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Antti Torittu

DEFINING AND QUANTIFYING CUSTOMER VALUE

– Case: General carrier

TURUN AMMATTIKORKEAKOULU
TURKU UNIVERSITY OF APPLIED SCIENCES

MASTER'S THESIS | ABSTRACT

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CUSTOMER VALUE QUANTIFICATION

The thesis contains driving forces behind the traditional general carrier owner and what are the variables which are affecting owner decision making at ship building project. The MacGregor cargo solution is designed to increase ship utilization rate and ultimately increase earned revenue. Starting point for solution design is the owner business case which directly reflects to the new building project. Business case owner defines the intended route, cargo profile, commercial requirements and technical limitation on which ship will be operated. Value adding of specified cargo handling products is defined and how the value is affecting the owner's business case.

The value of the cargo solution for the owner is the fully optimized cargo handling solution and the overall optimized utilization of the ship potential throughout its service life. Earned revenue depends on the utilization rate of the ship cargo carrying capacity and how it can be maximized with MacGregor solution design. MacGregor solution design is a project and customer specified solution which is aiming at introducing the highest level of added value to its ship owner individual business case.

General cargo ships generally introduce a high level of specification and unique technical concepts. General carrier is used at specified trade to which it's designed but the ship is also seldom used in different trades throughout ship service life which need to be considered when solution design concept is designed and offered to the customer.

The general carrier average utilization rate varies greatly. General carrier calling Finnish ports at 2013 average utilization rate varies between 35%-41%, but a purpose build general carrier carrying specific cargo utilization rate can reach 85%. Thesis work contains a specific case formulation where different alternatives are considered to be used at the specific vessel design stage in order to increase vessel earning potential by increasing the utilization rate of the vessel.

Ultimately the aim of the thesis is to be a sales tool and work as a guideline when solution based design is offered to the customers. The thesis contains different solutions which can be utilized at the offer stage. Generally there are two different solutions which need to be considered. If owner business case is specified solution design can be prepared to increase the carrying capacity of specific vessel, on specific route and with specific cargo profile. The Second solution if the owner doesn't have a specific business case, the vessel needs to be designed as flexible as economically reasonable in order to benefit the owner at varying business cases. When the vessel cargo profile is designed to be flexible in its utilization can be increased with different computer software's which are improving the cargo loading, vessel operating or cargo offering. Digitalization can be utilized as a tool to increase vessel's utilization rates. Software's need to be more developed in order to replace human knowledge. If software development is carried, out there are lucrative new applying areas in the merchant ship sector were MacGregor can earn reasonable revenue.

When the value quantification of the solution concept is presented to the customer focus need be used to increase the desirability of the solution concept. Due to the weak markets if vessel revenue is not guaranteed to get financing for the vessel may be problematic. Solution concept can be utilized to help owner get financing by providing ship cargo design which will guarantee a certain level of income regardless of the fluctuating cargo or market prices. At the moment new building prices are coming down but also the general cargo ship financing is challenging as the cargo volumes and prices have dropped. Macgregor need to present a convincing solution concept which will guarantee certain revenue level. Different options need to be created in order to show to the owner the future options which he or she would have. Vessel needs to be fit to the current downturn, but it needs to be ready to answer to the next boom as the shipping business is very cyclic.

The thesis includes owner financial report in order to clarify the financial aspects behind owner decision making. MacGregor as a technical firm can understand owner technical issues, but the owner decision making is ultimately based on to the financial items. Best suitable solution based design can be defined when Macgregor understands the owner financial aspects and the ships business case.

KEYWORDS: General Carrier, Solution, Value quantification.

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ASIAKKAAN ARVON MÄÄRITTÄMINEN

Lopputyö käsittelee traditionaalisen yleisrahtialuksen omistajan päätöksien takana olevia tekijöitä, sekä miten ne vaikuttavat uudisrakennus projektiin. MacGregorin lastiratkaisu on suunniteltu kasvattamaan laivan käyttöastetta ja lopullisesti omistajan tuottoa laivasta. MacGregorin lastiratkaisun lähtökohtana on omistajan liiketoimintasuunnitelma, mikä määrittelee uudisrakennus projektin ääriviivat. Laivan omistajan liiketoimintasuunnitelma määrittelee aiotun reitin, rahti profiilin, kaupalliset vaatimukset ja tekniset rajoitukset joiden sisällä alusta tullaan operoimaan. Lastin käsittelylaitteiden arvon lisäys on määritelty ja miten se vaikuttaa omistajan liiketoimintasuunnitelmaan.

Lastiratkaisun arvo omistajalle on täysin optimoitu lastinkäsittely malli ja kokonaisvaltainen laivan käyttöasteen optimointi kauttaaltaan koko laivan elin iän. Ansaittu tuotto riippuu laivan lastinkuljetus kapasiteetin käyttöasteesta ja miten se voidaan maksimoida MacGregorin ratkaisujen avulla. MacGregorin lastiratkaisu on projekti ja asiakas kohtaisesti määritelty, ratkaisu tähtää tuottamaan korkeinta mahdollista arvon nousua yksittäisen laivan omistajalle ja hänen liiketoimintasuunnitelmalleen.

Yleisrahtialuksien erittely ja uniikit tekniset ratkaisut on suunniteltu vastaamaan spesifioitujen reittien vaatimuksia, mutta yleisrahtialukset operoivat harvakseltaan uusilla reiteillä, joiden vaatimuksiin vastaaminen tulee huomioida lastiratkaisua suunniteltaessa ja tarjottaessa asiakkaalle.

Yleisrahtialusten keskimäärinen täyttöaste vaihtelee suuresti. Vuonna 2013 Suomen satamissa käyneiden yleisrahtialuksien keskimääräinen täyttöaste vaihteli 35%-41%, mutta yhteen tarkoitukseen rakennetun yleisrahtialuksen täyttöaste voi aina nousta 85%. Lopputyö sisältää yksittäisiä tapaus tutkimuksia, joissa eri ratkaisu vaihtoehtoja yksittäisille aluksille on tutkittu, jotta aluksen ansainta potentiaalia voitaisiin kasvattaa täyttöastetta nostamalla.

Pohjimmiltaan lopputyön tarkoitus on olla työkalu myynninavuksi ja olla ohjenuora lastiratkaisua tarjottaessa asiakkaalle. Lopputyö pitää sisällään eri näkökohtia, jotka pitää huomioida ja joita voidaan hyöty käyttää tarjousvaiheessa. Yleisesti ottaen on kaksi erilaista lähtökohtaa lastiratkaisua suunniteltaessa riippuen omistajan liiketoimintasuunnitelmasta. Omistajan liiketoimintasuunnitelma voi olla spesifioitu, jolloin lastiratkaisu voidaan suunnitella kasvattamaan spesifioidun aluksen lasti kapasiteettia, spesifioidulla reitillä ja spesifioidulla lasti profiililla. Toinen vaihtoehto on, jos omistajan liiketoimintasuunnitelma ei ole spesifioitu, alus suunnitellaan taloudellisia ja teknisiä raameja noudattaen joustavaksi, jotta omistaja hyötyy eri liiketoimintamallien mukaisesti alusta käyttäessään. Kun aluksen lasti profiili on suunniteltu joustavaksi, sen täyttöastetta voidaan parantaa tietokone ohjelmilla kuten lastin käsittely, aluksen operointi ja lastin saaminen. Digitalisaation kasvaessa eri apuvälineitä kuten tietokone ohjelmia voidaan käyttää apuna aluksen täyttöastetta kasvatettaessa. Ohjelmia täytyy kehittää, jotta niitä voidaan käyttää päätöksiä tehtäessä, mutta jos kehitystä jatketaan, löytyy uusia ansainta alueita joista MacGregor voi kehittää tuottavaa toimintaa.

Taantuman aikana uudisrakennus laivojen käyttö mahdollisuudet, sekä rahoituksen löytäminen voi aiheuttaa hankaluuksia asiakkaalle, joten lastinkäsittely konseptin haluttavuutta täytyy nostaa fokusoitumalla arvon nousu konseptin käsittelyyn. Siinä tapauksessa lastinkäsittely konseptin pitää esitellä ratkaisua, jotka takaavat varman tuotto tason riippumatta vaihtelevista rahti tai markkina hinnoista. Uudisrakennusten hintojen ollessa matalat tällä hetkellä, rahoituksen järjestäminen yleisrahtialukselle on haastavaa, johtuen pudonneista rahti määristä ja rahti hinnoista. MacGregorin tulee esitellä uskottava lastiratkaisu konsepti, joka takaa varman tuotto tason ja tuota tasoa tarkkaillaan aluksen operoinnin aikana ja vaadittavat toimenpiteet suoritetaan tuotto tason takaamiseksi ja nostamiseksi. Tulevaisuutta varten erilaisia ratkaisu malleja tulee valmistella asiakkaan tueksi. Alus tulee rakentaa vastaamaan nykyistä laskusuhdannetta, mutta aluksen tulee olla valmis vastaamaan tuleviin nousukausiin johtuen rahtiliikenteen syklisyydestä.

Lopputyö sisältään omistajan tilinpäätöksen, selventääkseen liiketoiminnallisia vaikuttimia omistajan päätöksien takana, lopullisesti omistajan liiketoimintamalli tulee olla taloudellisesti kestävällä pohjalla tuottaakseen tuottoa omistajalle. MacGregorin ollessa teknisesti suuntautunut yhtiö tulee sen siitä huolimatta ymmärtää niin teknisiä kuin taloudellisia vaikuttimia asiakkaan päätösten takana. MacGregorin ymmärtäessä asiakkaan taloudelliset vaikuttimet MacGregor voi selvittää, mikä omistaja on taloudellisesti tukevalla pohjalla investoidakseen uudisrakennuksiin ja kohdentaa resursseja sen mukaan.

ASIASANAT: Arvonnousu, Rahtiaiva, Ratkaisut.

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LIST OF ABBREVIATIONS (OR) SYMBOLS

Deadweight (dwt)	The weight a ship can carry when loaded to its marks, including cargo, fuel, fresh water, stores and crew.
HS	High Sulphur
COA	Contrat of Affreightment
GC	General Carrier
IASB	International Accounting Standards Board
IFO 380	Intermediate fuel oil with a maximum viscosity of 380 Centistokes (<3.5% sulphur)
IFO 180	Intermediate fuel oil with a maximum viscosity of 180 Centistokes (<3.5% sulphur)
IFRS	International Financial reporting Standard
IMO	International Maritime Organization
ISO	International Organization for Standardization
LNG	Liquefied natural gas
lo-lo	lift on, lift off
LS 380	Low-sulphur (<1.0%) intermediate fuel oil with a maximum viscosity of 380 Centistokes
LS 180	Low-sulphur (<1.0%) intermediate fuel oil with a maximum viscosity of 180 Centistokes
MDO	Marine diesel oil
MGO	Marine gasoil
MOC	MacGregor Onboard Care
MPP	Multi-purpose
P&I	Protection and indemnity

ROI	Return on Investment
ROCE	Return on Capital Employed
SDRs	Special Drawing Rights
SECA	Sulphur Emission Control Area
SOLAS	Safety of Life at Sea Convention
TEU	twenty-foot equivalent unit
U.D.L	Uniform Distributed Loads

1 INTRODUCTION

MacGregor as a company is a part of Cargotec group. MacGregor designs and provides fabrication of cargo vessel's weather deck and tween deck hatch covers, cranes, lashing bridges, container lashing fittings, steering gear and deck machinery. Hatch covers, lashing bridges and container lashing fitting protect and secure cargo during the voyage. Ship based cranes enable cargo loading and unloading without a shore based cranes. Steering gears and deck machineries increase MacGregor portfolio by offering products for ship operation.

The purpose of the thesis work is to define customer value quantification from general cargo carrier cargo solution. The purpose of the study would be to find values and benefits that shipping companies would get from choosing MacGregor's cargo solution which includes at a product level fixed fitting, lashing bridges, lashing fittings, hatch covers and cranes. Cargo solution contains cargo capacity utilization designing and support packages for ship daily operation. The main benefits for the owner are the increased cargo capacity and the ability to get all cargo related equipment from a single supplier.

For the thesis work research is also done to find out the value which ship owners is gained when the owner is investing more at the beginning of the new building process. Hatch covers cost from the overall new building cost is 9%. The study's purpose is to find out what value owner will get from our solution based design. Solution based design main point is to start the design of the cargo handling equipment before owner has ordered the vessel. Traditionally owner will order vessel from shipyard which orders cargo equipment from cheapest supplier in this case vessel cargo capacity isn't fully utilized. Solution based design starts from identifying the owner business case and how MacGregor can answer for it with our design. Items which need to be considered at the solution design and offering stage are what type of cargo vessel can transfer, what are the owner's service cost and his equipment reliability, re-sale price of the vessel, insurances feeds and ships daily operating cost.

When the study has been done, we have more tools to be shown to our customers why to choose MacGregor solution based design and what benefits customers can gain from it. Thesis work would be a sales tool which can be used to find a solution to different business cases. The next step for this work would be specifying cargo solution concept for the specific owner’s business case. As general carriers are complex vessels with a unique cargo profiles the flexibility and how easily the customer value can be defined when solution design is utilized is an important factor for MacGregor.

2 METHODOLOGY

The thesis project is based on quantitative research methods. Discussion and meetings were kept with MacGregor professional who are directly related to general carrier sales or general carrier design. Product and sales data supporting the project were collected from MacGregor Enterprise Resource Planning-system or from key personnel correspondence.

In-house meetings were carried out with specific agendas supporting the thesis project. Separately discussion were kept with the in-house personnel, the discussions were kept without specific agenda and discussion were relaying to specific problems or ideas which could be developed.

Case studies were chosen from the GEN-DTS project carried by Wahlström (2012). The GEN-DTS was qualitative research project carried by conducting interviews of specific general carrier owners.

The customer value quantification was based on similar concept introduced successfully at the container carrier solution sales. The value quantification products and services in the general carrier solution concept is varying from the products and services introduced at the container carrier solution sales.

3 SOLUTION CONCEPT

3.1 SOLUTION CONCEPT SALES

The aim of this thesis is to develop a solution concept for the owner of MacGregor's to support the company's sales of general cargo vessels. MacGregor's ultimate goal in the future is to present a joint solution that includes hatch covers, cranes and deck machinery equipment that is provided by Hatlapa. Hatlapa was recently bought by MacGregor's to increase its product portfolio. The solution concept is only feasible when MacGregor's representatives are able to influence the customer in the vessel's pre-project planning stage MacGregor's regarding its cargo profile, ship operating profile and business case. The concept offers alternatives for creating space for cargo capacity maximization and increasing the cargo capacity utilization rate, decreasing operational costs, increasing vessel flexibility, and offering life cycle services and future cargo boost solutions. MacGregor's objective is to maximize owner investment efficiency and move from traditional product-based sales to solution sales, establishing a new concept for ship owners' decision making and investment processes, which would ultimately increase the owner's profit level.

A solution sales concept has been approved for working with container vessels, as the initial orders have been delivered and new solution sales orders have been received. For container vessels, only hatch covers, lashing bridges and fixed and loose fittings are currently included in the solution package. All product lines are located in Kaarina, Finland, and use similar design practices, processes and tools.

Solution sales difficulties with the general cargo vessels are seen in the current working practices and the various product lines. The general cargo solution product line hatch covers are located in Kaarina, Finland. Cranes operate in Örnsköldsvik, Sweden, and deck machinery and steering products are designed and produced by Hatlapa in Hamburg, Germany. Different product lines do not utilize the same technical tools or drawings board. Apart from the traditional means of communication, the design process does not enable integration of the various design processes so as to control and handle all the different design and sales processes as a single entity (Wahlström 2012, 7-8). A solution sales organization has been created to enable sales to represent and sell all products as a package rather than as a single product. At the same time, a product sales department has been maintained to serve customers who do not see the full potential of the solution concept. MacGregor's needs to identify the projects for which the solution concept would be offered; it is not reasonable to offer only a solution concept, as many sales are still made via product-based sales. The incorporation of a solution concept for the general carrier vessel requires close co-operation between the staff for different products at every stage of the project delivery process. Tendering, contract management, design, R&D, purchasing, logistics, fabrication, commissioning and other process-based co-operation needs to be developed to ensure that the products will increase the owner's revenue and the solution concept is beneficial to MacGregor's.

