

PRICING OF MEGA YACHTS

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PRICING OF MEGA YACHTS
MEGA YATLARIN FİYATLANDIRILMASI

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Anahtar Kelimeler (İngilizce)

- 1) Mega Yacht
- 2) Yacht Market
- 3) Pricing Methods
- 4) Hedonic Model
- 5) Regression

Abstract

This study initially focused on defining the term of ‘mega yacht’ with explaining historical development. After necessary definitions, literature search carried out on hedonic pricing and application area. Subjected data of the study consist of 744 observations between the years 2009 – 2012 and 14 independent variables are used on established hedonic model. The model re – established with omitting insignificant variables results were evaluated according to restricted model. Consequently, the most effective variable on mega yacht price is length of the yacht.

Özet

Bu çalışma ilk önce mega yat kavramını tanımlayıp tarihsel gelişimini açıklamaya odaklanmıştır. Gerekli tanımlar sonrasında önce mega yat kavramı üzerinde sonra hedonik fiyatlama ve uygulama alanlarında literatür araştırması yapılmıştır. Çalışmanın söz konusu datası 2009 – 2012 yılları arasındaki 744 gözlemden oluşmuştur ve kurulan hedonik modelde mega yatlarla ait 14 bağımsız değişken kullanılmıştır. model anlamsız değişkenler çıkartılarak bir daha kurulmuştur ve sonuçlar kısıtlanmış modele göre değerlendirilmiştir. Sonuç olarak, mega yat fiyatını en çok etkileyen değişken yatın boyudur.

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1. Introduction

1.1. Mega Yacht Historical Development and Definition

The word of “yacht” originally come from Dutch and defines as a pirate or hunting ship. Simpson and Weiner (2001), also define 'yacht' as a light fast – sailing ship, in early use especially for the conveyance of royal or other important persons. The Encyclopedia Americana (1998) defines that in the broadest sense, a yacht is any boat, vessel, or ship privately owned and used for pleasure, although the term is only occasionally applied to small undecked sail, motor and rowing boats. The Encyclopedia Americana (1998) also clarify that England became acquainted with yacht via Charles II, when he introduced the pastime into England in 1660 while returning from exile in Holland.

England Royal Family has been met by yachts and the closest wealthy people followed them by building similar yachts. They used the yacht to socialize and to be close to royal family. That followed by establishment of yacht clubs and wealthy people could be a member of any yacht club to socialize. At this era, yacht clubs were accepting members up to their yacht tonnage. For instance, requirement of joining a yacht club called 'Royal Yacht Squadron' which still is the most prestigious yacht club, was having a qualification entitling a gentleman to become a member was the ownership of a vessel not under 10 tons. These yacht clubs organizations called 'yacht cups' are key element of the widespread of the yachting sport.

One of the mile stone at yachting history is The America's Cup. Stone (1930) explains that yacht called 'America' was a 101 feet long schooner that built for New York Yacht Club in 1851.

Americas' captain Commodore Stevens decided to attend to Royal Yacht Squadrons open race and left New York on August 22. America's

opponents were seventeen British cutters and schooners in varying tonnages between 47 and 392. Even though there are tonnage differences between the sail yachts, there was no time allowance for size. The first prize was a cup called Hundred Guineas Cup that named considering its cost.

As a result, the Hundred Guineas Cup that arranged by Royal Yacht Squadron was concluded with America's victory and Hundred Guinea Cup was designated as America's Cup in 1857 by the yacht's original owners.

One of the most difficult sailing trophy is America's Cup without doubt. Beyond the sailing trophy, the Hundred Guineas Cup was also symbolizing the unbeatable power of Great Britain on sailing. Robinson (1971) wrote in his legendary book that yachting is an international sport in all over the world because of 'The America's Cup'. With the great victory of America, many people have become interested in yachting and yachting was started to known as a popular and prestigious sport originated from United States of America, England and more European countries. At this era, yachting was known as sailing cups at all over the yacht clubs.

After the industrial revolution, the whole world started to change in many ways and the first steam engines applied to ships. Since the first steam powered ship called Great Western was designed by Isambard Kingdom Brunel in England, steam power took a lead at building steam boats of America in 1850. Afterwards, steam powered propulsion applied to yachts at later 19th century by many wealthy men who wanted to have large decks without sail and masts.

In 19th century, using steam power propulsion and its pleasure factor transformed the yacht concept into pleasure other than just being a racing machine. While narrow decks, long masts and big sails were replacing by the steam engine, hull constructed bigger and was being able to place more luxurious items. For instance, S/Y Savanora includes a fireplace that originally comes from a Portugal chateau.

In the second half of the 19th century, luxurious longing in mega yachts, placed to glorify the palace lifestyle and bear this lifestyle on sea. In 1850's with the joining of the American bourgeoisie into the yachting

adventure, owning a fast, large and luxurious yacht has become a prestige and glory factor for American millionaires. Especially for the Long Island and New York millionaires as much as a luxury for the wealthy, boat speed was an important requirement. Yacht owners, competitors' boats go by, rising to a higher position. The habit of humiliation and abasement was inevitable for poor quality yacht owners. Bill Robinson (1971) said that Edward S. Jaffray in 1883 built the 'Atalanta' his mega-yacht (240 feet) 20 Knot speed. With wide cabins and quality wooden saloon increasing the luxury factor dominated the yacht 'Stanger' in the 95 miles trophy behind 11 minutes and gain a huge prestige.

The second step of the engine technology on yacht starts with invention and implementation of the combustible engines onboard. The Encyclopedia Americana (1998) explain that the first motorboat have been introduced by Gottlieb Daimler, the German inventor of the gasoline – powered internal – combustion engine, ran a motorboat on the Seine River in 1887. Combustible engines have advantages in many ways such as requiring less volume to settle and man power to run as well.

Robinson (1971) gives an example on diesel powered yachts as Vincent Astor launched a new 263 feet length 'Nourmahal' that took the advantage of the diesel technology. This yacht named 'Hussar', subsequently changed name as 'Sea Cloud', 'Patria', 'Angelita' and 'Antarn', constructed with iron hull and diesel powered engine as well.

1.2. Nowadays Mega Yachts

Mega yacht industry has also survived after many crisis for instance transatlantic era and World War I and II. Many mega yacht yards changed and adapted in changing circumstances such as constructing war ships, submarines even aircrafts. During the World War II, Blohm & Voss shipyard has constructed various aircrafts, warships and also submarines for war industry.

Nowadays, mega yacht industry mostly undertaken by exclusively custom and semi – custom yacht builder companies such as Ferretti, Sunseeker, CRN, Pershing, Azimut, Benetti, Palmer & Johnson, Perini Navi and Blohm&Voss. These brands are exercising the latest technology on yachts and offer customer appreciation in their own products.

While mega yachts are constructing at different lengths, hull material and different technologies, must adopt maritime regulations determined by maritime authorities such as SOLAS (Safety of Life At Sea), MARPOL (Maritime Pollution), Load Line Convention. For instance, according to Load Line regulations are applied to new ships of more than 24 meters (79 feet) in length existing ships more than 150 tons. Even Load Line regulation not applied to pleasure yachts, more mega yacht owner prefers to register the yacht to use in trade, chartering as well. According to another major maritime rules enforce is MARPOL restricts all ships to prevent pollution of seas.

From the 17th century until now, “yacht” term actually refers larger tonnage of boats. However, due to yachts have been used by mid-income people a new term is required to refer the luxury yachts. According to the literature, Ryan Schulz (2002) defined mega yachts as a yacht greater than 80 feet in length and set mega yacht criteria.

This thesis contains more than 24 meters yachts as mega yachts because 24 meters is a limit for most of the ships and mostly 24 meters ships and above is regulated by maritime authorities in another category.

1.3. Mega Yacht Market Review

Luxury consumption is much more necessary for contain prestige at all among the people. Between the 17th and 19th centuries, higher income was a prestige factor and this situation has changed with increasing major cities population. Since then, people expressed their prestige with their purchasing power rather than their high income.

After 1960s, developing countries such as Italy and Greece that economies' based on maritime business have started a new era in maritime with developing Arabic countries. Arabic sheiks started getting wealthier with petroleum and this extravagance impacted the mega yacht market. Saudi Arabia's oil minister Sheikh Ahmad Yamani's, launched in mid – sixties, yacht “Adriyah” (258 feet) and “Lady Sarga” (251 feet) launched in Sardinia, Italy have brought back the mega yacht glory of early 20th century. Yamani's yacht “Giant” built in Holland, 1973 was mentioned with two jeep and Mercedes car located in lower deck. While luxury patterns have been expanding, especially Italian brands like Ferretti and Azimut have implemented mass production on new “powerboat” concept.

Table 1. Top – Ten Yacht Building Yards

Yacht Building Yards	Total Order in length (m)	Total Yacht Number	Average Length (m)
Azimut - Benetti	2612	70	37,74
Ferretti Group	1749	50	34,98
Sanlorenzo	1137	33	34,45
Sunseeker	948	29	32,69
Feadship	878	13	67,54
Lurssen	666	6	111
Princess	634	22	28,82
Amels	541	10	54,1
Heesen	492	10	49,2
Horizon	449	15	29,93

Source: www.boatinternational.com.

According to the 2013 order book, top yacht building yard is Azimut

– Benetti with 70 yachts, average 37 meters in length following by Ferretti Group with 50 yachts, average 35 meters. England's best yacht building yard is Sunseeker with 29 yachts, average 32 meters. Approximately according to the 2013 order book of top ten yards, % 46,5 of order belongs to Azimut – Benetti and Ferretti yacht building yards because of the fact that Italian designers experience factor in yacht building.

