SCAF Paper – September 2003

Experiences with the Procurement and Build of Modern Cruise Liners – is it different and how?

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This paper has been produced for the Annual Conference for the Society for Cost Analysis and Forecasting to be held at the Defence Procurement Agency, MoD Abbey Wood, Bristol.

Contents

1. Executive Summary

The key points from the paper are :-

- The cruise industry has developed a timely and cost effective procurement methodology
- Performance based elements of the specifications encourage cost competitiveness and innovation, leading to the wide spread development and use of COTS
- Cost breakdown analysis indicates the design costs for Cruise Vessels runs at around 10% of construction cost with management a further 4 %
- Design times can be around 6 months prior to contract signing.
- Construction times are in the region of 25 months regardless of size.
- Effective cost control is achieved through experienced on site project management.
- Series production can result in substantial cost savings
- Cruise vessels can provide a suitable benchmark for Naval Vessel procurement.
- Cruise vessel characteristics are similar to CVF and could provide beneficial experience to Naval construction projects.

2. Cruise Industry Background – Current Best Practice

a. Normal Process

Clearly the driving factor behind the ordering of a new cruise vessel is a commercial one. The Owner or Operator may be seeking to expand their current fleet, replace older obsolete tonnage to keep up with new vessel trends or may be they have identified a gap or niche in the market that they feel they can exploit.

If it is the former of the above then it is common practice that the owner will order new tonnage based on existing vessels. Often simply increasing the number of vessels to an existing order. This can clearly be seen in the Table 1. SCAF Cruise Order Books where the vast number of new orders are part of a series. This has many benefits in that the Owner is purchasing a known commodity, design and production time and costs are minimized, series production has economies of scale, maintains leverage with the yard on existing contracts etc. This is explained in more detail in Section 6.2 – Series Production.

If it is one of the later then the first step is to produce a financial model to support the business case. Simple costing models are produced based on easily identifiable market factors. The cost per lower berth or cost per GRT can be used to establish a base price based on the production of a vessel 'similar' to an existing one. Anticipated revenue and yields can be examined in the model along with likely running costs. If the new business case or anticipated market growth is established then the process towards ordering can begin and the financial models become more sophisticated.

The conventional approach to the New Build ordering process is to draw up an outline specification covering a number of key parameters, such as :-

Number of passengers
Speed
Area of operation
Standard 4 star, 5 star etc
Operational requirements
Technical needs in relation to HVAC spec etc.
Crew numbers
Description of public space needs and indicative standards
Flag and Classification
Etc.

This outline specification can be anywhere between 5 and 20 pages.
A series of parallel activities usually then follows whereby the Owner / Buyer fleshes out the outline specification whilst the yards, approached either directly or through a broker, respond with an indicative price and technical back up. This is in the form of a fuller specification and an outline general arrangement plan.

Without fail there is a difference between what the yards will offer and what the Owner is requesting or expecting. This can be for a number of reasons. The yard may make an offer based around an existing or modified design in order to seek a competitive advantage. This could be less cost or faster delivery. Their understanding of the "Owner's vision" may not be easily derived from the outline specification. Clearly their aim at this stage of initial enquiry is to ensure they can qualify for the next phase. In the past many other factors have come in to play at this stage such as the levels of subsidy applicable, build slot availability etc. In the current climate these issues are of far less concern.

Upon the receipt of 5 or 6 quotations the Owner would usually carry out a simple review and continue the development work with only 2 or 3 yards.

The basic analysis at this stage is usually fairly simple which will cover cost, revenue and outline technical assessment. A typical working example can be seen in Table 5. SCAF 2 Sheet 2 Objective Assessment.

Clearly the line items used in the above are adjusted to suit each situation and to present the information in a way that suits the Owners Objective Assessment requirements.

As the process continues more information is added for analysis and comparison.

b. Design by Convergence

The ongoing process with the selected yards forms part of the classic design spiral. Information is developed, verified and checked as the specification is developed. Some Owners engage an independent third party consultancy or have their own in house expertise to develop the Owners specification and GA the yards will ultimately receive a very much more detailed set of information than would usually be the case. In any event once the yards respond with their offer and their version of the GA and specification a process of analysis and comparison with the Owners requirements must take place. In my experience no yard will meet the Owners specification at the outset. Again many factors come into play as to why this is the case. Different yards have different standards, have different ways of designing structure, may want to ensure compliance with contractual requirements etc. Regardless of what the Owners or their consultants request the legal implications of "delivering" rest with the yard. Therefore a complex hull form aimed at saving on fuel consumption or obtaining greater speed for the same installed power may fall outside of the yards previous experience or not match the same technical assessment. They also need to build in margins so as to ensure they will not need to pay any penalties.