MacGregor's has a product-centred operation method that, until now, has supported MacGregor's market leader position in the global market (Wahlström 2012, 7-8). Hatch covers, deck machinery, steering systems and cranes have been seen as separate products representing top quality, long life spans and low maintenance costs. The reason that products have been difficult to integrate into a solution is because products vary by their technical complexity and installation phases. The physical distance between the offices allows the different product lines to act more or less as individual companies with each project and product having their own separate blueprints and, until now, separate economic targets.

With the solution design concept, MacGregor's is seeking more lucrative, complete sales while also MacGregor's producing the actual products. Traditionally, shipyards can order either a complete package from MacGregor's or only the design and key components. There has been variation between shipyards in terms of which packages have been ordered from MacGregor's, depending on the price, shipyard production facility availability, delivery schedule and technical considerations.

The customer business case articulates a clear path to an attractive return on investment (ROI). The business case should examine the benefits and risks involved when action is taken and not taken (Whatis.com). The conclusion should be an overall argument for implementation. Both short-term and long-term costs and revenue should be considered.

3.2 THE SOLUTION CONCEPT PROCESS

The solution sales process has been implemented for the container vessels because the organizational processes and technical knowledge base are located at a single office, enabling simpler process development. In the general carrier vessels, different working practices increase the challenges of developing clear guidance, instruction, command and control.

The majority of MacGregor's hatch cover clients today consist of shipyards even though the preferred business interface consists of ship design firms and ship owners (Wahlström 2012, 8). Shipyards have a strong focus on cost efficiency, whereas MacGregor's focus is customer-centred, emphasizing operational and investment efficiency (Wahlström 2012, 8).

MacGregor's major market area for general carrier vessels is in Asia. Some of the vessels are still produced in Europe due to the value and complexity of the vessels. When the ship design is complex and its value is high, the cheaper labour and fabrications costs that are found in Asia are not the major sources of the overall costs. The depression, during which shipyards were seeking more work for their own manufacturing plants, led to lower numbers of complete hatch cover deliveries. Different shipyard traditions and working methods also affected the complete hatch cover deliveries. To increase the complete solution design sales, MacGregor's established work groups for sales and tendering. Sales and design tools were also sought to identify the methods and processes that would support the complete solution design (Wahlström 2012, 8). Further-more, the hatch cover product line has experienced difficulties in entering the Asian market. The global economic depression has decreased customers' brand loyalty inclinations as the main competitors are heavily competing with lower steel structure weight and lower costs to increase their market share.

3.3 THE OBJECTIVE OF SOLUTION CONCEPT

The purpose of solutions sales purpose is to give the customer the best technical solution to ensure the greatest profitability of the vessel. How profitable the solution concept is for the ship owner depends on the ship owner and his shipping operation type and company strategy.

The knowledge of key drivers and priorities behind a ship owner's decision making process is imperative in establishing optimal tailor-made cargo solutions (Wahlström 2012, 8). There is fairly limited knowledge about these key factors affecting the decision making process, and one solution is the value quantification of the solution concept — in other words, describing how much more money the owner will receive with the solution design concept.

When planning a general cargo vessel, traditional European ship owners are believed to possess a fair or good idea about what type of cargo or cargo mix the vessel intends to carry, the operational environment, duration and type of possible charter contract and what qualities or features the vessel should have (Wahlström 2012, 8).

MacGregor's aim is to influence and support ship owners during the decision making process. To achieve this, MacGregor's must develop close relationships with the ship owners and those in charge of the decision making or those who have significant influence on the decision making. MacGregor's acting after the quotation is received from the yard for hatch covers, cranes and deck equipment is too MacGregor's late for MacGregor's. Influence with the owner should preferably be established when the owner is calculating the business case by introducing vessel revenue calculations based on the solution concept. When influence is established before the actual project implementation, MacGregor's can affect, produce and propose different solutions for the owner — i.e., how the owner can achieve maximum revenue from the investment and minimize the maintenance and operational costs. Early engagement and tighter co-operation with the ship owner and design bureaus provide the opportunity to affect and include technical solutions and requirements that benefit both the owner and MacGregor's before the technical specifications are submitted to the shipyard. Shipyards do not benefit from the value adding of the vessel itself unless it can increase its sales. Traditionally, shipyards in Asia divide the project into the smallest parts as possible to decrease their costs. The main benefit for shipyards comes from the minimized scope and interface reduction between equipment providers. The value adding has to be aimed at the owners, who will be using the ship for the next 30 years and can obtain the maximum benefit from a larger investment made during the purchase phase.

It is estimated that only approximately 10% of all ship owners — namely, bigger operators — carry out advanced numeric evaluations, whereas the large majority is believed to rely on their experience and less on statistically advanced approaches in new building and investment decision making processes (Wahlström 2012, 8). MacGregor's needs to influence the owner business case calculations with the solution concept. At the business calculation stage for a container ship, MacGregor's can calculate the revenue increase that a solution concept can bring. The value creation of the solution concept for the general carrier is researched for the thesis by evaluating the value increase of the cargo efficiency rate and flexibility in the specified business case.

The hatch cover, crane and deck equipment product line groups support each other by contributing their strengths, such as know-how, and capitalize on their contacts with existing customers. Various product lines can utilize other product lines for potential customers and introduce joint solutions. A synchronized sales process, which is now introduced at MacGregor's, enables possible profit adjustments. Simultaneous sales of a joint solution may result in cost efficiency when MacGregor's can offer a better price. The creation of unique joint solution design for a single customer adds added value for the customer (Wahlström 2012 8).

MacGregor's purpose for the solution concept is to increase the more lucrative complete sales business compared to the design and supply of key parts. Complete projects increase the total value of the business and ensure improved quality of the overall product, as production and quality control is kept within MacGregor's hands. MacGregor's is also strengthening its overall solution position by offering part of the solution deal: an evaluation of the customer's actual business when the ship is trading is conducted and support is offered to the owner to achieve the intended revenue goals. The purpose of the evaluation and business support is to check how the customer is operating the ship and whether it is fulfilling the technical and business case guidelines that were designed at the contract stage. If the guidelines are not being followed, the question is raised as to how the increase in the revenue can be achieved. The service support is also linked more closely with the new sales to strengthen the overall position of the solution concept. MacGregor's also offers a cargo boost concept for ship owners with old ships, for which the cargo profile will be evaluated and new solution will be introduced and implemented to increase the ship revenue.

For a cost- and quality-conscious ship owner or fleet manager, a solution concept can be demonstrated clearly and effectively with regard to time management and investment efficiency (Wahlström 2012, 8). MacGregor's can demonstrate its full competence by presenting ready-processed and concerted solution concept alternatives, in which all technical interface problems and other related challenges have already been solved. This can be presented at a single meeting with expertise representation from all product lines involved in the business and technical knowledge at hand. Therefore, customers may perceive MacGregor's as a more complete supplier, as MacGregor's has prepared a turnkey delivery where all products are matched with each other and the existing interface problems are solved. The solution concept does not end with the ship delivery; after the ship delivery, the customer care, service and possible cargo boost concepts are taken care of responsibly by the order fulfilment department to ensure that the customer benefits from the vessel. During the meetings with the ship owner, clear and prepared tendering and design argumentation need to be carried out to convince owner of the quantified benefits related to the investment efficiency, operational efficiency and ship flexibility (Wahlström 2012, 9).

3.4 INVESTMENT EFFICIENCY

The ship type solution should be seen as a response to a customer's individual business case, in which the vessel's maximum cargo capacity and earning potential, is ensured by collaboration between the owner and MacGregor's at the pre-project planning phase is ensured (Wahlström 2012, 13).

There are two major investment points concerning the general cargo vessel: the maximum capacity and utilization of the capacity. Vessel earnings are linked to its capacity and the cargo carried. The revenue of the vessel depends on the ship's cargo arrangement, layout and maximization of the cargo capacity utilization. Even more important is the nominal capacity, i.e., how efficiently cargo capacity can be utilized. The availability of the cargo and the transportation route affects to the cargo utilization rate.

The main key performance indicators are payback time, ROI and return on capital employed (ROCE). The maximum investment efficiency is achieved through maximum freight capacity, freight capacity utilization, a higher second-hand value and financing elements (Wahlström 2012, 13).

3.5 BUSINESS CASE MODELLING

The customer's business case is modelled by evaluating their business with regard to bottlenecks, which are sought and identified in the ship's system or the overall logistical chain. The question concerns the total optimization of each piece of equipment offered by MacGregor's and the optimization of this equipment as a single entity. The central issues are the bottleneck identification and the technical restrictions, which can be answered with an overall optimization of the system (Wahlström 2012, 13). The goal of the solution concept is to improve the customer's competitive edge and business case.

The question introduced by Wahlström (2012, 13) is the following: If MacGregor's produces these business cases for the ship owner, is this considered value added for the ship owner? Is value added if MacGregor's offers business review assistance to create business cases on the earnings side? If shipping companies have not compiled business cases (for banks), could MacGregor's be of assistance? The value adding ability of the MacGregor's solution business case is studied in this thesis by the evaluation of the technical solution for different business cases.

3.6 EARNING SCENARIOS AND QUANTITATIVE MEASURES

Earning scenarios are built around the owner's business case. When earning scenarios are built, an evaluation of the changing circumstances and fluctuations of pre-defined aspects need to be included in the scenario. The general carrier scenario consists of many changeable aspects that need to be considered. For example, a general carrier is not designed to haul single-type cargo and it is not competitive in a single trade context like a container vessel, which is only designed to carry containers, not bulk cargo. The general carrier value quantification includes two types of variables: first, the factors that are directly linked to the vessel itself — operation costs, cargo profile, capital costs, etc. — and second, the variables that are not linked to the ship itself but affect the operation and cargo of the vessel, availability of the cargo, port and sea way conditions, management and administration costs. The thesis evaluates only the variables that affect the ship cargo profile and the owner's business case, in addition to the effects that these factors have to the value proposition of the solution concept.

3.7 CARGO PROFILE & SYSTEM FLEXIBILITY

Wahlström (2012, 13) describes the variables of the cargo profile and system flexibility. The general cargo segment of the ship is designed and tailor-made for a particular use and type of shipping operation — whether it is the spot market, where the ship owner is carrying specific cargo between two ports, a long-term ship charter, regular COA or liner market. Ships are designed to be flexible should the purpose of use, cargo or trade areas change over time. Tailor-made designs are common for general cargo vessels. Customers that have 25-year freight contracts and specific profiles exist within the general cargo business segments but are in the minority. If the vessel is designed to operate in several markets, specialist ships are often excluded from markets that could be served by more flexible ships. The cargo and routes may vary over the ship's lifetime; therefore, it is reasonable to design vessel with flexible cargo solutions. The trade-off between the cost and operational performance is the key aspect when a general carrier solution design is utilized. A flexible ship is more expensive to construct and does not outperform ships that are designed for a single purpose for any type of trades; instead, the key is whether that specially designed ship is able to benefit from features such as reduced ballast voyages or revenue increases due to the amount of cargo carried. The individual ship owner's intended business case analysis is vital. The main commodities and properties need to be established and identified as well as the type of operations that the ship will sail in, contract lengths, and conversion options to evaluate the optimal solutions. The first task is to analyse the cargo profile and then estimate the different utilization rate probabilities and how these can be best addressed to increase owners' revenue.

4 SHIPPING COSTS

Shipping unit costs have been gain from the time of the Karvonen and Lappalainen studies, which stated the unit cost of vessel traffic in 2013. The study examined different types of vessels — container ships, dry bulk vessels, tankers, Ro-Ro vessels, passenger and car ferries and conventional dry cargo vessels — with which the thesis is solely focused. The study includes ships that either import to or export from Finland, regardless of the ship's flag.

Fuel costs constitute the largest (49-73%) expense for all ships, followed by capital costs (13-25%); this is listed in table 1. The analysis shows that a 30% rise in fuel costs would increase the total cost for different types of ships by 15-22%. A 30% decrease in capital expenditure would have a 4-8% impact and the cost impact in manning the ships would be 1-3% (Karvonen & Lappalainen 2013, 5).

The operating costs of the ship also depend on the ship's age. For a 5-year-old capsize bulk carrier, capital costs are 47%; maintenance, 2%; voyage costs, 33%; and operating costs, 18%. For a 20-year-old ship of the same size, capital costs are 11%; maintenance, 5%; voyage, 40%; and operating costs, 31%. (Polemis 2012, 18.) The comparison shows the change of costs, from the capital costs for the newer vessels to the operating costs for the old vessels.

Table 1. Conventional dry cargo vessels unit costs (Karvonen & Lappalainen 2013, appendix 1/8, 12).

Ships costs (price level 2013) Conventional dry cargo vessels						
Draught (m)	NT	DWT	Cargo capacity tonnes	Price €	Annuity €/year	Capital costs €/day (F/365)
A	B	C	D	E	F	G
7	3016	8394	7890	24445675	1716663	4703
8	4150	11505	10815	27557351	1935176	5302
9	5464	15107	14200	31158622	2188070	5995
10	6959	19197	18046	35249488	2475345	6782
11	8634	23778	22351	39829948	2797001	7663
12	10490	28848	27117	44900003	3153039	8638
Draught (m)	Manning costs €/day	Repairs + maintanance €/day (2%*E/365)	Insurance €/day (1,25%*D/365)	Over head cost €/day (8%*(G+H+I+J))	Fuel cost €/sea day	Fuel cost €/port day
A	H	I	J	K	L	M
7	2196	1339	837	726	7439	1676
8	2446	1510	944	816	9819	1981
9	2697	1707	1067	917	12528	2327
10	2947	1931	1207	1029	15568	2716
11	3198	2182	1364	1153	18938	3147
12	3448	2460	1538	1287	22637	3620
Draught (m)	Ship operating costs €/sea day (G+H+I+J+K+L)	Ship operating costs €/port day (G+H+I+J+K+M)	Fixed costs €/day (G+H+I+J+K)	Ship operating costs €/t/sea day (N/D)	Ship operating costs €/t/port day (O/D)	
A	N	O	P	Q	R	
7	17240	11478	9801	2,19	1,45	
8	20836	12998	11018	1,93	1,2	
9	24911	14710	12383	1,75	1,04	
10	29465	16613	13897	1,63	0,92	
11	34497	18707	15560	1,54	0,84	
12	40008	20991	17371	1,48	0,77	
Draught (m)	Length (m)	Beam (m)	Engine power (kW)	Speed (kn)	Speed (km/h)	
A	S	T	U	V	W	
7	113,1	16,9	3804	14	25,9	
8	123,2	18,4	5021	14,8	27,4	
9	133,2	20	6407	15,5	28,8	
10	143,2	21,5	7961	16,3	30,3	
11	153,2	23,1	9684	17,1	31,8	
12	163,2	24,7	11576	18	33,3	

4.1 FUEL COSTS

Fuel oil is the single most important item for voyages, accounting for 49% of the total costs (Liikennevirasto 41-2014, 7). Shipping companies cannot control the fuel prices, but they have some level of influence in terms of how much fuel is consumed. The ship machinery fuel consumption depends on the design, type and quality of care with which it is operated. Figure 1 illustrates the daily usage of the Panamax-sized bulk carrier. At a speed of 14 knots, this ship consumes 30 tons of bunker oil and 2 tons of diesel oil a day. Approximately 27% of this energy is lost in cooling the engine, 30% is lost as exhaust emissions, 10% is lost at the propeller, and hull friction accounts for an additional 10% of loss. Only a residual 23% of the energy consumed is actually used to propel the vessel through the waves. (Stopford 2009, 233-234.)

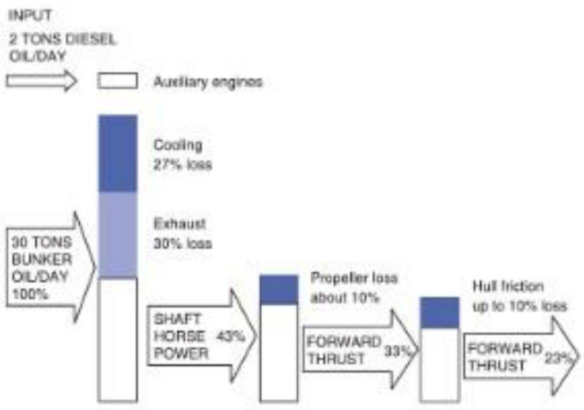


Figure 1. Energy losses in typical 1990s built Panamax bulk carrier (Stopford 2009, 233).

