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List of symbols and abbreviations

bkW	Brake kilowatts
CAPEX	Capital Expenditure
DP	Dynamic Positioning
DSGo	Damen Shipyards Gorinchem
GA	General Assembly
GT	Gross Tonnage
IMO	International Maritime Organization
IRM	Inspection Repair and Maintenance
MPM	Multiple Point Mooring
OPEX	Operational Expenditure
PoB	Person on Board
RoRo	Roll-on Roll-off
ROV	Remote Operated Vehicle
URN	Underwater Radiated Noise
WP	Work Package

1 EXECUTIVE SUMMARY

1.1 Problem definition

The objective of task 3.1 is to set the detailed requirements for a multi-purpose platform based workboats product family. These requirements are set in the form main dimensions and key performances which are to be used as input to the design efforts and functional modules determination in the following tasks of WP3.

1.2 Technical approach and work plan

A brief analysis of main operations, typical performances and characteristics of suitable designed and delivered workboats by the partner DSGo has been made prior to selecting the most relevant ones.

The analysis has only considered designs and built vessels by the partner DSGo, derived from various different markets such as aquaculture support, general marine contracting and environmental protection.

1.3 Results

A single platform able to carry out all the seven main different operations is designed. The platform will serve as base for a family of vessels originated by standardized modifications and scaling procedures.

1.4 Conclusions and recommendation

The operations and their main requirements described in this report, leading to the workboat platform definition, are based on the extensive database of recently ordered and designed vessels by the partner DSGo; they are assumed to be a good indication of the real market status quo.

The market analysis to be carried out during task 3.2 should indicate whether the current assumed results must be in anyway revised and discussed; additionally, from the results of the market analysis, some conclusions on the market share size for each operation will be drawn giving a more grounded and reliable market expectation analysis.

Finally, after conducting the detailed market analysis deliverable D3.1 will be updated if D3.2 provides new findings.



2 INTRODUCTION

This report is the deliverable of task 3.1.

The WP3 of the NAVAIS project aims to develop a platform-based workboat family which can efficiently and effectively satisfy a wide range of customer demands through the analysis and re-design of standard and scalable functional modules often present in the workboat industry.

Even if it is a small part of the worldwide tonnage, the workboat market, due to its multi-purpose nature, has often been characterized by a customized engineering to order process where the design procedure has been of the point-based approach in which an initial concept is iteratively refined up to the desired degree of accuracy.

2.1 Task/Sub-task text

- T3.1.1: Determine market expectations for workboats up to 500 GT and define combinations of geographical service areas and service types including corresponding regulatory regimes.
- T3.1.2: Determine workboat basic function such as payload, work deck area, speed, positioning, lifting capacity, hotel capacity and endurance.
- T3.1.3: Determine service conditions, maintenance requirements and infrastructures.
- T3.1.4: Determine an initial workboat classification (class profiles) and corresponding platforms.
- T3.1.5: Prepare the task deliverables

2.2 Approach

A modular workboat family will be identified as result of an analysis of the designed and delivered vessels to worldwide spread customers of the DSGo partner in the last 10 years.

For each analysed vessel/design the service/operational areas and basic requirements/functions such as: main dimensions, propulsion installation, cargo capacity and deck equipment will be collected.

From this partial technical analysis however no conclusions on the relative actual and foreseeable workboat market volume size will be drawn; for this purpose the market analysis will be carried out in due course of task 2 of the WP 3.

3 PLAN

3.1 Objectives

The main objectives of Task 3.1 are:

- The detailed requirements for the platform-based workboat product family.
- The initial classification of the workboat product family

3.2 Planned activities

The task 3.1 started with respectively defining and analysing the workboats and their typical operations based on the extensive database of recently ordered and designed vessel by the partner DSGo.

Moreover a proper look at framework of rules and regulations as well as area of operations in chapter 5 has been carried out.

Finally the basic requirements and the initial workboat classification are described in chapter 6.