Naval Architecture is the epitome of compromise and the yards will always seek to ensure the compromise favours their methods of design and construction. As such each variation between the yards offer and the Owners requirements needs to be identified by the Owner. In a fairly well developed specification this can prove to be many hundreds of items.

Each item will need to be raised with the yards, discussed, debated, quantified and if necessary costed prior to agreement being reached for inclusion in the specification. Usually this is happening on multiple levels with each yard. Items they are happy with will be included in the specification or GA and the base price established previously will be accordingly amended. Those items where there is uncertainty or dispute the yard will often seek to price separately as an addition to the price. Often the list of these items are invariably those on the leading edge of technology or regulations. Alternatively they may be outside of the yards experience and they cannot cost them sufficiently accurately to ensure they have no risk. This can be used to the Owners advantage if budget constraints mean a "shopping list" approach is required to prioritise which items are included and which are excluded or diluted.

This process I term **Design By Convergence**. The ultimate aim is to obtain like for like offers from all the yards whereby the only differences are total project cost and possibly the delivery date. In reality there will be differences between each yard and the practical conclusion of this phase is to know exactly what the differences are, whether they be in costs or technical terms. The next phase is to select the preferred yard, this is best done by use of Objective Assessment Techniques.

This process leads to a very cost effective solution as radical changes in design direction can be avoided. The expense to the Owner for front end consultancy can be minimized and each element of the specification is discussed in detail and in a methodical fashion. For example the Owner should look carefully at the specification if all yards indicate they have a problem with a certain request. Likewise solutions to a problem discussed with one yard may be applied to the others.

c. Objective Assessment

The following methodology has been developed to highlight key features, areas of concern etc., to allow :-

a. comparison with the Owners specification and
b. to compare with the other bids.

Elements relating to technical assessment are fairly straightforward but even levels of compliance with the Owners designs, profile, cabin layout, public spaces etc. can be covered. The philosophy is based around a weighted scoring system allows comparison of each bid both with the requirements given in the Owners specification and with the other competing bids.

Clearly in the early stages the first round of objective assessment will cover the responses to the outline specification and will relate to the main items only. As the design and interaction spiral continues more and more specific sections can be dealt with in the same manner. See Table 5 SCAF 2 Sheet 2.- Objective Assessment. In this way the yards are led into the process rather than being confronted with it at the beginning. This

methodology has already been carried out with a number of European yards and has been shown to be successful.

As each yard is asked to clarify certain issues and respond to comments and questions arising from the analysis of their bids a general impression of "how they do business" can also be observed. In the long term this can prove to be quite useful. A communication tracking system to follow all correspondence and dialogue with the yards is essential.

As each yard responds, coming ever closer to the Owners requirements the scoring will get closer to the maximum. In essence this is the proof of the "convergent" process described above.

Quite clearly the ultimate goal is to achieve a position where all bids are compliant with the Owners requirements. The main decision parameters will then become, cost, delivery date, financing, revenue generation etc along with the more subjective issues relating to personal choice. This would cover the aesthetics of the yard proposal, working relationship, assessment of quality etc.

It is also necessary to assess the revenue potential for each design at this stage based on the yards General Arrangement plans. Each yards proposed GA will be slightly different and will have marginally different cabin arrangements, one may have more balcony cabins or have cabins of a slightly larger size etc. Though likely to be small it is necessary to analyse the difference between and then to compare with the capital cost. Typical revenue analysis is easily carried out at this stage to determine the best return on investment.

In any decision making process there needs to be transparency that demonstrates the decision makers are making the right decision for the right reasons. The use of this type of approach clearly gives a level of security to all concerned that the "due diligence" has not only been followed but can be seen to have been followed.

Note : The scoring and weighting system and the relative importance of the items to be analyse is clearly derived to suit the factors which are important to the Owner.

d. Non Marine versus Marine Contracts

The key difference between marine and non marine / land based contracts is the total lack of the quantity surveying discipline. Payments for new vessels are not based on a measure but on key dates that are derived from historical factors. As the Owner is not funding the construction process with payments that reflect the progress, the yard's "cost of money" to build in this fashion is added into the total contract price to reflect this process. As a result cost plus contracts are very rare.