The design of the main engine is the single most important influence on fuel consumption. Fuel consumption can also be reduced by fitting auxiliary equipment in the ship. One method is to utilize the main engine as a driver of the generator when the ship is at sea. This enables the generation of auxiliary power by more efficient main engine rather than a small auxiliary engine that burns the more expensive diesel fuel.

The ship design is optimized for a certain speed. Vessel operation at lower speeds results in fuel savings because of the reduced water resistance. Regardless of the ship's speed, fuel consumption depends on the hull smoothness and design. According to a study carried out by British Maritime Technology, a reduction in hull roughness from 300 micrometres to 50 micrometres can save 13% on fuel costs (Stopford 2009, 235).

The cost of different fuel types fluctuate at any given time. Absolute cost increases are not greater than those seen in the previous average operating costs of cargo ships and Ro-Ro passenger ships (Karvonen & Lappalainen 2013, 8). However, fuel costs approximately doubled between years 2009 and 2011 when monthly fluctuation is not considered. In a 2006 report, the fuel prices were at 152€/ton (IFO 380) and 281€/ton (MDO); in the 2009 report, the fuel prices were 271€/ton (IFO 380) and 474€/ton (MDO) (Karvonen & Lappalainen 2013, 18). Due to the tightening emissions regulations, more fuel types were used in the report (figure 2). Three-year average prices of different fuel types were 459€/ton (IFO 380 HS), 485€/ton (IFO 380 LS), 478€/ton (IFO 180 HS), 504€/ton (IFO 180 LS) and 697 €/ton (MGO) (Karvonen & Lappalainen 2013, 18).

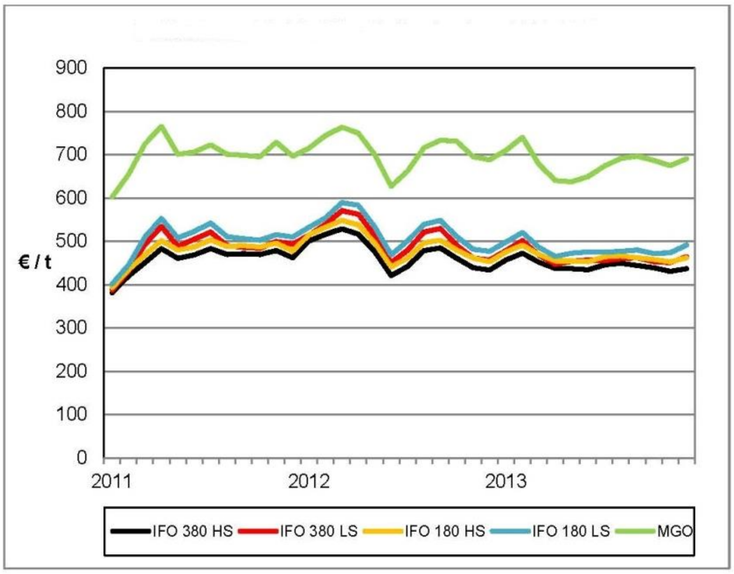


Figure 2. Fuel cost development at Rotterdam 2011-2013 (Karvonen & Lappalainen 2013, 19).

The unit cost of vessel traffic in the 2013 report assumes that the ships were using IFO 380 LS during voyage and MGO at the harbours. The sulphur content of IFO 380 LS is less than 1%; in contrast, the sulphur content of IFO 380 HS can be over 3,5%. At the beginning of 2015, ships that operating in the SECA region, which consists of the Baltic, North Sea and English Channel, allowed a sulphur content of 0,1% if they do not use sulphur washers on board. Due to the regulations, ships are forced to use low-sulphur fuels such as MGO or other equivalent types. Ships can also use LNG, but converting old engines to use natural gas is not economically beneficial. New buildings can be outfitted with either LNG or multi-fuel burning main engines. The usage of LNG is minimal at the moment, so LNG is not considered in the unit cost of vessel traffic calculations.

Ship fuel consumption during the voyage is calculated by the type and draught classes using a formula.

Consumption= [0,00002 [200 g/kWh]*0,8*max engine output [kW] + 5% [lubricants]] *24 [h]

The calculation considers the ship’s main engine with a specific consumption of 200 g/kWh, which is same as calculated by the Finnish water traffic emissions calculation system, MEERI 2012.

The auxiliary engine power output is determined by utilizing procedures given by MEERI 2012 (Karvonen & Lappalainen 2013, 23). Smaller vessels have a greater harbour days fuel cost than larger vessels. The energy is consumed during the harbour days for heating, lighting, etc. Harbour days’ fuel consumption is calculated by using the MGO and calculation formula.

Auxiliary engine max output [kW] = 257,904 [constant] + 0,089 [slope] * main engine max output [kW]

Lubricants costs have fluctuated with fuel prices, and the cost of lubricants has been added directly to the fuel costs in the calculations.

4.2 CREW COSTS

The flag state regulation usually determines the minimum number of crew members on a merchant ship. However, it also depends on commercial factors, such as the degree of automation of mechanical operations, particularly the engine room; catering and cargo handling; the skill of the crew; and the amount of on-board maintenance undertaken. Automation and reliable monitoring systems have played an important part in reducing crew numbers (Stopford 2009, 227).

Ship age has an impact on the number of crew needed for ship operations. Stopford describes the situation with a capsize bulk carrier, but a similar approach can be used for the general carrier. A 5-year-old Capesize bulk carrier has a crew of 21. A 10-year-old ship, in which the maintenance workload is beginning to increase, may require a crew of 24, while a 20-year-old ship may have a crew of 28. Extra crew members are needed to handle the repair and maintenance workload.

The crew cost calculation is based on Finnish foreign trade ships. The calculations have been carried out based on monthly salaries, including benefits by the position on different ship types and draught classes. By using the salary and ship-manned information, the monthly crew cost for each ship type and each draught was obtained by using a formula (Karvonen & Lappalainen 2013, 24-25).

Finnish flagged ships operate under a crew rotation system and is found by using a constant factor of 2,10.

The calculations use a manning factor, which can be found in table 2 for conventional bulk carriers.

Table 2. Modified from Manning factor table (Karvonen & Lappalainen 2013, 26).

Conventional bulk carrier				
Flag country	Number of calls	Flag country quantity	Cost level compared to Finland	Manning factor
Netherlands	2093	37 %	0,85	
Finland	1159	21 %	1	
Antigua and Brabuda	815	14 %	0,5	
Russia	472	8 %	0,5	
Gibraltar	417	7 %	0,5	
Cypros	358	6 %	0,5	
Great-Britain	335	6 %	0,75	
Above together	5649			0,75

Manning cost €/day = crew quantity per position * average net salary on Finnish flags €/day * 2,10 * manning factor.

4.3 OTHER COSTS

Other ship costs, which are included in the ship operating costs, are service and upkeep costs, insurance costs and overall costs.

The upkeep and service includes the routine repair needed to maintain the vessel to the standard required by company policy (it does not include periodic dry docking, which is not generally considered an operating expense) (Stopford 2009, 229).

- Routine maintenance: Includes planned condition monitoring, preventive, corrective and condition-based maintenance actions. The objective is to avoid breakdowns and keep equipment ready for the designed operations (MacGregor 2015b, 4).
- Breakdowns: Mechanical failure may result in extra costs outside of those covered by routine maintenance. This type of work is often carried out by ship repair yards on ‘open order’. “Analysis of maintenance costs

indicates that the repair performed in the reactive mode will average about three times higher than repairs made within a scheduled or preventive mode" (Mobley 2002). Additional costs are incurred by the loss of trading time.

- Spare: Includes inventory of components onboard and spare pat management onshore (MacGregor 2015b, 5).

The rate of service and upkeep costs is kept at 2% of the new building cost per year. A determination of the service and upkeep rate is difficult due to the cost dependence of the ship's age, as costs tend to increase with the ship's age. Service and upkeep costs are calculated with the formula below.

Service and upkeep costs [€/day] = new building cost [€] * 2% / 365 [day]

The rate of insurance costs in the calculation is kept at 1,25% of the new building cost per year. The rate contains only the direct insurance for the ship — for example, full insurance and ship owner liability insurance. Insurance cannot be directly linked with the ship's new building as the ship's size, type and cargo profile have an impact on the insurance and the cost of insurance. The third party insurance required by ship owners falls under four headings: protection and indemnity (P&I) cover, which is generally obtained through a club; collision liability cover, war P&I cover and the provision of certificates of financial responsibility, which is required to trade in the United States (Stopford 2009, 231). Different sources claim that the overall insurance rate for a new building may only be 0,7%, but for ships that are nearly at the end of their service life, the rate could be 10% of the ship's market value. The overall insurance costs have been calculated using the formula below.

Insurance cost [€/day] = new building cost [€] * 1,25% / 365 [day]

Overall costs have been calculated by using a standard practice, so costs cover 8% of capital, insurance, manning, upkeep and service costs.

Costs that are handled by the overall costs are, for example, port charges, tugs, pilotage, canal charges, cargo handling and general costs.

Port-related charges represent a major part of overall costs and include various fees levied against the vessel and/or cargo for the use of the facilities and services provided by the port. Costs fall into two components: port dues and service charges. Port dues are levied on the vessel for the general use of port facilities, including docking and wharf time charges. The actual charges can be determined in four different ways based on the volume of the cargo, the weight of the cargo, the gross registered tonnage of the vessel, or the net registered tonnage of the vessel (Polemis 2012, 24). The service charge includes different services that the vessel uses in port, including pilotage, towage and cargo handling.

Canal dues only affect ships that sail through either the Suez or Panama canals. The Suez Canal toll is based on two units: the Suez Canal net ton and special drawing rights (SDRs). The Panama Canal toll is a flat rate charge per Panama Canal net ton.

Cargo-handling costs can be calculated separately by calculating the sum of the loading costs, discharging costs and an allowance for the cost of any claims that may arise. These costs may be reduced by an investment in modern shipboard cargo-handling gear, which enables quick cargo loading and unloading. (For example, a forest product carrier with open holds and four cranes per hold can achieve faster and more economical cargo handling than an open hatch carrier with gantry cranes. (Stopford 2009, 236.)

The general cost to operate a ship contains the yearly flag state fee and administration costs.

Overall costs [€/day] = $\sum$ v[capital, insurance, manning, service and upkeep costs][€/day] * 8%.

4.4 CAPITAL COSTS

Capital costs are very different in character compared to other costs. Operating and fuel costs are necessities without which the ship cannot operate. Crew and bunker suppliers are usually the first creditors to be paid in a financial crisis; unless these fees are paid, the ship is marooned. Once a ship is built, its capital costs are obligations that have no direct effect on the ship's physical operation. When the ship is built, its capital costs are obligations that do not have a direct effect on the ship's operating costs. These obligations take three forms when only the shipping company's cash flow is concerned. First, there is the initial purchase and the liability to pay the shipyard; second, there are periodic cash payments to the banks or equity investors who gave the capital to purchase the vessel; and third, the cash gain from the sale of the vessel. How these obligations appear in the cash flow is not determined by the ship's trading activities — as fuel costs are, for example. They are the result of financing decisions made by the ship's owner, and there are different ways in which this can be handled. (Stopford 2009, 237-238.)

4.5 OPERATING EXPENSES

Periodic maintenance includes a cash payment to cover the cost of interim dry docking and special surveys. These costs account for approximately 2% of costs, though this depends on the age and condition of the ship (Liikennevirasto 41-2014, 54). To maintain a ship in class for insurance purposes and to determine its seaworthiness, the ship must undergo regular surveys with a dry docking every 2 years and a special survey every 4 years. During the dry docking, special surveys are carried out, which become more extensive as the age of the ship increases. All defects must be mended before a certificate of seaworthiness is issued.

4.6 DEPRECIATION

If equity investors are investing for the long term, they need to estimate how much profit the shipping company is making and the depreciation information of the shipping company's assets. The ships are crucial for estimating the profit-earning potential. The ship endures wear, so its cost must be deducted from the profit at some point. This is usually achieved by using ‘straight-line depreciation’. By analysing Figure 3, the Panamax bulk carrier sale prices are shown, and the relationship between the year of the build and sale price is approximately linear. The regression coefficient is 0.93, indicating a relatively good fit, suggesting that the depreciation curve is linear and that the expected life is approximately 25 years (Stopford 2009, 239).

Figure 3. Market value and age of Panamax bulk carriers (Clarkson Research Studies 1993).

4.7 CASH FLOW AND GEARING

Capital is the cash flow aspect over which the owner has the most control at the outset. Operating and voyage costs can be adjusted marginally, depending on the ship owner’s decisions, but the cash payment linked to the capital can be very high or minimal relative to how the ship is financed (Polemis 2012, 6). The ship purchasing price can be initially paid with cash, either from the owners’ reserves or directly from the cash flow. If this is done, there is a single capital payment and no further cash flow related to the capital until the ship is sold. Owners who follow this approach and purchase the ship with cash have no further cash costs and can survive on a freight rate equal to the operating and voyage costs. If, instead of paying with cash, the ship-owner borrows the full purchase price from a bank, the capital repayments would be added on top of the operating and voyage costs, and this would require higher freight rates to fulfil the daily payments to which the company is committed. In a volatile market such as shipping, this may be a problem because the company would often not be able to meet the payments from the trading income. This is why banks rarely advance the full capital cost of the vessel and demand that the lender pay for some of the purchase price of the ship with equity. The ratio of debt to equity is referred to as gearing; the higher it is, the riskier it is. (Stopford 2009, 240.)

4.8 TAXATION

Due to the international nature of the business, it is possible to avoid taxes by registering the company under one of the many open registry flags — for example, Panama, Liberia, the Bahamas, Malta, etc. — which exempt shipping companies from taxes).

5 THE REVENUE THAT THE SHIP EARNS

The owner of the vessel has three different options to choose from with regard to how the vessel is operated and revenue earned. Each option comes with a variation on how the risk is divided between the ship owner and the charterer and a different apportionment of costs. The risks are shipping market risks, which concerns the availability of cargo and the freight rate paid, and operational risk arising from the ability of the ship to perform the transport task (Stopford 2009, 242).

- Voyage charter. This system is used in the specialist bulk market and in a rather different way from the liner trade. The freight rate is paid per unit of cargo transported. Under this arrangement, the ship owner generally pays all costs — as shown in Table 3 — except possibly cargo handling. The owner is responsible both managing the operation of the ship and the planning and execution of the voyage. An owner carries the operational and shipping market risk. If no cargo is available, if the ship breaks down or if it has to wait for cargo, the owner loses money (Stopford 2009, 242.)
- Time charter. The charterer hire is specified as a fixed daily or monthly payment for the hire of the vessel. Under a time charter contract, the ship owner still carries the operational risk because if the ship breaks down, owner does not get paid. It is the owner’s duty to pay the repair costs, as shown at the Table 3 (Stopford 2009, 242). The charterer takes on the market risk as the charterer is required to pay, regardless of the market conditions.
- Bare boat charter. This is basically a financial arrangement in which the charter hire only covers the financing cost of the ship. The owner finances the ship and receives a charter payment to cover expenses (Stopford 2009, 242.) All operating, voyage and cargo-related costs are covered by the charterer. The charterer carries both the operating and the shipping market risk.

Table 3. Voyage charter, time charter and bare boat cost distribution (Stopford 2009, 182).