The task deliverable is developed by the partner DSGo.

3.3 Resources and Involved partners

Project partner DSGo performed the required studies and contribute to the task deliverable. The task deliverable is developed by DSGo.

3.4 Timeline

The work is executed during the first 6 months of the project. The task deliverable is due to be completed at the end of project month 6 (M6), on 30th November 2018. Issue of the task deliverable at M6 is required as input for tasks T3.2 which is to start shortly afterwards.

4 PLAN EXECUTION

4.1 Performed activities

An initial task kick-off meeting, internal members of DSGo partner only, was held in the course of August 2018 to structure the task work and set timelines for preparing the task deliverable.

The task work was executed as planned and no major deviations occurred.

5 ANALYSIS

5.1 Workboat generalities

According to the Oxford Dictionary a workboat is defined as "a boat used for carrying out various kinds of work", indeed the perfect definition for the most versatile vessel type in the shipping industry.

5.2 Workboat operations

Despite 98% of the IMO registered fleet¹ is dominated by vessels which are designed and operating for very specific tasks such as cargo or passenger transportation, the workboats are designed for carrying out various operations.

Typical operations of a workboat are:

- Towing
- Inspection, repair and maintenance (IRM)
- Diving & ROV support
- Environmental response
- Research
- Containerized dry and/or bulk liquid cargo transport
- Ro-Ro cargo transport with landing and/or grounding capabilities.

Each one of the above mentioned operations has certain impact on the vessel design in terms of size of the vessel, peculiar performances and dedicated equipment and systems. A deeper and more exhaustive explanation of both operations and design impacts is addressed below.

The below described main performances and characteristics of the different vessel type are based on extensive database of recently ordered and designed vessel by the partner DSGo.

- Towing

The vessel will use its pulling force to move other floating bodies and/or marine structures. The propulsion system will be designed for pulling conditions (typically fixed pitched propellers in nozzle) and the unit will be fitted with towing equipment such as a winch/hook, ropes and towing pins. For towing operations the manning can be kept to a minimum, i.e. 3-4 PoB.

- Inspection, repair and maintenance

The vessel will carry out IRM operations on marine structures and floating bodies such as navigational aids. The vessel will be designed with pulling capacities and with an ample deck space sufficient for the storage of the to-be-maintained structures. Additionally a deck crane with a daughter craft will be fitted. For enhanced operations the station

¹ Source IHS Fairplay database

keeping is usually guaranteed by a dynamic positioning system. A total manning of 6 PoB is expected.

- Diving & ROV support

In diving and ROV operation the vessel serves as floating base for divers and/or ROV operators. The vessel will be designed with an ample deck space able to carry the diving equipment (containers). The accommodation quarters will need to have extra rooms for divers and/or ROV controls; a total manning of 12 PoB is expected. Additionally a deck crane together with a moon pool will be fitted for ROV launching and tool handling. For enhanced diving operation the station keeping is usually guaranteed by a multiple mooring system or by a dynamic positioning system.

- Environmental response (ER)

The vessel is deployed for safe containment and recovery of polluting liquid spills at sea such as oil. The vessel will be designed with recovered liquid holding tanks and necessary deck space with container fittings for the spill containment and recovery system. The vessel will feature a deck crane to handle the recovery systems (skimmers) and an additional workboat to move the containment booms. This vessel type can be manned by 6 PoB.

- Research

The vessel will carry out oceanographic, fishery and sea bottom research. The vessel will be designed with ample deck space able to carry all the research and survey equipment (typically in containers); the accommodation quarters will need to have extra rooms for a laboratory and dedicated research personnel spaces. Key performances are station keeping with low URN during survey and towing of the fish catching cages/echo sounder. The necessary deck equipment will be deck cranes and A-/L-frames with winches. A total manning of 12 PoB is expected.

