

## The International Maritime Human Element Bulletin

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## The Alert! project is about Human Element awareness

– across the whole of the  
maritime sector.

Some 70,000 of these quarterly Bulletins are distributed, in the main, through the professional journals of The Nautical Institute, The Royal Institution of Naval Architects (RINA), The Royal Institute of Navigation (RIN), The Institute of Marine Engineering Science and Technology (IMarEST), The International Federation of Shipmasters' Associations (IFSMA), The International Maritime Pilots' Association (IMPA) and The Institute of Marine Surveying (IMS). Other maritime stakeholders such as training and education establishments, trade unions, shipyards, naval architects, designers, and regulators receive their copies through direct mailing. Electronic versions are also freely available from the web site.

Our website statistics suggest that the project is truly international, registering visits from some 89 countries from around the world. It is also interdisciplinary in scope, evidenced by the variety of issues that we have so far focused on, not only in the Bulletins but also on the website database.

We are grateful to those of our readers who responded to our request for feedback. *Working hours, fatigue, poor ergonomics, alarms and communication* featured prominently amongst your concerns – we will continue to address these issues in forthcoming Bulletins.

We seek to represent the views of all sectors of the maritime industry – contributions for the Bulletin, letters to the editor and articles and papers for the website database are always welcome.

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## Testing times for the crew

When they eventually board their new ship, the expectations of the crew are of a ship that is 'fit for purpose' - designed and built with the user and the operational task in mind, taking into account the environmental conditions that it is likely to encounter during its working life. Few, if any, of the crew will have been involved in the design and build, yet these are the people who are going to work and live within the ship.

It is the crew members – and not just the senior officers - who will first spot those irritating design errors, some of which may not be readily identified until sea trials; but which could so easily be rectified before commissioning, such as: critical lines of sight obscured by equipment, machinery or furniture; poor leads for ropes and wires; tripping hazards around the decks; doors that open onto narrow working alleyways; hand rails that are too close to the bulkhead; poor access and removal routes for equipment and machinery – to name but a few.

The practice of using experienced senior crew standing by the ship to undertake checks of systems and equipment is fading fast. Indeed, in

some cases, a substantial discount is offered to purchasers who surrender this right. This discount represents a fraction of the money the yard will save by not being monitored. It is an even smaller fraction of the through-life cost of living with, working around and/or correcting the resulting obstacles to optimum operation of the ship.

It is important that the crew are familiar with their ship, well before it leaves the builder's yard. Those who have to operate the various systems must be properly trained on them; they should not be expected to 'pick it up' after they have joined the ship, or accept a quick briefing on it from the commissioning engineer, or simply read the handbook - which may in itself be technically complicated, difficult to understand, and not even written in the native language of the reader.

These are testing times for the crew, in more than the truly literal sense – the ship may prove eventually to be effective and productive to the owner or operator, but how much more effective and productive would it be if it were also acceptable, safe and operable to the crew?



*Taking over*

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# Alert!

The International Maritime Human Element Bulletin

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President IMarEST

## Safety in the Shipbuilding and Repair Industry

In the time I have spent in this industry safety has always been my number one priority; this edition of **Alert!** is focusing on the shipbuilding industry.

When I started my career in 1958, at the Swan Hunter Shipyards on the North East Coast of the UK, it was good to see a high quality of shipbuilding, but it was without any reasonable sense of safety being applied by most of the staff. Some years later when building ships in the Far East I was appalled at the poor standard of safety, the main example being staging which was the most dangerous I have ever seen.

Most ships are built with a high degree of automation in steel preparation and erection, which improves the safety – people do however still persist in walking under loads being handled by working cranes. Likewise, openings in decks and bulkheads are not always cordoned off and are easy to fall down if one is not

careful. Safe access to the vessel is always an important issue.

When designing and building a vessel you also need to consider the difficulties the operator may encounter when dismantling areas for repair – many accidents have occurred because of a lack of attention to maintainability.

Sea trials also need careful planning to ensure only the correct number of people attend that are required and that there is enough life saving equipment on board to cater for the total compliment, during the trials.