1. Voyage Charter Master Instructed by:- Owner	2. Time charter Master Instructed by:- Owner for ship and charterer for cargo	3. Bare boat Master appointed by:- Charterer
Revenue depends on: Quantity of cargo & rate per unit of cargo	Revenue depends on: Hire rate, duration and off-hire time	Revenue depends on: Hire rate & duration
Costs paid by owner:	Costs paid by owner:	Costs paid by owner:
1. Capital costs Capital Brokerage	1. Capital costs Capital Brokerage	1. Capital costs Capital Brokerage
2. Operating costs Wages Provisions Maintenance Repairs Store & supplies Lube oil Water Insurance Overheads	2. Operating costs Wages Provisions Maintenance Repairs Store & supplies Lube oil Water Insurance Overheads	Operating costs: note that under bare boat there are paid by the charterer
3. Port costs Port charges Stevedoring charges Cleaning holds Cargo claims 4. Bunkers, etc. Canal transit dues Bunker fuel	Voyage costs: note that under time charter and bare boat contracts these costs are paid by the charterer	
4. Contract of Affreightment (COA): cost profile same as voyage charter		

5.1 FREIGHT REVENUE AND SHIP PRODUCTIVITY

Revenue calculation basically involves two steps. First, specifying how much cargo the vessel can carry in the financial period is measured in whatever units are appropriate (tons, ton miles, cubic meters, etc.), and second, the price or freight rate that the owner will receive per unit transported. The revenue per deadweight of shipping capacity can be seeing more technically as a product of the ship's productivity measured by ton miles of cargo transported per annum and the freight rate per ton mile divided by the ship's deadweight. (Polemis 2012, 34-36.) The revenue can be calculated by using the formula below, where R is the revenue per dwt per annum, P is the productivity in ton miles of cargo per annum, FR is the freight rate per ton mile of cargo transported, t is the time period and m is the ship type.

$$R_{tm} = \frac{P_{tm} \times FR_{tm}}{DWT_{tm}}$$

The ship's productivity is a useful concept because it measures the overall cargo-carrying performance, measured in terms of ton-miles of cargo transportation provided. A general carrier potentially has much higher productivity than a tanker or bulk carrier because the carrier is more versatile and can carry different types of cargo, if necessary. The productivity analysis can be carried further by subdividing its components by using a formula where S is the average operating speed per hour, LD is the number of loaded days at sea per annum and DWU is deadweight utilization.

$$P_{tm} = 24 \times S_{tm} \times LD_{tm} \times DWU_{tm}$$

The formula states that the ship's productivity is measured by the transported cargo of ton miles in year t, which is determined by the distance that the vessel actually travels in 24 hours, the number of days it spends loaded at sea in a year, and the extent to which it travels with a full deadweight of cargo (Stopford 2009, 242-243).

5.2 OPTIMIZING THE OPERATING SPEED

The operating speed of the ship determines the amount of cargo the vessel can deliver during a fixed period and hence the revenue it earns. In a high freight rate market, the owner earns more revenue when the vessel is at full speed, whereas at low freight rates, a reduced speed may be more economical because lower speed leads to lower fuel consumption and fuel cost savings, which may be greater than the loss of revenue. The financial logic of how the optimal operating speed is defined can be shown with an example in Table 4, which shows the effect of speed on the cash flow of a ship for different fuel prices and freight rates. By slowing down from 14 knots to 11 knots, the amount of fuel used in a year is more than halved from 33.9 tons per day to 16.5 tons per day. The slower speed saves the owner in bunker costs, which depend on the level of fuel prices. There is a direct link between the revenue loss due to less cargo being delivered because of the lower speed. The size of this loss depends on the level of freight rates.

Table 4. Effect of speed on cash flow for high and low freight and bunker costs (Stopford 2009, 244).

Ship speed knots	Fuel consumption tons per day	FUEL COST SAVING by slowing down $/day	FUEL COST SAVING by slowing down $/day	REVENUE LOSS by slowing down $/day	REVENUE LOSS by slowing down $/day
14	33.9	-	-	-	-
13	27.2	2,697	674	1,440	4,320
12	21.4	5,016	1,254	2,880	8,640
11	16.5	6,979	1,745	4,320	12,960
Assumptions: 70,000 ton cargo; 300 days a year at sea; 10,000 mile round voyage					
		bunker assumptions		**freight assumptions**	
		high	low	low	high
		$400/ton	$100/ton	$10/ton	$30/ton

5.3 MAXIMIZING LOADED DAYS AT SEA

A ship's operation time is divided between productive loaded days at sea and unproductive days spent in ballast, in port or off hire. A variation in any of these variables will have an effect on the number of loaded days at sea. LD is determined by using a calculation formula where OH is the number of days off hire per annum, DP the number of days in port per annum and Bal the number of days in ballast per annum (Stopford 2009, 244).

$$LD_{tm} = 365 - OH_{tm} - DP_{tm} - BAL_{tm}$$

Off hire days reflect time spent for repairs, breakdowns, surveys and etc. The off hire figure can be expected to vary due to the freight market and overall vessel conditions.

Port days depend upon the type of the ship, the loading facilities available on shore and on board and the handled cargo type. The more time the ship is required to be at port, the less time it is operating at sea. Homogeneous cargoes such as iron ore and grain can be loaded effectively where good facilities are available. Iron ore loading rates of 6,000 tons per hour are common. Awkward cargo types such as forest products and general cargo loading or unloading may take much longer due to the complexity of the process. Ultimately, a ship handling bagged sugar can spend a month loading and/or discharging, which significantly reduces time spent at sea and the ship's revenue earning capabilities.

The days spent in ballast is the third and most important aspect of loaded days at sea. For tankers and other single cargo ships, the determination is simple as backhauls are not generally available and the ship spends half its sea time in ballast. For combined carriers, general carriers, most bulk carriers, reefers and liners, the calculation is more difficult as these vessels can carry a wide range of different cargo types and are often able to pick up backhaul cargo. The bigger the ship, the more difficult it is to obtain a backhaul because the size of the ship will restrict the possibilities of getting a full backhaul load. The backhaul impact to the owner’s cash flow is shown in Table 5. The calculation is carried out with the assumption of a full backhaul load as the determinations become more difficult if the backhaul load is not full and contains more than one cargo type. (Stopford 2009, 245).

Table 5. The effect of the backhaul on cash flow (Stopford 2009, 245).

	Cargo 000 tons per year	**Freight per ton $**	**Annual revenue $m**	**Annual cost $m**	**Casflow $'000**
Backhaul	308	15	4.62	4.43	19
No back-haul	252	15	3.78	4.28	-500

5.4 DEADWEIGHT UTILIZATION

Deadweight utilization refers to the extent to which the vessel travels with a full payload of cargo. The utilization rate is calculated by dividing the ton mileage of the cargo by the ton mileage of cargo that the vessel could have carried if it had always been at a full payload. The deadweight cargo capacity of a vessel represents the physical maximum that the vessel can carry, and it is a commercial decision as to whether the vessel capacity is fully utilized. The ship owner has the option of choosing the vessel to carry part of the cargo capacity.

A general carrier offers the ship owner the option of obtaining very high deadweight utilization by carrying bulk cargo, project cargo, containers or combinations of all of the above.

6 THE DISTINCTION BETWEEN PROFIT AND CASH

Accountants and investment analysts use profit as a way to determine the financial return of a business. Profit is calculated by taking the total revenue earned by the business during an accounting period (e.g., a year) and deducting the costs that the accounting authorities consider incurred in generating that revenue. The cash flow of a company represents the difference between cash payments and receipts in the accounting period. (Stopford 2009, 237.) To survive shipping recessions, cash is what matters. The reason for the cash flow and profit difference in a particular year is that some costs are not paid in cash at the time when the accountant considers them to have been incurred. The best example in the shipping business is the payment for the ship. When the ship is built or a cash transaction is performed, the ship loses a proportion of its value as it grows older.

Accountants have developed procedures for reporting large capital items in the profit and loss account to give investors an honest look at the business as to whether it is making money (Stopford 2009, 237). If they do so, shipping companies would report a huge loss whenever they bought a new ship. Instead, the cost of the ship is recorded in the company’s balance sheet as a ‘fixed asset’, and each year a percentage of its value is charged as a cost of the profit and loss accounts to reflect the loss of value during the accounting period (Stopford 2009, 237). This charge is known as depreciation and is not a cash charge as the ship was paid in full with cash when it was acquired. This practice is used for bookkeeping purposes so the profit will be lower than the cash flow by that amount.

If a merchant ship depreciates over 20 years on a linear basis, the most common method used is to include one-twentieth of the ship’s original cost in the company’s overhead costs each year for 20 years. Stopford (2009, 238) describes two situation of the deduction. The first example is if the ship was purchased for $10 million cash and depreciated at the rate of $1 million per annum, the position might be as shown in Table 9. In each of the first two years, the company has the same profit of $1 million, which is calculated by deducting costs, including depreciation, from the total revenue earned. However, the cash flow profile is quite different. The operating cash flow at line 3 is $2 million each year because depreciation is not a cash item — it is a bookkeeping entry — so it is not shown in the cash flow calculation. From this, the cash payment for the ship in year 1 is deducted, giving a negative cash flow of $8 million in year 1 and a positive cash flow of $2 million in year 2.

Table 6. Example of profit (loss) account and cash flow for shipping company purchasing vessel for cash (equity) ($ million) (Stopford 2009, 238).

	Profit (loss) account		Cashflow	
	Year 1	Year 2	Year 1	Year 2
1. Freight revenue	10	10	10	10
2. LESS: operating costs	5	5	5	5
3. voyage costs	3	3	3	3
4. depreciation*	1	1	0	0
5. Total operating profit/cash flow	1	1	2	2
6. Less capital expenditure on ship	None*	None	10	0
7. Total profit/cash flow	0	1	-8	2

*Capital expenditure is covered by the depreciation item (see text)

Shipping companies generally do not buy their ship with cash. A particularly important aspect of cash flow is the method used to pay for the ship. In Table 10, the company pays cash on delivery and this shows up as a 'bump' in the cash flow, the following of which there is nothing more to pay for capital. If the ship is purchased with a loan, the cash flow profile changes because it now includes the payment of interest and repayment of the loan. This situation is illustrated in Table 10, showing what happens if the ship is financed with a five-year loan instead of paying cash. Although the company generates a positive operating cash flow of $2 million (line 5) after deducting interest (line 6) and capital repayments (line 8), it has a net cash outflow in both years. If the company has sufficient funds available, this negative cash flow required to meet finance payments may not present a serious problem.

Table 7. Example of profit (loss) account and cash flow for shipping company purchasing vessel on five-year loan ($ million) (Stopford 2009, 238).

	Profit (loss) account		Cashflow	
	Year 1	Year 2	Year 1	Year 2
1. Freight revenue	10	10	10	10
2. LESS: operating costs	5	5	5	5
3. voyage costs	3	3	3	3
4. depreciation*	1	1	0	0
5. Total operating profit/cash flow	1	1	2	2
6. LESS interest at 10%	1	0.8	1	0.8
7. Profit/cash flow after interest	0	0.2	1	1.2
8. LESS capital repayment	None	None	2	2
9. Total profit/cash flow	0	0.2	-1	-0.8

*Capital expenditure is covered by the depreciation item (see text)

7 GENERAL CARGO VESSEL

General cargo vessels (GC) are used where a continuing demand for flexible liner tonnage exists. Ships of this size are typically between 10,000 and 24,000 dwt with three to five holds, each containing a ‘tween deck’ (UNCTAD 2014, 31-32). These vessels are designed to carry a full load of containers as well as general cargo, bulk cargo and heavy lift project cargoes. This is done by designing the lower hold and the ‘tween deck’ with dimensions corresponding with the containers and container cranes that are capable of a 35-40 ton lift. In 2014, there was a fleet of 10,381 general cargo ships with an average size of 18,16 dwt and an average age of 18.7 years. The fleet of general cargo ships remained stagnant between 2013 and 2014, given that far fewer new ships of the type are being built. The size of the new ships being grown from an average size of 9,142 dwt in year 2006 to 18,16 dwt in year 2014, illustrating the need for bigger general cargo vessels which are replacing the older tonnage. (UNCTAD 2014, 31-32.)

In economic terms, general cargo vessels are a compromise between bulk and container vessel to be used in trade routes that are partly containerized. Especially where heavy and awkward cargoes exists that cannot be containerized, their ability to pick up bulk cargo helps increase the deadweight utilization. The drawback of the cargo flexibility is the general cargo ship’s cargo handling. If cell guides are not installed, the container handling is more time-consuming as in the purpose-built container ship. General cargo carriers are able to carry pre-slung cargo, palletized cargo, flats, containers, heavy and awkward cargo and wheeled vehicles.

An example of the general cargo ship is shown at Figure 4, which shows outline drawings for an average-sized general cargo vessel that are aimed more at the heavy lift and project cargo markets; this is a 12,000-dwt vessel that can carry 684 TEU. Two cranes capable of lifting up to 80 tons, and open deck and removable ‘tween decks’ enables the vessel to transport a wide variety of projects and heavy lift cargoes. The vessel described has been designed to fulfil the requirements of the Dutch manning code, as the gross tonnage designed is 8,999, which allows it to be manned by crew of 13. The vessel is designed as a single-deck open-hatch type with long holds, hydraulic-operated folding hatch covers, and a lift-away type ‘tween deck’. The ‘tween deck’ is designed from 15 separate hatch covers that can be lifted out and stowed at the aft end of the no. 2 hold when it is not being utilized. The design of the ship was made to allow the maximum numbers of containers to be transported: 372 TEU on deck and 312 TEU in the holds. Four tiers of containers can be stacked in the hold, two below the ‘tween deck’ and two above, enabling a mixed cargo type to be carried in either the container or unit cargoes, or both, to be carried in the holds when the ‘tween deck’ is in place. Another two to four tiers of containers can be stacked on deck, with the height of the forward tiers reduced to comply with the SOLAS line of sight regulations. (Stopford 2009, 587.)

The ship has two electric hydraulic deck cranes, with both having capabilities of 30-80 tons for heavy lifting and project cargoes. To leave the deck space open, the cranes are located on the starboard side of the vessels. This arrangement allows the ship to have an open deck/hatch area of over 100 meters on which it can carry project cargoes. Capability of ballasting including the correction of heel with anti-heeling tanks equip with a dedicated pump.

The advantage of the arrangement is that the vessel can carry a mix of containers and general cargo in the hold whilst having the option to carry heavy project cargos or containers on deck or mix of all above cargo types depending on the availability of the types. The arrangement offers a high degree of flexibility and good operating efficiency but the building and operating costs of the general cargo vessels per TEU are higher when compared to those of a dedicated container ship. Ships of this sort fill an important role in the shipping market, and because they are more expensive to build than dedicated single cargo type vessels and require careful planning to achieve the best mix of cargo, the business philosophy varies greatly compared to the deep-sea container and commodity trade vessels.

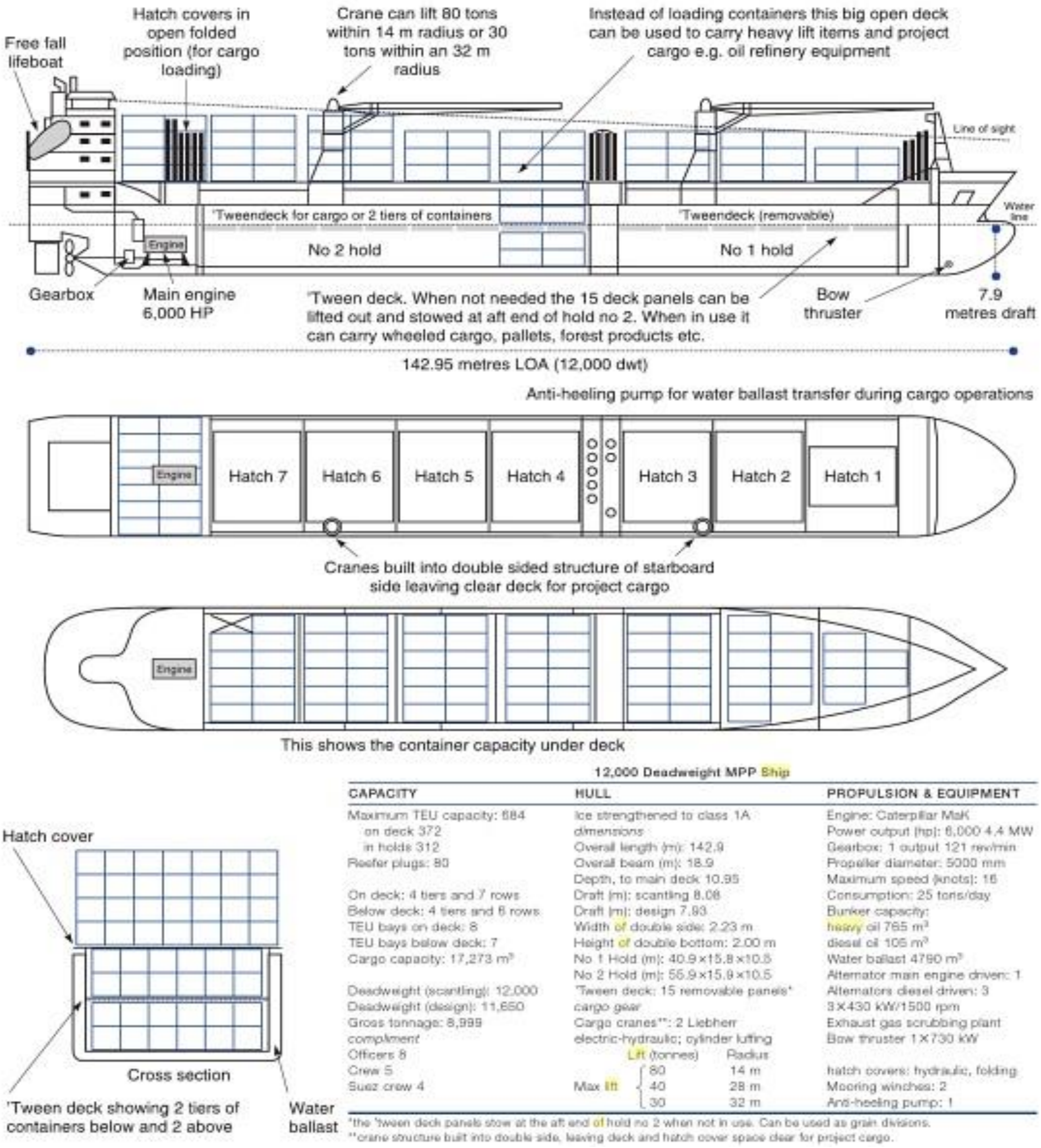


Figure 4. General cargo, heavy lift ship, 12,000 dwt (Stopford 2009, 588).