The mega yacht market is a submarket of luxury market and like other markets; mega yacht market consists of buyers' and sellers'. Mega yachts appeal to more elegance people because of their purchasing power is much higher. Demander of the mega yacht should be much more prefer to imply his prestige with spending habit. Also, there is a close relation between the billionaires and mega yachts sold.

Table 2. Billionaire's Number and Mega Yachts Sold

Year	Billionaires	Percentage (%)	Mega yachts sold	Percentage (%)
2012	1226	1.32	224	-11.76
2011	1210	19.68	236	44.12
2010	1011	27.49	191	87.25

Table 3 shows the billionaire change in percent and mega yacht sold in percent between the years 2010 and 2012, billionaire number and mega yacht sold percentage is linear. The most significant change is in the year 2010. While mega yachts sold percentage is 87, billionaire number change is 27%; however, in year 2012, while billionaire percent is about 1%, mega yacht sold number is decreasing.

Buckley (2012) state that in tax perspective, the 2008 financial crisis in Europe and United States laid more taxes on almost all industries and tried to increase the taxation revenue. As a result of this bottleneck, especially in both year 2011 and 2012, fiscal tightening like VAT (Value

Added Tax) obliged to yachting industry.

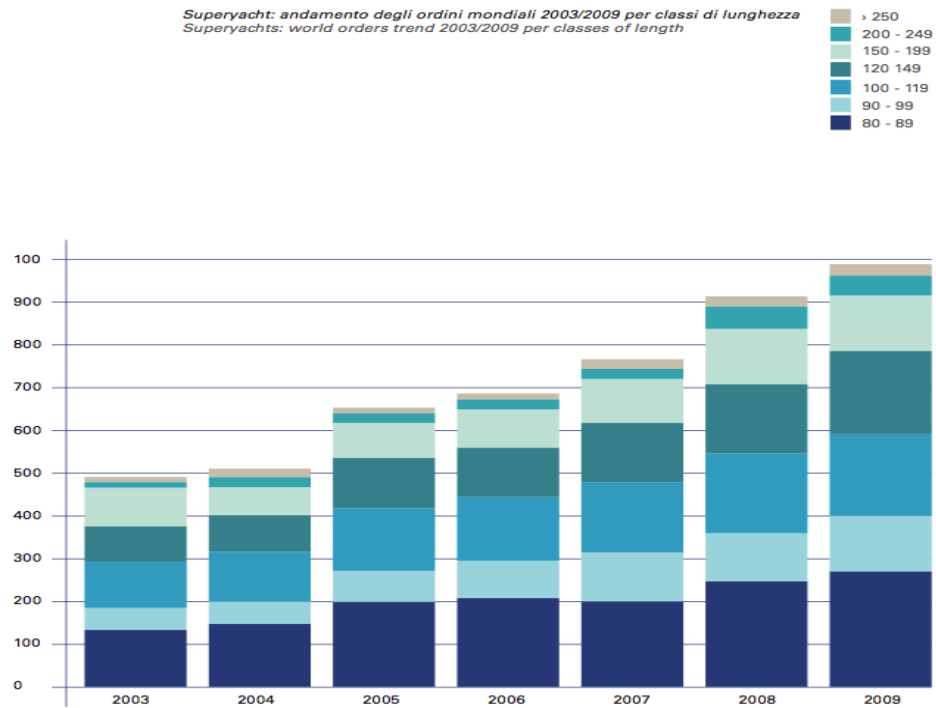
Nowadays, classification is one of the key elements in sale and purchase market due to inevitable expenses of registering and surveying. Registering a yacht is mandatory for all countries and a flag state is the country or a governmental entity under whose laws a vessel is registered. Flag state has authority to enforce international and national regulations over the yacht. Flag state determines inspection, certification, safety and pollution prevention regulations, and liability and tax issues.

1.3.1.1. Mega Yacht Building Industry

Mega yacht building industry drivers are energy prices, interest rates and consumer spending. Mega yacht building market, like other product markets, is based on demand function. The building process starts with a simple decision whether have a own mega yacht or charter and continues with the budget of the clients' yacht project.

The owner's demand sometimes could be very excessive and this factor affects the mega yacht's price directly. For example, a mega yacht called Al Salamah, owned by Saudi Arabian defense minister Prince Sultan bin Abdul Aziz, have an indoor pool with a glass roof. Another example is Oman's sultan of Said al Said's yacht called Al Said. The 300 million dollar worth mega yacht has a concert hall big enough to house a 50 piece orchestra. Except for the fact that mega yacht order is in increasing trend even after the economic crisis.

Figure 1. Superyacht World Order Trend 2003/2009 Per Classes of Length



Source: http://ptpub.ucina.it/files/2011/annoattivita_2011.pdf

Figure 1 shows the mega yacht order trend between the years 2003 and 2009. The total demand has been almost doubled in this period and 200 – 249 feet long yachts is growing constantly. On the other hand on the year 2007, before the financial crisis, 80 – 89 feet long mega yacht order dropped for the first time, however total order book increased.

Table 3. Mega Yacht Order Book 2013

COUNRTY	TOTAL LENGHT (M)	YACHT NUMBER	AVERAGE LENGHT (M)
ITALY	10536	272	38.74
NETHERLANDS	3671	66	55.62
TURKEY	2821	65	43.4
USA	2670	65	41.08
UK	1871	62	30.18
TAIWAN	1255	41	30.61
GERMANY	1235	13	95
CHINA	792	21	37.71
UAE	608	11	55.27
FRANCE	450	11	40.91

Source: www.boatinternational.com.

The 627 24+ meters mega yachts will be delivered in 2013 will be built in 10 different countries. In 2013, most yachts will be built in Italy, 272 yachts with a total length of 10536 meters and an average size of 38.74 meters. The Netherlands will be the world's second largest builder of mega yachts in 2013 with 66 yachts measuring 3671 meters). Although Turkey delivered just one mega yacht less than the Netherlands, is very close to USA as the average length per yacht was 43.4 meters compared to 55.62 meters from The Netherlands. The fourth and fifth places were taken by USA and the United Kingdom.

Özkuşaksız (2007) wrote that Yacht building process usually takes one or two years depends on type of the yacht, length and hull material. The fact is mega yacht production require an extremely long production of a very detailed and lies in the fact that as the size of products that require a

serious labor. In general, yacht building process could be separated in three steps as designing process, construction process and delivery process.

Yacht design process could be explained as following;

- ▲ Determining of the design concept (custom, semi – custom, length etc.)
- ▲ Determining the price
- ▲ Redesign of the yacht if yachts' budget exceed the clients'

Determining the design concept is the initial step and mostly based on customer demands and expectations. The hull concept is almost standard and based on empirical hull forms. Choosing the yachts type is also important. Due to the fact that a motor yacht includes more useable space to live, first choice is mostly motor yacht. For instance, between the years 2009 and 2012, only 85 sail yachts have been sold while 659 motor yachts sold. Any mega yacht weather it propulsion type is sail or motor, could be based on custom or semi – custom design.

1.3.1.1.1.1. Custom Mega Yachts

Custom mega yacht production requires high investment cost and also high design ability to perform effective yachts to clients. The term "custom design" used to apply to yachts designed from scratch for individual yachtsmen. A yacht designer would create a profile to please the yachtsman's eye and an arrangement to satisfy his living requirements at sea. A hull form and scantlings were developed to suit his performance and service requirements.

Custom designed yachts usually include different luxury items other than semi-custom mega yachts. For an instance Nowell and Lenz (2012) wrote that a sailing yacht “Silverlining” designed by Chris Lenz include a bathtub that handcrafted from layer upon layer of wood and with its unique hull able to reach 12.5 knots per hour by sail as well.

1.3.1.1.1.2. Semi – Custom Mega Yachts

Semi – custom yachts are more likely to car production in design process. The project is almost certain and customer mostly changes interior design. There are few advantages of semi – custom yachts such as saving time and money. Also any semi – custom mega yachts hull is much more convenient (custom mega-yacht). Due to any hull form constructs with empiric hull forms, an experienced hull is much safer.

Usually semi – custom mega yachts create a interior layout options such as “Were Dreams”, “Bel Abri” and “Deniki” are all Amels 171 series semi – custom mega yachts and essential accommodation feature is different.

1.3.1.2. Mega Yacht Fleet

Total mega yacht fleet is increasing day by day even after the financial crisis. The underlying reason of this impact is any mega yachts useful life that is almost infinite with a good maintenance. Even now, the building industry tends to durable materials. Current world fleet 41% consist of aluminum – hull build and 26% composite build mega yachts.

By the year 2010, total mega yachts all over the world is approximately 5,750 However, around 365 mega yachts are new built and included in this figure. The percentage change between 2009 and 2010 is divided in three segments. 24 – 40 meter new delivery yachts dropped 18% while 50+ meter mega yacht deliveries increasing 11%. On the other hand, 40 – 50 meter market new deliveries have horizontal growing by 2%.

The mega yachts that ranging 24 to 30 meters are completely semi – custom built yachts and comprise of 44% of the entire fleet. Moreover, by the year 2010, 24 – 30 meter yacht number increases by 170. Owning a motor yacht is more common and 22% of the entire 24 – 30 meters yacht

fleet is consist of sailing yachts.

