i].ExtraCrane == "yes" || ships[i].MoonPool == "yes" || ships[i].ROV
== "yes"){
            Operability[i] = 0.05;
            if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                Operability[i] = 0.07;
                if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                    Operability[i] = 0.09;
                    if(ships[i].Accomodation == "yes"){
                        Operability[i] = 0.15;
                    }
                }
            }
            if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
                Operability[i] = 0.07;
                if(ships[i].Helipad == "yes"){
                    Operability[i] = 0.1;
                    if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                        Operability[i] = 0.12;
                        if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                            Operability[i] = 0.15;
                            if(ships[i].Accomodation == "yes"){
```

```
                Operability[i] = 0.2;
            }
        }
    }
    if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
        Operability[i] = 0.1;
        if(ships[i].Helipad == "yes"){
            Operability[i] = 0.13;
            if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                Operability[i] = 0.15;
                if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                    Operability[i] = 0.18;
                    if(ships[i].Accomodation == "yes"){
                        Operability[i] = 0.23;
                    }
                }
            }
        }
    }
}
if(ships[i].DP == "III" || ships[i].XBow == "yes"){
    Operability[i] = 0.09;
    if(ships[i].DP == "III" && ships[i].XBow == "yes"){
        Operability[i] = 0.11;
        if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.17;
        }
    }
}
if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
    Operability[i] = 0.09;
    if(ships[i].Helipad == "yes"){
        Operability[i] = 0.12;
        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.14;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.17;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.22;
                }
            }
        }
    }
    if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
        Operability[i] = 0.12;
        if(ships[i].Helipad == "yes"){
            Operability[i] = 0.15;
            if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                Operability[i] = 0.17;
```

```
                    if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                        Operability[i] = 0.20;
                        if(ships[i].Accomodation == "yes"){
                            Operability[i] = 0.25;
                        }
                    }
                }
            }
        }
    }

    if((ships[i].ExtraCrane == "yes" && ships[i].MoonPool == "yes") ||
ships[i].ROV == "yes"){
        Operability[i] = 0.1;
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.12;
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.14;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.2;
                }
            }
        }
        if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
            Operability[i] = 0.12;
            if(ships[i].Helipad == "yes"){
                Operability[i] = 0.15;
                if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                    Operability[i] = 0.17;
                    if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                        Operability[i] = 0.2;
                        if(ships[i].Accomodation == "yes"){
                            Operability[i] = 0.25;
                        }
                    }
                }
            }
            if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
                Operability[i] = 0.15;
                if(ships[i].Helipad == "yes"){
                    Operability[i] = 0.18;
                    if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                        Operability[i] = 0.2;
                        if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                            Operability[i] = 0.23;
                            if(ships[i].Accomodation == "yes"){
                                Operability[i] = 0.28;
                            }
                        }
```

```
                }
            }
        }
    }
    if(ships[i].DP == "III" || ships[i].XBow == "yes"){
        Operability[i] = 0.14;
        if(ships[i].DP == "III" && ships[i].XBow == "yes"){
            Operability[i] = 0.16;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.22;
            }
        }
    }
    if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
        Operability[i] = 0.14;
        if(ships[i].Helipad == "yes"){
            Operability[i] = 0.17;
            if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                Operability[i] = 0.19;
                if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                    Operability[i] = 0.22;
                    if(ships[i].Accomodation == "yes"){
                        Operability[i] = 0.27;
                    }
                }
            }
        }
        if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
            Operability[i] = 0.17;
            if(ships[i].Helipad == "yes"){
                Operability[i] = 0.2;
                if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                    Operability[i] = 0.22;
                    if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                        Operability[i] = 0.25;
                        if(ships[i].Accomodation == "yes"){
                            Operability[i] = 0.3;
                        }
                    }
                }
            }
        }
    }
}

    if(ships[i].ExtraCrane == "yes" || (ships[i].MoonPool == "yes" &&
ships[i].ROV == "yes")){
        Operability[i] = 0.1;
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.12;
```

```
    if(ships[i].DP == "II" && ships[i].XBow == "yes"){
        Operability[i] = 0.14;
        if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.2;
        }
    }
}
if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
    Operability[i] = 0.12;
    if(ships[i].Helipad == "yes"){
        Operability[i] = 0.15;
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.17;
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.2;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.25;
                }
            }
        }
    }
    if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
        Operability[i] = 0.15;
        if(ships[i].Helipad == "yes"){
            Operability[i] = 0.18;
            if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                Operability[i] = 0.2;
                if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                    Operability[i] = 0.23;
                    if(ships[i].Accomodation == "yes"){
                        Operability[i] = 0.28;
                    }
                }
            }
        }
    }
}
if(ships[i].DP == "III" || ships[i].XBow == "yes"){
    Operability[i] = 0.14;
    if(ships[i].DP == "III" && ships[i].XBow == "yes"){
        Operability[i] = 0.16;
        if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.22;
        }
    }
}
if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
    Operability[i] = 0.14;
    if(ships[i].Helipad == "yes"){
        Operability[i] = 0.17;
```

```
                if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                    Operability[i] = 0.19;
                    if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                        Operability[i] = 0.22;
                        if(ships[i].Accomodation == "yes"){
                            Operability[i] = 0.27;
                        }
                    }
                }
            }
            if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
                Operability[i] = 0.17;
                if(ships[i].Helipad == "yes"){
                    Operability[i] = 0.2;
                    if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                        Operability[i] = 0.22;
                        if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                            Operability[i] = 0.25;
                            if(ships[i].Accomodation == "yes"){
                                Operability[i] = 0.3;
                            }
                        }
                    }
                }
            }
        }
    }

    if(ships[i].ExtraCrane == "yes" && ships[i].MoonPool == "yes" &&
ships[i].ROV == "yes"){
        Operability[i] = 0.3;
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.32;
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.34;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.4;
                }
            }
        }
        if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
            Operability[i] = 0.32;
            if(ships[i].Helipad == "yes"){
                Operability[i] = 0.35;
                if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                    Operability[i] = 0.37;
                    if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                        Operability[i] = 0.4;
                        if(ships[i].Accomodation == "yes"){
                            Operability[i] = 0.45;
```

```
            }
        }
    }
}
if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
    Operability[i] = 0.35;
    if(ships[i].Helipad == "yes"){
        Operability[i] = 0.38;
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.4;
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.43;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.48;
                }
            }
        }
    }
}
}
if(ships[i].DP == "III" || ships[i].XBow == "yes"){
    Operability[i] = 0.34;
    if(ships[i].DP == "III" && ships[i].XBow == "yes"){
        Operability[i] = 0.36;
        if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.42;
        }
    }
}
if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
    Operability[i] = 0.34;
    if(ships[i].Helipad == "yes"){
        Operability[i] = 0.37;
        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.39;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.42;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.47;
                }
            }
        }
    }
    if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
        Operability[i] = 0.37;
        if(ships[i].Helipad == "yes"){
            Operability[i] = 0.4;
            if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                Operability[i] = 0.42;
                if(ships[i].DP == "III" && ships[i].XBow == "yes"){
```

```
                        Operability[i] = 0.45;
                        if(ships[i].Accomodation == "yes"){
                            Operability[i] = 0.5;
                        }
                    }
                }
            }
        }
    }

    if(ships[i].IceClass == "yes"){
        Operability[i] = 0.1;
        if(ships[i].ExtraCrane == "yes" || ships[i].MoonPool == "yes" ||
ships[i].ROV == "yes"){
            Operability[i] = 0.15;
            if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                Operability[i] = 0.17;
                if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                    Operability[i] = 0.19;
                    if(ships[i].Accomodation == "yes"){
                        Operability[i] = 0.25;
                    }
                }
            }
            if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
                Operability[i] = 0.17;
                if(ships[i].Helipad == "yes"){
                    Operability[i] = 0.2;
                    if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                        Operability[i] = 0.22;
                        if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                            Operability[i] = 0.25;
                            if(ships[i].Accomodation == "yes"){
                                Operability[i] = 0.3;
                            }
                        }
                    }
                }
                if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
                    Operability[i] = 0.2;
                    if(ships[i].Helipad == "yes"){
                        Operability[i] = 0.23;
                        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                            Operability[i] = 0.25;
                            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                                Operability[i] = 0.28;
                                if(ships[i].Accomodation == "yes"){
                                    Operability[i] = 0.33;
                                }
```

```
                    }
                }
            }
        }
    }
    if(ships[i].DP == "III" || ships[i].XBow == "yes"){
        Operability[i] = 0.19;
        if(ships[i].DP == "III" && ships[i].XBow == "yes"){
            Operability[i] = 0.21;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.27;
            }
        }
    }
    if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
        Operability[i] = 0.19;
        if(ships[i].Helipad == "yes"){
            Operability[i] = 0.22;
            if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                Operability[i] = 0.24;
                if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                    Operability[i] = 0.27;
                    if(ships[i].Accomodation == "yes"){
                        Operability[i] = 0.32;
                    }
                }
            }
        }
        if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
            Operability[i] = 0.22;
            if(ships[i].Helipad == "yes"){
                Operability[i] = 0.25;
                if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                    Operability[i] = 0.27;
                    if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                        Operability[i] = 0.30;
                        if(ships[i].Accomodation == "yes"){
                            Operability[i] = 0.35;
                        }
                    }
                }
            }
        }
    }
}

    if((ships[i].ExtraCrane == "yes" && ships[i].MoonPool == "yes") ||
ships[i].ROV == "yes"){
        Operability[i] = 0.2
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
```