We must ensure that Health and Safety is a top priority; every yard should have a safety system that is audited on a regular basis paying particular attention to the training and education of staff to reduce the risk.

Nearly all accidents are caused by the lack of attention to the human element - a safety culture must be instilled into every person involved in the building or repairing of a vessel.



**Tae-Woo Kim**  
Senior Vice President  
Korean Register of Shipping

## The need for robust ships

Recent statistics on structure related casualties have revealed that only one out of a hundred bulk carriers totally lost at sea was less than 5 years of age. This indicates that although most ships are delivered with a high level of robustness, a ship's structural integrity fails or degrades over time.

Investigations on ships sunk, capsized, or gone missing without known causes have revealed that some of them might have been, for a considerable period of time, in the process of gradual structural failure without being duly noticed by crew, surveyors and repairers. Such assumption is supported by the fact that a number of ships with fatal damage at side hull have arrived safely at the repair ports and succeeded to maintain their robustness after a couple days of structural refurbishment.

I am of the view that these casualties may have been prevented by the active promotion of the human element aspect

of ship operation and through a well-established human element alert system for the maritime community. Indeed, it is important to build a safe and robust ship in shipyards. It is, however, more important to maintain that robustness throughout the ship's lifetime. For this, the human element plays a crucial role.

In addition, I would like to stress the importance of the role of crew on board to prevent eventual failure of ship structures. If we are to rely more on the risk management aspect of crew on board and create a culture of respecting such roles of the crew, the latent defects which may lead to eventual structural failures of a ship may be identified by crew well before a casualty strikes.

A copy of Mr Kim's paper *Human factors and regulatory regime in design and construction of safe and robust ships* can be downloaded from: [www.he-alert.org](http://www.he-alert.org) (Ref: HE00415)

# Building platform management systems based on User Centred Design

Erik Styhr Peterson, Manager, Special Projects, Lyngso Marine

Most of us apply the processes that play an important role in User Centred Design (UCD) on an everyday basis.

Take next Friday for instance.

We are having the neighbours over for dinner, parents and the three children. Since it's 'just' the neighbours, it's informal and relaxed. Since the weather forecast is awful, we expect to eat indoors. In User Centred Design terms, this is the Context-of-use.

Our family is two adults and two children so the obvious stakeholders in this venture are the nine participants. There are additional stakeholders: my boss expects me at work on Friday afternoon, so I can't be home, cooking; my suppliers will realize if I deliver substandard products; my bank manager will frown if I spend too much. The police are not expected to be a stakeholder, since the guests can walk home, so won't violate traffic rules in spite of having wine. The lesson is of course that stakeholders 'interests' play an important part in decision-making.

Knowing the stakeholders, the requirements come next. The kids are particular with food, but like what children usually like. There are no allergies, but two adults don't like fish. I like red wine. Everybody likes Italian. The important thing is to ensure that all requirements are known and considered. I would be in trouble if I missed the requirement that my neighbour's wife didn't like tomato, because, based on these requirements, the 'design' solution in this case is to cook lasagne. The cooking is the least part, but it is rapidly followed by evaluation, where my instance of lasagne is measured against the common acceptance criteria of frozen supermarket lasagne, or, worse, the superb lasagne from our local pizza provider.

Everyday UCD is commonplace, known to all and easy to apply. We have the tools. The figure illustrates one method from the marine industry. Why is it so hard to 'sell' UCD to this sector? Or, rather, is it really hard?

The common understanding is that, yes, it is hard.

Leaving the 'why?' aside until later there are hopes. In Lyngsø Marine A/S, we have been building on the UCD lessons learned in the European ATOMOS (Advanced Technology to Optimize Manpower Onboard Ships) and DISC (Demonstration of Integrated Ship Control Systems) projects, and evolved our products to accommodate real-life UCD, despite the

commercial and contractual barriers that usually exist. In our view, the points are modularity and flexibility, the latter in hardware, software and attitude - the attitude issue perhaps being the most important.

The proof of the pudding - or maybe lasagne, in this case - is indeed in the eating. UCD has been trialled with a close customer on a large and quite complicated series of mid-life replacement of entire 1990's automation systems.

