S. A. Malliaroudakis Maritime (UK) Ltd.

Naval Architects - Marine Software - Ship Management Consultants

Introducing SMM-Ship Performance ®

SMM (UK) Ltd. is a software company focusing on maritime solutions for ship management companies.

The company has been delivering practical applications to help our clients achieve their business goals.

Working together with our clients we are introducing another innovative, value-added solution, tailored to the need of evaluating ship performance in a most accurate, practical and simple way.

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The challenge faced by ship managers, operators and charterers

The monitoring and analysis of the in-service propulsion performance of ships has been the "*quest for the holy grail*" of the shipping community since the late 1920's.

It may seem paradoxical, still as of 2015 no reference/benchmark values exist for the in-service propulsion performance of ships, to allow proper comparison with actual measured data.

A plausible explanation is that most shipbuilding projects are carried out with non-disclosure of essential information pertaining to the specific propulsion characteristics of the ship.

On the other hand, the in-service performance of the ship is a topic with numerous complexities and uncertainties that emerge from:

- Environmental conditions, i.e. wind, waves, currents, shallow water effects etc.
- Hull and propeller external degradation, i.e. roughness and fouling
- Operational conditions, i.e. draft, trim, speed
- Onboard measurements, i.e. non-calibrated sensors, installation errors, human errors, etc.

For many years, naval architects and consultants focused on the analytical estimation of each parameter influencing the ship's performance, known as the "resistance decomposition" method. Whilst the resistance decomposition method is ideal for academics, researchers and designers, the method is impractical for ship managers/operators. This is due to the method's inherent lack of adequate and systematic correlation with full scale actual conditions as well as the related uncertainties of the estimation of the resistance components for any ship under actual conditions.

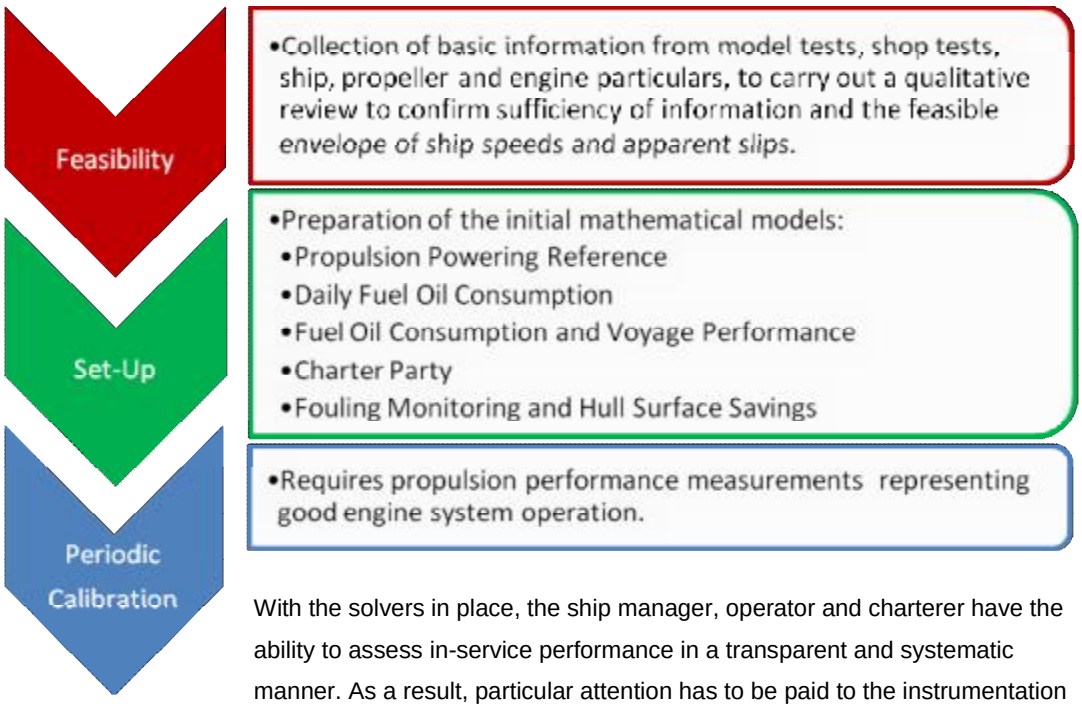
With SMM-SP, the "*quest*" is over.