8 TRANSPORTED CARGO TYPES FOR GENERAL CARRIER VESSELS

General carrier (GC) vessels can transport a wide variety of cargoes that can come in all shapes and sizes. For example, grain and fertilizers are homogeneous while other materials, such as timber or steel products, consist of large regular or irregular units. The same commodity can be transported in many different ways. For example, china clay can be loaded into bags transported loose on a pallet or in a container; because of different packing methods, it can be transported either on a container vessel, bulk carrier or general carrier vessel (Stopford 2009, 572).

General carrier ships carry two types of cargoes, natural cargoes and artificial units; additionally, project cargo is transported for which the overall dimensions, weight and handling differentiates it from the two standard types of cargo mentioned above. Natural cargoes include general cargo, which consists of small parcels of loose items — e.g., boxes, bags, packing cases, drums, a few cars, and machines. Dry bulk cargo consists of cargo that fills a full ship or holds that can be handled in bulk — e.g., iron ore, coal, and grain. Liquid bulk cargo parcel sizes can vary from a few thousand tons to 300,000 tons. General carrier ships carry only liquids that are either purposely built liquid container-sized tanks or are inside containers packed in liquid cells or drums, etc. Unit bulk cargo consists of large quantities of units that must be handled individually — e.g., logs, cut lumber, steel product, bales of wool or wood pulp. Heavy and awkward cargo consists of loads up to 2,500 tons — e.g., project cargo, modular industrial plants, ship sections, windmill sections, locomotives, yachts, and ship loader cranes. Wheeled bulk cargo consists of cars, tractors, trucks, etc., which are transported in large quantities.

Homogeneous bulk cargoes can be loaded and unloaded using grabs or suction as appropriate. General carrier vessels are designed to have one or more holds that can be separated into sections, with the tween deck lifting away hatch covers used as a bulkheads. The unit bulk cargoes and project cargo being handled individually presents special shipping problems in terms of the handling and stowing of the cargo.

Artificial units are used to increase the productiveness of the small unit's transportation as they are handled mechanically, and standard unit size allows seamless movement between rail, road and sea vehicles. The dimensions of the 20' feet and 40' feet standard-type ISO containers are shown in Table 11. The container is the most important artificial unit as it allows mechanized loading and discharging. The uncompromising size, shape and weight of the container box presents unique design problems. Intermediate bulk containers are large bags that are typically 1 cubic meter in volume with capacity of approximately 1 ton of granular material and are designed for efficient mechanical stacking, handling and discharging. Pallets and flats offer a degree of standardization without high capital costs of containers and trailers. Sacks, bales and forest products are usually pre-slung or banded to speed up loading and discharge and slings and bands are left in place during transit. The flat size is normally 15' x 8' and often, a corner post is applied to allow two high stacks.

Table 8. Principal dimensions of flat roof steel container (UNCTAD 1985, 141).

	Dimensions	
	20' × 8' × 8'6''	40' × 8' × 8'6''
Length (metres)	6.1	12.2
Width (metres)	2.44	2.44
Height (metres)	2.6	2.6
Cubic capacity (cubic metres)	32.9	67
Stacking capacity	9 high	9 high
Maximum weight (metric tonnes)	24	30.5

9 CARGO STOWAGE

Cargo spaces need to be optimized to fit the cargo units the ship will be carrying. General cargo vessels optimization is more difficult compared to container vessels and bulk carriers as general cargo vessels are designed to carry containers, bulk cargo and project cargo separately or simultaneously.

Stopford (2009, 575) describes the problem: as the merchant ships are mobile warehouses for which many different forms have evolved as a result of attempts to balance, on the one hand, the need for suitable storage capacity against the need for mobility on the other hand. Thus, a ship constructed as a simple rectangular box of appropriate dimensions could provide an ideal space for storing containers but would be difficult to propel through the water, while an easily driven hull would offer relatively little useable cargo space. Ship design is largely a matter of solving such conflicts to produce vessels that are suited to the services in which they will be employed.

A starting point in determining ship cargo capacity is the stowage factor, the volume of hold space in cubic meters occupied by a ton of cargo. The stowage factor varies enormously from one cargo load to another, as the example in Table 12 shows. Iron ore, the densest cargo material, stows at approximately 0,4 m^3 per ton, whilst wood chips stow at approximately 2,5 m^3 per ton and thus take up six times as much space. Design problems for general cargo ships include the optimization of the cargo capacity. If general cargo vessels were optimized to carry only heavy grain, which stows at approximately 1,3 m^3 per ton if the ship were loaded with iron ore, much of the available internal space would be empty. Light cargoes such as logs, in contrast, need much more space. General cargo vessels with a cubic capacity of 1,3 m^3 per ton could take a full cargo of coal but not a full deadweight of woodchips pulp, which stows at 2,5 m^3 per ton. (Wikipedia 2015.)

Optimizing cargo capacity is also problem when containers are transported. Twenty-foot container typically stow at approximately 1,6-3,0 m^3 per ton, one of the least dense commodities listed in Table 12. To utilize the ship's deadweight, containers are usually stacked on deck but the design deadweight per container slot is a matter of optimization as the cargo weight in the container varies greatly.

Hold dimension is also a key factor. General cargo vessels are able to carry a wide variety of cargo. For example, containers, packed timber or any standard unit are designed to have square 'open' holds that match the external dimensions of the cargo they are designed to carry and offer vertical access to speed up the loading-unloading process (Grubisic et al. 2009, 350).

Table 9. Stowage factors for various commodity trades (Stopford 2009, 576).

	Stowage factor		
Cargo type	**Cu. ft/ton**	**Cu. m./tonne**	**Density index[a]**
Dry cargo			
Iron ore	14	0.40	31
Bauxite	28	0.80	62
Phosphate (rock)	30–34	1.00	77
Soya beans	44	1.20	92
Grain (heavy)	45	1.30	100
Coal	48	1.40	108
Barley	54	1.50	115
Wood pulp (bales)	60	1.70	131
Copra	73	2.10	162
Pre-slung timber	80	2.30	177
China clay (bagged)	80	2.30	177
Paper (rolls)	90	2.50	192
Wood chips	90	2.50	192
Logs	100	2.80	215
Containers, 20 ft	56–105	1.6–3.0	123–230
Containers, 40 ft	85–175	2.4–5.0	185–385
Cars (vehicle carrier)	150	4.2	323
Toys, footwear	300–400	8.5–11.3	230–869
Liquid cargo			0
Molasses	27.0	0.80	62
Heavy fuel oil	32.8	0.93	72
Heavy crude oil	33.7	0.95	73
Diesel oil	37.2	1.06	81
Light crude oil	37.6	1.07	82
Gas oil (light fuel oil)	38.6	1.10	84
Paraffin	40.3	1.14	88
Motor spirit (petrol)	43.2	1.23	95
Aviation spirit	45.1	1.28	98
Naphtha	46.4	1.32	101

[a]Density index based on grain (heavy) = 100. Big numbers take more hold space, whilst small numbers like iron ore take up little.

Source: Various

10 CARGO HANDLING

One of the most important aspects of general cargo vessels is the cargo handling. The efficiency with which cargo can be loaded and unloaded from the ship is a key factor that can reduce the time required at port, which reduces ship operating costs. The efficiency depends on the cargo characteristics and the ship design, and there are many ways to improve the general cargo ship design to increase cargo-handling efficiency.

- Cargo-handling gear: Jib cranes, heavy lift derricks, or other cargo-handling gear such as gantry cranes or other ship base cranes may be fitted to speed up the loading and discharging of the cargo. Heavy lift cranes allow general cargo vessels to handle heavy project cargoes.

- Hatch design: General cargo ships for transporting unit loads such as containers or packaged lumber may be designed with hatch coamings that match the standard package size, thus facilitating the efficient stacking of packages in the hold and on deck. Wide (sometimes called 'open') hatches provide vertical access to all parts of the hold (Grubisic et al. 2009, 350). 'Tween deck' hatch covers can be applied to increase versatility of the general cargo ship, allowing the hold to be separated in sections to allow transportation of different cargo and generally increases the ship flexibility.

- Cell guides: In the case of containers, cell guides guide the container inside the cargo hold, speeding up the loading unloading process. Cell guides enables the containers to be unsecured.

- Cargo access ramps: Ramps can be used to load cargo either with forklift trucks or vehicles that can be driven directly onto the ship with their own wheels. Ramps are accessed through watertight doors in the hull and can be located at the bow, stern or at the side of the vessel.

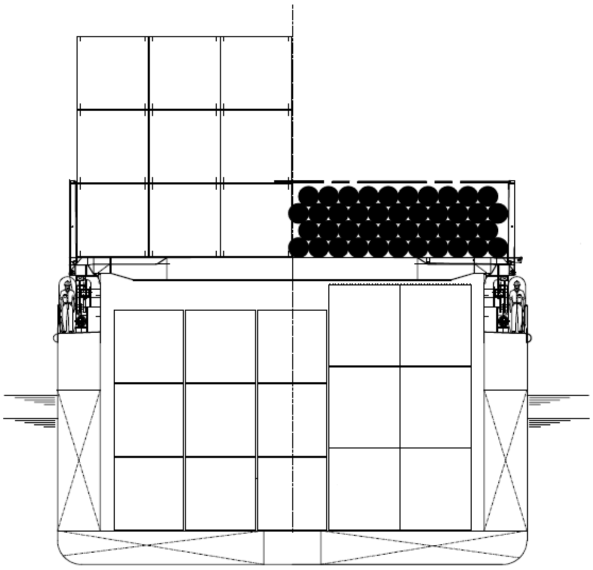
The above points describe some of the ways of how ship cargo efficiency can be increased. Cargo efficiency can also be increased with computer software, which can be used to calculate the most efficient way for cargo to be loaded on board, increasing the ship’s cargo capacity. The software can also be used to determine most lucrative routes for the ship when possible cargoes from ports are known and unchanging costs, such as the ship’s daily operating costs, port fees and piloting fees, are known.

11 BUSINESS CASES

11.1 Specified business case wood products

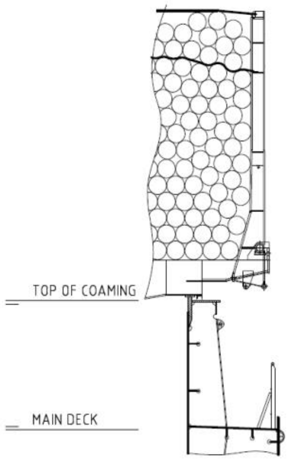
When the owner's business case and ship operation profile is focused on carrying wood products, the value quantification of the MacGregor's products can be identified. The ship in question, according to its operating profile, is carrying different types of wood products — chips, logs of different species and pellets. The ship is a 7,100 Dwat open hatch general carrier with a timber stanchion shown in picture 1.

The open hatch design allows large cargo units to be lowered directly into place. In this case, the holds/hatches can be designed around the different types of wood products being transported. If the shipboard crane were fitted either with a gantry type or conventional type, it would increase the unloading and loading speeds. A conventional bulk carrier with slewing cranes handle forest products at a rate of 250 tons per hour, requiring 4 days to load a 25,000 ton cargo load, whereas an open hatch bulk carrier with 40 ton gantry cranes can load at over 400 tons per hour, cutting the loading time to 2.4 days. This reduction in ship loading-unloading time is mirrored by the increased terminal throughput, which reduces the cost of the overall transport operation and the economics of the operation. (Stopford 2009, 496.)



Picture 1. Open hold/hatch design with timber stanchions (MacGregor 2015a).

Timber stanchions, shown in Picture 1, allows the ship to fully utilize its whole cargo-carrying potential as the cargo profile of the case vessel shows that it was 58 times in 2011, mainly with wood products but also had single cases of asphalt and metal scraps. When ship loads logs, chips or pellets, the utilization rate average is 82%. For single voyages, when wood products are not carried, the utilization rate with asphalt was 88% and was 34% for metal scrap. The asphalt density of a 2,4 ton/m^3 vessel carrying capacity is fully utilized when asphalt is only loaded in the hold.



Picture 2. Timber stanchions (MacGregor 2015a).

11.2 Flexible business case: M/V Päivi

Picture 3. M/V Päivi (H.H. Danship AS, 2015).

The motor vessel Päivi is a multipurpose coaster and is strengthened for heavy cargo. Its main characteristics are listed in table 13. The owner of the vessel is H.H. Danship AS, which focuses especially on timber, paper and pulp cargoes from the Baltic area to a number of European destinations. H.H. Danship AS vessels are also designed to carry project cargo, wind energy-related products, raw minerals, chipboards, fertilizers, steel and grain. The vessels are operated under charter contracts.

Table 10. M/V Päivi; techincal figures (H.H. Danship AS, 2015).

Name	Päivi
Build	2008
Flag	Cyprus
Class	Bureau Veritas AUT-UMS Finish ice class 1A
Dwat	3400 mt
GT / NT	2474 / 1412
Geared	No
Loa & Beam	82,50 m / 12,50 m
Cubic	177.000 cubic feet grain / bale
Hold dimensions	1 hold 55,00m x 10,30m x 8,99m hight last 7 m in front narrowing to 6m
Hatch dimensions	1 hatch: 55,00m x 10,30m
Bulkhead(s)	1 (one) – can be used as tweendeck
Container intake	34 teu – on deck only
Timber intake	4.500 cbm LP
Strenght tanktop / hatch	13 mts / 1.55 mts per square meter strength on tweendeck 1.8 mts per square meter

M/V Päivi was chartered to transport 830 Gefle standard poles. The Gefle standard can be changed to cubic meters by multiplying it by 2.83. At the time, M/V Päivi was at Saint Petersburg and, according to the contract, 530 units were loaded from Puhos and 300 units were loaded from Mustola, and the units were to be unloaded at Boston in the UK (Mönkkönen 2010, 31).

The utilization rate of the M/V Päivi can be calculated by dividing the cargo cubic meters with the total hold capacity. (830 x 2,83) / (55,00 m x 10,30 m x 8,99 m) ≈ 46%. The weight of the poles can be calculated by multiplying the total cubic meter size of the cargo with the density, which is 0,85-1,2 ton / m^3 for debarked coniferous round wood, fresh IMO (2011) (830 x 2,83) x 1,2 ton / m^3 ≈ 2819 ton. The tank top of the Päivi is designed for 13 mts per square meter and the pole weight per square meter is 2819 tons / (55,00 m x 10,30 m) ≈ 5 ton / m^3. According to the calculations, M/V Päivi is not fully loaded and can take cargo in the hold. Additionally, the deck is being not utilized.