The approach of a fixed price to provide a vessel that meets the specification is one favoured by the yards. However it does not allow the purchaser to build up knowledge

and experience of how the cost is made up. It can be argued from the yards perspective that if the Owner is happy with the price and the deliverable then why give them all the details that could be used against them in the future.

Open book practices are virtually unheard of principally due to the lack of qualified estimators that could act on behalf of the Owner but more importantly due to how the Owner views the process. Once they have signed the contract for an agreed price all they care about is ensuring delivery on time and on budget. The responsibility of ensuring the Owner gets what he has paid for as laid down in the specification and accompanying documentation becomes the responsibility of the Owners New Build Team. If the specifications, contract and GA are well developed and thought out then there is a fair chance of being able to achieve this. Clearly the New Build team has other responsibilities such as ensuring timely delivery of design information from the Owners' appointed designers, plan approval, organising delivery, providing management reports and feedback to head office etc.

Problems have arisen in the past in this regard for many reasons, lack of interior design detail or suitable references, use of prototypes, poor procurement by the yard etc. This risk can be substantially reduced with the employment of a suitably qualified and experienced team along with the use of purpose designed project management software. This is covered in more detail in Section 6.

The industry has suffered with cost overruns and it is recognised that the minimisation of this risk is of paramount importance to any Owner. Yards are quite happy to have an Owners Allowance funded in the contract price. Although this is used to pay the Owners costs relative to the project outside of the yard contract such as legal fees, designer costs, site supervision, outfit of equipment etc, the allowance can be used to cover changes and cost over runs. Clearly a large allowance can suit the yard and they may seek to maximise their return from this "pot". There are ways to control this but principally it is through a well defined specification and general arrangement.

It is worth noting that cost over runs are usually through design changes by the Owner and the extent of late deliveries reflect the yards need to agree ever faster delivery times. Given the complexity and value of newbuild projects the level of late deliveries is fairly minimal though the reporting of them is widespread.

3. Design - Prescriptive Versus Performance

There are two schools of thought in relation to the production of specifications and the design discipline :-

1. Prescriptive Design

2. Performance related Design.

In simple terms the former involves a very detailed specification which will provide every design detail from choice of material to the size of valves etc. Clearly for an Owner this very expensive and time consuming to produce. On the plus side he will get exactly what he prescribed. On the down side 'ownership' of the design does not fully rest with the yard and therefore they are unlikely to accept penalties for failures in compliance.

Performance related design is faster and though the risk is that the yard could deliver in a less than desirable way there are a number of ways to minimize this. For example the list of rules and regulations described below to be adhered will define many aspects of the vessel.

Classification
Flag
Rules and Regs(as in owner spec.)
Bahamas Admin. Applic Reg.
IMO SOLAS 74(prot 78)
IMO Int. conv Tonnage Measurements 69
IMO ILLC 66
IMO Int. COL REG 72
IMO Int. MARPOL 73 (prot 78)
IMO Resolution A.468(XII)(noise) 81
ILO Conv. 133 (crew accom.)
ITU & radio Regulations 82
IEC 92 (electrical installations)
USCG Regs(CVE&Inspection)
USPH Requirements
Suez Canal (Nav. Rules & Tonnage Req.)
Panama Canal (Nav. Rules & Tonnage Req.)
*Kiel Canal (Nav. Rules & Tonnage Req.)
Elevators (DNV51,52 or equiv.)
ADA compliance

Principal characteristics such as speed, deadweight, noise and vibration levels etc will also be included. Failure to meet these requirements will usually carry some level of penalty that is defined in the contract.

Further more it is very common practice to use reference vessels or spaces. The owner will choose a suitable vessel or space that allows a cost value to be allocated without the full detail design having to be produced. This saves time and cost before the contract is signed. Preliminary layouts from the interior designers or architects will be incorporated within the GA.Having a reference to work to also sets a yardstick for the designers to work to. The GA will define the space boundaries and the reference will define the

complexity and the materials to be used. For example if the reference space has a marble floor with complex patterns in different colours then a similar value will be accorded to the new design. If on the other hand the reference only has a plain carpet in two colours then that is all that will be allowed for and any deviation will be costed as an extra. It is not the most scientific way of undertaking projects of these magnitudes but it has become an established way of working and for the most part it is successful.

Lump Sums are frequently used to cover issues or areas that cannot be fully defined at an early stage. This could cover anticipated changes in legislation, rules or regulations or simply there is not sufficient time to fully describe it. Shipyards are adverse to the inclusion of something they cannot define by way of words or reference Likewise they will seek to remove the words **Minimise or Maximise**. By implication there is no end to where the max or min could lead to. All such nebulous terminology that is included in the Owners specification has to be debated discussed and defined in such a way so as to allow the yards to cost it.