```
    Operability[i] = 0.22
    if(ships[i].DP == "II" && ships[i].XBow == "yes"){
        Operability[i] = 0.24;
        if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.3;
        }
    }
}
if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
    Operability[i] = 0.22;
    if(ships[i].Helipad == "yes"){
        Operability[i] = 0.25;
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.27;
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.3;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.35;
                }
            }
        }
    }
    if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
        Operability[i] = 0.25;
        if(ships[i].Helipad == "yes"){
            Operability[i] = 0.28;
            if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                Operability[i] = 0.3;
                if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                    Operability[i] = 0.33;
                    if(ships[i].Accomodation == "yes"){
                        Operability[i] = 0.38;
                    }
                }
            }
        }
    }
}
if(ships[i].DP == "III" || ships[i].XBow == "yes"){
    Operability[i] = 0.24;
    if(ships[i].DP == "III" && ships[i].XBow == "yes"){
        Operability[i] = 0.26;
        if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.32;
        }
    }
}
if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
    Operability[i] = 0.24;
    if(ships[i].Helipad == "yes"){
```

```
                    Operability[i] = 0.27;
                    if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                        Operability[i] = 0.29;
                        if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                            Operability[i] = 0.32;
                            if(ships[i].Accomodation == "yes"){
                                Operability[i] = 0.37;
                            }
                        }
                    }
                }
                if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
                    Operability[i] = 0.27;
                    if(ships[i].Helipad == "yes"){
                        Operability[i] = 0.3;
                        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                            Operability[i] = 0.32;
                            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                                Operability[i] = 0.35;
                                if(ships[i].Accomodation == "yes"){
                                    Operability[i] = 0.4;
                                }
                            }
                        }
                    }
                }
            }
        }

        if(ships[i].ExtraCrane == "yes" || (ships[i].MoonPool == "yes" &&
ships[i].ROV == "yes")){
            Operability[i] = 0.2
            if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                Operability[i] = 0.22
                if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                    Operability[i] = 0.24;
                    if(ships[i].Accomodation == "yes"){
                        Operability[i] = 0.3;
                    }
                }
            }
            if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
                Operability[i] = 0.22;
                if(ships[i].Helipad == "yes"){
                    Operability[i] = 0.25;
                    if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                        Operability[i] = 0.27;
                        if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                            Operability[i] = 0.3;
                            if(ships[i].Accomodation == "yes"){
```

```
                Operability[i] = 0.35;
            }
        }
    }
    if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
        Operability[i] = 0.25;
        if(ships[i].Helipad == "yes"){
            Operability[i] = 0.28;
            if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                Operability[i] = 0.3;
                if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                    Operability[i] = 0.33;
                    if(ships[i].Accomodation == "yes"){
                        Operability[i] = 0.38;
                    }
                }
            }
        }
    }
}
if(ships[i].DP == "III" || ships[i].XBow == "yes"){
    Operability[i] = 0.24;
    if(ships[i].DP == "III" && ships[i].XBow == "yes"){
        Operability[i] = 0.26;
        if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.32;
        }
    }
}
if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
    Operability[i] = 0.24;
    if(ships[i].Helipad == "yes"){
        Operability[i] = 0.27;
        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.29;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.32;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.37;
                }
            }
        }
    }
    if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
        Operability[i] = 0.27;
        if(ships[i].Helipad == "yes"){
            Operability[i] = 0.3;
            if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                Operability[i] = 0.32;
```

```
                    if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                        Operability[i] = 0.35;
                        if(ships[i].Accomodation == "yes"){
                            Operability[i] = 0.4;
                        }
                    }
                }
            }
        }
    }

    if(ships[i].ExtraCrane == "yes" && ships[i].MoonPool == "yes" &&
ships[i].ROV == "yes"){
        Operability[i] = 0.4;
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.45;
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.5;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.53;
                }
            }
        }
        if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
            Operability[i] = 0.5;
            if(ships[i].Helipad == "yes"){
                Operability[i] = 0.6;
                if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                    Operability[i] = 0.65;
                    if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                        Operability[i] = 0.7;
                        if(ships[i].Accomodation == "yes"){
                            Operability[i] = 0.73;
                        }
                    }
                }
            }
            if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
                Operability[i] = 0.6;
                if(ships[i].Helipad == "yes"){
                    Operability[i] = 0.7;
                    if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                        Operability[i] = 0.75;
                        if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                            Operability[i] = 0.8;
                            if(ships[i].Accomodation == "yes"){
                                Operability[i] = 0.83;
                            }
                        }
```

```
                    }
                }
            }
        }
        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.47;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.52;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.55;
                }
            }
        }
        if(ships[i].extraBP == "yes" || ships[i].extraP == "yes"){
            Operability[i] = 0.5;
            if(ships[i].Helipad == "yes"){
                Operability[i] = 0.6;
                if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                    Operability[i] = 0.67;
                    if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                        Operability[i] = 0.72;
                        if(ships[i].Accomodation == "yes"){
                            Operability[i] = 0.75;
                        }
                    }
                }
            }
            if(ships[i].extraBP == "yes" && ships[i].extraP == "yes"){
                Operability[i] = 0.6;
                if(ships[i].Helipad == "yes"){
                    Operability[i] = 0.7;
                    if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                        Operability[i] = 0.77;
                        if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                            Operability[i] = 0.82;
                            if(ships[i].Accomodation == "yes"){
                                Operability[i] = 0.85;
                            }
                        }
                    }
                }
            }
        }
    }
}

//AHTS
```

```
   if (ships[i].shiptype == "AHTS"){

      if (ships[i].shipmission=="SUPPLY"){

         var ajuda = ((-3.2)*(Math.pow(10,-4))*ships[i].DWT) + 1.4996;
         var GT = (Math.pow(ajuda,0.5))/(-1.6*(Math.pow(10,-4)))+7654;
      }

      if (ships[i].shipmission=="TOWING"){
         var GT = Math.pow((ships[i].BP/0.4934),1.3797);
      }

      if (ships[i].shipmission=="CONSTRUCTION"){
         var GT = Math.pow((ships[i].DCW/0.1988),0.9262);
      }

   function AHTSf(GTonnage){
      this.DCW = (0.1988)*(Math.pow(GTonnage,1.0797));
      this.Accomodation = (-5 * (Math.pow(10,-7))) * (Math.pow(GTonnage,2))+
0.0129 * GTonnage;
      this.InstalledPower = 34.751 * (Math.pow(GTonnage,0.7294));
      this.BollardPull = 0.4934 * (Math.pow(GTonnage,0.7248));
      this.DWT = -8 * (Math.pow(10,-5)) * (Math.pow(GTonnage,2))+ 1.2246 *
GTonnage;
      this.Price = 0.0011 * (Math.pow(GTonnage,1.2733));
      this.IPrice = 0.0011 * (Math.pow(GTonnage,1.2733));
      this.LWT = (-
0.012*Math.log(GTonnage)+0.375)*(4.7096*Math.pow(GTonnage,0.9654));
      this.Length = (5.9411*Math.pow(GTonnage,0.316));
      this.Breadth = (1.5031*Math.pow(GTonnage,0.3073));
      this.Draugth = (0.6313*Math.pow(GTonnage,0.2906));

   }

      Results[i] = new AHTSf(GT);

      //EXTRA POWER AHTS

      if (ships[i].extraP == "yes"){
         Results[i].InstalledPower += Results[i].InstalledPower * (ships[i].PowerM);
         Results[i].Price += Results[i].Price*(ships[i].PowerM/4);
         Results[i].DWT -= Results[i].DWT*(ships[i].PowerM*0.04);
         Results[i].LWT += Results[i].LWT*(ships[i].PowerM*0.25);

      }

      //EXTRA BOLLARD PULL AHTS
```

```
if (ships[i].extraBP == "yes"){
   Results[i].BollardPull += Results[i].BollardPull * (ships[i].BPM);
   Results[i].Price += Results[i].Price*(ships[i].BPM/8);
}

//EXTRA ACCOMMODATION AHTS

if (ships[i].extraAcc == "yes"){
   Results[i].Accomodation += (ships[i].AccM*1);
   Results[i].Price += Results[i].Price*0.005*ships[i].AccM;
   Results[i].DWT -= Results[i].DWT*(ships[i].AccM*0.005);
   Results[i].DCW -= Results[i].DCW*(ships[i].AccM*0.002);
   Results[i].LWT += Results[i].LWT*(ships[i].AccM*0.005);
}

//EXTRA CRANE AHTS

if (ships[i].ExtraCrane == "yes"){
   Results[i].DWT -= Results[i].DWT*(ships[i].CraneM*0.0004);
   Results[i].Price += (Results[i].Price*0.005*ships[i].CraneM);
   Results[i].DCW -= Results[i].DCW*(ships[i].CraneM*0.0003);
   Results[i].LWT += Results[i].LWT*(ships[i].CraneM*0.0005);
}

//EXTRA DP AHTS

if (ships[i].DP == "II"){
   Results[i].Price += (Results[i].Price*0.05);
   Results[i].DWT -= Results[i].DWT*(0.002);
   Results[i].LWT += Results[i].LWT*(0.002);
}
if (ships[i].DP == "III"){
   Results[i].Price += Results[i].Price*0.1;
   Results[i].DCW -= Results[i].DCW*(0.003);
   Results[i].LWT += Results[i].LWT*(0.003);
}