- Containerized dry and/or bulk liquid cargo transport

For this operation the vessel will be designed with necessary deck space with container fittings and liquid cargo holding tanks. Deck cargo will be handled by a deck crane while for the liquid cargo a dedicated system (pumps, pipes, and deck connections) will be fitted on board. Particular attention has to be paid to the stability of the vessel for safe navigation. Manning for this vessel will be 6 PoB.

- Ro-Ro cargo transport with landing and/or grounding capabilities

The vessel will carry wheeled cargo on deck to/from locations where berthing is not possible, either because the berthing infrastructure is absent or tide variations make it unusable. The vessel will be designed with ample deck space accessible by a ramp and with a shallow draught. To enhance the operability of the vessel the design features for controlled grounding (strengthened bottom structures and adapted water cooling capabilities) can be added. Manning for this vessel will be 3-4 PoB and some room has to be reserved for the drivers during sailing.



A summarizing table shows the main requirements of the operations as described above.

Operation	PoB	Deck area [m2]	Deadweight [t]	Pull force [t]	Main lift [tm]	Station keeping
Towing	4	N.A.	300	15-30	N.A.	N.A.
IRM	6	100-250	300	15	220	DP
Diving & ROV	12	100-250	300-400	N.A.	220	MPM
ER	6	150	400	N.A.	50	N.A.
Research	12	100-250	300	15	50	DP
Dry/liquid cargo	6	150	300-400	N.A.	220	N.A.
Ro-Ro cargo	4	250	300-400	N.A.	50	N.A.

Noteworthy reminder is that the above described operations and their typically main requirements are based on the extensive database of recently ordered and designed vessel by the partner DSGo and are assumed to be a good indication and representation of the real market status quo. The very same requirements will be checked with the market analysis results to be determined in Task 2 of WP 3.k

Although the great majority of the workboats will carry out a combination of these operations it is still possible to find examples of workboat designed just for a specific function e.g. the fire-fighting vessel and inland pusher. Below some pictures are shown as an example.



Figure 1: Fire-fighting vessel



Figure 2: Inland pusher

5.3 Rules and regulations

As all marine units, also workboats have to comply with the Classification society rules and the statutory prescriptions of the National Maritime Authority of which the vessel is carrying the flag.

The first-mentioned set of rules certify that the construction and maintenance of a vessel complies with internationally accepted and well established standards; complying with these rules is a necessary step to obtain a marine insurance policy for the vessel.

The second set of rules certify that the vessel is, at minimum, complying with the International Maritime Organization (IMO) requirements in respect of safety, security and environmental protection. Generally workboats complying with the European State members regulations will achieve the highest standard in the above mentioned fields.

By analysis of the application domain of rules set out by the classification societies and by the international convention it is found:

- SOLAS convention is applicable for vessel above 500 GT engaged in international voyages.
- Load line convention not applicable for vessel below 24 m rule length.
- Damage stability analysis not necessary for vessel below 500 GT.

From the above mentioned findings it can be concluded that both workboats designers and owners keep an eye on two key parameters of the vessel, being the 500 GT and 24 m rule length, in order to design and operate the vessel within a more relaxed regulatory framework than the ones applicable for international sea going vessels.

Within this range of vessel sizes designers have also to consider the local rules of the relevant Maritime Authorities (flag state). Just as examples:

- For vessels below the 24 m rule length the UK Maritime Authority calculates the tonnage in a different way than the international tonnage convention.

- For vessels below the 500 GT and with a total propulsion power of less than 1000 hp, the Norwegian Maritime Authority allows the manning of the vessel with less qualified seafarers.

Complying with local rules would finally lower both the operational expenditure (OPEX) and the capital expenditure (CAPEX).

5.4 Areas of operations

The workboats are typically operating worldwide from the Persian Gulf to the North Sea basin with clear implications on the vessel systems such as cooling, machinery spaces ventilation and air conditioning. Very few vessels, mainly tugboats, are deployed in extremely cold climates with sailing in iced water and de-icing of port terminal area capabilities.