UCD was applied with the scope-related constraints of the project, and led to usability improvements, especially on the Human-Machine Interaction (HMI).

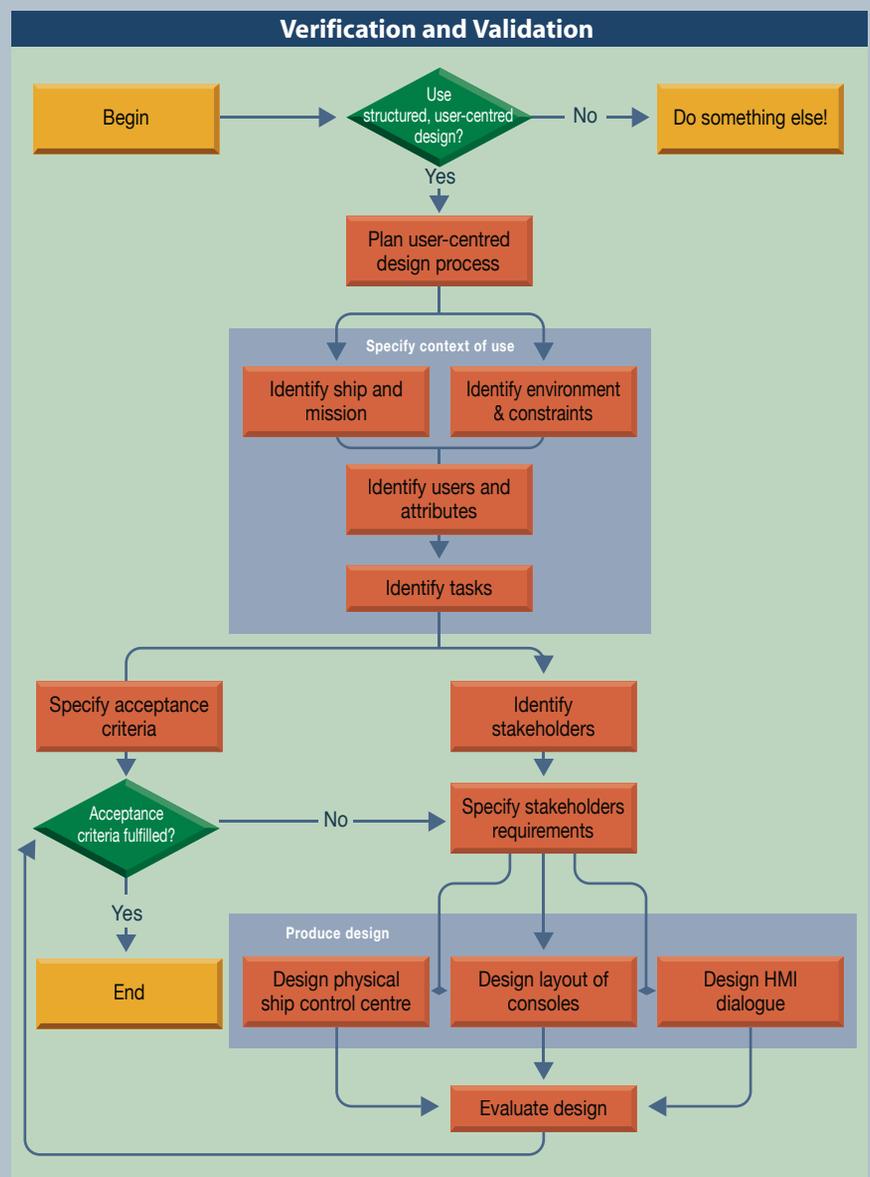
As well as the direct HMI improvements the application of UCD had the hoped-for effect of greatly increased user

acceptance. For the supplier that is invaluable, since it shortens and sweetens the most difficult phase, commissioning and initial use. At that stage, money is flowing rapidly out, and any prolongation can make or break a project economically - whereas a responsive, cooperative and positive crew and superintendent certainly can ease the pain.

