The MUNIN project

The MUNIN project is investigating potential concepts for a fully or partially unmanned merchant vessel. The case ship is a dry bulk carrier of handymax size, operating on routes between Europe and South America. The project is being partly funded by the EU in pursuit of one of the projected outcomes of the European Waterborne Strategic Research Agenda: The autonomous ship. The project has now come to the end of the first 16-month phase of its three-year duration and, although much work remains to be done, it is time to look at some of the results.

The MUNIN project has not found any fundamental obstacles to the introduction of unmanned ships. This is not to say that these do not exist, but they are mainly related either to the public perceptions or to current cost levels for certain types of equipment and consumables. So far, we are quite confident that we will be able to develop a probable conceptual design, although this does not automatically mean that we will see any realizations in the near even medium term. However, we do expect that some of the necessary technology, such as improved maintenance strategies, shore control centre assistance and better sensor systems, could have a significant impact also within a shorter time frame.

Benefits of unmanned ships

Partly or fully unmanned ships will offer many possible benefits, but one of the main driving forces for the project has been the problem of recruiting sufficient qualified crew-members. This is already a significant problem in Europe, and it will increase as “slow steaming” becomes more widespread. Lower speeds and longer voyage durations will increase the overall demand for crew while reducing the attractiveness of the job: staying at sea for three weeks or more and
communicating with friends and family via an expensive and slow Internet connection is not a job description that is likely to attract many young people today.

Reduced operating costs are obviously also an important factor. Crewing costs are increasing and under slow steaming, additional crew time onboard cancels out much of the fuel savings. Having fewer or even no crew onboard is certainly attractive from this perspective. On the other hand, an unmanned ship will need additional equipment and other technical solutions than a manned ship. For example, communication costs related to remote monitoring and control may well increase. In order to acquire a more complete overview of this picture, MUNIN will perform an in-depth cost-benefit analysis once the operational concepts have been developed.

Safety is paramount – keep it simple!

The idea of a ship sailing without a look-out and helmsman is worrying and even frightening to many people. One important part of the project, therefore, is to show that unmanned ships can be at least as safe as conventional vessels, and may even be safer. Professionals agree that “human error” is the cause of between 65 and 90% of shipping accidents. While the definition of human error and the role played in it by technology can be discussed, there is arguably great potential for improving safety by relieving the crew of the most tedious tasks, such as keeping a look-out over open sea for three weeks at a stretch. Stories of small boats nearly being run down by large vessels can testify to this. However, replacing crew by technology may involve complex solutions that can lead to safety problems themselves. To reduce this problem, the MUNIN project will employ the KISS principle: Keep It Simple and Stupid! It is critical that the technology employed is well-tried and trustworthy. It is also important to use the appropriate technology for the problems at hand. This requires a holistic view of how operational principles and technology requirements can be combined.

One consequence of this could be to restrict unmanned sailing to open sea and rely on manned operation for port approach and departure. Already during planning of the MUNIN project, it was regarded as unlikely that it would be acceptable to sail unmanned ships in congested or coastal waters. To do this, one would probably have to rely on reserved sailing lanes with special traffic restrictions and high capacity data links for continuous remote monitoring and control. This option will continue to be examined by the project, but we do not expect that it will be part of the final concept specifications.

New functions for the autonomous ship

The KISS principle will also be applied to the ship itself and it is also important to look at how existing vessels can be modified to support unmanned operation. At the hardware level, technical modifications will be necessary, for example to the fuel-processing system, while an electric-powered water-jet for back-up propulsion and steering may have to be retrofitted.

New sensors to replace the look-out are also an important part of the unmanned ship. A combination of high-resolution radar, low-light and infrared cameras form the ’advanced sensor system’. Most of the technology involved is already available and its adoption would be more a question of cost than of general availability. The sensor system will be integrated with more conventional equipment such as the AIS system and ARPA radar. Computer-based data fusion, using information from the various sensors, will further increase the capability of the sensor system.
communication to be routed through to the SCC operator. The question of detecting and recognizing visual signals such as emergency flares must be looked into. We will also consider whether unmanned ships will need special classification, e.g. as regards AIS transmissions and collision-avoidance regulations.

Technical reliability is a critical factor

The overall technical reliability of the unmanned ship is obviously a critical factor. With no crew onboard important systems cannot be allowed to fail as on-board repair or improvised procedures to get the ship safely back to shore will not be possible. Critical systems must either be duplicated or be sufficiently reliable to last through the whole ocean passage. On the other hand, where cost and efficiency issues are involved, it is not currently an option to use, two-engine systems or diesel-electric propulsion. The low cost and high energy efficiency of bulk carriers is mainly related to their use of a single highly efficient two-stroke diesel engine. This means that solutions will have to be found that eliminate the main failure modes from this configuration. Maintenance strategies must also be developed so that any degradation in performance can be detected sufficiently early to enable repairs to be made. One example of this is that heavy fuel oil is probably out of the question, as the necessary fuel treatment system and operation may be too difficult to automate. A problem with this is of course the much higher costs of distillates. On the other hand, this also means that there is an opportunity here to look at alternative fuels such as LNG.

Shore supervision and control

Another consequence of the KISS principle is the introduction of the shore control centre (SCC), which will cooperate with the ship’s own systems to ensure effective and safe operation. The ship systems will relieve the SCC operators of tedious monitoring and control tasks for most of the voyage. In the event of something unexpected that is beyond the capacities of the onboard systems, the SCC can rapidly provide human guidance. On the other hand, minimising SCC interaction with the ship will be important as a means of reducing communications costs.

Automating the look-out also raises the issue of how to handle direct interactions with other ships, VTS and other shore facilities. Such facilities must be in place that will enable AIS, VHF and other
The unmanned ship must also be a green ship

Energy efficiency and the reduction of harmful emissions are increasingly important issues in international shipping and must also be considered for the unmanned ship. In line with international developments, MUNIN also aims to improve energy efficiency. One aspect of this is slow steaming itself, but additional provisions will be made both in the on-board automated systems and in the shore control centre to ensure that the ship always operates as efficiently as possible. This is closely related to improved engine operation and maintenance.

Finally, a potential barrier to the introduction of unmanned ships could be legislative and commercial constraints. Unmanned ship will have to be permitted to sail by relevant flag and coastal states and will also have to be accepted by class societies and insurance companies. This is obviously a complex area, but so far, no fundamental obstacles have been identified. Prescriptive technical standards will need to be complemented by goal-based standards and legislation will have to be based on documentable performance rather than on technical compliance alone.

Please contact us

MUNIN is planning a number of public dissemination events in the two years that remain of the project, and we invite you to contact us if you are interested in more information on MUNIN or its results.

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