Ship control systems – reducing the risk

We have all heard about the risks of errant ship control systems – but fixing the problems is much more tricky. *Digital Ship* ran a conference with Lloyds Register to explore the options

A GROWING NEED for "lite" automation was the feeling among many of those present regarding the problems with current shipboard systems.

The increasing range of available functions is not proving beneficial to the users or owner, many of the delegates felt.

None of the drivers [which encourage the development of so many functions] are credible with respect to user or owner need, and potentially increase risk because they are more difficult to use, or reduce overall integrity due to increased system complexity.

This also applies to the presentation of information and alerts.

It was agreed that both functions and information must be tailored to the problem for which they are needed, rather than the current case of individual preference or supplying everything that can be made available.

An equally important problem is lack of specification with respect to the degree and type of integration of systems.

There was a tacit consensus amongst attendees that shipyards do not address the issue of control or of complex, integrated systems, but that they cannot be responsible for creating solutions to these problems.

A performance standard for system integrators was mooted during the discussion of the requirements of integration.

It was noted that the industry has been developing down dual tracks.

There is a progressive market of shipowners, which is learning how to specify requirements and willing to pay for individualized solutions, working next to a 'bread and butter' market, consisting of standard ships where the manufacturers drive innovation by selling-on selected functions and features from progressive market innovations and other sectors of industry.

There are also some sectors which have been perceived to shift between groups. For example, the tanker market has recently been seen to be moving into the progressive market.

Another issue raised in this area was that of industry learning. Solutions such as common specifications, standards addressing systems rather than equipment and more sharing of experience were suggested as possible areas for improvement.

Concerns were raised about crew not getting the chance or being required to increase their levels of competency, especially in the engine room where seafarers have begun to feel that they are now being driven by the automation, rather than the reverse.

Recommendations from the event

The issues raised and discussed during the day sparked suggestions and recommendations from different parties as to different ways to improve the operations of everyone concerned.

One of the key points was certainly the use of standards and regulation. Current standards and regulations are judged to act too late, and the feeling is that they do not address the risks that arise from novelty, complexity and differing levels of competence.

It is widely accepted, however, that change will be slow and will lag behind the need for improvement, since most of the industry has yet to learn that prescription is of limited value. What is needed is process improvement and goal setting.

There is also great diversity in the interpretation of the phrase "system integration" and the scope of such an activity. This will naturally lead to confusion between project stakeholders.

A system integration standard which defines the terms, scope and practice of system integration would be seen to be very beneficial, and many attendees offered to review such a standard as it develops.

Subsequent to the meeting the Defence Logistics Organisation (DLO) volunteered to run a project to define the technical content, and Lloyd's Register's Jonathan Earthy has made contact with another organization starting a general project in this area that could be extended to include maritime operations. Lloyd's Register will investigate converting the results into a standard.

One other impediment to technological development is that there is a considerable amount of research work and experience in the industry that is not shared. Many of the leaders in the industry are working on new projects that are not reported. It was suggested that Digital Ship may be able to make a contribution here, in investigating and publishing the findings of innovative researchers and developers, and helping to make them more widely known.

Background

Ship control, monitoring and alarm systems are the first line of defence if anything goes wrong on a vessel - the hope is that an alarm will sound, a control system will make a correction, and a potential disaster will be averted.

As we all know, the systems are getting increasingly complex, and surprisingly few checks are made of the functions of integrated systems to demonstrate that they work properly.

Seafarers have gotten used to silencing and accepting alarms without checking what they are. If the integrated control systems are not used as intended the ship may not operate as efficiently as possible.

In extreme cases time-saving functions or whole systems may not even be used. This represents, at the very least, a significant amount of unnecessary expenditure, and possibly more serious consequences for safety-related functions or systems.

There are many different types of risk that need to be managed correctly, not just safety, to ensure that a ship is running as well as possible.

The range of risks involved with complex software-based systems is not always understood.

Poor business processes result not only in delay but also in the product failing to meet required performance targets such as time or accuracy, poor maintenance record, users' lack of faith in systems causing annoyance and avoidance of use; the list of potential pitfalls goes on and on.