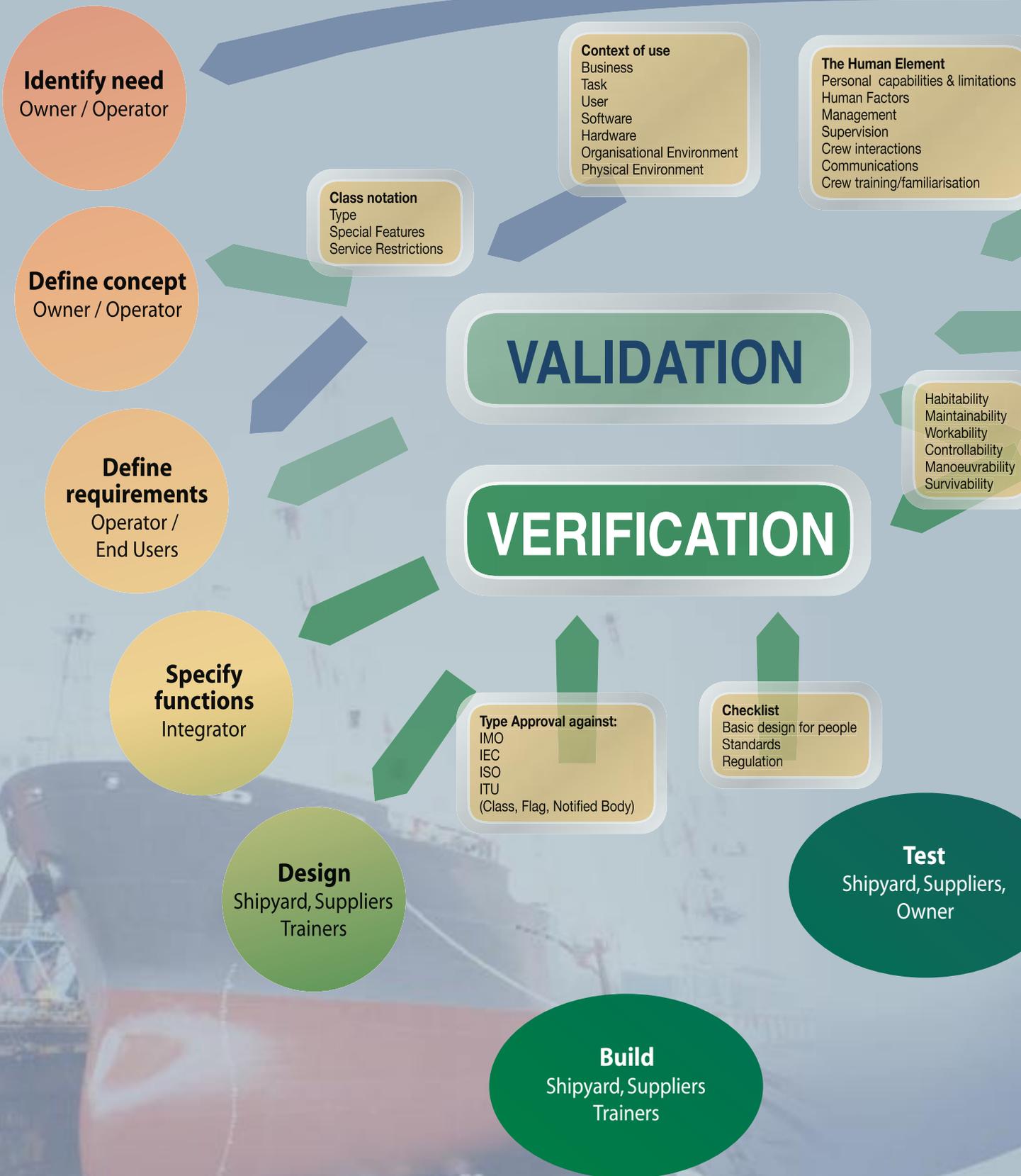
For us, this trial is sufficient motivation to proceed along the UCD line.

What about everybody else - and the 'Why?' that was left hanging? Maybe the lasagne story has an additional point. UCD should be sold as common sense, not something complicated.