SMM – Ship Performance (SMM-SP)

SMM-SP is a powerful toolbox for the assessment of ship propulsion performance, without the need to decompose the ship resistance elements, nor introducing uncertainties for normalizing actual operating conditions and measurements. The method utilized in SMM-SP is based on the principle that the propeller does not sense wind, waves, fouling or any other resistance. It does sense a reduction in the rate of inflow. More precisely, the rate of inflow variation which is incorporated in the ship's apparent slip; is related to a reference power for a range of operating speeds. The benefit of this method is that it is always applicable since it is not affected from the fluctuating environmental, vessel and hull & propeller conditions, provided that the propeller stays submerged and the ship does not drift.

Ship-specific

SMM-SP contains a variety of powerful solvers, representing the mathematical models specific to the ship under consideration.
The development of SMM-SP is carried out in three stages:

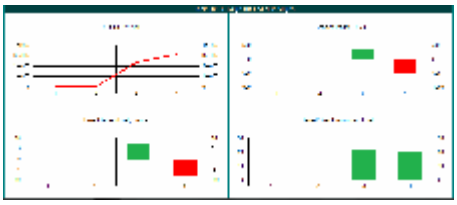


With the solvers in place, the ship manager, operator and charterer have the ability to assess in-service performance in a transparent and systematic manner. As a result, particular attention has to be paid to the instrumentation and measurement procedures. In order to achieve a meaningful comparison it is critical that the in-service measurements are taken on the basis of a well-defined methodology, using reliable, calibrated and accurate instrumentation.

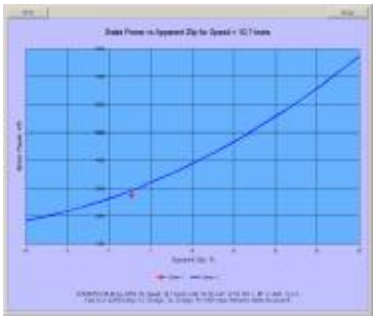
Technical Advantages

SMM-SP offers a number of technical advantages for the proper assessment of ship's propulsion performance during service.

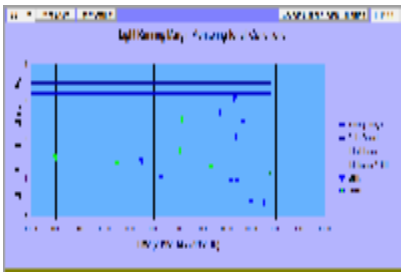
- **Unique Essential Calibration:** It is an industry fact that there are uncertainties associated with full-scale propulsion performance prediction and actual measurements. Since the in-service performance analysis involves the measurement of physical quantities, it is important to be aware of the errors involved. Random errors, which contribute to the scatter of the data and systematic errors which shift all readings to a new mean. Both types of errors are critical for long-term performance analysis. Random errors are in general simpler to deal with because they can be effectively reduced when an appropriate filtering procedure is applied. On the other hand, systematic errors are more complex because they may distort significantly the final outcome and lead to serious misinterpretations in the long-term. The systematic errors can be amended by calibrating the initial reference points so as to mirror the good performance of the engine-fuel system as intended. In order to perform the calibration, quality measurements need to be taken at milestones: after launching, dry-docking or main engine overhauling. Therefore, the calibration process of SMM-SP is not only unique to the ship, it is essential during milestones.



- **Voyage Performance:** In Charter Party agreements; speed and consumption warranties are incomplete or vaguely defined in engineering terms. Thus it has always been a challenge to determine whether ship performance is due to adverse external factors or due to a badly maintained engine system, giving rise to disputes between charterers and operators. The SMM-SP assists by establishing systematic records for the evaluation of the voyage performance against Charter Party: fuel consumption calculation, time calculation, charter party claim and overall voyage assessment.