M/V Päivi is small enough to operate at Finnish lakes. The freight charge for Lake Saimaa in the 2008 season was 19,4–22,4 €/m3 (Ministry of Economic Development of Karelia 2008). The freight charge for Lake Saimaa cannot be directly used to determine M/V Päivi's revenue from the above case but it gives a rough estimate of the situation. If the M/V Päivi utilization rate were ~80%, it would increase the ship's revenue compared to the earnings with the 46% utilization rate by (55,00 m x 10,30 m x 8,99 m) x (0,8-0,46) x (19,4–22,4 €/m3) ≈ 33592 – 38787 €.

If M/V Päivi were fitted with timber stanchions on deck, it would increase ship flexibility and utilization rates as the timber stanchions would allow the ship to accept round wood as deck cargo.

The wide range of stowage factors presents challenge if the owner's business case and cargo profile are not clear. If the aim is to design the ship to be as flexible as possible, the design must be executed with an average of high- and low-density commodities.

Table 11. Stowage factors by Deakin and Seward 1973 (Stopford 2009, 386).

Cargo type	Stowage factor	
	ft^3 / ton	m^3 / ton
Iron ore	18	0.5
Grain	45-50	1.3-1.4
Coal	50	1.4
Pre-slung timber	80	2.3
China clay (bagged)	80	2.3
Logs	100	2.8
Containers	120	3.4
Cars (vehicle carrier)	150	4.2
Toys, footwear	300-400	8.5-11.3

Due to the charter contract, ship owners cannot easily find suitable cargo that can be carried to fully utilize ships' earning potential, as multiple contracts are not bundled traditionally in the shipping business. A more suitable system would be to digitalize the cargo offering and ship capacity system, which would allow the contract bundle and cargo offers to benefit from the cheaper shipping prices.

12 SOLUTIONS

12.1 Weather tightness

The sources of cargo damage claims due to weather tightness issues on a cargo ship can be divided into five different categories: blocked bilges, leaking manhole covers, leaking hatch covers, leaking lines and leaking ventilators (The Swedish Club 2013, 6). Directly linked to the hatch cover design, the maintenance and working procedures are leaking hatch covers and leaking ventilators, which are located at the hatch covers. The biggest source of the claims, as shown in Figure 5, is the leaking hatch covers at 51% and leaking ventilators at 8% of the total number of claims.

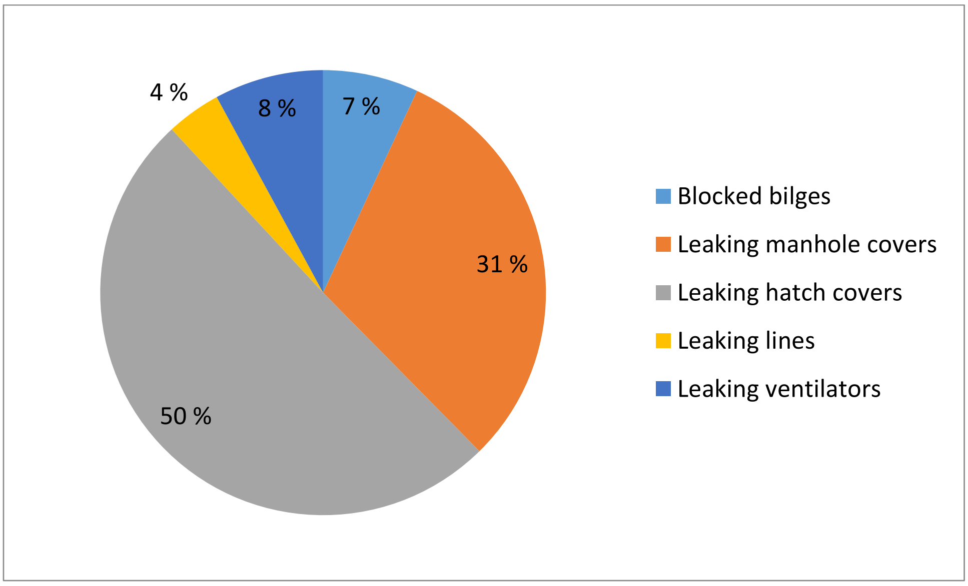


Figure 5. Total number of claims (The Swedish Club 2013, 6).

However, the average cost of the leaking hatch covers is the lowest of the five different categories. The average cost per claim is approximately 30,000€ as shown in Figure 6, and the largest average cost of leaking ventilators is approximately 140,000€. The owner value quantification proposal for the weather tightness issue should be focused to introduce design solutions that could decrease weather tightness claims coming from ventilator hatches as the quantity of the claims is low, but average cost is the highest. Figure 7 shows the cost per average claim of the different transported products, the most costly being steel products and container claims due to the weather damage if general cargo carrier owner business cases are focused on steel product transport — like Langh Shipping, in which the cargo mix is focused on carrying steel products, containers and dry bulk (Wahlström 2012, 16). The value quantification effort should be focused on decreasing cargo claims due to weather tightness. The dry bulk claims are the most frequent and have the highest total cost of all wet damage claims. Steel product claims are the most expensive because of the high value compared to bulk cargo. (The Swedish Club 2013, 7.)

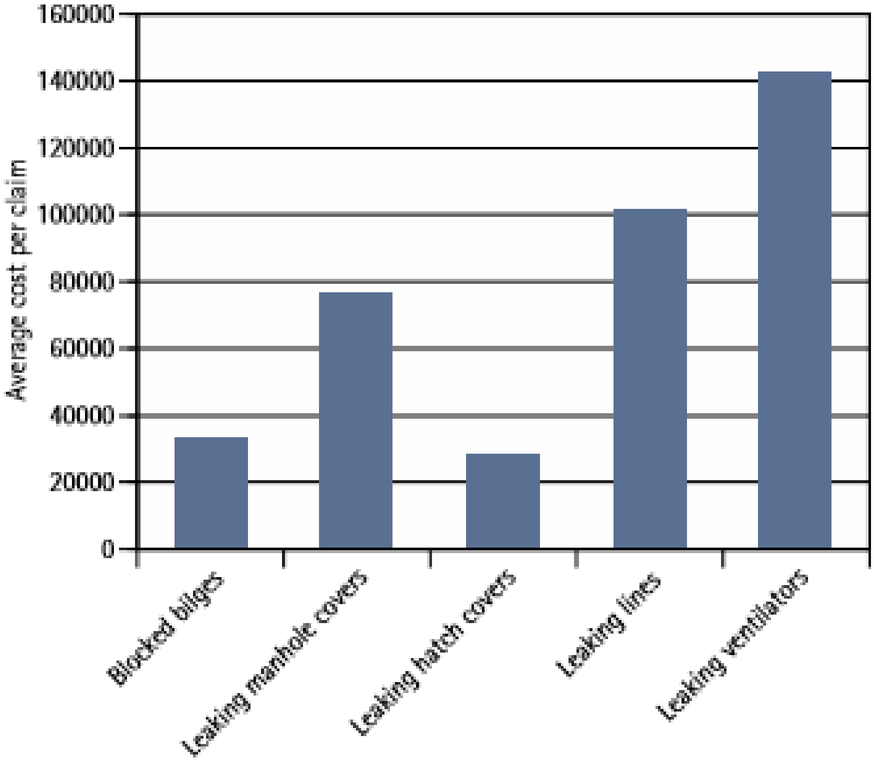


Figure 6. Average per claim cost (The Swedish Club 2013, 7).

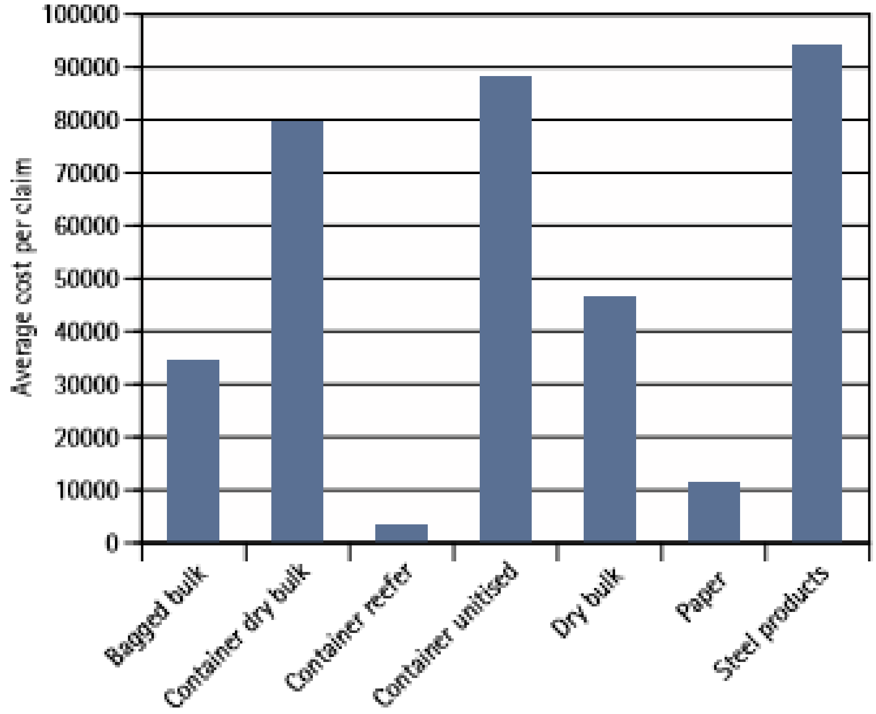


Figure 7. Average per claim cost (The Swedish Club 2013, 7).

MacGregor's offers sealing systems for hatch covers and ventilator hatches, which protect the cargo and guarantee the safety of the vessel by allowing hull and coaming deformations at sea while still maintaining effective sealing. Cargo dryness is ensured by the waterproof weather tight sealing. Any protective gases are also kept inside the hold with weather tight sealing. Bulkhead seals are offered to prevent cargo damage in the general cargo carriers when different products are loaded. The purpose of bulkheads seals is to protect cargo from water damage and contamination. MacGregor's offers standard ventilators for hatch covers, which are equipped with seals to ensure similar performance to the hatch cover sealing. Value quantification, which owner gains from the equipment offered, include the detailed operation manuals and education packages offered to the crew to ensure proper competence in operating and maintaining the equipment. MacGregor's also offers service packages for ship owners to prevent claims and to ensure the proper functioning of MacGregor's equipment. Insurance costs should also be lowered when the vessel is designed and maintained to be weatherproof.

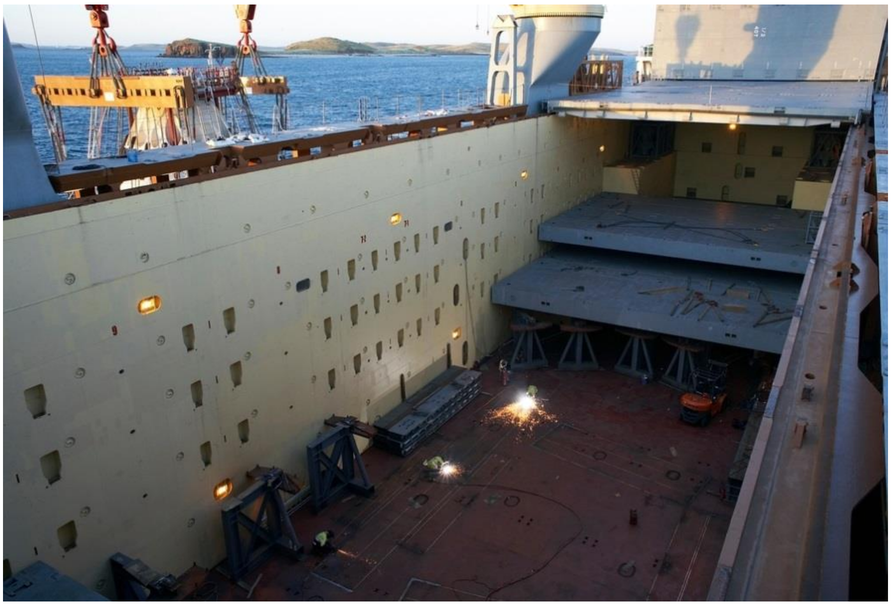
12.2 Weather deck hatch covers and cranes

General cargo carriers are generally equipped with folding-type hatch covers and cranes to enable flexible utilization of the vessel. Folding-type hatch covers and cranes are essential when ships are operating at ports that are not equipped with shore-based cranes to carry out the unloading-loading processes. Heavy lift cranes are designed to handle heavy cargo as project cargo unloading-loading locations may be remote and may not have any cranes, or the shore cranes may not be able to handle heavy and awkward project cargo. Folding-type hatch covers do not need cranes during the operation of the hatch covers compared to lift-away hatch covers, which are usually used in container vessels and in most cases need to be lifted either on shore or stacked on deck. Depending on the owner's business case, folding-type hatch covers can be designed as open-hold or standard types. The open-hold type is more expensive as its needs more structural strength for ship hull but enables unrestricted access to the cargo hold.

To quantify the folding-type weather deck hatch cover for the owner, the main points are the container arrangement and stack weights, project load, reinforcements needed in the hull, lashing arrangement, need for partial/non-sequential opening of covers, need for sliding container foundations, handling of hatch cover panels by the container crane and timber load (MacGregor's 2015). All the mentioned items can be linked to the owner's business case, or if this is not known, the value and cost of a single item can be determined, and the owner can make a decision from there.

12.3 Lift-away tween deck benefits

Lift-away tween deck hatch covers enable the improvement of cargo efficiency for cargo that cannot be stacked. Lift-away tween deck hatch covers can be utilized as bulkheads as well.



Picture 4. Siestas/SAL, Type 176, M/V Anne-Sofie hold (Cargotec mediabank).

The application of lift-away tween deck hatch covers for general cargo vessels enables the vessel to carry a wide range of loads on top of the tween deck panel containers, axle loads, U.D.L. payload and project loads. Tween deck lift-away panels can be used in multiple functions as a grain bulkhead, a ballast when filled with water, a counter weight when lifting heavy loads, lifting beams and working platforms.

China Navigation operates ‘Chief’ class 22,000 DWT Multipurpose Vessels, which holds 2 and 3, are equipped with lift-away tween deck panels that are designed to withstand 6 t/m^2 and TEU or FEU stacks that weigh up to 90t. Vessels that hold 2 and 3 are also designed for 22 t/m^2 load. China Navigation is focused on transporting steel and forest products and machinery equipment (Wahlström 2012, 17-18). A vessel loading scheme could be one in which Dv12 diesel locomotives are loaded on the tank top, for which the axle load is 15,5-17,0 t, the overall mass is 63-69 t and the height is 4,6 m. Without the tween decks, the rest of the hold would be unutilized but with the tween decks, the vessel can simultaneously load, for example, steel products, for which the ocean freight cost from Italy to the Netherlands would be 13,35 $/ton for a 15,000 DWT vessel when fully loaded (Steelonthenet.com 2015). If the cost is directly translated to the China Navigation situation, then the vessels' increased income from the tween decks would be 13.35 \$ x 6 $/m^2$ = 80.1 $\$/m^2$, depending on the area of the tween decks and when the operating costs are not included in the calculation.

12.4 Green values

MacGregor's offers electric cranes for general cargo carriers. Cranes offers improved overall efficiency and lower power consumption, translating to lower costs and ultimately a lower environmental impact (MacGregor's 2015). The environmental impact offered by electric cranes are the lack of hydraulic oil, low noise levels, energy savings, regenerated and consumed power are monitored, control of power consumption/back power, lower energy consumption and less power consumption affecting the generator capacity (MacGregor's 2015).

For a side-rolling bulk carrier, the weather deck hatch cover opening mechanism has traditionally been hydraulically operated but now a fully electric MacRack opening system has been installed. When a similar concept is introduced to the general cargo carrier deck equipment, the result is no hydraulic oil usage, which decreases the possibility of oil spillage on deck. Oil spillage can lead to environmental issues and cargo damage.

Green values value quantification can be introduced to the ship owners by emphasizing the environmentally-friendly features and greener solutions on board. Possible future scenarios are increasing legislation from the EU or at the government level.