Note: ATOMOS and DISC projects have now disbanded; for background information about ATOMOS go to: [www.control.auc.dk/atomos/](http://www.control.auc.dk/atomos/)



# Addressing the human element during build



**In service**  
Owner, Operator

Effective  
Productive  
Acceptable  
Safe  
Operable

Full operation

Whole ship system  
(Task, 'Fit for purpose')

**Acceptance testing**  
Ship builder, Integrator,  
Owner/Operator, End users,  
Class/Flag (safety issues)

Workstations  
Displays  
Controls  
Accommodation  
Galleys  
Recreational spaces  
Organization  
Policies  
Procedures  
Manuals  
Checklists  
Charts  
Drawings  
Publications  
Information Technology

**Installation & Commissioning**  
Systems Integrator  
Class/Flag

Unit/Sub-system

Component

Integrating people & equipment

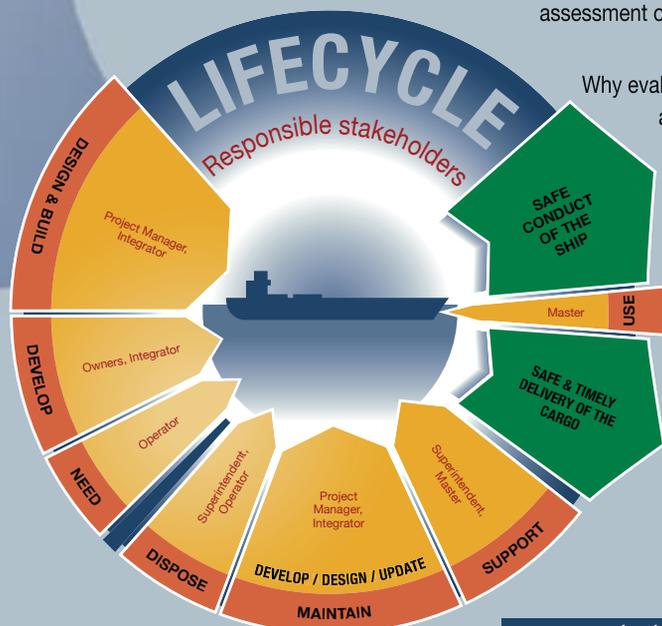
The operability requirements in the specification will only have an effect if the detailed design, selection of components, Factory Acceptance Tests (FAT), installation, commissioning, and sea trials take account of the needs, limitations and capabilities of the crew. Evaluation of the developing systems is required, taking into account how the equipment will be used, the crew's competence and motivation, their training, the procedures that they will be following and the type of supervision.

Type approval does not fully address ergonomic issues. Design is more about reduction of costs, and system integration is (at best) about making sure that everything is working on the day the ship is delivered. Therefore, additional monitoring is required if the Human Element is to be successfully addressed during build. That is to say:

- Has the manufacturer followed the standards for the intrinsic ergonomic properties of working and living spaces and equipment? This includes health and safety issues from Class, Flag and ILO.
- Has the designer taken account of necessary attributes, context of use (user, task, physical and social environment) and maintainability of the layout and ship's sub-systems? In addition to good operational design this includes the requirements of Class, Flag and ILO, for operational safety.
- Can typical crew perform the intended working procedures with the provided equipment? Is the ship operable in terms of the effectiveness, productivity, acceptability and safety of the crew's work?

The crew form an essential part of the operational ship system. Integration includes ensuring that they are recruited, trained and worked according to the assumptions behind the specification. ISM requires assessment of the risk to operability from any change.

Why evaluate operability? Because it affects the bottom line. Poor effectiveness means human error. Lack of productivity means inefficient use of limited manpower. Safety problems mean compensation or increased premiums. Low acceptability decreases motivation.



In the next issue:  
Operations



**Captain Bill Harvey**  
Shipmaster  
Graig Shipping

It has always been considered prestigious to be chosen by the owners to stand by a new build. As master, I stood by the last of a series of 8,874 dwt multi-purpose vessels for Graig Shipping, in Shanghai. Prior to my appointment, the company and I discussed the benefits of appointing a deck cadet during the commissioning period. I readily agreed to this as the opportunity to stand by a new build may only occur once in a career. The appointment of the cadet paid dividends; his experience in the building yard gave him a better understanding not only of the ship and its systems, but also of the documentation and of the difference between the requirements of Class and Administration.