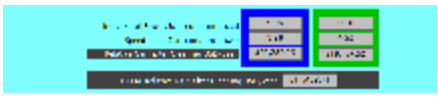


- **Fuel Oil Consumption Reference:** SMM-SP has a solver for the derivation of fuel oil consumption reference points in the format of tonnes/day or kg/mile.



- **Propulsion Performance:** For Overall Engine-Fuel System Evaluation, any systematic unreasonable deviation between the actual points from measurements and the reference powering points from SMM-SP; alerts the ship operator to inspect the ship's engine system so as to check for important faults such as fouled turbochargers, faulty injection or erratic combustion due to lower quality fuel oil. SMM-SP is not intended to substitute the diagnostic task of a chief engineer on board, however it assists those ashore to monitor and evaluate the overall performance of the engine-fuel system.

- **Light Running Margin:** Concerning monitoring of Roughness & Fouling, the ship has been designed and built with a light running margin. Over time and under same weather conditions, the margin is reducing due to increased hull roughness and fouling.



- **Hull Surface Savings:** SMM-SP includes a solver for the estimation of the loss of speed and increase of power based on Divers' Report. In addition, the relative gain ($/year) for hull cleaning or new coating application is derived.

- **Compliance with Environmental & Energy Regulations and Industry Standards:** The introduced CO_2 index scheme for ships such as the Energy Efficiency Operational Index (EEOI), the mandatory implementation of a Ship Energy Efficiency Management Plan (SEEMP), the Monitoring Reporting Verification (MRV) Scheme, the optional integration of the ISO 50001 Energy Management Systems (EnMS) and the applied Tanker Management Self-Assessment (TMSA) elements for energy efficient operations by tanker operators, all require continuous monitoring and assessment of the ship's propulsion performance. In turn, the assessment would infer transparent procedures and practical tools to be in place from start. Unfortunately, Shipbuilders do not usually provide Shipowners the required information, let alone the tools. Hence most ship managers and operators need to either invent these, or carry out in-house research, or seek external support in order to keep up with regulations and industry standards. The SMM-SP becomes a practical solution on the matter.

- **Monitoring of Shipboard Personnel:** With SMM-SP the ship manager and operator can monitor remotely the situation onboard. In that way, any arbitrary actions, such as hidden fuel oil reserves or measurement inconsistencies from the part of the crew can be assessed.

- **Turning Information into Action:** SMM-SP allows the user to integrate own alert levels, thus helping with the interpretation of the information and plan future actions.

Benefits

- **Accuracy:** There are many solvers and services in the market, aiming towards ship propulsion performance assessment, requiring many parameters to be monitored dependent on the methodology applied, thus adding on the overall complexity and the implementation cost for the user. It is worth adding that most complex methodologies have either hidden, or undefined, or higher uncertainties by default. SMM-SP uses only the minimum number of parameters, as required by its method, leading to inherently greater accuracy than the classic resistance decomposition method.

- **Image and Reputation:** The use of SMM-SP demonstrates the commitment of the ship manager and operator towards a systematic monitoring, preventative and ongoing improvement strategy that companies with quality, environmental and energy management policies apply. Its use portrays a trustworthy image and builds up reputation.

- **Affordable:** SMM-SP is by far the most affordable toolbox in the market today. Don't take our word for it. Just do the comparison yourself.

- **Easy to Implement:** An intuitive user-friendly interface makes its use a play. You'll be up and running in minutes!

- **Value for Money:** A unique toolbox offering high added value and benefits in today's techno-economic world of ship operations.

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Company Profile and Services

Improving your ships and operations is the key driving force of our business

S.A. Malliaroudakis Maritime (UK) Ltd. specializes in marine software and consultancy services with experience and commitment to the shipping industry since 1986.