Then there are the risks to the ship, crew and environment which can arise from a failure of systems on board a vessel.

These are all issues which stem from a lack of total confidence in available information and a lack of integration between key systems. At the conference some of the leading players in the industry offered their thoughts on the matter.

Richard Vie, Carnival

Richard Vie, vice president of new building and technical development, corporate shipbuilding, Carnival Corporation, talked about his project to find the essential functional requirements of alarm, monitoring and control systems (IAMCS) and making a standard for future vessels.

The issue is making sure that the benefits of IAMCS can be maximized whilst avoiding the problems, he said.

Richard Vie, vice president, Carnival Corporation, with Bernard Thomey

The main problems which arise, he said, are new equipment adding lots of additional functions on each ship and the ease of providing large amounts of information to the watchkeeper.

New functions may have been put in due to reasons which were important in the past but not now, and no-one removes the functionality when it isn't needed.

Seafarers start to feel that they are being driven by the ship, continually responding to one alarm after another, rather than the other way around, he said.

Carnival Cruises are working together with British Maritime Technology (BMT) to work out exactly what functions and information are needed by the watcheeper and link the equipment requirements to that, finally including the (few) additional functions that the company management needs.

"This has already produced a nice mapping of functional needs," he said. "It will help a lot. It is new in the industry to lay this out."

It has not proven particularly easy to convince engineers about the benefits of a functional system, he said.

"Engineers hate functional models. They want to see a physical system."

Mr. Vie stressed the importance of listening and understanding what watchkeepers say about the operation and the system. He pointed out that specialists are required to collect and interpret this information.

The information acquired by the BMT study will support accurate cost versus function trade offs, he said.

Derek Chubb, UK MoD

Derek Chubb, from the marine electrical systems integrated project team, Defence Logistics Organisation, UK Ministry of Defence (MOD), presented the requirements of ship control systems from the perspective of a ship-owner.

Mr Chubb stressed the importance of looking at the ship as a whole system, and analyzing risk and ways to reduce risk from the ship as a whole system.

The ambition is to get effective and efficient systems which last for the entire lifetime of future navy vessels, he said.

The project team identified the relevant technology, cost drivers and cost constraints.

The objective was to develop a procurement method which could be linked into the MoD UK acquisition process, which would lead to buying the right equipment keeping risk at an acceptable level, he said.

Another key aspect of this initiative was to develop common terminology to be used across multiple projects and organisations, in areas as diverse as acquisitions and culture. This requires the re-use of established specification and requirements.

A clear definition of your requirements is essential to the procurement function. "If you define what you want and can't afford it, then you have to continually upgrade towards it throughout the lifespan of the vessel", he said.

"The performance provided by the system is what is of interest, not who does it with what."

Mr. Chubb's idea of the system involves the creation of an 'integration loop', where the interaction of the different parts of the system is defined in terms of the needs they serve. Then the definition of those needs can include the descriptions of those systems.

"There are lots of tools available to use", he said, "and a culture change may be required to make the best use of them".

"The highest level requirements are generic to any marine platform and system, so the goal of increased integration and standardization is achievable."

But an increase in the level of standardization must also be coupled with an alignment in the relevant regulations if it is to be fully effective.

In this regard Mr. Chubb commented on the value of the new ISO standard 17894, saying "(It) was the best Christmas present. It provides principles to address all of the problems and can be used as the basis of a contract."

Jørn S Andersen, MAN B&W Diesel

Jørn S Andersen, manager, basic electronic systems, MAN B&W Diesel, discussed the industrial safety philosophy and issues of the control system for the electronically controlled engine.

"One of the most important issues to affect safety on vessels is the level of integration with other equipment onboard", he said, "and the risks of having open operating systems in control applications."

Derek Chubb from the UK Ministry of Defence's integrated project team, talks ship control systems with Gwynne Lewis, managing director of BMT SeaTech

The proper maintenance and updating of equipment and systems is also essential to maintaining a high level of safety. "It is unarguably mission critical. When manufacturing these systems we must assume that the operator is not capable of helping".