//EXTRA ICE CLASS AHTS

if (ships[i].IceClass == "yes"){
   Results[i].DWT -= Results[i].DWT*0.0001;
   Results[i].Price += Results[i].Price*0.005;
}

//EXTRA XBOW AHTS

if (ships[i].XBow == "yes"){
   Results[i].Price += Results[i].Price*0.005;
}
```

```
        //MOON POOL AHTS

        if (ships[i].MoonPool == "yes"){
           Results[i].Price += Results[i].Price*0.01;
           Results[i].DWT -= Results[i].DWT*0.03;
           Results[i].DCW -= Results[i].DCW*0.05;
           Results[i].LWT += Results[i].LWT*(0.03);
        }

        //EXTRA ROV AHTS

        if (ships[i].ROV == "yes"){
           Results[i].Price += Results[i].Price*0.01;
           Results[i].DWT -= Results[i].DWT*0.02;
           Results[i].DCW -= Results[i].DCW*0.008;
           Results[i].LWT += Results[i].LWT*(0.05);
        }

        //EXTRA HELIPAD AHTS

        if (ships[i].MoonPool == "yes"){
           Results[i].Price += Results[i].Price*0.01;
           Results[i].DWT -= Results[i].DWT*0.02;
           Results[i].DCW -= Results[i].DCW*0.005;
           Results[i].Accomodation -= 5;
           Results[i].LWT += Results[i].LWT*(0.02);
        }

        //OPERABILITY AHTS


    if (ships[i].shipmission == "SUPPLY" && ships[i].shipplace =="BRAZIL"){
       Operability[i] = 0.8;
       if(ships[i].DP == "II" || ships[i].XBow == "yes"){
          Operability[i] = 0.83;
          if(ships[i].DP == "II" && ships[i].XBow == "yes"){
             Operability[i] = 0.85;
          }
       }
       if(ships[i].DP == "III" || ships[i].XBow == "yes"){
          Operability[i] = 0.85;
          if(ships[i].DP == "III" && ships[i].XBow == "yes"){
             Operability[i] = 0.88;
          }
       }
    }
    if (ships[i].shipmission == "SUPPLY" && ships[i].shipplace =="NORTHSEA"){
       Operability[i] = 0.75;
       if(ships[i].DP == "II" || ships[i].XBow == "yes"){
          Operability[i] = 0.80;
```

```
        if(ships[i].DP == "II" && ships[i].XBow == "yes"){
            Operability[i] = 0.85;
        }
    }
    if(ships[i].DP == "III" || ships[i].XBow == "yes"){
        Operability[i] = 0.83;
        if(ships[i].DP == "III" && ships[i].XBow == "yes"){
            Operability[i] = 0.88;
        }
    }
}
if (ships[i].shipmission == "SUPPLY" && ships[i].shipplace =="ARCTIC"){
    Operability[i] = 0.4;
    if(ships[i].DP == "II" || ships[i].XBow == "yes"){
        Operability[i] = 0.43;
        if(ships[i].DP == "II" && ships[i].XBow == "yes"){
            Operability[i] = 0.45;
        }
    }
    if(ships[i].DP == "III" || ships[i].XBow == "yes"){
        Operability[i] = 0.45;
        if(ships[i].DP == "III" && ships[i].XBow == "yes"){
            Operability[i] = 0.5;
        }
    }

    if(ships[i].IceClass == "yes"){
        Operability[i] = 0.75;
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.80;
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.85;
            }
        }
        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.83;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.88;
            }
        }
    }
}


if (ships[i].shipmission == "TOWING" && ships[i].shipplace =="BRAZIL"){
    Operability[i] = 0.8;
    if(ships[i].ExtraCrane == "yes" || ships[i].BP == "yes" || ships[i].XBow == "yes"){
        Operability[i] = 0.83;
        if(ships[i].DP = "II" || ships[i].extraP == "yes"){
            Operability[i] = 0.85;
```

```
        if(ships[i].Accomodation == "yes"){
          Operability[i] = 0.87;
        }
        if(ships[i].DP = "II" && ships[i].extraP == "yes"){
          Operability[i] = 0.87;
          if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.89;
          }
        }
      }
      if(ships[i].DP = "III" || ships[i].extraP == "yes"){
        Operability[i] = 0.87;
        if(ships[i].Accomodation == "yes"){
          Operability[i] = 0.89;
        }
        if(ships[i].DP = "III" && ships[i].extraP == "yes"){
          Operability[i] = 0.89;
          if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.91;
          }
        }
      }
    }

    if((ships[i].ExtraCrane == "yes" && ships[i].BP == "yes") || ships[i].XBow ==
"yes"){
      Operability[i] = 0.88;
      if(ships[i].DP = "II" || ships[i].extraP == "yes"){
        Operability[i] = 0.90;
        if(ships[i].Accomodation == "yes"){
          Operability[i] = 0.92;
        }
        if(ships[i].DP = "II" && ships[i].extraP == "yes"){
          Operability[i] = 0.92;
          if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.94;
          }
        }
      }
      if(ships[i].DP = "III" || ships[i].extraP == "yes"){
        Operability[i] = 0.92;
        if(ships[i].Accomodation == "yes"){
          Operability[i] = 0.94;
        }
        if(ships[i].DP = "III" && ships[i].extraP == "yes"){
          Operability[i] = 0.94;
          if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.96;
          }
        }
```

```
        }
    }

    if(ships[i].ExtraCrane == "yes" || (ships[i].BP == "yes" && ships[i].XBow ==
"yes")){
        Operability[i] = 0.88;
        if(ships[i].DP = "II" || ships[i].extraP == "yes"){
            Operability[i] = 0.90;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.92;
            }
            if(ships[i].DP = "II" && ships[i].extraP == "yes"){
                Operability[i] = 0.92;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.94;
                }
            }
        }
        if(ships[i].DP = "III" || ships[i].extraP == "yes"){
            Operability[i] = 0.92;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.94;
            }
            if(ships[i].DP = "III" && ships[i].extraP == "yes"){
                Operability[i] = 0.94;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.96;
                }
            }
        }
    }

    if(ships[i].ExtraCrane == "yes" && ships[i].BP == "yes" && ships[i].XBow ==
"yes"){
        Operability[i] = 0.91;
        if(ships[i].DP = "II" || ships[i].extraP == "yes"){
            Operability[i] = 0.93;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.95;
            }
            if(ships[i].DP = "II" && ships[i].extraP == "yes"){
                Operability[i] = 0.95;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.97;
                }
            }
        }
        if(ships[i].DP = "III" || ships[i].extraP == "yes"){
            Operability[i] = 0.95;
            if(ships[i].Accomodation == "yes"){
```

```
            Operability[i] = 0.97;
        }
        if(ships[i].DP = "III" && ships[i].extraP == "yes"){
            Operability[i] = 0.97;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.99;
            }
        }
    }
}
if (ships[i].shipmission == "TOWING" && ships[i].shipplace =="NORTHSEA"){
    Operability[i] = 0.7;
    if(ships[i].DP = "II" || ships[i].XBow == "yes"){
        Operability[i] = 0.75;
        if(ships[i].extraP == "yes"){
            Operability[i] = 0.8;
        }
        if(ships[i].DP = "II" && ships[i].XBow == "yes"){
            Operability[i] = 0.8;
            if(ships[i].extraP == "yes"){
                Operability[i] = 0.85;
            }
        }
    }
    if(ships[i].DP = "III" || ships[i].XBow == "yes"){
        Operability[i] = 0.77;
        if(ships[i].extraP == "yes"){
            Operability[i] = 0.82;
        }
        if(ships[i].DP = "III" && ships[i].XBow == "yes"){
            Operability[i] = 0.82;
            if(ships[i].extraP == "yes"){
                Operability[i] = 0.87;
            }
        }
    }
    if(ships[i].ExtraCrane == "yes" || ships[i].BP == "yes" || ships[i].XBow == "yes"){
        Operability[i] = 0.75;
        if(ships[i].DP = "II" || ships[i].extraP == "yes"){
            Operability[i] = 0.8;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.82;
            }
            if(ships[i].DP = "II" && ships[i].extraP == "yes"){
                Operability[i] = 0.83;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.85;
                }
            }
```

```
        }
        if(ships[i].DP = "III" || ships[i].extraP == "yes"){
            Operability[i] = 0.83;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.85;
            }
            if(ships[i].DP = "III" && ships[i].extraP == "yes"){
                Operability[i] = 0.86;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.88;
                }
            }
        }
    }

    if((ships[i].ExtraCrane == "yes" && ships[i].BP == "yes") || ships[i].XBow ==
"yes"){
        Operability[i] = 0.78;
        if(ships[i].DP = "II" || ships[i].extraP == "yes"){
            Operability[i] = 0.83;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.85;
            }
            if(ships[i].DP = "II" && ships[i].extraP == "yes"){
                Operability[i] = 0.86;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.88;
                }
            }
        }
        if(ships[i].DP = "III" || ships[i].extraP == "yes"){
            Operability[i] = 0.86;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.88;
            }
            if(ships[i].DP = "III" && ships[i].extraP == "yes"){
                Operability[i] = 0.89;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.91;
                }
            }
        }
    }

    if(ships[i].ExtraCrane == "yes" || (ships[i].BP == "yes" && ships[i].XBow ==
"yes")){
        Operability[i] = 0.78;
        if(ships[i].DP = "II" || ships[i].extraP == "yes"){
            Operability[i] = 0.83;
            if(ships[i].Accomodation == "yes"){
```