Over the years, the length of time spent standing by a new building has been reduced from several months -

commencing in the early days of construction - to attending only the final period of fitting out, trials and commissioning. Building yards do not always appreciate the 'interference' of sea staff with advice or thoughts that may delay their building schedule, and the method of contract building rarely allows for any changes.

There was a time when the shipyard would first carry out yard trials, followed by owner's trials - these now seem to be condensed into one with no crew input whatsoever which, to say the least, is frustrating for personnel who have to sail the vessel. The yard provides a master/pilot who has some 15 persons in his bridge team. Blackouts and excessive manoeuvres are performed at the drop of a hat, both in heavy traffic and in reduced visibility. During our trials it didn't help

that most of the yard staff were seasick!

The crew normally join just prior to the ship's departure from the shipyard, being accommodated in a hotel prior to moving onboard. It is during this relatively short period that the crew database has to be set up and routines established, often being undertaken during the evening, at the hotel where the crew are being accommodated. They are not allowed into the ship's accommodation until the day before departure. This can present a human element problem in that on the first night onboard there are often no stores (not even food) and all fittings are covered in plastic. Co-operation and understanding from the crew is therefore paramount during this period.

Suffice to say, the pleasure of dropping the last outward pilot from the building yard is 'almost' as good as winning the lottery!

## Standing by a new build

- a Master's perspective

## What's new...

### IMO Maritime Safety Committee 80th session

#### Goal-based new ship construction standards

Basic principles and goals for goal-based standards (GBS) for new ship construction were agreed in principle. The five-tier system on which the development of GBS is being based consists of goals (Tier I), functional requirements (Tier II), verification of compliance criteria (Tier III), technical procedures and guidelines, classification rules and industry standards (Tier IV) and codes of practice and safety and quality systems for shipbuilding, ship operation, maintenance, training, manning, etc. (Tier V).

#### Amendments to the International Convention for the Safety of Life at Sea (SOLAS Convention)

*The SOLAS Convention is generally regarded as the most important of all international treaties concerning the safety of merchant ships, which therefore has an impact on the Human Element*

The MSC adopted amendments to SOLAS, with an expected entry into force date of 1 January 2007, which includes requirements for:

- Ship construction drawings to be maintained on board and ashore. (New regulation II-1/3-7)
- All ships to be provided with arrangements, equipment and fittings of sufficient safe working load to enable the safe conduct of all towing and mooring operations associated with the normal operation of the ship. (New regulation II-1/3-8)
- Water level detectors to be fitted in the cargo hold(s) on new single hold cargo ships other than bulk carriers. (New regulation II-1/23-3)

For further information go to:  
[www.imo.org/Newsroom/mainframe.asp?topic\\_id=1018&doc\\_id=4930](http://www.imo.org/Newsroom/mainframe.asp?topic_id=1018&doc_id=4930)

### Paris MOU Concentrated Inspection Campaign - seafarers' living and working conditions

In late 2004, the Maritime Authorities of the Paris Memorandum of Understanding on Port State Control carried out a three-month concentrated inspection campaign (CIC), to address the International Labour Organisation (ILO) Conventions covering living and working conditions, hours of work and manning of ships.

Particular attention was paid to the areas of: food supply and storage; condition of the galley; condition of equipment for receiving and producing potable water; ventilation and heating in accommodation spaces; sanitary facilities; hospital accommodation and condition of accommodation spaces.

Of a total 4555 ships inspected, 1345 (40%) had deficiencies in at least one of the selected inspection areas. In almost 50% of all inspections deficiencies (totalling 2392) were found related to working arrangements.

For further information go to: [www.parismou.org](http://www.parismou.org)

# Human Factors Engineering deficiencies in ship construction



**Gerald Miller, CPE, MA, BSc**  
Human Factors  
Engineering Consultant

Even though naval architects and marine engineers typically design a ship to a fine level of detail there is usually still some leeway left for the shipyard personnel to move or make adjustments to piping, equipment and wireways during the construction phase. For example, the final placement of pipes below 3/4" (19.05 mm) in diameter is often left to the pipe installer. In making these 'field run' installations the pipe fitter may not be aware that a particular area may have been left open on a bulkhead, or overhead, as pull space for the removal of a piece of equipment. All the pipe fitter sees is an opportunity for an easy run of pipe.