By the year 2010, 30 – 40 meter length yacht fleet had 102 new built yachts with 97 motor yachts and 5 sail yachts. In another perspective, by 2,047 yachts, 30 – 40 meter length fleet takes 36% of the total fleet. 30 – 40 meter length sailing yacht fleet only grow 4,9%.

40 – 50 meter length fleet had 53 new built in 2010 and reached 685 yachts with increasing only one more unit compared to 2009. 17% of the total 40 – 50 meter length fleet consists of sail yachts and by the year 2010, 10 new built yachts joined to the fleet. Furthermore, sailing yacht percentage increased slightly in 2010 compared to 2009.

50 meter and above length fleet is only 8% of the total mega yacht fleet by 496 yachts; however in 2010, the 50 meter and above fleet percent reached to 10% by 40 new built mega yachts. By 2010, the world's largest yacht 'Eclipse' delivered to his Russian owner and there are two more 100 meters above length yachts delivered as well. Thus, 10% of the top 100 list of mega yachts changed. Moreover, this top 100 mega yachts were mainly built at German, Netherland and United States shipyards.

Owning a mega yacht is an increasing trend in last 10 years and approximately 57% of the world mega yacht fleet built in this period. Approximately 40% of the mega yacht fleet is new built in last 5 years and it is forecasting that by the year 2010, there are 5750 mega yachts exist all over the world. Between the years 2006 and 2010 average figure of new delivery is 458 yachts for each year. In 2008, before the financial crisis, mega yacht delivery peaked with approximately 510 deliveries.

1.4. Mega Yacht Appraisal Methods and Appraisal Process

Mega yacht appraisal is conducting by professional appraisers in three different approaches. Appraiser firstly considers the market valuation approach to have a reference price on subjected mega yacht. In other words,

appraiser estimate the price of the mega yacht by doing a comparison with mega yachts sold in the market and appraiser make some adjustments for differences such as hull/machinery condition and equipment that affect the price of the subjected mega yacht.

The second approach is income approach that could be obtained from charter market. Usually mega yachts are not subjected to income producing, however, some enterprises are using mega yachts in charter market.

The third approach is cost approach that includes the replacement cost of the mega yacht including all equipment onboard. Cost approach is calculated with depreciation rate determined by appraiser's own experience. This method provides an effective reference to actual value of the mega yacht, however; the method is sensitive because it depends on appraiser's experience on depreciation rate.

These three approaches should support each other and appraiser should determine the mega yacht price much close to market valuation approach because comparable mega yachts have been sold and available for sale in the current yacht market. As a result, a valuation report issues and an extended valuation report consist of about 14 chapters.

Professional valuation report should remark the valuation type and it is useful to remark the other valuation results to customer and yacht owner. Furthermore, it should be remarked the date, place and weather condition of the inspected day. The appraiser should be certified by recognized appraiser society and conduct the valuation approaches independently. Moreover, the report should start with the scope of the inspection and define the limitations that occurred during the valuation process.

A proper valuation report's second chapter includes an extended yacht particular that includes brief information about owner, official number, valid certificates, built date, designer, dimension, displacement, registration number, engine qualification, fuel/water capacities and comments.

The third chapter gives extended information about design and construction of the mega yacht such as design and designer, propulsion power, hull, interior structure, decks, hull to deck joint and comments. The visual inspection of deck could be proved with additional photographs.

The fourth chapter is about hull, keel and steering gear status. It is useful that the valuation should be conducted while the mega yachts are under docking. Because appraiser could see hull condition and seachests, the result would be more accurate. If docking is not applicable, an underwater survey could be carried out by under appraiser's supervision.

The fifth chapter locates the interior specifications and extra luxury items as well. For instance, a mega yacht "Rising Sun" which appraised 200 million dollars include a living space with 8000 feet onyx countertops and a movie theater as well.

The sixth chapter locates the machinery installations with several diagrams. The main and auxiliary engine make, model, output, hours of operation is given with engine serial number. It is also useful to remark the last overhauled date and place.

The seventh chapter is reserved for safety and firefighting equipment because a mega yacht should comply with the rules and regulations.

In conclusion, the report should include a market analysis and necessary comparisons as well. The estimated price should be given in respect to fair market value and not affected by undue stimulus.

2. Literature Review

Literature review of this thesis have been carried out in two steps as first step, searching data of mega yacht concept and the second stage searching data of the most suitable pricing method. As a result of the first stage of the literature search, there are no any study have been carried out on pricing of the yachts. Even the term of “mega yacht” is newly being used by yachting industry, press and magazines firstly used at Ryan Schulz's (2002) article related to marina's capacity and present station in Ft. Lauderdale. He defined the “mega yacht” as a yacht greater than 80 feet and mentioned the master plan about financial assistance, tax benefits, zoning priority for marine-dependent uses, and environmental strategies.

Another literature search have been carried out on mega yachts' visual identities, luxury and leisure concepts and the thesis' mega yacht definition is simply based on Ryan Schulz's mega yacht definition. The study find out that development of the luxury items on ship started at XX. Century, after the II World War. Especially mega yachts were born by aristocrats and bourgeoisies as luxury and expensive toys with sail mega yachts. Especially growing number of sailing yachts were dominated by mega – motor yachts after the invention of the steam engine. Göksel (2003) said that beside the speed of the mega yacht, dimension and luxury items have become in front until today and competition between the yacht owners on luxury attributes peaked.

Even the word of “mega yacht” used frequently; there is no exact definition at reference books. Some frequently used web sites on yachting industry are using mega yacht or super yacht definition for the yachts over 24 meters, however, some websites or magazines are using super yacht definition for yachts over 50 meters.

The second stage of the literature review have been carried out by looking up of the valuation of the different assets such as real estate, tickets, automobiles, etc. For any valuation to have validity it must produce an accurate estimate of the market price of the property. The model should

therefore reflect the market culture and conditions at the time of the valuation. It should be remembered that the model should be a representation of the underlying fundamentals of the market. Valuation methods can be grouped as in Table 4.

Table 4. Valuation Methods

Valuation Methods	
A) Traditional Valuation Methods	B) Advanced Valuation Methods
• Comparable Method	• Artificial Neural Networks (ANNs)
• Investment/ Income method	• Hedonic Pricing Methods
• Profit Method	• Spatial Analysis Methods
• Development/ Residual Method	• Fuzzy Logic
• Contractor's/ Cost Method	• Autoregressive Integrated Moving Average
• Multiple Regression Method	
• Stepwise Regression Method	

Source: Pagourtzi et al., 2003.

The main difference between the traditional and advanced valuation methods is while tradition method is giving a generative impact on value, advanced valuation method make redistributive and financial transfer impact on value possible. Moreover, while multiple and stepwise regression model is under traditional valuation method, hedonic pricing method is under advanced valuation. This separation is necessary because hedonic pricing method makes estimation on coefficient easier with considering expected signs of coefficients.

2.1. Hedonic Model Literature Review

According to the article of Babin and Darden (1994), there are two distinct forms on consumer value from the shopping experience as hedonic

and utilitarian. Hedonic pricing is based on quality attributes of any goods and according to Cowling and Cubbin (1972) as a term; ‘hedonic’ was firstly used in adjusting price indices for quality.

Kaul (2007), in his article, wrote that hedonic value or ‘hedonism’ referred to the esthetical and practice-based subjective perspective of depletion and meant regarding daily products as wealth symbols. The combination of the experimental view and hedonic approach, compose a totalitarian approach to process of consumption and better problem-solving information processing view of consumption.

2.1.1. Hedonic Model Literature for Real Estate Market

Fixler et. al. (1999) said that hedonic models estimated values for intimate attributes related to each other to form a real estate or service. In other words, real estate, cars, yachts even electronic devices have different characteristics that make the pricing function difficult.

Hedonic pricing method frequently used of pricing real estate. The first implication of hedonic pricing theory on real estate market carried out by Ridker and Henning (1967) by assessing the air pollution effect on real estate prices with 167 observations in linear regression model. Moreover, the investment effects were studied by hedonic price regression model by Dewees (1976). He studied the relationship between residential property values and a subway investment in Toronto, Canada. The study is a before and after study in 1961 and 1971. Hedonic price regression model in the study was used to separate the effect of structural and location effects from transportation investment effects. The time series data consisted of 2000 residential property sales between 1961 and 1971. The functional form of the model is as follows:

$$P_i = \alpha_i X_i + \beta_i Y_i S + \gamma_i Z_i S + \delta_i T_i + \varepsilon_i$$

Where T indicates transportation variables, S represents size variable and ϵ is the error term of the regression. Independent variables of the model classified as structural, neighborhood characteristic and transportation area access. This hedonic regression based model independent variables are floor space, number of rooms and garage, parking space, age, house type, percentage non English speaking population, pollution and traffic level and dependent variables is price.

Furthermore, Yankaya (2004) in his master thesis wrote that travel time to the CBD (Central Business District) gave more correct measuring than distance to the CBD. After that, in the mode, travel time savings as value per year were estimated. The savings reflected to price of a house. In the study, two models with different data were estimated. Second model data set consisted of transportation variables. There are related to “door to door” access costs in major streets in Toronto before and after construction. Cross – sectional data was used in the model. The study found in the slope of the rent surface with distance from the subway stations. The result indicated that \$2370 premium per hour of travel time saved for sites within 20 minutes travel time. Thus, the study suggested land values for areas near transit increases more than further away.