```
            Operability[i] = 0.85;
        }
        if(ships[i].DP = "II" && ships[i].extraP == "yes"){
            Operability[i] = 0.86;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.88;
            }
        }
    }
    if(ships[i].DP = "III" || ships[i].extraP == "yes"){
        Operability[i] = 0.86;
        if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.88;
        }
        if(ships[i].DP = "III" && ships[i].extraP == "yes"){
            Operability[i] = 0.89;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.91;
            }
        }
    }
}

  if(ships[i].ExtraCrane == "yes" && ships[i].BP == "yes" && ships[i].XBow ==
"yes"){
    Operability[i] = 0.86;
    if(ships[i].DP = "II" || ships[i].extraP == "yes"){
        Operability[i] = 0.91;
        if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.93;
        }
        if(ships[i].DP = "II" && ships[i].extraP == "yes"){
            Operability[i] = 0.94;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.96;
            }
        }
    }
    if(ships[i].DP = "III" || ships[i].extraP == "yes"){
        Operability[i] = 0.94;
        if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.96;
        }
        if(ships[i].DP = "III" && ships[i].extraP == "yes"){
            Operability[i] = 0.97;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.99;
            }
        }
    }
```

```
    }
}
if (ships[i].shipmission == "TOWING" && ships[i].shipplace =="ARCTIC"){
    Operability[i] = 0.2;
    if(ships[i].DP = "II" || ships[i].XBow == "yes"){
        Operability[i] = 0.25;
        if(ships[i].extraP == "yes"){
            Operability[i] = 0.3;
        }
        if(ships[i].DP = "II" && ships[i].XBow == "yes"){
            Operability[i] = 0.3;
            if(ships[i].extraP == "yes"){
                Operability[i] = 0.35;
            }
        }
    }
    if(ships[i].DP = "III" || ships[i].XBow == "yes"){
        Operability[i] = 0.27;
        if(ships[i].extraP == "yes"){
            Operability[i] = 0.32;
        }
        if(ships[i].DP = "III" && ships[i].XBow == "yes"){
            Operability[i] = 0.32;
            if(ships[i].extraP == "yes"){
                Operability[i] = 0.37;
            }
        }
    }
    if(ships[i].ExtraCrane == "yes" || ships[i].BP == "yes" || ships[i].XBow == "yes"){
        Operability[i] = 0.25;
        if(ships[i].DP = "II" || ships[i].extraP == "yes"){
            Operability[i] = 0.3;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.32;
            }
            if(ships[i].DP = "II" && ships[i].extraP == "yes"){
                Operability[i] = 0.33;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.35;
                }
            }
        }
        if(ships[i].DP = "III" || ships[i].extraP == "yes"){
            Operability[i] = 0.33;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.35;
            }
            if(ships[i].DP = "III" && ships[i].extraP == "yes"){
                Operability[i] = 0.36;
                if(ships[i].Accomodation == "yes"){
```

```
                Operability[i] = 0.38;
            }
        }
    }
}

if((ships[i].ExtraCrane == "yes" && ships[i].BP == "yes") || ships[i].XBow ==
"yes"){
    Operability[i] = 0.28;
    if(ships[i].DP = "II" || ships[i].extraP == "yes"){
        Operability[i] = 0.33;
        if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.35;
        }
        if(ships[i].DP = "II" && ships[i].extraP == "yes"){
            Operability[i] = 0.36;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.38;
            }
        }
    }
    if(ships[i].DP = "III" || ships[i].extraP == "yes"){
        Operability[i] = 0.36;
        if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.38;
        }
        if(ships[i].DP = "III" && ships[i].extraP == "yes"){
            Operability[i] = 0.39;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.41;
            }
        }
    }
}

if(ships[i].ExtraCrane == "yes" || (ships[i].BP == "yes" && ships[i].XBow ==
"yes")){
    Operability[i] = 0.28;
    if(ships[i].DP = "II" || ships[i].extraP == "yes"){
        Operability[i] = 0.33;
        if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.35;
        }
        if(ships[i].DP = "II" && ships[i].extraP == "yes"){
            Operability[i] = 0.36;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.38;
            }
        }
    }
```

```
      if(ships[i].DP = "III" || ships[i].extraP == "yes"){
         Operability[i] = 0.36;
         if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.38;
         }
         if(ships[i].DP = "III" && ships[i].extraP == "yes"){
            Operability[i] = 0.39;
            if(ships[i].Accomodation == "yes"){
               Operability[i] = 0.41;
            }
         }
      }
   }

   if(ships[i].ExtraCrane == "yes" && ships[i].BP == "yes" && ships[i].XBow ==
"yes"){
      Operability[i] = 0.36;
      if(ships[i].DP = "II" || ships[i].extraP == "yes"){
         Operability[i] = 0.41;
         if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.43;
         }
         if(ships[i].DP = "II" && ships[i].extraP == "yes"){
            Operability[i] = 0.44;
            if(ships[i].Accomodation == "yes"){
               Operability[i] = 0.46;
            }
         }
      }
      if(ships[i].DP = "III" || ships[i].extraP == "yes"){
         Operability[i] = 0.44;
         if(ships[i].Accomodation == "yes"){
            Operability[i] = 0.46;
         }
         if(ships[i].DP = "III" && ships[i].extraP == "yes"){
            Operability[i] = 0.47;
            if(ships[i].Accomodation == "yes"){
               Operability[i] = 0.49;
            }
         }
      }
   }
   if(ships[i].IceClass == "yes"){
      Operability[i] = 0.7;
      if(ships[i].DP = "II" || ships[i].XBow == "yes"){
         Operability[i] = 0.75;
         if(ships[i].extraP == "yes"){
            Operability[i] = 0.8;
         }
         if(ships[i].DP = "II" && ships[i].XBow == "yes"){
```

```
            Operability[i] = 0.8;
            if(ships[i].extraP == "yes"){
               Operability[i] = 0.85;
            }
         }
      }
      if(ships[i].DP = "III" || ships[i].XBow == "yes"){
         Operability[i] = 0.77;
         if(ships[i].extraP == "yes"){
            Operability[i] = 0.82;
         }
         if(ships[i].DP = "III" && ships[i].XBow == "yes"){
            Operability[i] = 0.82;
            if(ships[i].extraP == "yes"){
               Operability[i] = 0.87;
            }
         }
      }
      if(ships[i].ExtraCrane == "yes" || ships[i].BP == "yes" || ships[i].XBow ==
"yes"){
         Operability[i] = 0.75;
         if(ships[i].DP = "II" || ships[i].extraP == "yes"){
            Operability[i] = 0.8;
            if(ships[i].Accomodation == "yes"){
               Operability[i] = 0.82;
            }
            if(ships[i].DP = "II" && ships[i].extraP == "yes"){
               Operability[i] = 0.83;
               if(ships[i].Accomodation == "yes"){
                  Operability[i] = 0.85;
               }
            }
         }
         if(ships[i].DP = "III" || ships[i].extraP == "yes"){
            Operability[i] = 0.83;
            if(ships[i].Accomodation == "yes"){
               Operability[i] = 0.85;
            }
            if(ships[i].DP = "III" && ships[i].extraP == "yes"){
               Operability[i] = 0.86;
               if(ships[i].Accomodation == "yes"){
                  Operability[i] = 0.88;
               }
            }
         }
      }

      if((ships[i].ExtraCrane == "yes" && ships[i].BP == "yes") || ships[i].XBow ==
"yes"){
         Operability[i] = 0.78;
```

```
        if(ships[i].DP = "II" || ships[i].extraP == "yes"){
            Operability[i] = 0.83;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.85;
            }
            if(ships[i].DP = "II" && ships[i].extraP == "yes"){
                Operability[i] = 0.86;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.88;
                }
            }
        }
        if(ships[i].DP = "III" || ships[i].extraP == "yes"){
            Operability[i] = 0.86;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.88;
            }
            if(ships[i].DP = "III" && ships[i].extraP == "yes"){
                Operability[i] = 0.89;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.91;
                }
            }
        }
    }

    if(ships[i].ExtraCrane == "yes" || (ships[i].BP == "yes" && ships[i].XBow ==
"yes")){
        Operability[i] = 0.78;
        if(ships[i].DP = "II" || ships[i].extraP == "yes"){
            Operability[i] = 0.83;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.85;
            }
            if(ships[i].DP = "II" && ships[i].extraP == "yes"){
                Operability[i] = 0.86;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.88;
                }
            }
        }
        if(ships[i].DP = "III" || ships[i].extraP == "yes"){
            Operability[i] = 0.86;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.88;
            }
            if(ships[i].DP = "III" && ships[i].extraP == "yes"){
                Operability[i] = 0.89;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.91;
```