"They must have self-checking and self-diagnostic facilities, and have distributed functions for increased reliability", he said. "The system needs to be tolerant of a single failure."

To guarantee the integrity of the system it is also important that the functions cannot be unintentionally altered.

"We want to lock the operator out from the operating system", he said, "we even include a physical lock for configuration control."

He also espoused the need for automatic regression testing.

Another issue considered important by Mr. Andersen was dealing with the possibility of viruses and the security of information.

"System security is interesting because it becomes more and more relevant as vessels move to the same operating system. Virus infection of ship automation must be assessed as a risk", he said.

"Getting telegrams to the office from the equipment is good, but it increases the risk of other things. The incremental growth of the computer system involves risks with regard to data security."

Erik Styhr Petersen, Lyngsø Marine

Getting the right system, and getting the system right. This was the basis of the presentation by Erik Styhr Petersen, manager special projects, Lyngsø Marine.

"The best system is one you never hear about" he said, pointing out that the system that runs easily and efficiently is rarely a subject for discussion.

He feels that the analysis of risk and having a user-centred design are the main tools for achieving such systems.

It is also important for the purchaser to choose their supplier carefully, and to "assess the historic competence of the seller", he said.

Mr Petersen suggested that owners buying a 'bread and butter' system were "not taking control of their own fate" and "need to interest themselves a little more in their life". His experience was that "owners that take control of their own destiny are very likely to make more money. The trick is to turn up in the manufacturer's office and have a discussion about what you really like. This reduces the yard to a factory doing assembly rather than taking overall responsibility, because owner and manufacturer come with a 'pre cooked' solution for where it really counts."

He suggested that a move towards generic toolsets that support customization would prove beneficial for the industry as a whole. He commented that if 'bread and butter' systems were now too rich in functions an "automation lite" version may prove attractive to many watchkeepers.

But he warned against trying to integrate systems designed for use outside shipping. Non-marine solutions are not a serious industry" he remarked. "We need real products for the job."

Sverre Gotaas, Kongsberg

The Kongsberg approach to the future of shipping technology was outlined to the conference by Sverre Gotaas, VP technology.

"The industry is not integrated", he said, "manufacturers sell boxes, yards want faster and cheaper operation, class apply rules, the owners ask for functions from the developers, but don't request integration. This is a sub-optimal situation."

Mr. Gotaas feels that shipping needs to learn some lessons from the oil industry. "There the end user is responsible" he said.

"They use function orientated specification, with a focus on operation. An integrator is appointed and given room to work."

"There is a focus on interoperability and standard communications; an operability, work and organization focus."

However, this all increases costs, one of the biggest stumbling blocks in technology adoption. "The only solution for the marine sector, which wants lowest cost," he said, "is standardization and tools."

"The only way to provide a dependable product is to provide a standard product. Then users can train to use the standard system." A standard system used across the board should lead to an increase in the general level of operational competence.

But Mr. Gotaas also felt that this will raise further questions, like "How many markets? Do you design 'different strokes for different folks'? What can be changed and how to do it?"

The issue of standardisation still lacks a standard solution.

Bernard Twomey, Lloyd's Register

Bernard Twomey, head of electrical and control engineering, Lloyd's Register, discussed the regulatory and class perspective in the first presentation of the event's afternoon session.

Mr. Twomey was another to raise the issue of the advent of ISO 17894, discussing the problems it addresses, its purpose and its structure, and was very positive about the standard's potential impact.

He also talked about the merits of using the Lloyd's Register product Dependable System Review (DSR). DSR is based on ISO 17894. It provides early analysis and the progressive monitoring of complex system risks specific to each project.

"DSR provides a set of dependability requirements that owners can request for all systems." he said. "It should be the first step for all risk-aware clients."

It tracks risk for the entire lifespan of the vessel, using a partnership approach in the analysis of the gap between project practice and the requirements of ISO 17894.

Mr. Twomey explained what he saw as some of the benefits offered by the DSR framework, such as "improved service performance and system confidence, reduced maintenance and enhanced safety, enhanced asset value and a through-life cost reduction."

