



The International Maritime Human Element Bulletin

Issue No. 7 April 2005



Feedback, please...

We are now well past the halfway stage in this three-year project, the aim of which is to *raise the awareness of the Human Element in the maritime industry*. Is *Alert!* achieving this aim? Are we striking the right balance with the mix of articles in each issue?

What do you think of the centrespread features? Do you use the website (www.he-alert.org)? Of what use has it been to you? Have you downloaded any papers from the database? Have they proven useful to you in the conduct of your business? What human element issues would you like to see featured in future editions of *Alert!*

If you have any thoughts on *Alert!*, please let the editor know, either by letter or by e-mail.

Your feedback is important to the future of the *Alert!* project.

Alert! is a forum for like-minded people to share ideas and solve problems on human element issues. The website - www.he-alert.org - provides a reference resource for study and information.

Contributions to the Bulletin and to the website database are always welcome, as are letters to the editor, which can now be uploaded and published on the website.

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Know thy users - for they are not you!

A ship is comprised of a number of *Systems*; each system has a specific purpose and it can either operate alone or form a component part of a larger system. A *System* is a combination of interacting elements (human and/or machine) organized to achieve one or more stated purposes.

The increasing reliance upon complex systems in merchant ship operations places certain demands and constraints on the human element, not least in terms of the competence of the user and of the organisational and physical environment in which he/she is required to operate.

The human element is a critical feature of all aspects of ship or system design and operation. User-input is essential to ensure that the operational parameters and the layout, crewing and procedures for the operation of shipboard systems are being optimised for the specific role or trade of the ship. Those who are involved in the design, build and updating of ships and their systems and in their operation need to be aware of the problems associated with onboard operations not only in terms of workplace design but also in respect to crew habitability and the education and training needs of the seafarer.

Human-Centred Design (HCD) focuses on making systems usable. It is the process of systematically applying human factors and ergonomics knowledge and techniques to minimize human error, enhance effectiveness and efficiency, improve human working conditions, and counteract possible adverse effects of use on the health, safety and performance of the mariner.

HCD - as a science - is a relatively new concept in ship design. The operational experience of the various users and the expert knowledge of a Human Factors specialist should be exploited by the designer to ensure that the number of design errors so often identified during the late stage of build, or even when the ship enters operational service, are minimized. The downstream effect will be a reduction in the number of costly 'change notices' during build, and in the number of slips, trips, falls, operating errors and other causes of accidents at sea, and an increase in crew satisfaction with their ship.

There are many stakeholders involved in the design of ships and their systems. Teamwork and communication at all levels, from concept to build, are essential to the success of any project.



Putting it all together

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Alert!

The International Maritime Human Element Bulletin

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A 'good design' is one that exceeds the owner's expectations

*Nigel Gee BSc CEng FRINA
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President,
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Architects*

Today's naval architect needs to be a well-rounded engineer with an eye towards inspirational and innovative design, but with a deep understanding of principles, an experienced 'feel' for the strength, durability and safety of the floating structures he designs, and an understanding of the 'ways of the sea' and of the needs of the User.

A 'good design' is one that exceeds the owner's expectations. Priorities will be that it meets his specification, is safe to operate, provides comfort and habitability for crew and passengers, meets environmental regulations and concerns, and complies with the relevant regulations of class, international and national authorities. Meeting the regulations is a question of diligence in assuring that all relevant rules are adhered to, and will produce a vessel with features that comply with an international consensus - but it may not necessarily be a good design.

Comfort and habitability is of increasing concern - the quality of life to a seafarer is one of the keys to a successful operation. There is no doubt that good ship motions, minimal noise and vibration, and well-planned ship accommodation are features of a good design.

The increasing use of safety case analysis and failure mode and effect analysis in ship design significantly enhances ship safety and is perhaps a better approach than the previous prescriptive and sometimes arbitrary safety rules - all provided that the naval architect does not become lost in a welter of analysis.

Probably the most difficult aspect, is that of providing the shipowner with a vessel that exceeds his expectations as regards specification. His requirements will include speed, deadweight and fuel consumption and also sea kindliness, maintainability, manoeuvrability, and reliability.

These are challenging times for today's Naval Architect.

*A longer article by Nigel Gee, can be downloaded from:
www.he-alert.org (Ref: HE00365)*



Usability in the maritime industry

*Dr Jonathan Earthy,
Principal Human
Factors Specialist
Lloyd's Register*

The usability of systems is described in terms of the efficiency, effectiveness and satisfaction of users performing tasks with the system in a defined context of use. This goal-based view of system performance offers considerable benefits in the design and acceptance of the increasing range of marine computer-based systems.

Targets for usability are defined and met through Human-Centred Design which entails the following project activities:

- Understanding and specifying the context of use;
- Specifying the user and organizational requirements;
- Producing design solutions;
- Evaluating designs against requirements.