Another safeguard for the Owner in a performance leaning specification is to include a Makers List for the equipment choices. In the negotiating phase the Owner can deselect a supplier. Clearly the yards need sufficient alternative suppliers in order to ensure competitive prices. Commercial of the shelf systems and the use of turnkey design and build contracting are the basis of modern day cruise ship construction. It reduces design time and reduces risk as they would not be included in the makers list otherwise.

Where an Owner has explicit issues or problems from previous operational experience then it would be of course sensible to include these elements in a prescriptive format within the specification.

The use of performance based elements of the specification free the yard to explore alternative solutions that encourage cost competitiveness and innovation. Suppliers can be encouraged to invest in solutions which develop into the wide spread use of modular Commercial Of The Shelf Systems

Section 4 Indicative Cost Breakdowns

Typical percentage cost breakdowns by section for a cruise vessel are as follows :-

Design	9.00%
Management	4.00%
steel	14.50%
insulation and painting	4.50%
public space outfit	9.00%
passenger cabins	4.50%
crew cabins	2.00%
Galleys, offices etc.	3.00%
hull piping	4.50%

hull equipment	7.50%
HVAC	7.50%
cold rooms	1.00%
electrical	9.00%
machinery	10.00%
spares	1.00%
financing	2.00%
insurance	2.00%
warranty	1.00%
Sea trials	0.50%
profit	2.00%
miscellaneous	1.50%

It should be noted that these percentages are based on the construction and outfit cost and does not include for the "Owners Allowance". This often in the region of a further 10% of the above.

Section 5 Project Management - Cost Control

Cost control starts with the outline design brief to the yards and just as importantly with the brief to the Owners designers, architects and consultants.

Clearly the main characteristics of the vessel have the biggest impact on cost. From the breakdown of indicative cruise ship costs in Section 4, the likely cost of public space outfit will be around 9% of the cost and this is an area which needs the tightest control. If structural changes are required, bulkheads to be moved etc then this will affect the 14.5% steel hull cost. Most of the technical issues can be well defined in the specification so risk is minimal providing there is no ambiguity or disagreement as to what the words in the specification are intended to say.

It is a common practice to use suitable references to establish a cost level in the early stages. Then as the Owners architects complete their work the resulting designs are costed and compared with the references. Invariably there is a debate as to why it is more or less. Clearly in this instance the cost control must begin with the designers and they must accept the responsibility to design to the value and complexity of the reference.

Pictures and material sample books can be helpful in this process.

The alternative approach is to fully design and specify all the materials at a stage before contract. In this case the Owner has a commitment to the cost of such works which can be considerable and runs the risk that the designs and layouts need to be substantially modified due changes in the vessel. For example it is not possible to do final elevations till the coordination work of services above deck heads is complete and the free heights have been finally established.

Usually there is growth in the cost from the initial response to an outline specification to the final contract price. The initial cost from the yard is invariably a “budget” price. This growth can be up to 15%. The more detailed the Owners specification, whether prescriptive or performance, at the beginning the less discrepancy there is in the initial contract cost from the yards.

At the LOI stage the Owner takes a more responsive view to costs and the cost levels do not climb so much. The time between LOI and contract signing is when the compromise process begins. Once signed there can be project growth due to changes requested by the Owner.

The other key factor is ensuring delivery on time. The Owner must play their part in this by ensuring all Owner supplied information or materials are delivered in a timely fashion against the schedule provided.

Strong disciplined project management is needed through out the whole process.

The use of project management tools can assist the Owners build team to ensure there is a full documented history relating to the whole process. This will track drawing and plan approval, inspections, defects and defect clearance, changes (cost and weight) etc. The complete database of all actions and responses becomes a deliverable with the vessel.

As part of the discussions with the yard this issue should be discussed as becoming part of the process and should be referenced in the specification and contract as to how this should be achieved. The electronic transfer of information between the parties improves transparency and timeliness. As a plus for the Owner it allows auditing of the “auditors” remotely from any head office location.