12.5 Digitalization

Digitalization provides a new market area for both software providers and equipment manufactures. Digitalization increases the value of MacGregor's's products as it increases the productivity of the ships. It can be utilized with cargo monitoring, optimizing cargo packaging on ships to fully utilize ship potential, equipment operation monitoring, equipment service needs evaluations, digital connection points between cargo providers and carriers, etc. When the cargo can be monitored, then the cargo damage costs can be lowered as the possible damages can be controlled by early warnings from the monitoring system. Energy consumption can be monitored with refrigeration and the cost can be kept minimal when the cargo is kept at the required temperature. Equipment monitoring can decrease the costs associated with error and incorrect or harmful operation of the equipment. Defining of the value of all these possibilities is complex as there are many variables that are effecting and change from ship to ship and operator to operator, given that working methods and cargo profiles vary greatly.

With the digitalization connection point between cargo providers and carriers' needs, an offering could be created in the spot and charter markets. Ultimately, a solution would show the cargo carrier what products are available for transport and the cargo provider could determine the quantity and type of free capacity that exists. Both providers and carriers could see what providers are offering and what price cargo carriers are charging.

A solution needs at least three parties to serve transport providers, ship operators and harbours. The cargo provider's main target group would be bulk cargo providers that cannot utilize liner services; additionally, the container spot market could utilize digitalization for transportation schedules, and the destination and price could compete with the liner services. The ship operator target group would be owners who operate their ship in spot and charter markets. In both markets, the owner could increase the ship utilization rate and operate it more efficiently.

From the harbours, infrastructure information is needed to determine whether the vessel at hand operates and loads or unloads cargoes from the harbour — for example, a modified datasheet from Helsinki harbour is shown in Table 15 (Tiehallinto 2009).

Table 12. Modified Helsinki harbour datasheet (Tiehallinto 2009).

Harbor parts	South harbor, West harbor, Vuosaari harbor and Katajanokka
Main cargo types	Export: General cargo, wood products Import: General cargo, coal
Depth of fairway	Vuosaari; 12,5m West harbor: 11m South harbor: 9,6m
Length of quay	Vuosaari; 2x 750m container quay; 15 pcs RoRo loading place West harbor: 4100 m (including passenger quays) South harbor: 2500m
Cranes	Vuosaari; 4 Panamax-ship to shore cranes, many container cranes West harbor: quays for passenger ships South harbor: quays for passenger ships
Special transportation	To west harbor standard special transportation road network (7x7m)
Lines service connections	Regular liner routes to example Rostock, Bremerhaven, St. Petersburg. Daily departures to Tallinn and Stockholm. Total ab. 150 cargo departures at a week.

12.6 Case MV Päivi

From the transportation tables 15 and 16, the transportation volumes between, for example, the harbours at Helsinki, Finland and Boston, UK can be defined. Boston, UK was the destination of the MV Päivi case from Mustola. From the ship owner’s point of view, digitalization could increase the utilization rate of the vessel at hand as the MV Päivi utilization rate when departing Mustola is less than 50%. The ship owner could offer free slots for cargo providers that could utilize the cheaper transportation opportunity as opposed to hauling the goods via liner routes or chartering the entire vessel. From Helsinki to Boston, the major transportation items that can be carried on the MV Päivi are cut wood, plywood and cement, all of which can be carried either in bulk or bagged and can be carried in the hold or in containers that can be loaded on deck.

Table 13. Cargo carried by ships in export by ports and commodity group 2013 (Statistics from the Finnish Transport Agency 5/2014).

Port	Timber, woodchips	Sawn wood	Wood pulp	Paper, pareboard	Plywood, Veneers	Ores, Concentrates
	tons					
Helsinki	469	293457	50153	755391	88919	22782

Port	Ores, Concentrates	Metals, metal manufactures	Crude oil	Oil products	Coal, coke	Fertilizers
	tons					
Helsinki	22782	246522	-	9	369	687

Port	Chemicals	Cement, Crude minerals, cements	Cereals	General cargo Other merchandise	Other merchandise
	tons				
Helsinki	124662	38805	376	2789372	482590

Table 14. Cargo carried by ships in export between Finland and foreign countries by ports and land of destination 2013 (Statistics from the Finnish Transport Agency 5/2014).

Port	Timber, woodchips	Sawn wood	Wood pulp	Paper, pareboard	Plywood, Veneers	Ores, Concentrates
			tons			
Boston	18016	53703	-	-	6799	-

Port	Ores, Concentrates	Metals, metal manufactures	Crude oil	Oil products	Coal, coke	Fertilizers
			tons			
Boston	-	-	-	-	-	6451

Port	Chemicals	Cement, Crude minerals, cements	Cereals	General cargo Other merchandise	Other merchandise
			tons		
Boston	2002	5378	10429	-	3053

12.7 Service

Customer value quantification as the main focus for the solution concept is seen in the new building service sales with the inclusion of the MacGregor’s Onboard Care (MOC) agreement to the new building contract. There are four different items under MOC agreements, each of which brings different types of value to the customer, the first being the availability of service support to assist the customer in maintaining optimal operations. All contacts between MacGregor’s and the customer are handled by the MOC coordinator, who acts as a single point of contact for customers for technical issues, maintenance planning and budgeting support problems.

The second item is the onboard maintenance, which keeps the customer's equipment in working condition. In the future, digitalization could significantly increase the value offered as sensor could be applied that would constantly monitor the equipment and automatically inform MacGregor's of maintenance needsMacGregor's. MacGregor's could then send a maintenance crew and parts to the ship's next port, where the equipment can be repaired before causing any delays to the ship's operation.

The third item offered is spare parts management, which ensures spare parts availability. Spare part management releases the customer from the need to bond capital for spare parts. In the future, MacGregor's could introduce a completely new solution by introducing, for example, 3D printers on the ships. This would enable the ship's crew to print the necessary spare parts and MacGregor's would only need to ensure that the spare parts documents are available, reducing spare parts delivery logistics and warehousing completely.

The last item is customer training, which provides personnel the knowledge and skills to operate and maintain the equipment efficiently and safely.

Routine maintenance costs are approximately 14% of the operating costs, which covering the routine repairs and maintain the vessel to the standard required by the company (Stopford 2009, 230). With the MOC, MacGregor's can ensure that customer maintenance costs are not increasing but rather decreasing due to the pre-hand maintenance and proper training of the crew.

Every solution that would help the vessel and customer to avoid costly breakdowns is present; in the event of a breakdown, trading would cease and the ship may be moved to the repair yard. When MacGregor's can offer a solution that decreases the possibility of breakdowns and introduce pre-hand maintenance, the value for customers who operate old vessels would be significant, as the maintenance and possible breakdowns factors in old vessels increase significantly.

12.8 Quantification

Wahlström (2012, 16) describes the business case of five different companies: China Navigation (CN), Chipolbrok, Grieg, Langh ship and Mastermind. The trade and cargo profiles are shown in Table 18. All five shipping companies operate general cargo vessels. CN, Chipolbrok and Mastermind operate similar vessels that are similarly equipped with weather deck hatch covers, cranes and tween deck hatch covers. CN, Chipolbrok and Mastermind vessels address the company's cargo profiles, which involve the transport of heavy lift project cargo, containers and break bulk material. The vessels address the different companies' business cases as CN and Chipolbrok focus on long-term contracts and liner service, and Mastermind operates in the spot markets. The Grieg and Langh vessels are unique compared to those of the three other companies. Grieg operates open hatch general cargo carriers that are equipped with gantry cranes, and Langh shipping operates general cargo carriers that are equipped with weather and tween deck hatch covers. A more close evaluation will be carried out for Grieg and Langh to evaluate their business cases and identify the possible value quantification methods of their current cargo profiles and business cases.

Table 15. Trade and cargo profiles of shipping companies (Wahlström 2012, 16).

	China Navigation	Chipolbrok	Grieg	Langh ship	Mastermind
Ownership	British	Chinese-Polish joint venture	Norwegian	Finnish	Cypriotic
Trade	The Pacific basin, world-wide	Europe-Far East/Middle East. Far East/Europe-US Gulf	World-wide	North Europe	World-wide
Contracts	Long-term prior to NB project	Long-term, liner traffic	Long-term regular COA's	Long-term (5 yr initial contract)	Spot market, COA's and long-term charters, no contract to NB project
General Cargo Fleet	Multipurpose	Multipurpose	Open hatch general cargo	Multipurpose	Multipurpose
Cargo mix	Heavy-lift, Project cargo, Break bulk (steel, forestry products) 60% containers, 40% break bulk	Heavy-lift, Project cargo	Industrial shipping, Project cargo, Forestry products 50% containers, dry bulk	Containers, break bulk (steel), dry bulk	Break bulk, dry bulk, container
Detailed cargo mix	Steel, forestry products (package lumber, plywood, timber, paper) machinery cranes, bulldozers	Windmill towers, blades, transformers, generators, subway-, railway- and power plant components	Newsprint, pulp, pipes, wind mills, metals, containers and dry bulk cargoes	Steel industry products, coke, steel scrap	No typical cargomix-varies
Benchmark	Container feeder market	General cargo, containers, dry bulk	Dry bulk	Containers, break bulk (steel), dry bulk	Break bulk, dry bulk, container

12.9 Case Grieg

Grieg is seeking possible new market areas in the forest industry in Brazil, which induces a need for a new building. Grieg is optimizing its new buildings to also accommodate backhaul cargoes. Port limitation affects the loading conditions and other factors such as the Panama Canal. Grieg seeks customers that can offer long-term contracts, but Grieg has a balance between long-term and case-by-case spot market contracts (Wahlström 2012, 18). Approximately 50 percent of Grieg hauled goods are forest products such as rolled paper, pulp and newsprint. On return voyages, Grieg shipping hauls cargoes such as project cargo and steel. Grieg ships operate in British Colombia, where there is a significant amount of rain and where ships supporting the forest industry. Ships are equipped with their own gantry cranes but sometimes need to rely on shore-based cranes to lift long project parcels such as windmill towers or blades that cannot be handled with gantry cranes. For future projects, Grieg aims to equip the ships with two 75-ton cranes that would enable Grieg to operate independently from the shore cranes. Money is saved when shore-based cranes are not necessary for the unloading and loading processes.

Theoretically, the Grieg shipping case could involve the hauling of wood chips from British Colombia to northern Europe and back. The Grieg vessel Star America's deadweight is 30,168 M/T. Its speed with a full load is 15 knots and it is equipped with two gantry cranes and weather deck hatch covers. If the Star America is fully loaded, it can carry approximately 28,358 tons of cargo, and the ship's operating costs per sea day are approximately 40,008€ and operating costs per port day are approximately 20,991€ (Liikennevirasto 41-2014). The distance from British Colombia to northern Europe is 16,500 km, and with the service speed of Star America, it would take 24,7days. The unloading and loading speed with two gantry cranes is 2*2000 ton/h=4000 ton/h (Konecranes 2015), so the entire cargo can be unloaded or loaded using the formula 28,358 ton/4000 ton/h = 7,1 h. The freight revenue of wood chips fluctuated on the spot market from 75 $/ton to 80 $/ton in 2008 but plummeted at the beginning of 2009 to 17-20 $/ton compared to the revenue from the long term contracts of 55

$/ton (Similä 2012, 42). In this way, the Grieg shipping business case of focusing on long term contracts is more reliable when the company seeks a steady cash flow. The utilization rate and revenue of the cargo act as the main items when the viability of the business case is studied. The ship owner can reduce the cost of shipping in some cases by reducing service and maintenance costs, but in long term, these savings will backfire. As seen in Table 19, even with a utilization rate of 100%, the revenue with the lowest freight rate of 16 €/ton is not covering the shipping costs but with the 51,7 €/ton gain from the long term contracts, the ship can be loaded only to 75% of capacity and the owner would still be earning revenue.

Table 16. +/- revenue of wood chips carried from British Colombia to North Europe with Star America at service speed of 15 knots.

Utiliza-tin rate (%)	Cargo (ton)	Revenue (€/ton)			Costs (€)		+/- with freight rates		
		16	51,7	75,2	Sea 24,7 days	Port 2 days	16	51,7	75,2
100	28358	453728	1466109	2132522	988198	41982	-576452	435929	1102342
75	21268,5	340296	1099581	1599391	988198	41982	-689884	69401	569211
50	14179	226864	733054,3	1066261	988198	41982	-803316	-297126	36081
35	9925,3	158805	513138	746383	988198	41982	-871375	-517042	-283797

For backhaul cargo that Star America can transport, the fully loaded containers can carry 1198 TEU. The transportation cost of a single TEU from the UK to Canada is 700 $ and 1100 $ for FEU (Stopford 2009, 519). If the shipping costs are kept the same, i.e., 24,7 sea days at 988,198€ and 2 port days at 41,982€ the revenue gain given a utilization rate of 100% is 700$/TEU*1198 TEU = 838,600 $ When changed to euros with a rate of 0,94 Forex (6.6.2014), the total revenue is 838,600 $*0,94 = 788,284. When the costs are reduced from the income the negative revenue is 788,284 €-988,189 €-41,982 €= -241,887€.

The outcome is that the hauling of wood chips is profitable, but the negative backhaul income will decrease the profits. The problem with the container cost is that the route distance is only 7400 km from the UK to the east coast of Canada. The solution for Grieg Shipping to earn more money would be obtaining backhaul cargo for which the destinations are either on the west coast of the US or in British Colombia. This can be achieved with the digitalization of the cargo provider's needs and the available cargo space offered. Grieg Shipping should also focus on project cargo — for example, forest and earth-moving machinery, which is needed in British Columbia and east coast of the US — as just focusing on the container business is not profitable enough. To increase the ability of carrying project cargo, more suitable cranes should be fitted as the gantry crane lifting capacity is 38,5 MT. Additionally, gantry cranes are not suitable for lifting long awkward cargo pieces, such as the MacGregor's GLH series cranes for which lifting range varies between 100-1000 tons and have a hoisting speed 20-36 m/min. Increasing the hatch cover for weather thickness would also benefit Grieg Shipping to minimize weather-related cargo damages risk due to leaking hatch covers. The Grieg Shipping value quantification would also include tailored educational packages for the crew if Grieg Shipping orders new buildings in which the equipment is different compared to the traditional equipment used on Grieg Shipping vessels.

The Grieg ship Star America represents a more than thirty-year-old design, as it was built in 1985. If the Star America were compared to similar sized modern vessel — such as the CN vessel Shansi, which is 31,000 DWT and is similar in size to Star America — but when other characteristics are compared, the modern design outperforms the Grieg shipping vessel. The CN vessel Shansi can load 2118 TEU compared to Star America, which can load 1198 TEU. Star America is equipped with two SWL 38,5 MT gantry cranes compared to the Shansi, which has four SWL 60ton/50ton and 40ton cranes, which are in a twin mode max. The SWL 120ton enables the CN vessel Shansi to transport project cargo more cost effectively as shore-based cranes are not required. However, the maximum bulk cargo capacity is roughly the same at 28,300 tons. However, the modern design utilizes the space much more efficiently and focuses on maximizing the carrying capacity of containers and project cargo. With the extra 920 TEU, the Star America back haul revenue would be 700$/TEU*2118 TEU=1,482,600$ which is 1,383,644€. When the costs are subtracted from the revenue, 1,383,644€-988,189€-41,982€= 353,473€; with extra container capacity, the Star America back haul cargo revenue would be positive. Star America's option is to focus on carrying a variety of bulk cargoes as it cannot compete with the modern general carriers with regard to container-carrying capacity, but the maximum cargo capacity is roughly the same.

Garratt and Teodoro (2013, 13) studied the impact of increasing the container ship capacity, which is shown at Figure 8, which reflects the utilization rate difficulty as the purpose-built container liners cannot achieve utilization rates greater than 80%. General carriers, however, have one to two aspects in which they can outperform container carriers. One aspect is where the general cargo carrier can fully utilize its container carrying capacity; general cargo carriers can carry fully loaded containers as the stack heights are lower than in container vessels, which usually can carry only empty container at the top of the container stacks. MacGregor'ss, in its solution design for container vessels, aims to fully utilize the ship's capacity so that container ships can carry loaded containers on the uppermost levels of their container stacks. The second aspect of general carriers is that the ships are usually equipped with cranes that enable them to trade at harbours that are not equipped with cranes.