The company's products and services aim to maximise customer benefits through increased efficiency of ship management and operation. This objective, stemming from dedicated work and deep understanding of our customers' needs, is achieved by:

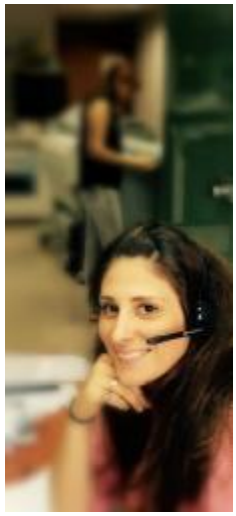
- Developing innovative products based on the latest marine and information technology.
- Ensuring that our products stay up-to-date and of superior quality.
- Offering practical solutions to real-faced problems.
- Having an efficient infrastructure to better serve our customers' needs.
- Developing and maintaining customer relationship based on trust and loyalty.

Easy-to-use software

Our objective is to develop and offer practical software solutions, helping our customers in their day-to-day work.

Our innovative Multiload for Windows program is a very successful example of such software. It is the only loading program in the world covering seven ship types simultaneously. Also, our Crew Rest Hours, Oil Record Book Trainer, SQUAT/Tide Calculation, Bunkers Survey Software are all designed to assist day-to-day ship management and operation. Also, we provide coverage of your vessels and effective response in times of crisis via our Emergency Response Service (on a 24 hour basis).

Contact us anytime and find out how you can benefit.



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Frequently Asked Questions

What is the technical background of the SMM-SP software?

SMM-SP is a toolbox for the assessment of ship propulsion performance. Unlike other software solutions found in the market, SMM-SP does not need to decompose the various ship resistance elements, nor introduce higher uncertainties for normalizing the measurements from actual operating conditions.

The SMM-SP toolbox contains a variety of solvers, specific to the ship:

- For the Voyage Performance module, the solver is based on the monitoring and reporting of basic parameters during the voyage, their comparison against reference values under actual conditions and charter party terms and warranty conditions.

Overall Voyage Assessment =	Function { Fuel Consumption Calculation, Time Calculation, Charter Party Claims }

- For the Propulsion Performance module, the solver is based on the principle that the propeller does not sense wind, waves, fouling or any other resistance. It does sense a reduction in the rate of inflow. More precisely, the rate of inflow variation, which is incorporated in the ship's apparent slip, is related to a reference power for a range of operating speeds. The algorithm is based on the well-known theory of propeller slip, first put in practice by Prof. E.V. Telfer and since applied by ship managers, operators and charterers worldwide. The user can optionally define the in-service acceptable envelope of main engine's specific fuel oil consumption. The solver defines the reference power and daily fuel oil consumption anywhere within a defined envelope (max-min) of ship speeds and propeller slips.

Power =	Function { Speed Through Water , Apparent Slip }

Daily Fuel Oil Consumption =	Function { Power , Specific Fuel Oil Consumption }

- For the Light Running Margin module, the solver is based on the principle that under same weather conditions, the margin reduces due to the increase of hull roughness and fouling. The software captures the reduced margin over time.

Margin =	Function { Power , RPM , Weather }

- For the Hull Surface Savings module, the solver is based on ship-specific algorithms, which estimate the loss of speed and increase of power by interpreting the findings of underwater inspection. The software allows the operator to derive the relative gain ($/year) in deciding hull cleaning or new coating application.

With the software in place, the user can then:

- evaluate the voyage performance against Charter Party terms and provisions
- compare the measured values during service with the respective reference values for power and fuel consumption
- monitor the light running margin due to increased roughness and fouling over time
- monitor the condition of the underwater hull surface and derivation of the savings from hull cleaning or new coating application

Is the SMM-SP service applicable for all ships?

The SMM-SP service is applicable for modern merchant vessels built with fixed pitch propeller, including but not limited to: General Cargo Vessels, Bulk Carriers, Ore Carriers, Chemical/Product/Oil Tankers, Gas Carriers, Container ships, etc.

Why is the feasibility stage necessary?