```
                }
            }
        }
    }

    if(ships[i].ExtraCrane == "yes" && ships[i].BP == "yes" && ships[i].XBow ==
"yes"){
        Operability[i] = 0.86;
        if(ships[i].DP = "II" || ships[i].extraP == "yes"){
            Operability[i] = 0.91;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.93;
            }
            if(ships[i].DP = "II" && ships[i].extraP == "yes"){
                Operability[i] = 0.94;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.96;
                }
            }
        }
        if(ships[i].DP = "III" || ships[i].extraP == "yes"){
            Operability[i] = 0.94;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.96;
            }
            if(ships[i].DP = "III" && ships[i].extraP == "yes"){
                Operability[i] = 0.97;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.99;
                }
            }
        }
    }
  }
}

if (ships[i].shipmission == "CONSTRUCTION" && ships[i].shipplace
=="BRAZIL"){
  Operability[i] = 0.4;
  if(ships[i].Helipad == "yes" || ships[i].MoonPool == "yes" || ships[i].ROV ==
"yes"){
    Operability[i] = 0.45;
    if(ships[i].DP == "II" || ships[i].XBow == "yes"){
        Operability[i] = 0.47;
        if(ships[i].DP == "II" && ships[i].XBow == "yes"){
            Operability[i] = 0.49;
            if(ships[i].Accomodation == "yes"){
                Operability[i] = 0.55;
            }
        }
```

```
        }

        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.49;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.51;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.57;
                }
            }
        }
    }

    if((ships[i].Helipad == "yes" && ships[i].MoonPool == "yes") || ships[i].ROV ==
"yes"){
        Operability[i] = 0.5
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.52
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.54;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.6;
                }
            }
        }

        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.54;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.56;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.62;
                }
            }
        }
    }

    if(ships[i].Helipad == "yes" || (ships[i].MoonPool == "yes" && ships[i].ROV ==
"yes")){
        Operability[i] = 0.5
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.52
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.54;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.6;
                }
            }
        }
```

```
        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
           Operability[i] = 0.54;
           if(ships[i].DP == "III" && ships[i].XBow == "yes"){
              Operability[i] = 0.56;
              if(ships[i].Accomodation == "yes"){
                 Operability[i] = 0.62;
              }
           }
        }
     }

     if(ships[i].Helipad == "yes" && ships[i].MoonPool == "yes" && ships[i].ROV ==
"yes"){
        Operability[i] = 0.7;
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
           Operability[i] = 0.75;
           if(ships[i].DP == "II" && ships[i].XBow == "yes"){
              Operability[i] = 0.8;
              if(ships[i].Accomodation == "yes"){
                 Operability[i] = 0.83;
              }
           }
        }

        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
           Operability[i] = 0.77;
           if(ships[i].DP == "III" && ships[i].XBow == "yes"){
              Operability[i] = 0.82;
              if(ships[i].Accomodation == "yes"){
                 Operability[i] = 0.85;
              }
           }
        }
     }
}

if (ships[i].shipmission == "CONSTRUCTION" && ships[i].shipplace
=="NORTHSEA"){
     Operability[i] = 0.4;
     if(ships[i].Helipad == "yes" || ships[i].MoonPool == "yes" || ships[i].ROV ==
"yes"){
        Operability[i] = 0.45;
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
           Operability[i] = 0.47;
           if(ships[i].DP == "II" && ships[i].XBow == "yes"){
              Operability[i] = 0.49;
              if(ships[i].Accomodation == "yes"){
                 Operability[i] = 0.55;
              }
           }
```

```
        }

        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
           Operability[i] = 0.49;
           if(ships[i].DP == "III" && ships[i].XBow == "yes"){
              Operability[i] = 0.51;
              if(ships[i].Accomodation == "yes"){
                 Operability[i] = 0.57;
              }
           }
        }
     }

     if((ships[i].Helipad == "yes" && ships[i].MoonPool == "yes") || ships[i].ROV ==
"yes"){
        Operability[i] = 0.5
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
           Operability[i] = 0.52
           if(ships[i].DP == "II" && ships[i].XBow == "yes"){
              Operability[i] = 0.54;
              if(ships[i].Accomodation == "yes"){
                 Operability[i] = 0.6;
              }
           }
        }

        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
           Operability[i] = 0.54;
           if(ships[i].DP == "III" && ships[i].XBow == "yes"){
              Operability[i] = 0.56;
              if(ships[i].Accomodation == "yes"){
                 Operability[i] = 0.62;
              }
           }
        }
     }

     if(ships[i].Helipad == "yes" || (ships[i].MoonPool == "yes" && ships[i].ROV ==
"yes")){
        Operability[i] = 0.5
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
           Operability[i] = 0.52
           if(ships[i].DP == "II" && ships[i].XBow == "yes"){
              Operability[i] = 0.54;
              if(ships[i].Accomodation == "yes"){
                 Operability[i] = 0.6;
              }
           }
        }

        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
           Operability[i] = 0.54;
           if(ships[i].DP == "III" && ships[i].XBow == "yes"){
              Operability[i] = 0.56;
              if(ships[i].Accomodation == "yes"){
                 Operability[i] = 0.62;
              }
           }
        }
     }
```

```
        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
           Operability[i] = 0.54;
           if(ships[i].DP == "III" && ships[i].XBow == "yes"){
              Operability[i] = 0.56;
              if(ships[i].Accomodation == "yes"){
                 Operability[i] = 0.62;
              }
           }
        }
     }

     if(ships[i].Helipad == "yes" && ships[i].MoonPool == "yes" && ships[i].ROV ==
"yes"){
        Operability[i] = 0.7;
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
           Operability[i] = 0.75;
           if(ships[i].DP == "II" && ships[i].XBow == "yes"){
              Operability[i] = 0.8;
              if(ships[i].Accomodation == "yes"){
                 Operability[i] = 0.83;
              }
           }
        }

        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
           Operability[i] = 0.77;
           if(ships[i].DP == "III" && ships[i].XBow == "yes"){
              Operability[i] = 0.82;
              if(ships[i].Accomodation == "yes"){
                 Operability[i] = 0.85;
              }
           }
        }
     }
}


if (ships[i].shipmission == "CONSTRUCTION" && ships[i].shipplace
=="ARCTIC"){
     Operability[i] = 0.1;
     if(ships[i].Helipad == "yes" || ships[i].MoonPool == "yes" || ships[i].ROV ==
"yes"){
        Operability[i] = 0.15;
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
           Operability[i] = 0.17;
           if(ships[i].DP == "II" && ships[i].XBow == "yes"){
              Operability[i] = 0.19;
              if(ships[i].Accomodation == "yes"){
                 Operability[i] = 0.25;
              }
```

```
            }
        }

        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.19;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.21;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.27;
                }
            }
        }
    }

    if((ships[i].Helipad == "yes" && ships[i].MoonPool == "yes") || ships[i].ROV ==
"yes"){
        Operability[i] = 0.2
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.22
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.24;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.3;
                }
            }
        }

        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.24;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.26;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.32;
                }
            }
        }
    }

    if(ships[i].Helipad == "yes" || (ships[i].MoonPool == "yes" && ships[i].ROV ==
"yes")){
        Operability[i] = 0.2
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.22
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.24;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.3;
                }
            }
        }
```

```
      if(ships[i].DP == "III" || ships[i].XBow == "yes"){
         Operability[i] = 0.24;
         if(ships[i].DP == "III" && ships[i].XBow == "yes"){
            Operability[i] = 0.26;
            if(ships[i].Accomodation == "yes"){
               Operability[i] = 0.32;
            }
         }
      }
   }

   if(ships[i].Helipad == "yes" && ships[i].MoonPool == "yes" && ships[i].ROV ==
"yes"){
      Operability[i] = 0.4;
      if(ships[i].DP == "II" || ships[i].XBow == "yes"){
         Operability[i] = 0.45;
         if(ships[i].DP == "II" && ships[i].XBow == "yes"){
            Operability[i] = 0.5;
            if(ships[i].Accomodation == "yes"){
               Operability[i] = 0.53;
            }
         }
      }

      if(ships[i].DP == "III" || ships[i].XBow == "yes"){
         Operability[i] = 0.47;
         if(ships[i].DP == "III" && ships[i].XBow == "yes"){
            Operability[i] = 0.52;
            if(ships[i].Accomodation == "yes"){
               Operability[i] = 0.55;
            }
         }
      }
   }

   if(ships[i].IceClass == "yes"){
      Operability[i] = 0.4;
      if(ships[i].Helipad == "yes" || ships[i].MoonPool == "yes" || ships[i].ROV ==
"yes"){
         Operability[i] = 0.45;
         if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.47;
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
               Operability[i] = 0.49;
               if(ships[i].Accomodation == "yes"){
                  Operability[i] = 0.55;
               }
            }
         }
```

```
        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.49;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.51;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.57;
                }
            }
        }
    }

    if((ships[i].Helipad == "yes" && ships[i].MoonPool == "yes") || ships[i].ROV
== "yes"){
        Operability[i] = 0.5
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.52
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.54;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.6;
                }
            }
        }

        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.54;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.56;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.62;
                }
            }
        }
    }

    if(ships[i].Helipad == "yes" || (ships[i].MoonPool == "yes" && ships[i].ROV ==
"yes")){
        Operability[i] = 0.5
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.52
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.54;
                if(ships[i].Accomodation == "yes"){
                    Operability[i] = 0.6;
                }
            }
        }

        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
```

```
            Operability[i] = 0.54;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
               Operability[i] = 0.56;
               if(ships[i].Accomodation == "yes"){
                  Operability[i] = 0.62;
               }
            }
         }
      }

      if(ships[i].Helipad == "yes" && ships[i].MoonPool == "yes" && ships[i].ROV
== "yes"){
         Operability[i] = 0.7;
         if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.75;
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
               Operability[i] = 0.8;
               if(ships[i].Accomodation == "yes"){
                  Operability[i] = 0.83;
               }
            }
         }

         if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.77;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
               Operability[i] = 0.82;
               if(ships[i].Accomodation == "yes"){
                  Operability[i] = 0.85;
               }
            }
         }
      }
   }
}


