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FLOATABLE CONTAINER WORKSHOP - A SMART SOLUTION TO INCREASE THE SHIPYARD PRODUCTIVITY

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ABSTRACT

In the paper the research performed within the European project SMARTYards is described. The idea is a specially designed and built mobile workshop, equipped with tools and machines for small operations such as welding, grinding, drilling, cutting, bending, etc. The mobile workshop is a module structure (a container-workshop placed on a pontoon); in this way it could be displaced by sea and used directly on the water, or be lifted with a crane and used on the dock or the deck. This paper provides a description of the prototype; its development stage was successfully performed, the design activities were carried out, then the building stage was also performed. At present, the installation of the equipment according to the lay-out is being carried out. Validation of the prototype as well as the assessment of its real productivity was performed during the validation in the shipyard.

Keywords: floatable workshop, mobile container workshop, smart technology.

1. INTRODUCTION

The SMARTYards project was focused to improve the productivity of European small and medium sized shipyards and their subcontractors by at least 20%. This objective has been achieved by improving knowledge and technological skills, in order to survive in a big global competition and to provide qualitative and innovative products. The objective is important because the technology gap between larger and smaller European yards has increased significantly over the last decades. The project partners have developped, tested and validated smart technology solutions particularly addressed to the specific needs and challenges of the target group. Seven key Technology Areas with related innovative ideas have been identified during the project activities. These areas represent critical processes from design through production to repair, conversion and new buildings. Finally all solutions have been introduced and documented in a Technology Catalogue. All technical developments have been completed by the innovative business models, productivity and environmental assessment, the development of training schemes. A sustainable innovation network (named SMARTYards cluster) in close cooperation with European associations has been created.

While improving the technology level of small and medium sized companies, the project has contributed to the overall competitiveness of the EU maritime sector, sustaining the wide network of large and smaller companies.

Within workpackage WP6 (Training Material and Schemes) of the SMARTYards project, the activities have been focused on the prototype developed in Technology Area 6: Floatable and Portable Container Workshop.

During shipbuilding and repairing many activities that require small machining operations appear. These activities force workers to move from the ship to the workshop in order to manufacture the required small piece. The time involved in these displacements may be really significant; in addition, not only is the worker who travels from one place to another wasting his working time, but also ordinary activities at the workshop are disturbed. These continuous displacements and time wasting will be avoided by using the solution developed within the project.

The idea of the research is a specially designed and built mobile workshop, equipped with tools and machines for small operations such as welding, grinding, drilling, cutting, bending, etc.

2. FLOATABLE CONTAINER WORKSHOP

The floatable mobile workshop is a module structure (a container-workshop on a pontoon); in this way it could be displaced by sea and used directly on water, or separately the container can be lifted with a crane and used on the dock or the deck.

For ship repairing in shipyard, many operations, especially for equipment in engine room, need small machining and therefore moving workers from the ship to the shipyard workshop.

The mobile workshop (container + pontoon) could be displaced by sea using the pontoon and then it could be lifted with a crane to the dock or even to the deck in big vessels. It will be also possible to use the container placed directly on the pontoon.

The mobile floatable platform will avoid the frequent workers travelling to the workshop and therefore it will allow the productivity to meaningful increase.

The mobile workshop (Fig. 1) is a modular structure (a container-workshop on a pontoon), being also a multifunctional system, with three working areas to obtain the best efficiency:

- one area inside the container especially for machining operations;
- the second and third areas on aft and fore ends of the pontoon, placed outside the container, especially used for welding, grinding and steel cutting operations.

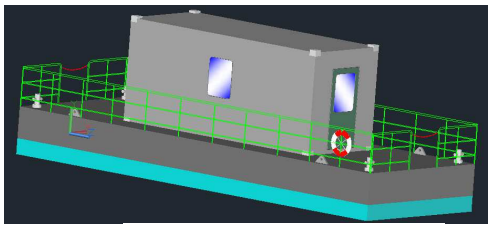

Fig.1. The Floating workshop model

The main dimensions of the system are:

- Pontoon: L=11.50m; D=1.10m; T=0.35m. Lightweight structure.
- Container: L=6.00m; B=2.60m; H=2.40m. Lightweight structure.

The container-workshop is fixed on the pontoon with a mobile fixing system (container locks).

The main important item of the workshop is to have a lightweight structure, having the possibility to be placed in various places in shipyard, by lifting it with a crane.

The pontoon is not a classical landing pontoon, but is a dedicated pontoon. The restrictions requiring the minimum free board have been considered in the stability calculus. The pontoon has been designed to operate in inland waterways so that the stability requirements of the national and international rules have been fulfilled. To obtain lightweight structure, for the floating workshop a hybrid system has been adopted: a

hybrid structure concerning frames (made out of steel pultruded profiles) and panels (made out of aluminium as outer skins and inner skins). Between the two skins the insulation (made out of specific naval material: mineral wool) is provided.