6 R Series – Details and the Benefits of Series Production

6.1 Vessel Details

Basic ship details

Length over all	181,00	m
Length pp	157,85	m
Breadth moulded	25,46	m
Design draught, moulded	5,83	m
Maximum draught, moulded	5,95	m
Scantling draught, moulded	6,20	m
Height to boat deck	14,30	m

The deadweight distribution is as follows :-

	Weight (t)
Passengers and their luggage	70
Crew and their luggage	50
Provisions	140
Hotel stores	100
Fresh water	480
Technical fresh water	100
Heavy fuel oil	730
Diesel oil	30
Lubricating oil	20
Black and grey water holding and misc. tanks incl. bilge & sludge	100
Heeling water ballast	70
Water in swimming pools	70
Hull / Engines stores	40
	2 000 t

Number of Passengers	684
Number of crew	371
Ship Speed	20 knots
GRT	30180 tonnes

Classification Notification

BUREAU VERITAS

I 3/3 E**,** **+** Passenger ship, + MACH, AUT-MS, CNC-E

6.2. Series Effects - Improvement in efficiency and reduction of costs.

From the purchasers perspective, improvement in efficiency is not just measured in the reduction of man hours but also in the reduction of contract cost and to a lesser degree the reduction in risk of late delivery.

The R Series construction programme afforded the opportunity to quantify and measure the improvements over a series of eight vessels.

a. A number of items such as detailed sea keeping and manoeuvring model tests, smoke emission tests, inclining experiments etc can be regarded as a non repeatable cost for the second and subsequent vessels. Therefore there is a 100% reduction in these costs from

the second vessel onwards. These costs are around 0,5% of the contract value. After model tests, simulations and full scale sea trials the Owner usually takes the view that there is a substantial reduction in risk associated with these items and accepts not to do them again.

b. The design studies form a large portion of the cost of the first in any series, around 8% of the *contract value* or 9% of the *real construction cost*. Some continued development is required through the second vessel principally learning the lessons from the first., amending drawings etc. Though less on the following some redesign is required in response to changes in legislation, use of different materials, improvement in techniques and equipment, change of suppliers etc.
The study / design costs for the second vessel are reduced by 85% and 90% for each of the following.

c. Material costs make up around 55% of the total production cost and clearly the effects of economies of scale and bulk purchasing become more to the fore the greater the number of vessels built.

The formula for the *reduction* in material costs is given by :-

%change = (((n)^-0.4)-1)*100%
where n = the position of the vessel in the series.

This is highly dependent on knowing the number of vessels in the series at the time of placing the material contracts.

d. Production man hours account for around 35% of the construction cost. The *reduction* in man hours is given by the following formula :-

% change = (((n)^-0.12)-1)*100%

again n = the position of the vessel in the series.

This is based on the assumption that the vessels and the associated work content are the same. Equally important is the time gap between the vessels, if the time is too long then the level of benefit is reduced. Similarly if the gap between vessels is too short then two teams of workers are required therefore reducing the benefit. However as was the case with the R Series build there was some overlap on certain vessels and therefore “two teams” were used. As there was more, 4 pairs of vessels, then the benefit was gained as in simple terms one team did the odd numbers and one the even.

In reality it was somewhat more complicated than that but there was a clear evidence in the sequential reduction of man hours across the build. The man hours were discussed during the build programme in the form of production S curves which were in percentage

terms so a direct comparison was applicable across the series. CA factored in the above formula in tracking a comparison of actual versus predicted.

It is worth noting that the R Series, although having some changes, provided CA with the ability to identify and compute these formulae with a great deal of accuracy.

The above can be seen in Table 4 SCAF2 – Series Production – Cost Reduction Trends. This clearly indicates the levels of *reduction* applicable to each item along with the overall total reduction in costs due to the series effect.

The ability to analyse the situation exactly is made somewhat more difficult by the application of intervention funding. Unlike in Italy for example, intervention funding in France was made available to the yard and not directly to the ship owner. During the construction of the vessels it was known that the first 2 vessels obtained intervention to the tune of 7% of the final contract value.

The second pair were funded under a tax offset scheme and as a result received no intervention funding as such. As can be seen in sheet – R Series Key dates of First Marine they were the most expensive vessels at $226m. A number of large non direct costs relating to the administration of this arrangement were covered in this sum. Even so it was a very profitable low risk deal for the yard particularly as they were paid in full by the members of the "Quirat" at contract signing. The deal for the ship owner was also a good one as they paid an annual bareboat charter at a rate equal to the rate determined by a standard 90% marine mortgage. After 5 years they then have the option to purchase the vessels for $50m each.