}


   //OSCV


   if (ships[i].shiptype=="OSCV"){

      if (ships[i].shipmission=="SUPPLY"){

         var GT = Math.pow((ships[i].DWT/3.0942),1.1905);
      }
```

```
        if (ships[i].shipmission=="TOWING"){

            var GT = Math.pow((ships[i].BP/0.023),1.07);
        }

        if (ships[i].shipmission=="CONSTRUCTION"){

            var GT = Math.pow((ships[i].DCW/0.0162),0.7455);
        }


    function OSCVf(GTonnage){
        this.DCW = (0.0162)*(Math.pow(GTonnage,1.3414));
        this.Accomodation = 1.9532 * (Math.pow(GTonnage,0.4343));
        this.InstalledPower = 5.0811 * (Math.pow(GTonnage,0.8628));
        this.BollardPull = 0.023 * (Math.pow(GTonnage,0.9346));
        this.DWT = 3.0942 * (Math.pow(GTonnage,0.84));
        this.Price = 0.000003 * (Math.pow(GTonnage,1.931));
        this.IPrice = 0.000003 * (Math.pow(GTonnage,1.931));
        this.LWT =
(0.197*Math.pow(GTonnage,0.0056))*(4.7096*Math.pow(GTonnage,0.9654));
        this.Length = (4.1904*Math.pow(GTonnage,0.3661));
        this.Breadth = (3.6089*Math.pow(GTonnage,0.2065));
        this.Draugth = (0.3607*Math.pow(GTonnage,0.329));

    }

        Results[i] = new OSCVf(GT);


        //EXTRA POWER OSCV

        if (ships[i].extraP == "yes"){
            Results[i].InstalledPower += Results[i].InstalledPower * (ships[i].PowerM);
            Results[i].Price += Results[i].Price*(ships[i].PowerM/4);
            Results[i].DWT -= Results[i].DWT*(ships[i].PowerM*0.04);
            Results[i].LWT += Results[i].LWT*(ships[i].PowerM*0.25);

        }

        //EXTRA BOLLARD PULL OSCV

        if (ships[i].extraBP == "yes"){
            Results[i].BollardPull += Results[i].BollardPull * (ships[i].BPM);
            Results[i].Price += Results[i].Price*(ships[i].BPM/8);
        }

        //EXTRA ACCOMMODATION OSCV

        if (ships[i].extraAcc == "yes"){
```

```
    Results[i].Accomodation += (ships[i].AccM*1);
    Results[i].Price += Results[i].Price*0.005*ships[i].AccM;
    Results[i].DWT -= Results[i].DWT*(ships[i].AccM*0.005);
    Results[i].DCW -= Results[i].DCW*(ships[i].AccM*0.002);
    Results[i].LWT += Results[i].LWT*(ships[i].AccM*0.005);
}

//EXTRA CRANE OSCV

if (ships[i].ExtraCrane == "yes"){
    Results[i].DWT -= Results[i].DWT*(ships[i].CraneM*0.0004);
    Results[i].Price += (Results[i].Price*0.005*ships[i].CraneM);
    Results[i].DCW -= Results[i].DCW*(ships[i].CraneM*0.0003);
    Results[i].LWT += Results[i].LWT*(ships[i].CraneM*0.0005);
}

//EXTRA DP OSCV

if (ships[i].DP == "II"){
    Results[i].Price += (Results[i].Price*0.05);
    Results[i].DWT -= Results[i].DWT*(0.002);
    Results[i].LWT += Results[i].LWT*(0.002);
}
if (ships[i].DP == "III"){
    Results[i].Price += Results[i].Price*0.1;
    Results[i].DCW -= Results[i].DCW*(0.003);
    Results[i].LWT += Results[i].LWT*(0.003);
}

//EXTRA ICE CLASS OSCV

if (ships[i].IceClass == "yes"){
    Results[i].DWT -= Results[i].DWT*0.0001;
    Results[i].Price += Results[i].Price*0.005;
}

//EXTRA XBOW OSCV

if (ships[i].XBow == "yes"){
    Results[i].Price += Results[i].Price*0.005;
}

//MOON POOL OSCV

if (ships[i].MoonPool == "yes"){
    Results[i].Price += Results[i].Price*0.01;
    Results[i].DWT -= Results[i].DWT*0.03;
    Results[i].DCW -= Results[i].DCW*0.05;
    Results[i].LWT += Results[i].LWT*(0.03);
}
```

```
        //EXTRA ROV OSCV

        if (ships[i].ROV == "yes"){
           Results[i].Price += Results[i].Price*0.01;
           Results[i].DWT -= Results[i].DWT*0.02;
           Results[i].DCW -= Results[i].DCW*0.008;
           Results[i].LWT += Results[i].LWT*(0.05);
        }

        //EXTRA HELIPAD OSCV

        if (ships[i].MoonPool == "yes"){
           Results[i].Price += Results[i].Price*0.01;
           Results[i].DWT -= Results[i].DWT*0.02;
           Results[i].DCW -= Results[i].DCW*0.005;
           Results[i].Accomodation -= 5;
           Results[i].LWT += Results[i].LWT*(0.02);
        }

        //OPERABILITY OSCV


if (ships[i].shipmission == "SUPPLY" && ships[i].shipplace =="BRAZIL"){
   Operability[i] = 0.8;
   if(ships[i].DP == "II" || ships[i].XBow == "yes"){
      Operability[i] = 0.83;
      if(ships[i].DP == "II" && ships[i].XBow == "yes"){
         Operability[i] = 0.85;
      }
   }
   if(ships[i].DP == "III" || ships[i].XBow == "yes"){
      Operability[i] = 0.85;
      if(ships[i].DP == "III" && ships[i].XBow == "yes"){
         Operability[i] = 0.88;
      }
   }
}
if (ships[i].shipmission == "SUPPLY" && ships[i].shipplace =="NORTHSEA"){
   Operability[i] = 0.75;
   if(ships[i].DP == "II" || ships[i].XBow == "yes"){
      Operability[i] = 0.80;
      if(ships[i].DP == "II" && ships[i].XBow == "yes"){
         Operability[i] = 0.85;
      }
   }
   if(ships[i].DP == "III" || ships[i].XBow == "yes"){
      Operability[i] = 0.83;
      if(ships[i].DP == "III" && ships[i].XBow == "yes"){
         Operability[i] = 0.88;
```

```
        }
    }
}

if (ships[i].shipmission == "SUPPLY" && ships[i].shipplace =="ARCTIC"){
    Operability[i] = 0.4;
    if(ships[i].DP == "II" || ships[i].XBow == "yes"){
        Operability[i] = 0.43;
        if(ships[i].DP == "II" && ships[i].XBow == "yes"){
            Operability[i] = 0.45;
        }
    }
    if(ships[i].DP == "III" || ships[i].XBow == "yes"){
        Operability[i] = 0.45;
        if(ships[i].DP == "III" && ships[i].XBow == "yes"){
            Operability[i] = 0.5;
        }
    }

    if(ships[i].IceClass == "yes"){
        Operability[i] = 0.75;
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.80;
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.85;
            }
        }
        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.83;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.88;
            }
        }
    }
}

if (ships[i].shipmission == "TOWING" && ships[i].shipplace =="BRAZIL"){

    Operability[i] = 0.6;
    if(ships[i].extraP == "yes" || ships[i].BP == "yes" || ships[i].XBow == "yes"){
        Operability[i] = 0.7;
        if(ships[i].DP = "II"){
            Operability[i] = 0.75;
        }
        if(ships[i].DP = "III"){
            Operability[i] = 0.8;
        }
    }

    if((ships[i].extraP == "yes" && ships[i].BP == "yes") || ships[i].XBow == "yes"){
```

```
        Operability[i] = 0.75;
        if(ships[i].DP = "II"){
            Operability[i] = 0.80;
        }
        if(ships[i].DP = "III"){
            Operability[i] = 0.85;
        }
    }

    if(ships[i].extraP == "yes" || (ships[i].BP == "yes" && ships[i].XBow == "yes")){
        Operability[i] = 0.75;
        if(ships[i].DP = "II"){
            Operability[i] = 0.80;
        }
        if(ships[i].DP = "III"){
            Operability[i] = 0.85;
        }
    }

    if(ships[i].extraP == "yes" && ships[i].BP == "yes" && ships[i].XBow == "yes"){
        Operability[i] = 0.80;
        if(ships[i].DP = "II"){
            Operability[i] = 0.85;
        }
        if(ships[i].DP = "III"){
            Operability[i] = 0.9;
        }
    }
}

if (ships[i].shipmission == "TOWING" && ships[i].shipplace =="NORTHSEA"){

    Operability[i] = 0.55;
    if(ships[i].extraP == "yes" || ships[i].BP == "yes" || ships[i].XBow == "yes"){
        Operability[i] = 0.65;
        if(ships[i].DP = "II"){
            Operability[i] = 0.7;
        }
        if(ships[i].DP = "III"){
            Operability[i] = 0.75;
        }
    }

    if((ships[i].extraP == "yes" && ships[i].BP == "yes") || ships[i].XBow == "yes"){
        Operability[i] = 0.7;
        if(ships[i].DP = "II"){
            Operability[i] = 0.75;
        }
        if(ships[i].DP = "III"){
            Operability[i] = 0.8;
```