He concluded that there was a need to "treat the ship systems lifecycle as a 'V', not a waterfall", saying that the performance of the vessel does not have to be in constant decline after construction.

He also wanted to "promote a systems-oriented view of development", which would take account of system operation and maintenance, and to allow developers to innovate. "There needs to be suitable assessment of innovative designs", he said.

Professor Jens Dalsgaard, Aalborg University

Computers and networks in ship control was the topic of the presentation by Professor Jens Dalsgaard of Aalborg University, where he discussed the history of control computers and networks, such as with fieldbusses, standards and proprietary systems.

He also outlined the future as seen from Aalborg's perspective, and changes in the costs for hardware and software. "Quality assurance of systems will be a design stage problem", he said, "not solved by buying certified hardware systems only."

"Integrated services standards are emerging from the entertainment industry, with better streaming and real-time protocols."

Prof. Dalsgaard outlined some of the requirements for future computer networks. "They must appear as a homogeneous robust control system, as intelligent machines and subsystems", he said.

"They must be able to operate in degraded modes, like a network failure, node failure, I/O failure, or in the case of machinery failure."

Jørn Andersen, MAN B&W Diesel

He stressed that they must be capable of operating in such a degraded mode for several days at a time, as it is usually the case that there are no experts around to be able to immediately deal with a system failure.

"IEC 61508 is almost essential", he said, referring to the safety standards introduced to lessen the occurrences of damage or injury due to system, hardware or software failure.

He also mentioned some problems of standardization, saying that "the quality and performance of components with the same specifications is very variable. Other industries have a better track record with integration."

"Matching of computer components for performance is rare" he said, adding that it is possible to model component and network performance "with interesting results."

"The actual bandwidth of networks is much smaller than data rates because of packing and conflicts," Prof. Dalsgaard commented when moving on to communications, and the deficiencies that exist in the sector.

He believed, however, that the 100/1000M Ethernetmay prove to be fast enough for current applications.

He went on to warn of how the "Intel Microsoft monoculture" and the speed of technological development had been the drivers behind the growing problem of viruses and other types of technological sabotage.

He also said that, from the viewpoint of himself and the University, the design systems currently in place are lacking something and are not up to the standard they should be.

The future, according to Prof. Dalsgaard, holds a couple of key issues. "Standardization is a must", he said, "and the legal issues surrounding developments in the area are still an unsolved problem".

He also advised that classification companies should be getting more involved in the design and construction of these systems.

Erik Styhr Petersen, Lyngsø Marine

Erik Styhr Petersen, manager special projects, Lyngsø Marine, spoke about work on the European ATOMOS project, trying to design safe and effective integrated ship control systems.

"This has been a ten year project during which the term Integrated Ship Control (ISC) took on a new meaning, in the sense that the project developed a framework, and quite a bit of the technology, required for total integration of information", he said.

"It was realized that ISC systems to the greatest possible extent should be formally and verifiably designed to cater for the user, in terms of requirements and capabilities."

He proceeded to outline some of the results of this project, one of which was a solution to the SOLAS Ch. V Reg. 15 requirement to improve the Ship Control Centre (SCC).

"Now there is a viable methodology and know-how available, and it is capable of being utilized by companies on the forefront of the industry" he said. "The supportive technology is available, and is continuously improving and maturing."

He also stressed that fewer problems at purchase meant that there were no resulting economic penalties, and that certainly over the lifetime of a ship the cost would be absolutely negligible. "There are no more excuses, but also no more surprises" he said. "It is up to you!"

So how should people proceed to fully utilize this type system? "We need to embrace the fact that bridge design is all about function, and not at all about electronics", said Mr Petersen.

"We need to recognize that owners' procedures, crew training and education, and ship equipment are very closely related, and should not be dealt with separately."

He suggested that people should acquire a copy of ATOMOS 'Conceptual Standard for SCC Design' (at www.atomos.org and www.he-alert.org), get ISO 17894 on dependable software, and with that background, formulate and accurately identify their requirements, "and then go do it".