A second potential problem arises when a previously undetected interference occurs between piping and structure, or between structure and a piece of equipment that turns out to be bigger, or different in arrangement, than was shown on the design drawings. These unexpected hits are sometimes solved 'in the field' by the movement of pipe or equipment by the construction crew. However, in doing so, this 'field correction' introduces Human Factors Engineering (HFE) problems such as unacceptable access for equipment removal or the placement of a control or

display beyond the operator's acceptable visual or reach envelope.

Another HFE problem that often occurs during construction involves vendor-supplied equipment that has been integrated into the design of a space on the ship without proper consideration by the design engineer as to the equipment's installation, maintenance or operational requirements. As a result, sufficient access to a system's access ports and openings for calibration, installation and repair, or its controls and displays, or simply the clear space required around the equipment for equipment movement or product protrusion, has not been provided in the design phase and must be corrected during construction. This can lead to a need to move equipments, provide elevated working platforms or add or relocate lighting fixtures, all of which have HFE implications.

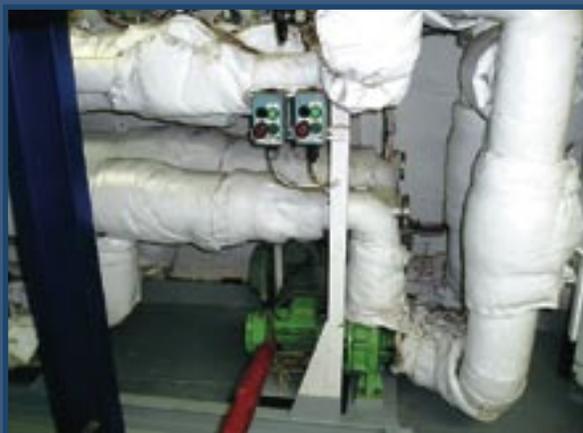
The picture below shows two small pumps sitting one in front of the other in a cruise ship main machinery room. The two control boxes however are sitting side-by-side as faced by the operator. As a result there is no visual spatial relationship between the pumps and their respective controllers. In other words, if I ask you to select the control that turns on the aft pump which control box would you reach for? This is a perfect example of a HFE design deficiency that should have been detected and corrected during construction, but was not.

Because of the frequency of these construction identified or created HFE problems shipyards have adopted different approaches to ensuring that they

are identified and corrected. One approach has been to provide in-house construction inspectors with a short but specialized HFE training program. Another has been to offer a similar training class to construction trade supervisors and leads. Both training sessions include a brief description of what HFE is; what has been done during the design phase to include HFE into the ship's design; examples of typical situations that occur during construction that can introduce a HFE problem; and typical activities that might be undertaken by construction personnel that should alert them to ask for HFE assistance or evaluation before proceeding with the 'field run fix'.

A further approach is for the shipyard to employ a HFE specialist who will make frequent and periodic visits to the construction site (this includes not only the shipyard but also the fabrication sites of vendors supplying hardware for the ship) to seek out HFE problems which have been created during the construction phase, and get them corrected before the construction is complete.

HFE deficiencies not detected or existing during the design of a ship, can be identified, or can be created during that ship's construction effort. This is a common and frequent occurrence that can provide opportunities for human errors to occur on the ship once in service, and thus must be eliminated wherever possible. However, there are techniques to identify and correct these HFE deficiencies before the ship leaves the yard - a good ship design and construction program will seek to find and eliminate them.



*'... a perfect example of an HFE design deficiency that should have been detected and corrected during construction, but was not'*

## Passenger vessel switchboard fire

**T**his report of a switchboard fire in a 55,451gt 'state of the art' passenger vessel, built in 1992, demonstrates that some regulatory, design/construction and training deficiencies only manifest themselves after an emergency has occurred - in this case some 10 years after the ship first entered service. The report, from the Transportation Safety Board of Canada, highlights a number of important Human Element issues.