The main characteristics of the system are:

- the mobile workshop system (a container placed over a pontoon).
- the container may be easily moved from one place to another in the shipyard
- the container workshop can also be used directly on the pontoon or on the ship.
- three working spaces: one inside the container, two outside, on the pontoon deck (fore ad aft).
- two doors (placed on container ends), one window.

Fig.2. The floating container workshop in shipyard bay

Fig.3. Workshop activity inside the container area

Fig.4. Workshop activity on outside area

Once the container and the pontoon were built, the next stage was installing the equipment and machines according to the lay out which had been previously designed in accordance with the requirements (Figs. 2, 3 and 4).

The working tools placed inside the container workshop are: Fixed electric drilling machine, Mobile electric drilling machine, Fixed electric grinding machine, Mobile electric grinding machine, Fixed electric pipe and profile cutting machine, Mechanical tool box, Small welding machine, Portable electric air compressor, Mechanical extractor kits, Bearing pullers, Induction heating machine for bearings, Manual hydraulic press, Pipe bending machinery, Roll grooving tool for piping systems fabrication assembly, PPR welding machine, Compressed air connection, Portable light, Chain hoist, Mechanical jack, Accessories of crane [1].

The Stability criteria are evaluated acc. To Bureau Veritas - Inland Navigation Rules November 2011, [2] Pt B, Ch 2, Sec 2, 4.1 General intact stability criteria.

3. PRODUCTIVITY AND ECONOMIC POTENTIAL

The portable container workshop is a technology that shortens the distance between the place where a part is assembled or disassembled and the place where it can be manufactured or modified. It thus makes these operations more efficient.

The main benefits for the end-user are that the machinery at the workshops can be used more productively and that the worker time is used a lot more efficiently by eliminating wasted time, such as travel, waiting and transport time. It thus has a positive impact on labor cost.

In the evaluation, it was shown that the portable container workshop can shorten repair operations by 36%. Especially in shipyards with high wages, this is an important achievement. The end-user is not located in one of the countries with high wages, yet the financial assessment was positive. In the end-users case, the payback time of the container workshop is 4.18 years and the periodical ROI for 5 years is 6.1%. In a country with high wages, these numbers would be even better.

The introduction of the container workshop reduces risks that are induced by traveling through a shipyard. The risk for Health, Safety and Environment, that could arise by using it were addressed. Additional safety measures could be necessary if the scope of usage changes.

According to Fig. 5, by using the prototype, we obtained around 20% better utilisation of Shipyard planning personnel over the time period.

According to Fig. 6, by using the prototype, the Return on Investment (ROI) is of about 5 years (depending on the scenarios). This prototype allows improving the quality rate in the shipyard activity. In addition, the decreased of the lost times in the working sector allowed them to check the results.

During shipbuilding and repair, many activities require small machining operations, which forces workers to move from the ship to centralized workshops. These travels lead to waste in the process, which will be explained with the following example.

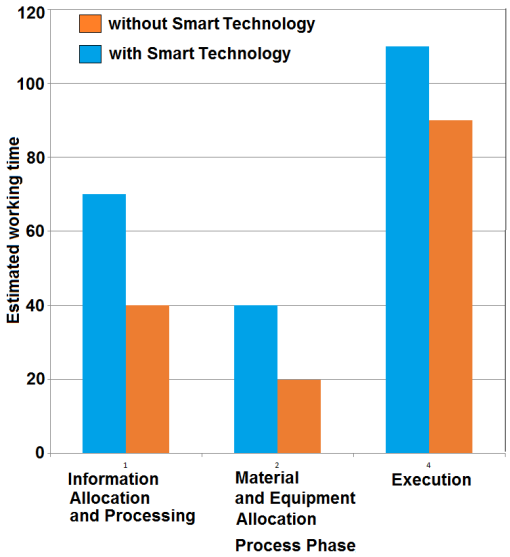

Fig.5. Estimated working time versus workshop activities options

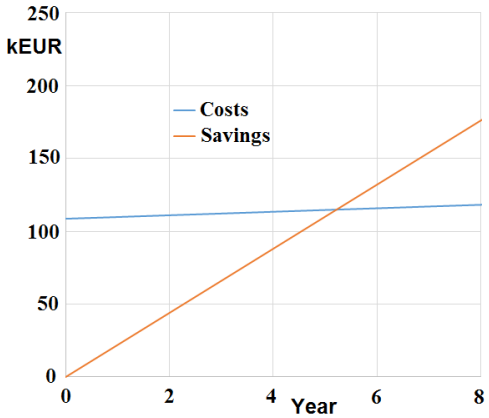

Fig.6. The Return of Investment

The following tasks are necessary for an exemplary replacement of a piping segment during repair activities (without the smart technology):

- identify the piping segment to be replaced (on board of the ship);
- determine necessary materials and operations;

- cut / disassemble old pipe segment and take measures for the new piece;
- travel to the workshop;
- get materials, wait for free work space, cut a raw shape of the new material (or wait for completion);
- travel back to the ship;
- check the pipe dimensions and it's components and adjust if necessary;
- travel to the workshop;
- finalize the welds;
- travel to the ship;
- mount the new segment.