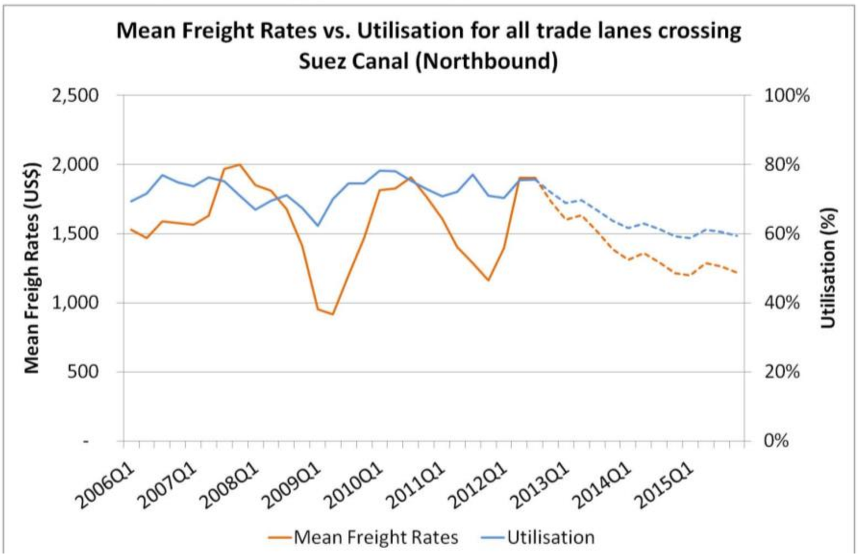
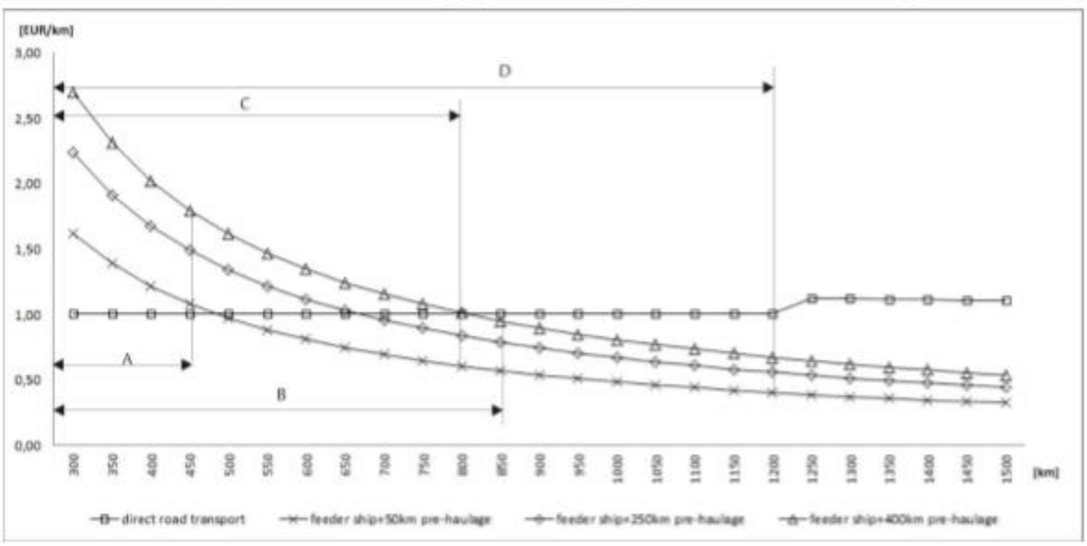


Figure 8. Mean Freight Rates vs. Utilisation for all trede lanes crossing Suez Canal (M. Garratt and A. Teodoro 2013, 13).

12.10 Case Langh ship

Langh ship (LS) needs to have a pre-defined customer and route prior to a new building project (Wahlström 2012, 19). LS specially designs and equips its vessels to meet specific customers' needs and route limitations. LS operates in the Baltic Bay area and transports specific customers' steel products and containers. There has been a need to carry both at the same time. LS ships are equipped with a flat hydraulic tween deck and weather deck hatch covers; additionally, pontoon cradle tween decks are used, which enable steel coils to be transported at the cradles.

The Langh shipping business and cargo profile is similar to the feeder business. The competition with road transportation needs to be considered, as shown in Figure 9 (Kotowska 2014, 25), especially in Central Europe, where distances are short.



Source: Author
A- distance from Hamburg to Szczecin
B- distance from Rotterdam to Szczecin
C- distance from Hamburg to Gdynia
D- distance from Rotterdam to Gdynia

Figure 9 Unit costs in land-sea transport chain (with feeder shipping and road transport) as well as direct road transport [EUR/(40' container*km)] (Kotowska 2014, 25).

The average cargo fulfilment rate of a Finnish flagged general cargo carrier is 48% for port inbound vessels and 33% for outbound vessels (Liikennevirasto 5-2014). Langh Shipping focuses on steel industry products. For containers, the assumption can be made that the Langh ships visit the Tornio port regularly as the Outokumpu steel mill is located there, and the cargo fulfilment rate of the Tornio port for inbound vessels sailing under the Finnish flag is 57% and 75% for outbound vessels.

The Langh shipping ms Linda can carry 907 TEU, and the ship's tank top strength is 18 t/m^2. If the ship is theoretically fully loaded at Tornio with the tank top square area being 1404 m^2 and the tank top fully loaded to the structural strength, it can load 1404*18=25,272 tons of steel coils in the holds, but as it is a 11,487 tdw vessel, it cannot realistically carry that much cargo. The maximum cargo that a ship can carry is approximately 10,815 tons (Liikennevirasto 41-2014). The Coaster Freight Index (2013) describes the total ocean freight for flat steel products transported in the Mediterranean at a 15,000 ton lot as 21-27 $/ton. When changed to euros with a rate of 0,94 Forex (6.6.2014), the total freight cost is calculated in table 20 and is between 213488-274485€ with the 21-27 $/ton freight rate. The total costs for the ship owner is approximately 20836€/sea day and 12998€/port day (Liikennevirasto 41-2014). Theoretically, a voyage from the port of Tornio to the port of Rotterdam is 1687 nm around the Kiel canal. A voyage with the ms Linda at a service speed of 17.7 knots will take 4,1 days. This means that the total sea day costs are 4,1*20836€ = 85428€ and if the ms Linda is loaded and unloaded in one day, the total port day cost is 2*12998€ = 25996€. Langh shipping's theoretical revenue is defined in table 20; with a 100% utilization rate at 21 $/ton the revenue is 102064€ and with 27 $/ton, the price is 163061€ if the utilization rate falls at the port of Tornio with an average of 75%. The revenue is defined in table 20. With the 21-27 $/ton freight rate, the revenue is 48692€ – 94,440€. The utilization rate fall more than halves the revenue, and if the revenue drops to the average utilization rate of all general carriers sailing under the Finnish flag, the revenue does not cover the costs.

Table 17. +/- revenue of steel products carried from Tornio Finland to Rotterdam Holland with MS Linda at service speed of 17.7 knots.

Utilizatin rate (%)	Cargo (ton)	Revenue (€/ton)		Costs (€)		+/- with freight rates	
		19,7	25,4	Sea 4,1 days	Port 2 days	19,7	25,4
100	10815	213488	274485	85428	25996	102064	163061
75	8111.25	160116	205864	85428	25996	48692	94440

If a full container load were transported out, the revenue from each container would be (85428€+25996€)/907 TEU = 123 €/TEU. However, if the fulfilment rate of the ship drops to the average fulfilment rate of Finnish flagged vessels, including inbound and outbound vessels (48%+33%)/2 = 40,5%, the revenue from a single container is (85428€+25996€)/0,405*907 TEU = 303 €/TEU. The risks for not getting sufficient amount of backhaul cargo being bigger as in container business there are much more competitions from dedicated container vessels, Ro-Ro ships, road transport and from rail transport.

There are two ways to promote a solution concept to the ship owner by quantification of the value gain, either from a revenue increase or from lowering the risks. At Langh Shipping, the case revenue increase of the ms Linda could be obtained by increasing the ship flexibility so that a different type of cargo can be carried. The business case of Langh shipping focuses on steel products and the container does not benefit from longer cargo holds and cranes used in the typical general cargo vessels, as it would mean that Langh shipping has to also focus on the specific cargo provider needs for the spot markets and for the project cargoes. Ms Linda can only carry project cargo reasonably well on the deck, but it needs shore-based cranes to unload and load project cargoes, which means that the port must be sufficiently equipped and the costs will be higher. The cell guides at holds that enable faster container loading also affect the bulk cargo transportation, as when the ship is loaded with bulk cargo, unloading the holds is more time consuming due to the cell guides. The main value quantification would be risk management by introducing more weather-tight hatch covers and service packages, which would ensure minimal cargo damage due to the weather, as steel products are sensitive cargo and are easily damaged due to the weather. A timber stanchion could also be either retrofitted or installed in the new buildings to increase the flexibility of the vessels; Finland and Sweden are major forest product producers, and the presence of a timber stanchion would also increase the after-marked price of the vessels as vessels could be used either at the container feeder market or as a general carrier with the option of carrying steel and forest products. Asia is producing cheap steel to the markets, which can be a risk for Langh shipping if the Nordic steel mills are not competitive enough, and their transportation needs could decrease. Langh shipping could seek new markets and market share by preparing for bio energy needs as more and more energy is produced with environmentally sustainable methods, which would mean an increase in the transportation of forest products such as pellets and wood chips.

13 CONCLUSION

The objective of this value quantification research was to introduce solutions and tools that can be used in the sales phase of general cargo vessels. The objective of the research was to study different approaches that would add value for the customer. Different approaches were studied, in addition to how these approaches can be described in detail to the customer by giving hard details regarding the costs and possible incomes that different solutions could bring. Different alternatives and solutions need to be tailor made to fit the customer's specified business case, which relies on the comprehensive knowledge and understanding of customer requirements, the operational aspects of the general cargo vessel, and what the best solution is for these requirements.

The main aspect of the solution concept design is the understanding and response to the customer's individual business case. The solution concept needs to ensure the best possible cargo capacity utilization and earning potential at the earliest possible moment of the customer project planning. The MacGregor's general cargo carrier solution concept is based on the optimization of the vessel cargo capacity for the intended cargo profile and routes throughout the vessel's service life. General cargo carrier solution concept can support the customer in obtaining financing if needed, as there will be estimate of the revenue in terms of what the vessel will bring and support throughout its service life to ensure the revenue level.

The decision making process of ship owners was first studied in addition to the financial items behind the decision making process. The key drivers behind the decision making are the needs of fleet upgrading, new market areas, geographical market shifts and new building prices. Owners generally carry out market research to determine the sustainability of the new building project-based financial and technical limitations. The shipping company establishes the technical and operational limitations of the ship before the contract is made, as well as technical issues such as the size of the vessel, the cargo profile and the operation profile. On the financial side, the investment cost, operational costs and cost of the new building itself are considered and compared to the expected earnings. If earnings and costs are not in balance, the ship owner need to re-evaluate the ship design, equipment type and construction shipyard. MacGregor's need to offer different types of solutions either to increase the revenue or decrease the costs if the owner's new building project is not economically sustainable.

Generally, there are two different approaches that can be followed to answer the customer business case. If the customer business case, operating profiles and financing are specified, then MacGregor's can offer a solution that is tailor-made to the specific case. The solution will have different alternatives to choose from, such as crane type, hold size, hatch cover type, service profile required, digitalization solutions and green values. The second solution to be offered is specified to fit customers for whom the business case, operating profile and financing are not specified or the owner seeks a multipurpose, flexible vessel. Those customers need support, which MacGregor's can offer to help owners obtain the maximum revenue from their business case.

The solution concept design starts from the ship owner's cargo profile. In the first phase, the ship owner has a very specific cargo profile that requires a special design solution to maximize the utilization rate. Other owners may want a truly multipurpose vessel that can be used to transport various products such as heavy lift project cargo and containers. The reason behind wanting a multipurpose vessel is the benefit of flexibility and that they do not have a specific concept of what vessel will carry in the future. A multipurpose and flexible ship increases the possibility of backhaul cargo. The cargo profile guides the design process. The specified concept design can be carried out without alternatives, but MacGregor's's solution concept maintains the monitoring of the vessel during the voyage and ensures the ship owners' revenue. It would benefit both owner and MacGregor's for the vessel design to contain upgrade possibilities; for example, cranes could have ready-designed positions if the owner wanted to add those later. Hatch covers and tank top strength could be increased to carry project cargoes and other heavy cargo. These ready-designed upgrade possibilities would also increase future conversion sales and enables ships to be upgraded to future standards.

When a solution concept is presented and offered to the customer, a close eye must be kept so that MacGregor’s’s expertise is not freely offered to the customers. Hours consumed by the solution design before the contract need to be carefully monitored as MacGregor’s does not have resources to waste. Resources at the beginning of the project need to be directed at customers who work with MacGregor’s and see the value that MacGregor’s can bring to them.

REFERENCES

Coater Freight Index © Coaster Freight Index 2013 [Referred to 22.06.2015]. www.me-freight.com

Cargotec [Referred to 22.06.2015]. https://cargotec.picturepark.com/Site/Mediabank

Garrat, M. and Teodoro, A. (18-19th April 2013) "The Impact of Increasing Container Ship Capacity" Global Liner Shipping conference London, MDS Transmodal.

Dr Polemis, D. (2012) "Costs, Revenue and Cashflow", University of Piraeus.

Grieg Star, A Class [Referred to 22.06.2015]. http://www.griegstar.com/vessels/open-hatch/

Grubisic R., Kucan E., Radelja N., Rimanic R., Vlak R., Sablic D., Maletic M., Grubisa R. & Dragovic M. (2009) "An 18680 dwt Multipurpose/Heavy Lift Cargo Vessel, Part 1", BrodoGradnja.

H.H. Danship AS [Referred to 22.06.2015]. http://www.danship.as/, B

IMO (2011) "Resolution A.1048(27) CODE OF SAFE PRACTICE FOR SHIPS CARRYING TIMBER DECK CARGOES 2011" (2011 TDC CODE).

Karvonen T & Lappalainen A, (2014) "Alusliikenteen yksikkökustannukset 2013" Liikenneviraston Tutkimuksia ja Selvityksiä 41/2014.

Konecranes Lifting business Gantry Cranes
http://wayup.konecranes.com/?gclid=CJXg59jHgscCFesLcwodhREСtg

Kotowska, Z. (2014) "The Competitivenss of Feeder Shipping Compared to Road Trasnport" Maritime University of Szczecin Poland.

LanghShip, MS Linda [Referred to 22.06.2015]. http://www.langhship.fi/laivasto/ms_linda

Liikenneviraston tilastoja (5/2014) "Ulkomaan meriliikennetilasto" Liikennevirasto ISBN 978-952-255-373-7.

MacGregor 2015a [Referred to 22.06.2015] http://www.cargotec.com/en-global/macgregor/Pages/default.aspx

MacGregor 2015b "MacGregor Onboard Care (MOC) Presentation" [Referred to 22.06.2015] http://www.carogtec.com/macgergor

Ministry of Economic Development of Karelia (2008) Official site of the Ministry of Economic Development of the Republic of Karelia.
http://www.gov.karelia.ru/gov/Power/Ministry/Development/index.html

Mobley, R. K. (2002). "An Introduction ot Predictive Maintenance USA" Butterworth-Heinemann.

Mönkkonen, A. (2010) "Laivanselvitys Osana Merikuljetusprosessia" Saimaan ammattikorkeakoulu Tekniikka, Lappeenranta Logistiikan koulutusohjelma.

Similä L. (2012) "Energiahyödykkeiden merikuljetukset" VTT ISBN 978-951-38-7835-1.

Stopford, M. (2009) Maritime Economics 3rd Edition, Routlege

The Swedish Club (2013) “Wet Damage to Cargo” The Swedish Club, Corporate Communications 1310TLR.

Tiehallinto (2009) Satamien tavaraliikenneselvitys 2009.

UNCTAD (2014) “Review of Maritime Transport 2041” UN ISBN 978-92-1-112878-9.

Valentino-Devries J and Singer-Vine J. (2012) “They Know What You’re Shopping For” Wall Street Journal.

Whatis.techtarget.com [Referred to 22.10.2015] http://whatis.techtarget.com/definition/business-case

Wahlström, I. (2012) “GEN-DTS”, Publications From the Centre For Maritime Studies University of Turku

Wikipedia, Free Dictionary: Stowage factor [Referred to 11.11.2015] https://en.wikipedia.org/wiki/Stowage_factor