Even though the workboats are very often designed and built for unrestricted navigation they mostly operate in the near shores.

The platform based workboat family should therefore be designed for unrestricted navigation and without any provisions for sailing in iced waters.

6 BASIC REQUIREMENTS

As mentioned in the first chapter of this report the primary goal of the NAVAIS project is to develop a family of workboats which should be designed in order to embrace as many operations as possible, as listed in Chapter 2 of this report.

6.1 Workboat family generalities

Workboats are typically built in marine grade steel. Other construction materials, e.g. aluminium and Fiberglass-Reinforced Plastic, will not be considered within this work package.

As already concluded in Chapter 2 of this report none of the developed products will cross the 500 GT limit. For classification the set of rules of the NAVAIS partner Bureau Veritas will be adopted while for statutory matters reference will be made to the IMO Codes and Conventions.

At present, due to the limited size of the platform, the typical requested range and the very discontinuous power request the only viable fuel option is Marine Diesel Oil (ISO 8217).

6.2 Workboat family technical description

The main idea is to develop a workboat below the 24 m rule length fulfilling the lowest side of the requirements.

Considering a maximum lifting capacity of 220 tm, from basic naval architecture calculations backed up by operating vessels data, it can be concluded that a minimum vessel beam of 12 m will guarantee the necessary stability for the vessel to operate safely.

With regards to diving & ROV, IRM and Research activities it is clear that the vessel might operate not far offshore in partially sheltered water with formed seas characterized by wave height up to 1.5 m. Looking at similar vessels of that kind it is noted that the typical operational draught can vary from 2 to 3 m. Therefore a freeboard of at least 0.9 m is advisable in order to maintain the working deck dry. This leads to a vessel depth of 3.9 m.

The above mentioned freeboard would guarantee safe navigations in coastal and often rough European waters such as the Scottish Orkney and Shetlands archipelagos.

Recalling the definition of the rule length, as a function of the vessel depth, it is possible to retrieve the actual length of the vessel on main deck which in this case will correspond to approximately 25 m.

Having fixed the main dimensions it is possible to define the internal layout of the vessel both in terms of work deck area and superstructure volume.

As stated in chapter 2, the clear work deck surface needs to be at least 100 m² and preferably, it should be maximised for carrying containers.

Being the vessel beam 12 m, it should be noted that some space needs to be reserved for mooring capstans, tank venting, escape hatches and possible crane foundations. From similar vessels it is found that a stripe of 1.5 m wide on each deck side will guarantee sufficient space for the above mentioned items. It can be concluded that for reaching 100 m² clear deck space on a 12 m wide vessel, the working area should be approximately 11 m long.

For vessel fitted with towing appliances, such as towing hook or winch, an additional 2 m long working deck is needed bringing the minimum deck length to (approximately) 13 m.

In a clear deck space area (LxW) of 11 x 9 m, 4 twenty feet long containers can be fitted.

From the initial main deck length of 25 m, 12 m can be reserved for the forecastle and superstructures where the accommodation spaces for 6 PoB will be fitted.

Accommodation should include a wheelhouse, single cabins, mess and day room, changing rooms, galley, stores and an office.