Another overall study carried out by Blackley, Follain and Lee (1986) with 55 independent variables including dummies on 34 different residential areas. The study created a price index between the years 1975 and 1978 to compare the price difference on sale or rent prices. The confidential interval of the average house or rent price is 87% in respect to the index. The 34 residential area indexes have full capacity of explaining the rent and sale price. The model is created on linear form.

Different models like box – cox, trans – log and logarithmic linear forms have been used to set hedonic pricing. Powe, Garrod, Brunsdon and Willis (1997) set a linear box – cox form by using 872 mortgages accepted real estate. The independent variables are under 5 topics are, woodland variables (distance to the nearest woodland, distance to the new forest park, location within 500m of woodland, location within the new forest park and

woodland index) , other amenity/disamenity characteristics of property (distance to the sea, location within 500m of the sea, location within 200m of a river, distance to the nearest large urban area, location within a large urban area, location within 500m of an oil refinery, location with 100m of a railway line, location within 100m of a road or a motorway), structural characteristics of the property (floor area, number of bathrooms, number of bedrooms, detached, semi, terraced, garage, full central heating, age), 1991 census enumeration district – level socio – economic variables (proportion of children, proportion of families with no car, cars per person, proportion of professionals, proportion of unskilled, proportion of retired, rate of male unemployment and rate of unemployment), other variables (1990 purchase, 1991 purchase and distance to nearest a road or motorway). A search across the parameters of the linear Box-Cox functional form was undertaken to find the best fitting specification for this model. This was achieved by taking the natural log of both the dependent variable and the forest index while leaving the remainder of variables untransformed. The study implies that the amenity benefits of planting woodland close to urban areas where there is currently low access to woodland are likely to be very large. This suggests that higher levels of payment may be worthwhile if they encourage more farmers to put land into the scheme.

Another impressive study carried out by Leishman (2001) with 1155 new built real estate sale observation in linear functional form. The analysis provides indications that builders have some success in differentiating, or 'branding', their output. This is evident in statistically significant differences in the transacted prices of housing sold by different builders in the case study and in the case results of Chow test for parameter equality across sub samples.

The study also implied the limitations if the analysis as the data used to estimate the hedonic regression models, while fairly rich in terms of physical characteristics information, included no direct indicators of quality (quality of finish, quality of construction materials and so on). Thus, it is likely that the house builder dummy variables that were found to be

significant in the regression analyses simply reflect unmeasured quality differences between the housing constructed by different house building firms.

The most observation used study carried out by Li, Prud'Homme and Yu (2006), using 33595 second hand resale real estate. The model set by 28 independent variables including 18 dummy variables. As a result, the Chow test results indicate that structural changes between adjacent years are mild though statistically significant. The pooled regression for the semi-log model, however, results in a price index that closely matched those from separate regressions on the annual base. In fact the hedonic price indexes are insensitive to structural changes over the years and to the differences in the Laspeyres and Paasche types' formulation. The Box-Cox analysis rejects the linear, semi log, and log-linear functional forms. It also suggests that the problem of heteroskedasticity can be mitigated by choosing the more correct functional form.

2.1.2. Hedonic Model Literature For Automobile Market

Early studies on automobile market started with Grilliches (1961) and indicate that quality of automobile factors were measured by advertised brake horsepower, shipping weight in thousand pounds, overall length, V8 engine, hardtop, automatic transmission, steering, brakes and designated as coin-pact. As a result of the study, hedonic price index was created compared to consumer price index and it is obvious that real automobile prices fell rather than rose during the years 1954 – 1960.

With parallel to this study, Hogarty (1975) used 992 American produced cars in hedonic model to explain price – quality relation. The study simply based 7 assumptions as; comfort, durability, economy, maneuverability, performance, safety and style and these attributions were used as dummy variables. Even the models suffer from multicollinearity; findings tend to support earlier researches.

Atkinson and Halvorsen (1990) used hedonic regression technique to

evaluate the consumer's life value. In another words, they measured the willingness of consumer's payment on safety matters. As a result, the study give statistical output of life value based on marginal willingness of payment on safety and the value of the life is \$ 3.4 million.

Another recent study has been carried out by Bhomwick (2001) on American and Japan model cars. The model based on trunk capacity, motor specification and other quality dependent. The result indicates 30% of American car and 44% of Japan car price change could be explain by quality change.

2.1.3. Hedonic Model Literature for Other Markets

First hedonic based approach has been come up with agriculture on price and quality study because the hedonic model is easily applied on wine pricing with the quality. The first study of hedonic approach of wine carried out by Marc Nerlove (1993). In the study, he use a body of data for Sweden to estimate Swedish consumers' preferences for different attributes of wine, arguing that variety prices are determined by world supply and demand considerations and may be treated exogenously to the Swedish consumers of wine. The model based on 235 observations and 21 dependent variables with Box – Cox transformation.

Another study on agriculture carried out by Schollenberg (2010) with hedonic model on quality/ value of coffee in Sweden. The study aims to investigate the impact of the Fair Trade label on the market for coffee in Sweden. Unlike the other studies, this model use only 12 dummies and no dependent variables. As a result, a considerable premium of 38% to be paid for Fair Trade labeled coffee in Sweden.

Furthermore, developing technologies make possible new implementations of hedonic models. The study of Changes in Computer Performance by Knight (1966) pioneered performance evolution on computers and continued with study of Chow (1967) by evaluating technological change and demand for computers. A remarkable quality

adjusted price index for personal computer is created by Berndt and Rappaport (1995). The study use new surviving models in the estimation of hedonic price equations, a variety of quality – adjusted price index with varying interpretations. Although there are some differences, the study find that on average these qualities – adjusted price indexes decline about 30% per year, with a particularly large price drop occurring in 1992.

In conclusion, as latest technology products, PDAs (Personal Digital Assistants) are evaluated in hedonic regression model by Chwelos et. al. (2004) with 11 dependent variables and 35 dummy variables in log – linear form. Quality-adjusted prices derived by hedonic regression fell at an average annual rate of approximately 21% per year over the period of 1999 – 2004.

3. Methodology

Hedonic pricing theory is practically based on attributes of goods that makes possible of high area of application. This study is subjected to hedonic pricing model because mega yachts are mostly designed and constructed up to first owners' demand. The attributes such as installation of jacuzzi or pool is depend on clients' budged and hedonic approach.

Murray and Sarantis (1999) wrote that the hedonic approach hypothesize that hedonic market exist for each good quality (Q_1) and each of these hedonic markets clears to generate an equilibrium price for that quality. That's why each quality of goods will command price for that marginal value of that quality to customers.

Consequently in this equation, the price of a new yacht (P_i), where I represents the i th good owned in a given period, can be thought of as the sum of expenditure on the attributes contained within that good. Expenditure on the j th attribute is the product of the quantity of that quality ($Q_{i,j}$) and the marginal value or hedonic price of that attribute (α). Therefore, the price of the good is given by the equation;

$$P_i = \alpha + \alpha_1 Q_1 + \alpha_2 Q_2 + \dots + \alpha_j Q_j$$

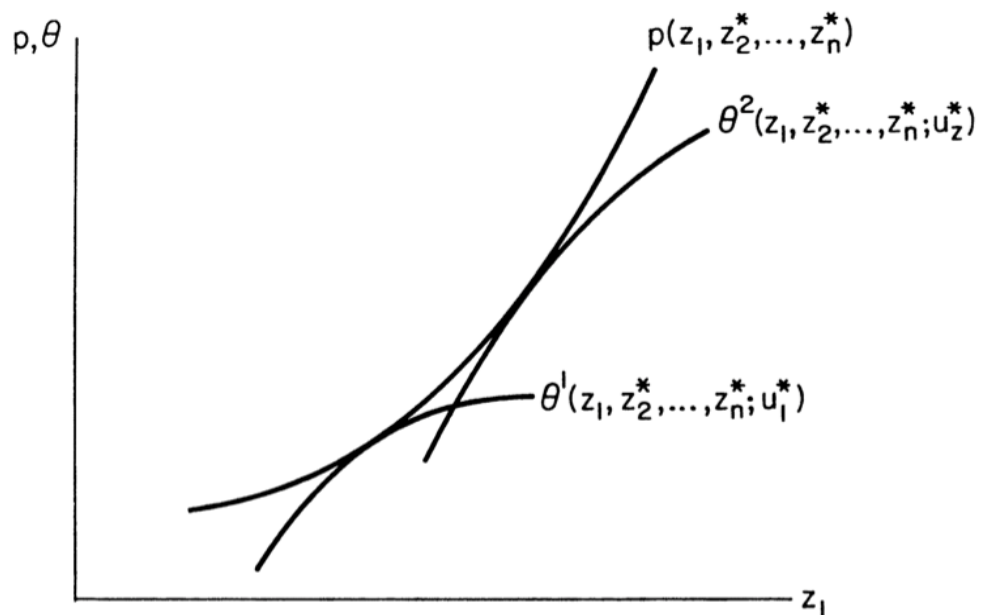
The equation is essentially a hedonic price equation. Even though the price of goods and the quantity of each quality attribute can be observed, the marginal value of each characteristic cannot be directly observed but regression analysis and cross – section data can be used to estimate the marginal prices. Usually price of the service or good is used as dependent variable on model and each attribute would consider as independent variable to produce unique estimates of the hedonic price of the characteristics

One of the mile stone at development of the hedonic pricing model is Rosen's paper that has shaped the way economist's thought about the hedonic pricing of heterogeneous characteristics of attributes. The paper simply emphasizes on price determination rather than utility of the attributes

and provided a base of non-linear hedonic pricing models.