When asked if ATOMOS had been implemented in relation to fulfilling SOLAS Ch. V Reg. 15, Mr Petersen answered "Specifically, the ATOMOS procedure applied to the bridge is an alternative to IACS UI181 at build time, is more true to the intention of SOLAS V/15 and fits seamlessly into the operation of the ship."

"Generally ISO 17894 is being specified in new building contracts. Lyngsø use ATOMOS procedures as part of their standard business process. All project partners are using the findings in their business. ATOMOS advisory body (mainly composed of EU Flags) is aware of the findings, and this informs policy decisions." DS

ELECTRONICS / NAVIGATION NEWS

AIS applied to Search and Rescue

A shipboard AIS system came in handy in alerting a nearby ship, after a diver was lost from a dive vessel, in the English Channel in late July.

Dover Coastguard received a report from dive vessel Sundancer stating that they had lost a diver 7 miles North West of Cap Griz Nes and that he had been missing for an hour. The French Coastguard was notified and a French Navy rescue helicopter began a search.

Dover Coastguard used a SARIS (Search and Rescue Information Service) to re-plot the diver's position, allowing for factors like drift and tides. This predicted a location 8 miles north of Cap Griz Nes for the diver.

After consulting the AIS, in conjunction with the Channel Navigation Information Service (CNIS), the coastguard contacted the closest ship to this position, the Polish ship Rolnik, and requested that they try to locate the diver.

Within minutes Rolnik reported that they had found the diver and immediately launched a life boat to bring him aboard. Dover Coastguard contacted Sundancer and arranged for the dive boat to proceed to Rolnik's position for the rescued man to be returned to his ship.

DNV develops new HIL maritime certification standard

www.dnv.com

Class society DNV has developed a standard for testing ship control systems, using a type of testing called "Hardware-in-the Loop" (HIL). It hopes that it will become an industry standard testing procedure.

HIL testing enables shipboard equipment, often made by different suppliers, to be tested on a simulated vessel environment.

"Modern maritime machinery plants are constructed by integration of several computerised control systems and subsystems. This has resulted in increased complexity of the machinery system. This has not been followed up with necessary development of quality assurance and the test regime," says DNV.

"HIL simulates the vessel environment, enables comprehensive testing and radically expands test possibilities and the number of potential failure modes which can be tested."

"In addition, the process reduces the time needed for expensive sea-trial testing and allows for the training of operators."

"The HIL tests require deep technological knowledge of the target control systems. In addition, a large number of detailed HIL tests are available. This means that there is a need for a standard set of HIL requirements and interpretation of the actual test results by a third-party certification body," says Jon Rysst, head of DNV's maritime technology and production centre.

The first part of the standard gives requirements to the HIL test supplier organisation and quality assurance procedures to be applied by the test supplier. Based on these requirements, DNV can certify the test supplier.

The second part of the standard gives requirements to certification of HIL testing for a specified shipboard system. The main requirements are related to the scope of the test plan, the test setup, HIL surveyors witnessing the tests, interpretation of the test results and requirements for possible re-testing.

HIL testing may be performed for newbuildings during Factory Acceptance Tests (FAT), commissioning, sea-trials, as well as for ships in operation.

QinetiQ's high-sensitivity GPS module wins award

www.qinetiq.com

QinetiQ's high-sensitivity GPS has been recognised at the annual Security Industry Innovation Awards by taking the award for "best new electronic, communication or internet protocol product". The receiver is 1000 times more sensitive that standard GPS devices, the company says, providing an accuracy of less than 5 metres outdoors and less than 50 metres indoors.

Jakob Hatteland new display range

www.hatteland.com/jhi

Norwegian company Jakob Hatteland Display AS (JHD) has launched a new range of maritime displays.

The products are IEC60945 tested and approved by major classification societies. The computer software attached to the displays can be detached, which should make the displays easier to service.

Hatteland's new maritime display

Screens range from 12in to 19in, with additional sizes planned for future release, and use optical bonding technology to reduce reflectance to a minimum while enhancing the optical performance.