In 1998 the yard negotiated a sum of funding from the government to replace the intervention payable to each vessel that was ordered in order to undertake a streamlining and redevelopment of the yard. This was necessary with the impending reduction of the working week to 35 hours that was introduced in 2000. This sum was also used to help "win" contracts and was therefore used at the yards commercial discretion. Given the other orders for Festival and Celebrity, particularly, that were being sought at the time it is my understanding that R5 and R6 received 4% each and R7 and R8 2.5% each.

The above has been factored into the spreadsheet to determine the "real construction" price in Table 2 SCAF Sheet 2 R Series Key Dates and Figures.

7. Cruise Vessels are the Nearest Commercial Comparator to CVF

The above sections illustrate the process, experience and analysis of a major cruise ship construction programme. It's relevance to Defence Procurement, in particular Naval projects, is important as a benchmarking exercise to establish a target as to what could be achieved in reduced construction times and the benefits of planned series construction.

It is also worth exploring the hypothesis that cruise vessels are the nearest merchant vessel comparator for say the CVF. Though clearly not exactly the same in complexity, capital cost, role or function there are a number of similarities.

Similarities

a. Volume Carriers – similar displacements, deadweights and lightweights.
b. Higher speed hull forms – 24 knots plus
c. Varied operational profiles – worldwide operation
d. Both Suitable for power station concept
e. Power and propulsion for new CVF could be direct from cruise ships
f. Noise and vibration signatures need to be at the very low end of the spectrum.
g. Passenger / Crew complements are similar.
h. F&B, hotel services and domestic requirements are similar. 24 hour running.
i. High levels of redundancy / safety.
j. Higher levels of emergency power supply
k. High Levels of automation
l. High capital costs
m. Extensive communication requirements
n. Complex fuel arrangements and fuel handling.

Major Differences

o. Cruise vessels operate on average 51 weeks per year.
p. HVAC requirements more difficult on ACV due to NBCD and citadel concepts.
q. Increased fire fighting, detection containment extinction for CVF
r. CVF Carries armaments, aircraft, weapons etc. Lifts etc require more hydraulic power etc.
s. CVF has even greater compartmentation and subdivision,
t. Cruise ships have faster turn arounds, loading of stores etc.
u. Cruise vessels must comply with much higher environmental considerations.
v. Design and build times much faster for cruise vessels.
w. Cruise ships have low levels of technical manning. Deck and engine complements typically around 70.
x. A cruise vessel only takes around 25 months to build.

There are enough similarities and plus points from cruise vessel build and operation that would substantiate a case to be argued that lessons can be learnt from their design, construction and project management. Furthermore applied across series production these positive inputs could make a substantial difference to the cost and construction time of Naval procurement. Further more the use of COTs and design of the vessels to make optimum use of them would substantially decrease running costs and increase vessel availability.

Comparing the basic 'outline' design data with similar cruise vessels demonstrates some of the similarities.

CVF

Hull particulars	LBP	257m
	Beam	37m
	Draft	9.96
	Lightship	41,000 tonnes
	Full Displacement	58,000 tonnes
	Max Speed	25 knots

These particulars would indicate a block coefficient of around 0.597.

Indicated propulsion power is around 72MW which delivers a maximum speed of 24 knots. Total installed power is in excess of 120MW.

By comparison the MV Millenium has the following details :-

Particulars	LBP	270m
	Beam	32.2m
	Draft	8.3m
	Deadweight	10,800 tonnes
	Displacement approx	47000 tonnes
	Cruising speed	24 knots
	GRT	90,000 tonnes

Propulsion is by 2 Mermaid 20mW pods giving a total of 40mW of propulsive power. Power plant is 2 x GE LM2500+ plus one steam turbine plant. Total installed power is around 65MW

For the QM2 :-

Particulars	LBP	325m
	Bream	40m
	Draft	9.95m
	Displacement approx	80,000 tonnes
	Cruising Speed	28 knots
	GRT	150,000 tonnes

Propulsion is by 4 Mermaid 20MW pods giving 80MW of propulsive power. Total installed power from Wartsila diesels and two gas turbines is 118MW.

From Table 1 - Cruise Ship Orders the overall most expensive project is clearly the QM2 at almost £500 million and with a GRT of 150,000 tonnes but the cost per GRT is still

only £3312. Although well higher than the average this is due in part to the high speed requirement, one off design, increased scantlings for trans Atlantic passage etc.

If the percentage breakdown figures hold true for this one off design then a 9% or 10% cost for design will indicate a figure of around £50m.

Acknowledgments

Chantiers de L'Atlantique for information on Series Effects – improvements in efficiency and reduction of costs