Rosen simply create an equilibrium that a producer and consumer are perfectly pair off when their demand and offer functions overlap, with common curvature at that point given by the curvature of the market clearing hedonic price function $p(z)$. Due to the consumption decision depends on utility; firstly suppose that consumers purchase only one unit of a brand with a particular value of Z . The utility function could be assumed as $U(x, z_1, z_2, \dots, z_n)$ where x is all other goods consumed. Set the price of x equal to unity and measure income, y , in terms of units of x : $y = x + p(z)$. The expenditure a consumer is willing to pay for alternative values (z_1, \dots, z_n) at a given utility index and income is represented by $\theta(z; u, y)$.

Figure 2. Demand Function of Consumer



Source: Rosen, 1974.

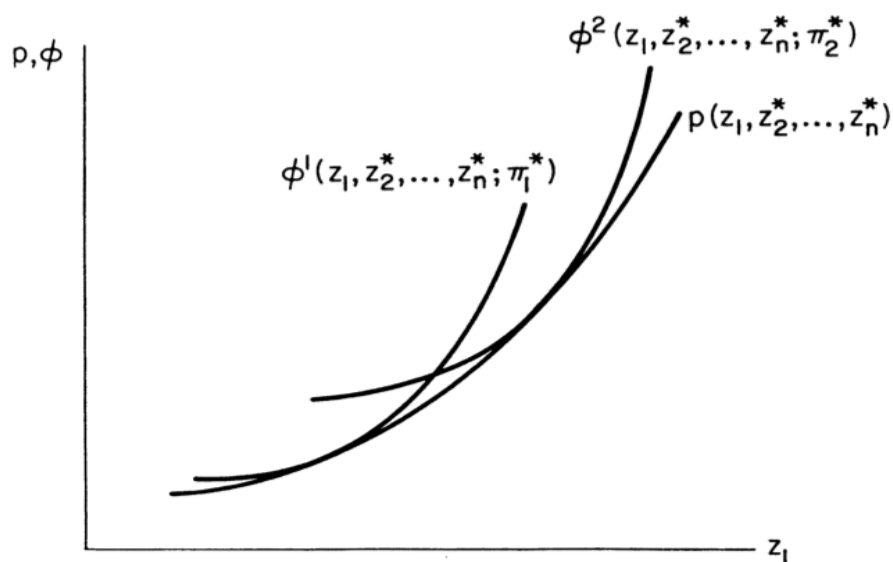
Figure 2 indicates the bid curves for two individuals. The amount the consumer is willing to pay for z at a fixed utility index and income is $\theta(z; u, y)$, while $p(z)$ is the minimum price he must pay in the market.

In respect to producers' objective, there should be production decision. Rosen denoted $M(z)$ as number of units produced by a firm of designs offering specification z . Total costs in an establishment are $C(M, z;$

β), derived from minimizing factor costs subject to a joint production function constraint relating M , z , and factors of production. The shift parameter β reflects factor prices and production function parameters.

With respect to following equation $\pi = Mp(z) - C(M, z_1, \dots, z_n)$, unit revenue on design z is given by the hedonic price function for attributes and each producer tries to maximize the profit by choosing M and z optimally. Comparably with the evaluation of demand function, $\phi(z_1, \dots, z_n; \pi, \beta)$ defines an offer function. This offer function indicates the optimal unit price that the firm is willing to produce on several models at fixed profit when each model is optimally selected.

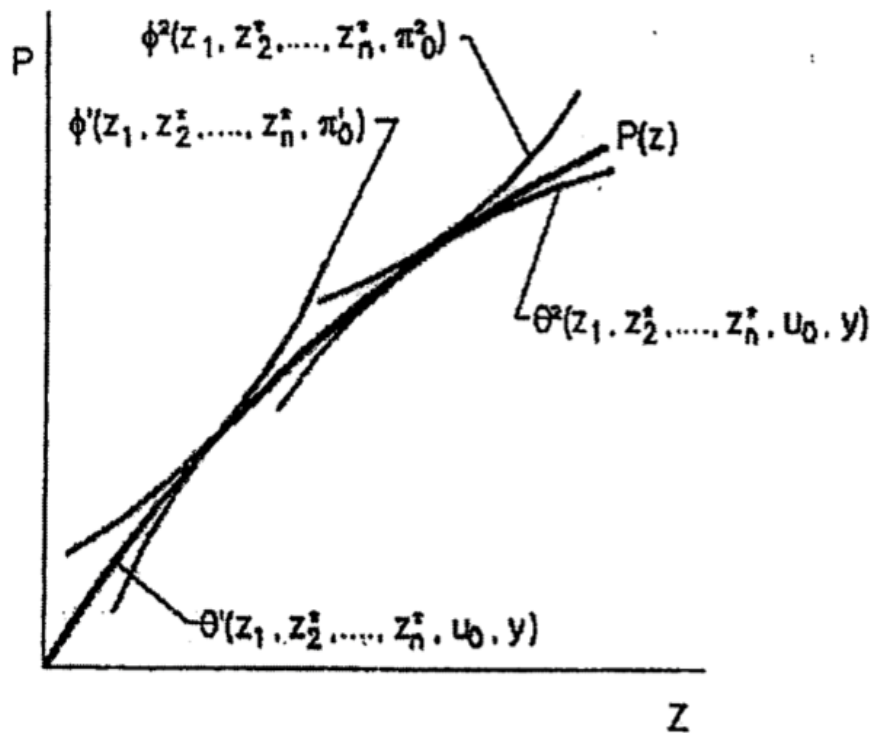
Figure 3. Offer Function of Producers



Source: Rosen, 1971.

The both curves labeled as ϕ^1 and ϕ^2 are indicating the offering unit possessing production and cost conditions. However the differences of the curves are indicating that ϕ^2 has comparative advantage at producing higher value of z_1 .

Figure 4. Hedonic Equilibrium



Source: Alkay, 2002.

Figure 4 shows the equilibrium of hedonic function and it consists of overlapping of demand function of consumer and offer function of producer. It could be infer from the graph, hedonic price occurs when consumption function and production function intersects. Market equilibrium is the key point in hedonic pricing because without market equilibrium, marginal willingness to pay function for individuals could not be estimated conveniently.

Rosen's model has been criticizing for years in many ways. For instance according to Bartik (1987), on demand side, the most accepted thought is that an individual consumer's decision cannot affect suppliers in the hedonic model because an individual consumer does not affect the hedonic price function. According to another approach that Bajari et. al. (2011) developed is that the economist is unlikely to directly observe all product characteristics that are relevant to consumers, and these omitted variables may lead to biased estimates of the implicit prices of the observed

attributes. Even though all criticizes, today Rosen's model is the most frequently used hedonic model approach.

Multiple regression analysis based hedonic approach simply based on five assumptions that shows coefficient estimates are valid.

1. $E(\varepsilon_i) = 0$
2. $\text{Var}(\varepsilon) = \sigma^2 < \infty$
3. $\text{Cov}(\varepsilon_i, \varepsilon_j) = 0$
4. $\text{Cov}(\varepsilon_i, x_i) = 0$
5. $\varepsilon \sim N(0, \sigma^2)$

The first assumption means average values of errors are zero. In fact, if a constant term is included in the regression equation, this assumption will never be violated. This study includes “c” as constant term that provides the assumption valid.

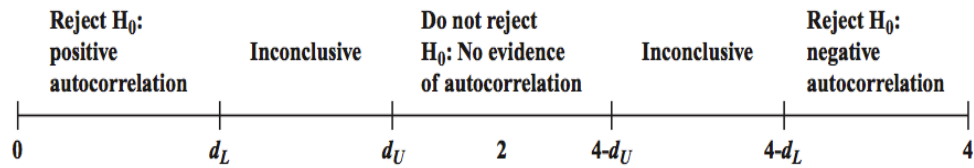
The second assumption means variance of the errors is constant and σ^2 is known as assumption of homoskedasticity. The situation of means variance of the errors is variable called heteroskedasticity. Detection of heteroskedasticity is carried out by White's test. There is also an alternative approach to detect heteroskedasticity, known as LM (Lagrange Multiplier) method which centers on the value of R^2 for the auxiliary regression. The Lagrange Multiplier test carried out by simple following formula:

$$TR^2 \sim X^2(m)$$

Where T is number of observations and m is the number of regressors in auxiliary regression. If TR^2 value is greater than the table value, reject the null hypothesis of no heteroskedasticity.

The third assumption known as the errors is statistically independent of one another. Unless the errors are uncorrelated, they are auto correlated and could be tested in several methods. This study includes DW (Durbin – Watson) test that only indicate if there is a relationship between an error and its immediately previous value.

Figure 5. Durbin – Watson Statistic



Source: Brooks, 2008.

The validity of autocorrelation on model depends on if Durbin – Watson value on model is between table value of d_U and $4 - d_U$. Moreover, the Durbin – Watson test is valid only regression model include a constant term.

The fourth assumption of $Cov(\varepsilon_i, x_i) = 0$ means that there is no correlation between the error and corresponding independent variables. Brooks (2008) wrote that, since $E(u) = 0$, this expression will be zero and therefore the estimator is still neutral, even if the regressors are stochastic.