Additionally to the possibility of having to wait for free work space in a centralized workshop, the activities given above can also disturb the normal workflow in that workshop.

Implementing the portable container workshop in the shipyard has an instrumental impact on these activities. It eliminates the need to travel to the workshop to work on the material. These travels can take up a lot of time if the distance is significant. It also eliminates waiting times and possible disruptions of the workflow in the classical workshop. The actual working time in the classical workshop consists of:

- Internal bureaucracy: talking to the supervisor, filling in the documents, launching the work order, etc.
- Manufacturing time / waiting for the required part in the workshop.

The main issue concerning the manufacturing is the fact that the operator in the workshop will stop his ordinary activity and manufacture the part, while the worker from the ship will simply wait, wasting time. This can also occur the other way around.

Additionally, it is possible to store small amounts of material in the container and on board of the pontoon for scheduled operations. During repair operations necessary materials can also be stored on board of the repaired vessel. If one of these options is the case, the portable container workshop totally eliminates the need to travel.

Although the concept of the prototype appears as simple, the introduction of the prototype in a shipyard is a strategic business decision as it offers much flexibility for production workers affecting their productivity.

However it does require an investment and when successful in use, can be become a scarce key resource.

The prototype business strategy was discussed within SMARTYards shipyards and only one realistic strategy has been identified.

The identified strategy is for Floating container workshop to be incorporated in the shipyards production process (repair, new buildings, outfitting).

The floating container workshop is owned, operated and maintained by the shipyard (Fig. 7).

The choice for this strategy is most likely done by a shipyard having multiple locations where ships can be moored and where the distance to the workshops is substantial. With the use of the floating container workshop man-hours spent by walking back and forth can be reduced.

From a human factors point of view there is a chance that workers may not like the idea, because they may lose their periodic contacts in the workshops and the small talk.

Fig.7. The inserting of Floating container workshop in the shipyard activity

On the other hand, the concept reduces the physical load for workers, which is beneficial in the event of many older employees. Further it increases the independence of workers as they can do the job at location vice under supervision of a workshop manager.

To ensure support of the future workers, it is advised to install a user group consisting of representatives of future users. This user group can provide much valuable and very practical information on the requirements of a future workshop.

Having all of this in mind, it could be noticed at NAVREP that workers embraced the concept very well.

4. CONCLUSIONS

The Floatable container workshop has been successfully performed within European project SMARTYards: the design activities were carried out; then the building stage was also performed. The mobile workshop system was built in NAVROM SHIPYARD that was end user in the projects. Nowadays, the system is introduced in the shipyard activity. Real performing as well as real productivity data will be assessed during the validation period. Calculations of estimated productivity have been made in order to assess the economical feasibility of the prototype; from this basis it has been concluded that the floatable workshop would cover this main productivity and efficiency objective: lead time would be reduced from 620 to 3800 hours per year. In economic terms, savings would vary in the range of 12000 to 20000 €/year, depending on the economical status of the state and region in which the shipyard is situated.

Benefits from the using of Floating Container Workshop can be resumed to the following two items:

- The implementation of the idea in the shipyard working facilities brought a plus of productivity by eliminating unnecessary travelling time for the workers in addition to various activities developed on board of the vessel, eliminating further bureaucracy and time stops in the workshop, improving safety and environmental conditions, all of this by only bringing the "workshop" next to the ship.
- There are no significant risks involving the exploitation of the prototype in the shipyard over common risks present in use of equipments in the shipyard activity.

Certain lessons learned from the use of Floating Container Workshop can be resumed to the following three items:

- An useful lessons learned database that can be used to continually improve project in just a few simple steps.
- The floating workshop can be adaptable to the shipyard type (inland or maritime).
- The pontoon hull can be provided with a stern shape in one ends of the pontoon, to have possibility to be carry on outside the shipyard for small repairing.

The research group has planned an exploitation of the SMART Prototype Floating Container Workshop:

- Building a new system on demand.
- Developing of the prototype for other activities. E.g.: using only the pontoon for carrying oversized pieces etc.

Acknowledgements

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