Following the catastrophic failure of the main circuit breaker for one of the diesel generators, fires were started in the main switchboard room (MSR) and the adjacent engine control room (ECR). During the events leading up to the failure of the circuit breaker, none of the senior engineering or electrical officers demonstrated sufficient knowledge or expertise in troubleshooting problems with medium-voltage propulsion plants.

It was company policy for senior engineer officers who were standing by the construction of a new ship to be trained in the vessel's 6.6 kV electrical systems

by the equipment manufacturers, with these officers then training the incoming generation of ship's crew, who in turn would train the ones who followed them. However, this system of succession training had fallen into disuse such that, at the time of the accident, neither the engineers nor the electricians had been trained in the ship's electrical generation, distribution, and application systems.

Because the MSR did not have an independent smothering system, the crew extinguished the fires using portable carbon dioxide (CO2) extinguishers. The lack of an independent connection to the ship's CO2 smothering system in the MSR deprived the vessel of an effective and safer means to fight fires in this compartment. Furthermore, as the fire was being fought, one of the diesel generators continued to supply 6.6 kV power to the switchboard, located approximately one metre from the firefighting activities. This exposed the crew to undue risk, albeit there were no injuries.

The report recommends a review of the requirements for structural fire protection and fire-extinguishing systems to ensure that the fire risks associated with compartments containing high levels of electrical energy are adequately assessed; and that the provisions of the International Convention for the Safety of Life at Sea (SOLAS) dealing with structural fire protection and fixed fire-extinguishing systems are addressed.

Furthermore, the report highlights the need for internationally accepted minimum standards for training, expertise, and certification for shipboard electrical officers.

*This comprehensive and very technical investigation report is essential reading for all those involved in the regulation, design, construction and operation of ships with medium-voltage generation and distribution systems.*

The full report can be downloaded from: <http://www.tsb.gc.ca/en/reports/marine/2002/m02w0135/m02w0135.pdf>

## Reports & Studies

### HIGH TECH BRIDGE EQUIPMENT PROMISES INCREASED SAFETY

**Nils Nordh**, Executive Vice President, Star Cruises (February 2005)

More and more companies understand the benefits to safety by the proper application of new technologies on the bridge. This paper examines some of the issues concerning the application of these new technologies and demonstrates the need for shipowners to ensure proper training in the functionality and limitations of the equipment; and for port authorities to ensure that pilots are up-to-date with the latest technology and trained in its usage.

Downloadable from [www.he-alert.org](http://www.he-alert.org) (Ref: HE00425)

### CRITICAL SIGNIFICANCE OF HUMAN FACTORS IN SHIP DESIGN

**Thomas G. Dobie**, Director, National Biodynamics Laboratory, University of New Orleans (October 2003)

There is a critical need for a human factors input whenever technology and people interact. When systems are functioning well, few seem to appreciate that this smooth operation is largely due to the prior thought and effort that has gone into optimizing the human element. Severe ship motions limit the human ability to operate command and control and communication systems, navigate, perform routine maintenance and prepare food.

The human being is susceptible to degraded performance in a number of ways. Knowledge of the sea/hull interaction and its potentially deleterious effect on the physical activities of crewmembers can provide valuable information for improved ship and equipment design as well as establishing guidelines for efficient heavy weather operations. Attention to onboard habitability issues and fostering a high level of morale among crew members are

also very important factors in support of crew retention. The author addresses these issues and makes recommendations to improve the incorporation of the human element in future ships.

Downloadable from [www.he-alert.org](http://www.he-alert.org) (Ref: HE00420)

### A PROPOSAL FOR A JOINT INDUSTRY EFFORT AT IMPROVING BILGE OILY WATER SEPARATION OPERATION AND DESIGN

**Hendrik F van Hemmen**, Chairman SNAME T&R Ad Hoc Panel for OWS Systems (March 2005)

This paper discusses the problems associated with the design and operation of Oily Water Separators and outlines a proposal for a joint industry effort at arriving at more effective and user friendly designs and operational methods.

Downloadable from: [www.he-alert.org](http://www.he-alert.org) (Ref: HE00410)

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