The fifth assumption requires distribution of the disturbances normally, called normality assumption. Brooks (2008) wrote that the detection of normally distribution of the disturbances is possible with Bera – Jarque test that uses the property of a normally distributed random variable that the entire distribution is characterized by the first two moments as the mean and the variance. The standardized third and fourth moments of a distribution are known as its skewness and kurtosis. Skewness measures the extent to which a distribution is not symmetric about its mean value and kurtosis measures how fat the tails of the distribution are. A normal distribution is not skewed and is defined to have a coefficient of kurtosis of 3.

Literature search indicates that most of the models suffer from multicollinearity. Brooks (2008) indicate that as a result of multicollinearity, regression becomes very sensitive to small changes in the specification, so

that adding or removing an explanatory variable leads to wide changes in the coefficient values or significances of the other variables and multicollinearity will thus make confidence intervals for the parameters very wide, and significance tests might therefore give inappropriate conclusions, and so make it difficult to draw sharp inferences.

Another limitation occurs due to data set. Almost all yacht sales were collected in subjected years, however, there are few exemptions such as, some yachts omitted due to the fact that its length over all is about 23.95 and some yachts does not include price.

There are some transformations on hedonic model that provide the assumptions. Selection of these transformations and creating the correlation table is the essential step of hedonic pricing. Regression based hedonic pricing model have several functional forms as linear, semi – log, double – log, inverse semi log, quadratic and Box – Cox transformation forms. Selection of the best form highly depends on data set and the stability of the model.

Table 4. Functional Forms and Elasticity Analysis

	Functional Form	Marginal Effect	Elasticity
Linear Form	$Y = \beta_1 + \beta_2 X$	β_2	$\beta_2 (1/X)$
Linear Log Form	$Y = \beta_1 + \beta_2 \ln X$	$\beta_2 (1/X)$	$\beta_2 (1/Y)$
Log Linear Form	$\ln Y = \beta_1 + \beta_2 X$	$\beta_2 (Y)$	$\beta_2 (X)$
Log – Log Form	$\ln Y = \beta_1 + \beta_2 \ln X$	$\beta_2 (Y/X)$	β_2

Source: Gujarati, 1995.

Table 4. shows calculation of marginal effect and elasticity for each model. This study is subjected to log – log model because other methods give unexpected results because of the yacht prices are highly distributed.

3.1. The Data

The data set consist of actual mega yacht sales between the years 2009 – 2012. While actual total sale between these years is 834, due to missing information, the data set decreased to 744. The name, price and length data of mega yachts have been downloaded from ‘www.boatinternational.com’ and for each characteristic attributes were examined via various web sites. The data includes information about 6 independent variables as length, age, number of guest, top speed, deck number and 8 dummy variables as hull type, refit, boat garage, teak deck, helipad, flybridge, pool/jacuzzi and custom build. The data collected in order of necessary explanatory definitions and importance of the data.

Depended variable of the model is actual sale price of the mega yacht and the actual price converted to U.S. Dollars in related month with average currency rate at converting Euro and Pound currencies. Payment of any mega yacht occurs within the frame of yacht contract. The contract terms depend on costumers’ bank and credit history. Furthermore, the most common method is delaying the proportion of the loan and interest repayments until the end of the loan term the most important sale issue is purchase tax of the mega yacht effected by registration decision. European registered mega yachts obliged to VAT (Value Added Tax) ranging from 15% to 25% of the yacht's value depending on European country also, tax is an important determinant of delivery of the yacht. This thesis considers selling price including VAT and converted currency in U.S. Dollars.

Independent variables are selected related to empirical sale data, length is the initial determinant of the useful usage area of any mega yacht. Any expansion in length provides more space for quality attributes such as pool, helipad, etc. There are four important length definition for floating boats are LPB (Length Between Perpendiculars) explaining by the length of a vessel along the waterline from the forward surface of the stem, length at waterline defining by variable length depend on loaded condition. The most frequently used length definitions are registered length that is used for only

registration issues and LOA (Length Overall) is used for also registration issues and technical service as well.

Age of any mega yacht is important for hull condition and mostly yacht's technological development. For instance, today's sail mega yacht has self – tuning system on its mast, means yacht automatically adjust the sail for propulsion. Due to model selection, age variable have been determined as month rather than year because in logarithmic function, zero is undefined.

Guest number of yacht is another quality factor which increases the prestige of the yacht. Besides, according to the international safety at sea regulations, a ship carrying more than 12 passengers on international voyages are obliged to comply with the rules of IMO (International Maritime Organization).

Speed is very variable characteristic because even sister hull's speed could be different. It is highly depend on machinery capacity and the hull form of the yacht. Speed of the yacht is also regulated by IMO as long as yacht is under international voyage. According to DNV high speed code (2013), high speed is calculated by following formula:

$$\text{Maximum speed} = 3.7 \Delta^{0.1667} \text{ (m/s)}$$

where Δ is the displacement corresponding to the design waterline in m^3 .

A deck is a permanent cover on hull of the yacht and usually increases useful space on yacht providing more layers on hull. Decks are named as its purpose on ship such as heli-deck, main deck, lifeboat deck, etc. Even mega yachts named “Quinta Essentia” include a waterfall on complete aft deck. Some mega yachts could be operated on top deck that called flybridge, increase the quality attribute and flybridge deck usually contain a jacuzzi as well.

The data set consist of 8 dummy variables that used to explain more about pricing mega yachts. The dummy variables are in binary form and used to indicate the absence or presence of some attributes that may be effect the price of the mega yacht.

Type of the motor yacht could be distinguished easily by visually. Motor yacht refers any yacht that main propulsion is conducted by engine

power. Main hull forms are designed to reach maximum speed and obtain more useful area for owner. Usually motor yachts are known as a boat for comfort in contrast to sail propelled yachts. Sail yacht on the other hand, also owns a combustible engine to be propelled in calm weather. Sail yachts main propulsion is conducted by high masts and big sails and qualified crew to operate. It is expected that sail mega yachts are more expensive than motor yacht because sea worthiness and stability of sailing yachts are more improved.

When any mega yacht changes hand, new owner usually change the interior design and other specifications. This revision process is usually called as refit that could be performed in several ways depend on refitted yacht condition. For an instance; modernizing an old yacht means refitting a yacht with modern styling, technologies and systems. Refit is a good alternative to new building in cost and experience factor of the hull. Refitting of any yacht could satisfy the consumer's demand in economical way.

Teak deck is another quality attribute because its oily containment makes teak highly water resistant and increase the quality in visual. Actually, teak wood is hard as the highest grade of wood that requires low maintenance because of its natural oily containment and it is termite or insect resistant as well. Besides all advantages, teak is known as marine wood due to its slip resistant in wet conditions.

Boat garage is an area to maintain safe area for some equipment. Boat garage is common and most of the mega yachts include some guest attractions such as jet – ski, kayak, a powerboat, banana, etc., called sea toys. These “sea toys” are usually store and maintain in mega yacht's garage. Relatively, quality of any yacht increase with garage. Moreover, some extreme built mega yachts even include a garage for cars, SUVs or motorcycles.

Helipad, an extreme luxury attribute, is simply defined as an area that helicopter take off. Helipad requires an area of approximately 14-meter-diameter and various classification requirements such as appropriate

firefighting equipment, an approach area, a safety construction and also it is necessary a safe aviation storage if refuel of helicopter is available. Until the year 2008, while only 54 mega yachts had permit to have helipad on board, in by year 2013 helipad permit is valid for 100 mega yachts.

Flybridge is the open and topper deck of any yacht and includes duplication of yacht controls as steering motor control and other systems. A flybridge offers large sun bathing area and mostly jacuzzi or pool. Moreover, some mega yachts include a bar or a party area on flybridge deck.

Pool define an existence of the swimming area on board that increase quality attribute on mega yacht and require extra costs, as well. New concept pools are designed to take fewer places and the build outside of the boat with several extension parts. Jacuzzi on the other hand, defines an area that makes water massage with pressurized water or air. Instead of pool, jacuzzi is more preferred quality attribute.

Custom built mega yachts were examined in introduction part. In brief, semi – custom mega yachts provide an opportunity to have the world's most prestigious designed yachts in restricted outline. In contrast, custom mega yachts are offering various design and luxury attributes limited by the mega yacht project's budget.

Table 5. Descriptive Statistics of Variables

	Price	Length	Age	Guest Number	Speed	Deck Number
Mean	11,902,318	36.53	142.22	9.38	20.41	2.22
Median	5,727,218	34.00	100.50	8.00	18.00	2.00
Maximum	184,153,230	104.00	1,206.00	120.00	50.00	4.00
Minimum	450,000	24.00	3.00	4.00	7.00	1.00
Std. Dev.	18,480,306	11.46	144.87	5.14	7.81	0.72

Table 6. Descriptive Statistics of Dummy Variables

	Type	Refit	Teak	Garage	Helipad	Flybridge	Pool	Custom
Mean	0.89	0.33	0.72	0.76	0.03	0.83	0.31	0.54
Median	1	0	1	1	0	1	0	1
Max.	1	1	1	1	1	1	1	1
Min.	0	0	0	0	0	0	0	0
Std.Dev.	0.32	0.47	0.45	0.43	0.17	0.38	0.46	0.5

The data collected with several dummy variables in other words, qualitative variables. Basically dummy variable are for calculating immeasurable variables such as weather refit applicable or not in binary (1 – 0) form. Assume that a regression model use dummy variable as following:

$$Y = \alpha_0 + \alpha_1 X_1 + \alpha_2 D_1 + \varepsilon$$

In this equation, D_1 is dummy variable and X_1 is independent variable. While dummy variable takes 1 and 0 values, the equation become,

$$(D_1= 1); Y = (\alpha_0 + \alpha_2) + \alpha_1 X_1 + \varepsilon$$

$$(D_1 = 0); Y = \alpha_0 + \alpha_1 X_1 + \varepsilon$$

The difference between two equations is that while dummy variable changes, only constant of the regression change.