The feasibility stage is necessary in order to verify that the information provided is sufficient as well as suitable for the preparation of the ship-specific software service. If the information proves sufficient and suitable for purpose, then the ship-specific mathematical model will have a defined envelope (max-min) of ship speeds and apparent slips, within which the solvers will perform.

What information do I need to forward to SMM for the feasibility stage?

The following information will need to be collected and forwarded in electronic format or hard copies:

- Ship Type and Particulars
- Model Tests Report
- Propeller Plan/Drawing
- Engine Particulars
- Shop Tests Report and, if available, the Engine Manufacturer's Nominal SFOC Table at ISO Conditions

The hard copies are returned back to customer.

What is the periodic calibration and how often is this carried out?

The SMM-SP toolbox contains ship-specific mathematical models. Calibration is essential in order to ensure representation of a good engine system operation, according to the latest milestone set of quality performance measurements. In general, performance measurements tend to be carried out at milestones: after launching, dry-docking or main engine overhauling.

Do I need all the measurements taken onboard?

Particular attention should be paid to the instrumentation and measurement procedures. In order to achieve a meaningful comparison it is critical that the in-service measurements are taken on the basis of a well-defined methodology, using reliable, calibrated and accurate instrumentation.

In order to reduce the scatter of the recorded data and ensure that the instrumentation provides the user reliable measurements, it is recommended to exclude measurements when any of the following conditions apply:

1. Large fluctuations of speed, Large ship motions.
2. Acceleration and deceleration of the ship, Periods of transit.
3. Propeller emergence and ventilation.
4. SS>3, BF>4.
5. Outside the range of Drafts found in model tests report.
6. Outside the range of Speeds tested in model tests report.

How do I review the ship's performance against the Charter Party?

Extract from Marine Insurance P&I Club News, dated 4 June 2015:

> *Performance (speed/consumption) claims remain a common complaint from Charterers and a common source of deductions from hire. The frequency of such claims over the last five-six years (since the crash in hire rates in early 2009) is more often than not attributed to the increase in bunker prices as well as technological advances in monitoring vessels adopted by Charterers. That said with hire rates not increasing dramatically and the current drop in bunker prices a drop in performance claims might have been anticipated. However, this does not seem to be the case, with performance remaining a real issue on both a small and large scale. Perhaps what has changed is the cause of such claims with e.g. hull fouling being a commonly cited cause for both reduced speed and over consumption.*

Particular attention should be paid to the warranty conditions which take many forms. The following example, stated to apply throughout the charter period, is typical and is adopted herein for discussion purposes:

> *"… speed/consumption is given on the basis of unrestricted navigation in open deep waters, good weather conditions winds not exceeding Beaufort Scale 4 and/or Sea State 3 and not against adverse currents and adverse swell …"*

The principle feature of a continuing warranty is that it should establish the benchmark against which Owners' continuing obligations are to be measured. The choice of words used will determine the warranty conditions that apply. In the above example, the warranty conditions are as follows:

1. In weather conditions not exceeding Beaufort Force 4
2. In sea conditions not exceeding Sea State 3
3. No adverse current
4. No adverse swell
5. No shallow waters
6. No restricted navigation

Now, let us compare the conditions shown in the previous question "Do I need all the measurements taken onboard?", with those in the example above. It can be observed that the former conditions represent a more robust technical framework and one that should be aimed in charter party agreements.

Therefore, SMM-SP takes into account the conditions which should apply for a fair evaluation of ship's performance.

Subsequently, when all conditions exist, the ship will be expected to demonstrate an ability to perform at the promised speed and consumption and will only be excused from doing so if one or more of the warranty conditions is/are absent.

Periods of warranty conditions are sometimes loosely referred to as good weather days. In fact, they should be more accurately described as good weather periods, as the periods of interest are not restricted to full days only.

Therefore, the SMM-SP user should establish sufficient individual and cumulative periods of warranty conditions, with respective sets of quality measurements to permit a reliable and objective assessment of the ship's performance.

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