```
        }
    }

    if(ships[i].extraP == "yes" || (ships[i].BP == "yes" && ships[i].XBow == "yes")){
        Operability[i] = 0.7;
        if(ships[i].DP = "II"){
            Operability[i] = 0.75;
        }
        if(ships[i].DP = "III"){
            Operability[i] = 0.8;
        }
    }

    if(ships[i].extraP == "yes" && ships[i].BP == "yes" && ships[i].XBow == "yes"){
        Operability[i] = 0.75;
        if(ships[i].DP = "II"){
            Operability[i] = 0.8;
        }
        if(ships[i].DP = "III"){
            Operability[i] = 0.85;
        }
    }
}

if (ships[i].shipmission == "TOWING" && ships[i].shipplace =="ARCTIC"){

    Operability[i] = 0.05;
    if(ships[i].extraP == "yes" || ships[i].BP == "yes" || ships[i].XBow == "yes"){
        Operability[i] = 0.15;
        if(ships[i].DP = "II"){
            Operability[i] = 0.2;
        }
        if(ships[i].DP = "III"){
            Operability[i] = 0.25;
        }
    }

    if((ships[i].extraP == "yes" && ships[i].BP == "yes") || ships[i].XBow == "yes"){
        Operability[i] = 0.2;
        if(ships[i].DP = "II"){
            Operability[i] = 0.25;
        }
        if(ships[i].DP = "III"){
            Operability[i] = 0.3;
        }
    }

    if(ships[i].extraP == "yes" || (ships[i].BP == "yes" && ships[i].XBow == "yes")){
        Operability[i] = 0.2;
        if(ships[i].DP = "II"){
```

```
            Operability[i] = 0.25;
        }
        if(ships[i].DP = "III"){
            Operability[i] = 0.3;
        }
    }

    if(ships[i].extraP == "yes" && ships[i].BP == "yes" && ships[i].XBow == "yes"){
        Operability[i] = 0.3;
        if(ships[i].DP = "II"){
            Operability[i] = 0.35;
        }
        if(ships[i].DP = "III"){
            Operability[i] = 0.4;
        }
    }

    if(ships[i].IceClass == "yes"){
        Operability[i] = 0.55;
        if(ships[i].extraP == "yes" || ships[i].BP == "yes" || ships[i].XBow == "yes"){
            Operability[i] = 0.65;
            if(ships[i].DP = "II"){
                Operability[i] = 0.7;
            }
            if(ships[i].DP = "III"){
                Operability[i] = 0.75;
            }
        }

        if((ships[i].extraP == "yes" && ships[i].BP == "yes") || ships[i].XBow ==
"yes"){
            Operability[i] = 0.7;
            if(ships[i].DP = "II"){
                Operability[i] = 0.75;
            }
            if(ships[i].DP = "III"){
                Operability[i] = 0.8;
            }
        }

        if(ships[i].extraP == "yes" || (ships[i].BP == "yes" && ships[i].XBow ==
"yes")){
            Operability[i] = 0.7;
            if(ships[i].DP = "II"){
                Operability[i] = 0.75;
            }
            if(ships[i].DP = "III"){
                Operability[i] = 0.8;
            }
        }
```

```
      if(ships[i].extraP == "yes" && ships[i].BP == "yes" && ships[i].XBow ==
"yes"){
         Operability[i] = 0.75;
         if(ships[i].DP = "II"){
            Operability[i] = 0.8;
         }
         if(ships[i].DP = "III"){
            Operability[i] = 0.85;
         }
      }
   }
}

if (ships[i].shipmission == "CONSTRUCTION" && ships[i].shipplace
=="BRAZIL"){
   Operability[i] = 0.8;
   if(ships[i].Helipad == "yes" || ships[i].MoonPool == "yes" || ships[i].ROV ==
"yes"){
      Operability[i] = 0.84;
      if(ships[i].DP == "II" || ships[i].XBow == "yes"){
         Operability[i] = 0.87;
         if(ships[i].DP == "II" && ships[i].XBow == "yes"){
            Operability[i] = 0.89;
            if(ships[i].ExtraCrane == "yes"){
               Operability[i] = 0.91;
            }
         }
      }

      if(ships[i].DP == "III" || ships[i].XBow == "yes"){
         Operability[i] = 0.91;
         if(ships[i].DP == "III" && ships[i].XBow == "yes"){
            Operability[i] = 0.93;
            if(ships[i].ExtraCrane == "yes"){
               Operability[i] = 0.95;
            }
         }
      }
   }

   if((ships[i].Helipad == "yes" && ships[i].MoonPool == "yes") || ships[i].ROV ==
"yes"){
      Operability[i] = 0.86;
      if(ships[i].DP == "II" || ships[i].XBow == "yes"){
         Operability[i] = 0.89;
         if(ships[i].DP == "II" && ships[i].XBow == "yes"){
            Operability[i] = 0.91;
            if(ships[i].ExtraCrane == "yes"){
               Operability[i] = 0.93;
```

```
            }
        }
    }

    if(ships[i].DP == "III" || ships[i].XBow == "yes"){
        Operability[i] = 0.93;
        if(ships[i].DP == "III" && ships[i].XBow == "yes"){
            Operability[i] = 0.95;
            if(ships[i].ExtraCrane == "yes"){
                Operability[i] = 0.97;
            }
        }
    }
}

  if(ships[i].Helipad == "yes" || (ships[i].MoonPool == "yes" && ships[i].ROV ==
"yes")){
    Operability[i] = 0.86;
    if(ships[i].DP == "II" || ships[i].XBow == "yes"){
        Operability[i] = 0.89;
        if(ships[i].DP == "II" && ships[i].XBow == "yes"){
            Operability[i] = 0.91;
            if(ships[i].ExtraCrane == "yes"){
                Operability[i] = 0.93;
            }
        }
    }

    if(ships[i].DP == "III" || ships[i].XBow == "yes"){
        Operability[i] = 0.93;
        if(ships[i].DP == "III" && ships[i].XBow == "yes"){
            Operability[i] = 0.95;
            if(ships[i].ExtraCrane == "yes"){
                Operability[i] = 0.97;
            }
        }
    }
}

  if(ships[i].Helipad == "yes" && ships[i].MoonPool == "yes" && ships[i].ROV ==
"yes"){
    Operability[i] = 0.88;
    if(ships[i].DP == "II" || ships[i].XBow == "yes"){
        Operability[i] = 0.91;
        if(ships[i].DP == "II" && ships[i].XBow == "yes"){
            Operability[i] = 0.93;
            if(ships[i].ExtraCrane == "yes"){
                Operability[i] = 0.95;
            }
        }
```

```
        }

        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
           Operability[i] = 0.95;
           if(ships[i].DP == "III" && ships[i].XBow == "yes"){
              Operability[i] = 0.97;
              if(ships[i].ExtraCrane == "yes"){
                 Operability[i] = 0.99;
              }
           }
        }
     }
}
if (ships[i].shipmission == "CONSTRUCTION" && ships[i].shipplace
=="NORTHSEA"){
   Operability[i] = 0.77;
   if(ships[i].Helipad == "yes" || ships[i].MoonPool == "yes" || ships[i].ROV ==
"yes"){
        Operability[i] = 0.81;
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
           Operability[i] = 0.85;
           if(ships[i].DP == "II" && ships[i].XBow == "yes"){
              Operability[i] = 0.89;
              if(ships[i].ExtraCrane == "yes"){
                 Operability[i] = 0.91;
              }
           }
        }

        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
           Operability[i] = 0.89;
           if(ships[i].DP == "III" && ships[i].XBow == "yes"){
              Operability[i] = 0.93;
              if(ships[i].ExtraCrane == "yes"){
                 Operability[i] = 0.95;
              }
           }
        }
     }

     if((ships[i].Helipad == "yes" && ships[i].MoonPool == "yes") || ships[i].ROV ==
"yes"){
        Operability[i] = 0.83;
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
           Operability[i] = 0.87;
           if(ships[i].DP == "II" && ships[i].XBow == "yes"){
              Operability[i] = 0.91;
              if(ships[i].ExtraCrane == "yes"){
                 Operability[i] = 0.93;
              }
```

```
            }
        }

        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.91;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.95;
                if(ships[i].ExtraCrane == "yes"){
                    Operability[i] = 0.97;
                }
            }
        }
    }

    if(ships[i].Helipad == "yes" || (ships[i].MoonPool == "yes" && ships[i].ROV ==
"yes")){
        Operability[i] = 0.83;
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.87;
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.91;
                if(ships[i].ExtraCrane == "yes"){
                    Operability[i] = 0.93;
                }
            }
        }

        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.91;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.95;
                if(ships[i].ExtraCrane == "yes"){
                    Operability[i] = 0.97;
                }
            }
        }
    }

    if(ships[i].Helipad == "yes" && ships[i].MoonPool == "yes" && ships[i].ROV ==
"yes"){
        Operability[i] = 0.85;
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.89;
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.93;
                if(ships[i].ExtraCrane == "yes"){
                    Operability[i] = 0.95;
                }
            }
        }
```