Table 7. Expected Signs of the Coefficients of Variables

Variables	Meaning	Expected Sign
Length	Length overall of the yacht (in meters)	+
Age	Age of the yacht (in months)	-
Guest	Maximum guest number of yacht	+
Speed	Top speed of the yacht	+
Deck	Deck number of the yacht	+
Type	Main propulsion type (1 if motor yacht)	-
Refit	Refit application on yacht (1 if refit applicable)	+
Teak	Main coverage of deck (1 if teak deck applicable)	+
Garage	Existence of boat garage (1 if boat garage applicable)	+
Helipad	Helipad area (1 if helipad applicable)	+
Sun	Flybridge (1 if flybridge applicable)	+
Pool	Existence of pool or Jacuzzi on board (1 if applicable)	+
Custom	Custom build or semi – custom build (1 if custom build)	+

The descriptive statistics of the variables of the data are shown on Table 7. The overall result is except age of the mega yacht; all variables are expected to increase the price.

3.2. The Model

Determination of the actual model conducted in three steps. At first, an extended model set on Eviews and compared to expected signs of coefficients with considering correlation table in Annex I. First findings indicate that guest, speed, refit, garage, helipad and sun coefficients have different coefficient signs than expected. The second step continued with elimination of unexpected signed coefficients and the third step continued with elimination of the coefficients that have high probability. The final model concluded with examination of the regression analysis tests.

The final model set as:

$$\ln P = \alpha_0 + \ln \alpha_1 x_1 + \ln \alpha_2 x_2 + \ln \alpha_3 x_3 + \dots + \alpha_{12} x_{12} + \varepsilon$$

- $\ln x_1$ Length overall of the yacht (in meters)
- $\ln x_2$ Age of the yacht (in months)
- $\ln x_3$ Maximum guest number of yacht
- $\ln x_4$ Top speed of the yacht
- $\ln x_5$ Deck number of the yacht
- x_6 Main propulsion type (1 – motor yacht; 0 – sail yacht)
- x_7 Refit application on yacht (1 – refit applicable; 0 – not applicable)
- x_7 Main coverage of deck (1 – teak deck applicable; 0 – not applicable)
- x_8 Existence of boat garage (1 – boat garage applicable; 0 – not applicable)
- x_9 Helipad area (1 – helipad applicable; 0 – not applicable)
- x_{10} Flybridge (1 – flybridge applicable; 0 – not applicable)
- x_{11} Existence of pool/ Jacuzzi on board (1 – pool/ Jacuzzi applicable; 0 – not applicable)
- x_{12} Custom build or semi – custom build (1 – custom build; 0 – semi custom build)

Each coefficient obtained from regression model explains the implicit price of the attribute and totally all coefficients explain how the attributes effect on price of the mega yacht.

Main regression model estimated with least squares. Price of the yacht selected as dependent variable and other variables selected as independent variables including dummy variables. Main regression set by log – log regression form and marginal effect on price calculated as percentage. Initially, only qualitative independent variable model set and a main regression model set in following. The model considers the significance level as 10% and variance of the errors corrected by White's heteroskedasticity – consistent standard errors and covariance matrix.

The regression analysis with data has few limitations. Initially, the actual sale data obtained from brokers that report their sales. Some yacht owners intend to keep their records in secret. Moreover, the attribute assessment carried out by probing of all existing mega yachts on data set and there is a probability that there is misinformation on explained attribute.

The chosen attributes are very common in mega yachts and also they are easy to get information. Another important limitation is related weather there is another important regressor or not. For instance mega yachts hull construction could be different materials such as composite, aluminum, steel or wooden that supposes to have effect on mega yacht pricing. Furthermore, some mega yachts have specific interior or exterior attributes that have remarkable effect on price of the mega yacht. For example, a sailing yacht named 'Maltese Falcon' has self – adjusted sail system according to the wind speed and direction.

In conclusion, due to these limitations, the model and findings are not enough to explain the hedonic price of mega yacht.

4. Findings

Main regression result on 5% significance is indefinite on independent variables of speed, refit, garage, helipad, flybridge, pool/jacuzzi and custom. Table 8. shows only qualitative regressors in hedonic regression function.

Table 8. Qualitative Variables Hedonic Analysis

Variable	Coefficient	T – stat	10%	5%	1%
C	7.686	14.10	0.000	0.000	0.000
Log(length)	3.153	27.38	0.000	0.000	0.000
Log(age)	-0.473	-18.37	0.000	0.000	0.000
Log(guest)	-0.190	-1.67	0.096	0.096**	0.096***
Log(speed)	-0.222	-3.76	0.000	0.000	0.000
Log(deck)	-0.045	-0.74	0.457*	0.457**	0.457***
R ²	0.803				
Adj. R ²	0.801				
S.E. of regression	0.484				
Sum squared resid.	173.2				
Akaike Criterion	1.396				
Schwarz Criterion	1.434				
F – Statistics	600.65	(0.000)			
Durbin – Watson	2.039				

* insignificant at 10% ; ** insignificant at 5% ; *** insignificant at 1%

Table 8 shows that while only qualitative variables model is used,

adjusted R^2 of the model is 0.8. Main hedonic regression model includes dummy variables and including dummy variables and explained in table 9.

Table 9. Main Regression Model Significance Level

Variable	Coefficient	T – stat	10%	5%	1%
C	7.655	14.45	0.00	0.00	0.00
Log(length)	3.045	25.29	0.00	0.00	0.00
Log(age)	-0.448	-16.11	0.00	0.00	0.00
Log(guest)	-0.213	-1.88	0.06	0.06**	–
Log(speed)	-0.078	-1.01	0.32*	–	–
Log(deck)	0.190	2.15	0.03	0.03	0.03***
Type	-0.274	-2.77	0.01	0.01	0.01***
Refit	-0.051	-1.12	0.26*	–	–
Teak	0.119	3.01	0.00	0.00	0.00
Garage	-0.065	-1.53	0.13*	–	–
Helipad	-0.051	-0.31	0.76*	–	–
Flybridge	-0.059	-0.83	0.41*	–	–
Pool/Jacuzzi	0.056	1.20	0.23*	–	–
Custom	0.012	0.32	0.75*	–	–
R^2	0.809				
Adj. R^2	0.806				
S.E. of regression	0.479				
Sum squared resid.	167.67				
Akaike Criterion	1.386				
Schwarz Criterion	1.472				
F – Statistics	237.90	(0.00)			
Durbin – Watson stat.	2.006				

* insignificant at 10% ; ** insignificant at 5% ; *** insignificant at 1%

After evaluation of the main regression model with respect to the significance level on 5%, restricted model analyzed with omitting the insignificant independent variables.

Table 10. Restricted Regression Model Significance Level

Variable	Coefficient	T – stat	10%	5%	1%
C	7.655	14.46	0.000	0.000	0.000
Log(length)	3.045	25.29	0.000	0.000	0.000
Log(age)	-0.448	-16.11	0.000	0.000	0.000
Log(guest)	-0.213	-1.88	0.060	0.060**	–
Log(speed)	-0.078	-1.01	0.315*	–	–
Log(deck)	0.190	2.15	0.032	0.032	0.032***
Type	-0.274	-2.77	0.006	0.006	0.006
Refit	-0.051	-1.12	0.262*	–	–
Teak	0.119	3.01	0.003	0.003	0.003
Garage	-0.065	-1.53	0.126*	–	–
Helipad	-0.051	-0.31	0.758*	–	–
Flybridge	-0.059	-0.83	0.409*	–	–
Pool/Jacuzzi	0.056	1.20	0.232*	–	–
Custom	0.012	0.32	0.748*	–	–
R ²	0.806				
Adj. R ²	0.804				
S.E. of regression	0.481				
Sum squared resid.	170.73				
Akaike Criterion	1.382				
Schwarz Criterion	1.4195				
F – Statistics	611.46	(0.00)			
Durbin – Watson stat	2.025				

* insignificant at 10% ; ** insignificant at 5% ; *** insignificant at 1%

Future estimation and hypothesis testing of the both model is determining by R square. R square that ranges between 1 and 0 are pretty high in both models since the regression line does not missing the data inputs very much. The both model have similar R square value on selected model. However, the R square is not enough to indicate whether the correct model and regressor is used or not.

The problem of using correct regressor could be solved in several ways. The adjusted R square is calculated by taking sample size and total regressor numbers on R squared. Unlike the R square, the adjusted R square increase more than expected when a new explanatory regressor is used. Due to the formulation of adjusted R squared, adjusted R squared could be negative and could not exceed the R squared value. The restricted model that derived from the main model indicates that even the variables guest number, speed, refit, garage, helipad, flybridge, jacuzzi and custom variables are omitted, the adjusted R square decreased 0.0014.

The standard error of the regression is based on estimated variance of the residuals. The both model almost same value as 0.48.