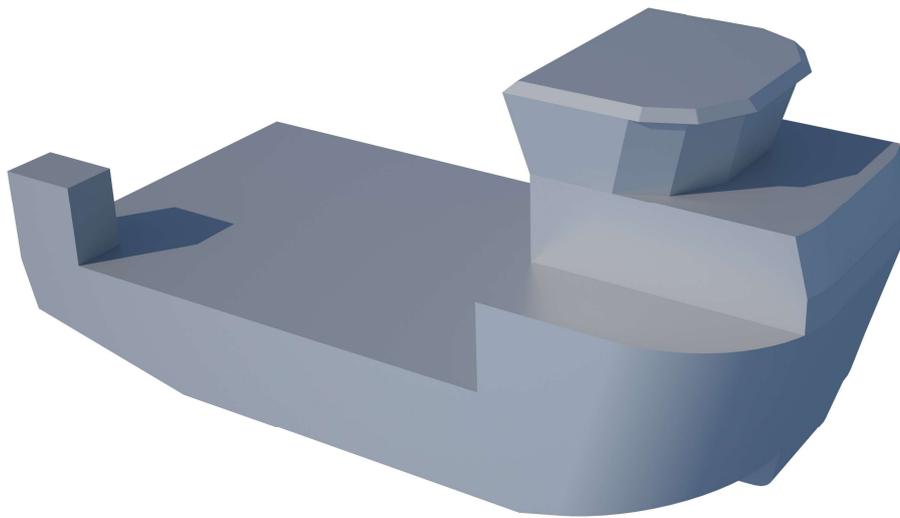


Figure 3: 3D model of the initial workboat platform

Finally, with regard to the ships propulsion system, due to the typically low CAPEX of the asset, a twin conventional shaft line with fixed pitch propellers in a nozzle driven by a diesel engine will be considered.

From the extensive full scale sea trials carried out over many years by DSGo, it can be found that for reaching the required minimum 15 t of pulling force, each shaft line should be powered by a 400-500 kW diesel engine.

7 CONCLUSIONS AND RECCOMANDATION

7.1 Conclusions

The table below summarizes the technical requirements of the workboat initial platform:

Length [m]	25
Beam [m]	12
Depth [m]	3.9
Working deck length [m]	13
POB [-]	6
Lifting capacity [tm]	< 220
Total propulsion power [bkW]	<1000
Propeller [-]	2x FP in nozzle

The family, of 3 other vessels, could then be created by scaling up the workboat by:

- Adding an extra accommodation deck for doubling the number of PoB,
- Elongating the mid-ship section up to the maximum allowed volume of the 500 GT for increasing the deck space and deadweight,
- Combination of the two solutions above.

In order to smooth the scaling up- /downwards of the model the hull and superstructure surfaces should be fully developable hull surfaces.

7.2 Recommendation

The operations and their typical main requirements described in chapter 5 of this report, leading to the workboat platform definition, are based on the extensive database of recently ordered and designed vessel by the partner DSGo; they are assumed to be a good indication of the real market status quo.

The market analysis to be carried out during task 3.2 should indicate whether the current assumed results must be in anyway revised and discussed; additionally, from the results of the market analysis some conclusions on the market share size for each operation will be drawn giving a more grounded and reliable market expectation analysis.

Finally, after conducting the detailed market analysis deliverable D3.1 will be updated if D3.2 provides new findings.

8 ANNEXES

8.1 Public summary

8.1.1.1 Problem definition

The objective of task 3.1 is to set the detailed requirements for a multi-purpose platform based workboats product family. These requirements are set in the form main dimensions and key performances which are to be used as input to the design efforts and functional module determination in the following tasks of WP3.

8.1.1.2 Technical approach and work plan

A brief analysis of main operations, performances and characteristics of suitable designed and delivered workboats by the partner DSGo has been made prior to selecting the most relevant ones.

The analysis has incorporated designs and build vessels, by the partner DSGo, derived from various different markets such as aquaculture support, general marine contracting and environmental protection.

8.1.1.3 Results

A single platform able to carry out all the seven main different operations is found. The platform serves as base for a family of vessels originated by standardized modifications and scaling procedures.

8.1.1.4 Conclusions and recommendation

The operations and their main requirements described in chapter 5 of this report, leading to the workboat platform definition, are based on the extensive database of recently ordered and designed vessel by the partner DSGo; they are assumed to be a good indication of the real market status quo.

The market analysis to be carried out during task 3.2 should indicate whether the current assumed results must be in anyway revised and discussed; additionally, from the results of the market analysis some conclusions on the market share size for each operation will be drawn.

Finally, after conducting the detailed market analysis deliverable D3.1 will be updated if D3.2 provides new findings.

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