```
      if(ships[i].DP == "III" || ships[i].XBow == "yes"){
         Operability[i] = 0.93;
         if(ships[i].DP == "III" && ships[i].XBow == "yes"){
            Operability[i] = 0.97;
            if(ships[i].ExtraCrane == "yes"){
               Operability[i] = 0.99;
            }
         }
      }
   }
}


if (ships[i].shipmission == "CONSTRUCTION" && ships[i].shipplace
=="ARCTIC"){

   Operability[i] = 0.37;
   if(ships[i].Helipad == "yes" || ships[i].MoonPool == "yes" || ships[i].ROV ==
"yes"){
      Operability[i] = 0.41;
      if(ships[i].DP == "II" || ships[i].XBow == "yes"){
         Operability[i] = 0.45;
         if(ships[i].DP == "II" && ships[i].XBow == "yes"){
            Operability[i] = 0.49;
            if(ships[i].ExtraCrane == "yes"){
               Operability[i] = 0.51;
            }
         }
      }

      if(ships[i].DP == "III" || ships[i].XBow == "yes"){
         Operability[i] = 0.49;
         if(ships[i].DP == "III" && ships[i].XBow == "yes"){
            Operability[i] = 0.53;
            if(ships[i].ExtraCrane == "yes"){
               Operability[i] = 0.55;
            }
         }
      }
   }

   if((ships[i].Helipad == "yes" && ships[i].MoonPool == "yes") || ships[i].ROV ==
"yes"){
      Operability[i] = 0.43;
      if(ships[i].DP == "II" || ships[i].XBow == "yes"){
         Operability[i] = 0.47;
         if(ships[i].DP == "II" && ships[i].XBow == "yes"){
            Operability[i] = 0.51;
            if(ships[i].ExtraCrane == "yes"){
```

```
                Operability[i] = 0.53;
            }
        }
    }

    if(ships[i].DP == "III" || ships[i].XBow == "yes"){
        Operability[i] = 0.51;
        if(ships[i].DP == "III" && ships[i].XBow == "yes"){
            Operability[i] = 0.55;
            if(ships[i].ExtraCrane == "yes"){
                Operability[i] = 0.57;
            }
        }
    }
  }

  if(ships[i].Helipad == "yes" || (ships[i].MoonPool == "yes" && ships[i].ROV ==
"yes")){
    Operability[i] = 0.43;
    if(ships[i].DP == "II" || ships[i].XBow == "yes"){
        Operability[i] = 0.47;
        if(ships[i].DP == "II" && ships[i].XBow == "yes"){
            Operability[i] = 0.51;
            if(ships[i].ExtraCrane == "yes"){
                Operability[i] = 0.53;
            }
        }
    }

    if(ships[i].DP == "III" || ships[i].XBow == "yes"){
        Operability[i] = 0.51;
        if(ships[i].DP == "III" && ships[i].XBow == "yes"){
            Operability[i] = 0.55;
            if(ships[i].ExtraCrane == "yes"){
                Operability[i] = 0.57;
            }
        }
    }
  }

  if(ships[i].Helipad == "yes" && ships[i].MoonPool == "yes" && ships[i].ROV ==
"yes"){
    Operability[i] = 0.45;
    if(ships[i].DP == "II" || ships[i].XBow == "yes"){
        Operability[i] = 0.49;
        if(ships[i].DP == "II" && ships[i].XBow == "yes"){
            Operability[i] = 0.53;
            if(ships[i].ExtraCrane == "yes"){
                Operability[i] = 0.55;
            }
```

```
            }
        }

        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.53;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.57;
                if(ships[i].ExtraCrane == "yes"){
                    Operability[i] = 0.59;
                }
            }
        }
    }
    if(ships[i].IceClass == "yes"){
        Operability[i] = 0.77;
        if(ships[i].Helipad == "yes" || ships[i].MoonPool == "yes" || ships[i].ROV ==
"yes"){
            Operability[i] = 0.81;
            if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                Operability[i] = 0.85;
                if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                    Operability[i] = 0.89;
                    if(ships[i].ExtraCrane == "yes"){
                        Operability[i] = 0.91;
                    }
                }
            }

            if(ships[i].DP == "III" || ships[i].XBow == "yes"){
                Operability[i] = 0.89;
                if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                    Operability[i] = 0.93;
                    if(ships[i].ExtraCrane == "yes"){
                        Operability[i] = 0.95;
                    }
                }
            }
        }

        if((ships[i].Helipad == "yes" && ships[i].MoonPool == "yes") || ships[i].ROV
== "yes"){
            Operability[i] = 0.83;
            if(ships[i].DP == "II" || ships[i].XBow == "yes"){
                Operability[i] = 0.87;
                if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                    Operability[i] = 0.91;
                    if(ships[i].ExtraCrane == "yes"){
                        Operability[i] = 0.93;
                    }
                }
```

```
        }

        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.91;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.95;
                if(ships[i].ExtraCrane == "yes"){
                    Operability[i] = 0.97;
                }
            }
        }
    }

    if(ships[i].Helipad == "yes" || (ships[i].MoonPool == "yes" && ships[i].ROV ==
"yes")){
        Operability[i] = 0.83;
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.87;
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.91;
                if(ships[i].ExtraCrane == "yes"){
                    Operability[i] = 0.93;
                }
            }
        }

        if(ships[i].DP == "III" || ships[i].XBow == "yes"){
            Operability[i] = 0.91;
            if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                Operability[i] = 0.95;
                if(ships[i].ExtraCrane == "yes"){
                    Operability[i] = 0.97;
                }
            }
        }
    }

    if(ships[i].Helipad == "yes" && ships[i].MoonPool == "yes" && ships[i].ROV
== "yes"){
        Operability[i] = 0.85;
        if(ships[i].DP == "II" || ships[i].XBow == "yes"){
            Operability[i] = 0.89;
            if(ships[i].DP == "II" && ships[i].XBow == "yes"){
                Operability[i] = 0.93;
                if(ships[i].ExtraCrane == "yes"){
                    Operability[i] = 0.95;
                }
            }
        }
```

```
            if(ships[i].DP == "III" || ships[i].XBow == "yes"){
               Operability[i] = 0.93;
               if(ships[i].DP == "III" && ships[i].XBow == "yes"){
                  Operability[i] = 0.97;
                  if(ships[i].ExtraCrane == "yes"){
                     Operability[i] = 0.99;
                  }
               }
            }
         }
      }


}

Volume[i] = (Results[i].DWT+Results[i].LWT)/1.025;
CB[i]=Volume[i]/(Results[i].Length*Results[i].Breadth*Results[i].Draugth);

}

for (var i = 0; i < ships.length; i++){

   results_str += ("<h3> SCENARIO " + ships[i].id + ": </h3>" + "Type: " +
ships[i].shiptype + ", " +  "Mission: " + ships[i].shipmission + ", " + "Place: " +
ships[i].shipplace + "<br>" + "Length: " + Results[i].Length + " m" + "<br>" +
"Breadth: " + Results[i].Breadth + " m" + "<br>" + "Draught: " + Results[i].Draugth
+ " m" + "<br>" + "LWT: " + Results[i].LWT + " ton" + "<br> DWT: " +
Results[i].DWT + " ton" + "<br> Volume: " + Volume[i] + " m3" + "<br> Cb: " +
CB[i] + "<br> Installed Power: " + Results[i].InstalledPower + " kW" + "<br>
Bollard Pull: " + Results[i].BollardPull + " ton" + "<br> Deck Cargo Weight: " +
Results[i].DCW + " ton" + "<br> Accommodation: " + Results[i].Accomodation + "
Persons" + "<br> CAPEX: " + Results[i].Price + " Million of Dollars" + "<br>
Operability: " + Operability[i] + "<br> <br>");

}

//Substitute the value inside the div_result for your answers!
document.getElementById("div_result").innerHTML= results_str;

}

function decisionTree(){
   //var operabilityscore = prompt("Put a score for operability, from 0 to 10.");
   //var pricescore = 10 - operabilityscore;

   //for (var i = 0; i < ships.length; i++){
   //    decideship[i] =
((10/Results[i].Price)*(pricescore))+(Operability[i]*operabilityscore);
   //}
```

```
    //for (var i = 0; i < decideship.length; i++){
        //if (decideship[i] > bestship){

        //    bestship = decideship[i];
        //    var position = i;
        //}
    //}
    //console.log(decideship);
    //console.log(bestship);

bestship_str = "<h3> Made Manually </h3>"

//bestship_str += ("<h3> DESIGN " + ships[position].id + ": </h3>" + "Type: " +
ships[position].shiptype + ", " +  "Mission: " + ships[position].shipmission + ", " +
"Place: " + ships[position].shipplace + "<br>" + "Length: " +
Results[position].Length + "<br>" + "Breadth: " + Results[position].Breadth + "<br>"
+ "Draught: " + Results[position].Draugth + "<br>" + "LWT: " +
Results[position].LWT + "<br> DWT: " + Results[position].DWT + "<br> Volume: "
+ Volume[position] + "<br> Cb: " + CB[position] + "<br> Installed Power: " +
Results[position].InstalledPower + "<br> Bollard Pull: " +
Results[position].BollardPull + "<br> Deck Cargo Weight: " +
Results[position].DCW + "<br> Accommodation: " +
Results[position].Accomodation + "<br> Price: " + Results[position].Price + "<br>
Operability: " + Operability[position] + "<br> <br>");

document.getElementById("decision").innerHTML= bestship_str;

}



</script>
</body>
</html>
```