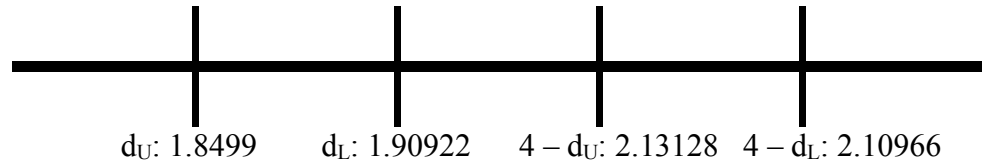
Sum squared resid is originally called residual sum of squares and used for calculating total sum of squares calculation. Residual sum of squares indicates the fitness of the model to data and smaller residual sum of squares is better. Even after rejection of the excess independent variables, residual sum of squares decreased.

Akaike and Schwarz Criteria are used to select the model. The only major difference between the criteria is Schwarz Criterion includes number of the observations. The restricted model gives better result on Akaike and Schwarz Criteria.

F – Statistic is even a determinant of fitness of the data to the model with showing test of the hypothesis. F – Statistics indicates that restricted model have 611.4643 that is greater than main model. While main model fits to the data better than restricted model, probability of both models is the same.

Also the model is significant in 0.05. Durbin – Watson table value of d_U and d_L with 744 observation in following:

Figure 6. Durbin – Watson statistic under 744 observations.



According to Durbin – Watson statistics the both model have no evidence of autocorrelation that means there is no relation between serial error terms.

The regression coefficients are referring the implicit (hedonic) prices that give quality/price relation and in the hedonic regression model, coefficient of the model explain the percentage change in mega yacht overall price.

Table 11. Coefficients and Percentage Change in Mega Yacht Price

Variable	Coefficient	Percentage Change
Log(length)	2.955	295.45
Log(age)	-0.455	-45.5
Log(guest)	–	–
Log(speed)	–	–
Log(deck)	0.147	14.74
Type	-0.344	-34.42
Refit	–	–
Teak	0.111	11.07
Garage	–	–
Helipad	–	–
Flybridge	–	–
Pool/Jacuzzi	–	–
Custom	–	–

Table 11. only contains the 5% significant coefficients on hedonic model. Length coefficient has positive effect and one meter long change in length increase the mega yacht price 295.45%. Age of the mega yacht is also effective determinant while pricing the yacht. One month newer yacht increases the price 45.5% in contrast one month older mega yacht. Deck number also has effect on yacht price. One deck more built on mega yacht increase the price 14.74%.

Guest number, speed, refit, garage, helipad, flybridge, pool/jacuzzi and custom independent variables are omitted because these variables are not significant in 5% significance level.

On the dummy variables side, type of the mega yacht has significant effect on mega yacht price. When a yacht built with sail equipment, price of the mega yacht increases 34.42%. Moreover, all decks of the mega yacht covered in teak, price increases 11.07%.

5. Conclusion

Yacht industry is developing and yacht fleet is increasing as well. Today's mega yacht could be defined as a yacht that length is 24 meters or more. After necessary definitions, mega yacht pricing model selected as hedonic pricing model that explain the pricing with change in quality attributes.

The literature search indicates that there is no any study in mega yacht pricing. Moreover, literature search could be classified in three categories as real estate hedonic pricing, automobile hedonic pricing and commodity/ goods hedonic pricing models. The literature search carried out with variable forms and critics of hedonic prices. Even all criticizes and limitations, Rosen's hedonic approach are mostly accepted model.

Hedonic pricing model is simply based on regression analysis and the regression coefficients are giving the implicit price of related attribute. The regression model is simply based on five assumptions to maintain the regression analysis valid. In this study, heteroskedasticity corrected with White's correction matrix. Even the proper correction carried out, only 5 independent variables are significant in 5 percent. After the elimination of the insignificant variables, all assumptions of the regression are provided. According to Durbin – Watson statistics, there is no evidence of autocorrelation in present restricted model.

As a result, the most effective variable on price is length of the mega yacht. Length and the deck number of the mega yacht determines the total floating area; however, while length of the mega yacht effecting the price around 295%, deck number is only effecting the price around 15%. The other effective variable is the length of the yacht. One month older yacht price decrease 45.5%. It is expected that there is colinearity between refit and age in respect to high correlation coefficient. Another effective variable is type of the mega yacht. According to cost analysis, while all variables are the same, price of the sail yacht is more expensive than price of the motor yacht because while length and tonnage of the yacht is increasing relatively,

necessary horsepower is increasing in both types of yachts. However, greater tonnage of the sail yacht requires more sail surface that be provided with and extra or bigger mast.

Restricted model calculated with excluding some dependent variables due to its significance level and this elimination also decrease the fitness of the model to data. Furthermore, main model dependent variables are not enough to pricing of any mega yacht.

When the findings are compared to a mega yacht appraisal process, it is not convenient to make an appraisal without expended onboard surveying. For example, while a main engine is cost around \$1 million, the price reduces while operating hour and depreciation increases. The findings indicate that the mega yacht price increase with length, however; if the mega yacht builder, designer and hull condition is not convenient, the price would be affected in other ways.

Moreover, the findings indicate that age affects the mega yacht price approximately %45. However, in professional appraisal reports the appraiser determines a depreciation rate in respect to his experience and reduces the price. Hull and machinery of any mega yacht become old year by year, however; the depreciation is mostly related to the usage of the yacht. It is inconvenient to set an equal price between two yachts while the one have every year docking period, the other one have two year.

Lastly, the findings indicate that motor yachts are %34 expensive than sail yachts in same length, age, deck number and teak deck. In practice, a professional mega yacht appraiser prepares the report by considering motor yachts and sail yachts in different group and appraiser conduct the market valuation approach.

As a result, for a convenient pricing of mega yacht it is necessary to appraise the yacht by a professional appraiser who is recognized by an appraiser society.

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	HELIPAD	HIZ	KABIN	PRICE	REFIT	SUN	TIK	TUR
BOY	0.357618	-0.239281	0.518214	0.694188	0.111066	0.226017	0.264743	0.099646
CUSTOM	0.118450	-0.346595	0.125405	0.167331	0.218644	-0.028654	0.132825	-0.171108
FIYAT	0.344700	-0.138615	0.311312	0.744544	-0.060419	0.175292	0.206794	0.077617
FIYATF	0.239554	-0.085600	0.324552	1.000000	-0.079893	0.141989	0.174005	-0.002026
GARAJ	0.083171	-0.257006	0.117133	0.117849	0.134375	0.214643	0.086539	0.150876
GUVERTE	0.181160	-0.196471	0.364794	0.299532	0.012300	0.523023	0.095625	0.529912
HAVUZ	0.167626	-0.117750	0.227553	0.288356	0.046826	0.241212	0.134746	0.211237
HELIPAD	1.000000	-0.078312	0.166608	0.239554	0.057754	0.060841	0.059352	0.039734
HIZ	-0.078312	1.000000	-0.101624	-0.085600	-0.223625	0.016540	-0.222215	0.373039
KABIN	0.166608	-0.101624	1.000000	0.324552	0.063734	0.153104	0.124989	0.118801
PRICE	0.239554	-0.085600	0.324552	1.000000	-0.079893	0.141989	0.174005	-0.002026
REFIT	0.057754	-0.223625	0.063734	-0.079893	1.000000	-0.077407	0.108152	-0.119266
SUN	0.060841	0.016540	0.153104	0.141989	-0.077407	1.000000	0.041383	0.429624
TIK	0.059352	-0.222215	0.124989	0.174005	0.108152	0.041383	1.000000	-0.186067
TUR	0.039734	0.373039	0.118801	-0.002026	-0.119266	0.429624	-0.186067	1.000000
YAS	0.026012	-0.341320	-0.015790	-0.179654	0.533188	-0.240745	0.093681	-0.155039

	BOY	CUSTOM	FIYAT	FIYATF	GARAJ	GUVERTE	HAVUZ	YAS
BOY	1.000000	0.299812	0.774560	0.694188	0.242568	0.574014	0.492370	0.011111
CUSTOM	0.299812	1.000000	0.195234	0.167331	0.110322	0.093312	0.082543	0.222064
FIYAT	0.774560	0.195234	1.000000	0.744544	0.150082	0.433695	0.406816	-0.207439
FIYATF	0.694188	0.167331	0.744544	1.000000	0.117849	0.299532	0.288356	-0.179654
GARAJ	0.242568	0.110322	0.150082	0.117849	1.000000	0.355218	0.227412	0.100586
GUVERTE	0.574014	0.093312	0.433695	0.299532	0.355218	1.000000	0.492768	-0.097918
HAVUZ	0.492370	0.082543	0.406816	0.288356	0.227412	0.492768	1.000000	-0.134520
HELIPAD	0.357618	0.118450	0.344700	0.239554	0.083171	0.181160	0.167626	0.026012
HIZ	-0.239281	-0.346595	-0.138615	-0.085600	-0.257006	-0.196471	-0.117750	-0.341320
KABIN	0.518214	0.125405	0.311312	0.324552	0.117133	0.364794	0.227553	-0.015790
PRICE	0.694188	0.167331	0.744544	1.000000	0.117849	0.299532	0.288356	-0.179654
REFIT	0.111066	0.218644	-0.060419	-0.079893	0.134375	0.012300	0.046826	0.533188
SUN	0.226017	-0.028654	0.175292	0.141989	0.214643	0.523023	0.241212	-0.240745
TIK	0.264743	0.132825	0.206794	0.174005	0.086539	0.095625	0.134746	0.093681
TUR	0.099646	-0.171108	0.077617	-0.002026	0.150876	0.529912	0.211237	-0.155039
YAS	0.011111	0.222064	-0.207439	-0.179654	0.100586	-0.097918	-0.134520	1.000000