And, by observing the following principles:

- The active involvement of users and a clear understanding of user and task requirements;
- An appropriate allocation of function between users and technology;

- Iteration of design solutions;
- Multi-disciplinary design.

The maritime environment presents potential challenges to the existing range of methods and techniques. The inaccessibility of the working environment, the 'make do' attitude of the seafarer, the need for detail on seafarer culture and communication, and long operating life of marine systems requires all parties to work from a detailed context of use statement.

Furthermore, the high complexity of integrated systems, the uniqueness of each ship's design and the dependence on (and lack of seafarer input to) prescriptive standards requires a detailed and carefully maintained specification of user requirements. From a process point of view the emphasis on contract, short design and build times, low profit margins and the number of equipment suppliers to each ship, requires management commitment to achieving usability.

Despite these challenges usability is starting to be used in the marine sector. However, work has so far emphasised new building and bridge operations and thus missed the easier targets of office and control systems, especially in retrofit.

For further information go to: www.usabilitynet.org



Captain Charles Piersall
Chairman ISO TC 8

The foremost aim of international standardization is to facilitate the exchange of goods and services worldwide through elimination of technical barriers to trade, a precept of the World Trade Organization. Three bodies are responsible for developing International Standards:

- The International Organization for Standardization (ISO), responsible for all sectors excluding electro-technical. Its membership comprises of the National Standards Bodies of some 130 countries. Technical Committee 8 (TC8) deals specifically with Ships and Marine Technology.
- The International Electro-technical Committee (IEC), responsible for international standards for all electrical, electronic and related technologies.
- The International Telecommunication Union (ITU) responsible for developing internationally-agreed technical and operating standards for international telecommunication services

The scope of the ISO Technical Committee 8 (TC8) is:

Standardization of design, construction,

structural elements, outfitting parts, equipment, methods and technology, and marine environmental matters, used in shipbuilding and the operation of ships, comprising sea-going ships, vessels for inland navigation, offshore structures, ship-to-shore interface and all other marine structures subject to IMO requirements.

TC8 is comprised of eleven subcommittees - two of which are devoted to our role with IMO Committees; five are for major subsystems in ships and shipbuilding, and others cover inland navigation vessels, computer applications, general requirements, and intermodal and short-sea shipping.

A principal role for TC8 is to serve as the linking instrument between the requirements/regulatory regime and the international maritime industry. (See Figure) Over 100 current items of work in ISO/TC8 relate directly to IMO. IMO has asked us to develop some standards, while some ISO standards bring about more specificity and clear guidance on compliance with IMO regulations, and some IMO circulars determine requirements from ISO standards.

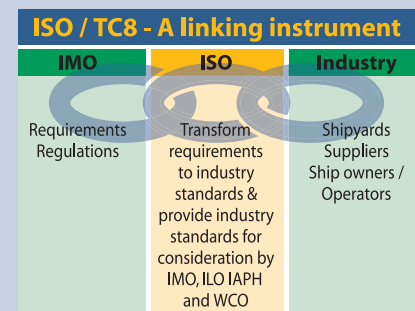
We have focused on the Human Element in a number of standards, such as: Integrated bridges; life saving and fire protection; pilot and embarkation ladders; and navigation equipment. We are also looking at alarms and indicators - to bring some

order to the system so that the watchstander has better information and is not overwhelmed with noise and flashing lights.

TC8 is proactive in working with all the relevant international stakeholders, both industry and government. The ISO/TC8 philosophy is: *Timing and Timeliness* - You have to 'be there' when the need is stated and you must be 'on time' for delivering the finished standard to meet the stakeholder needs! This is not a spectator sport - you have to be on the playing field, not in the stands or on the sidelines. Also, remember that if you as a stakeholder are not participating, then the chances are that your competitor is!

Further information on the work of TC8 can be found at:

http://www.iso.org/iso/iso_technical_committee?commid=45776



Jorgen Rasmussen
Chief Ship Surveyor,
Danish Maritime Authority
Chairman,
IMO Human Element
Working Group

- Owners/operators want a ship that is easy to maintain and operate, inexpensive, safe, etc.
- Shippers/cargo owners do not want any harm caused to the cargo and they also want the cargo to reach its destination, i.e. the ship should be safe.
- Passengers are looking for a comfortable, exciting and safe ship.
- Masters and crew want a ship that is easy to operate, comfortable and also safe, in the broadest sense of the word, and certainly with respect to the working environment.
- Society wants environmentally friendly as well as safe ships.

Designing usable ships

The only real common concept seems to be *safe*. However, *safe* might not be given the same meaning by all users. Society would probably tend to view safe as no disasters while the crew would look at a safe ship as one that not only keeps floating but also is not inviting small personal accidents such as slips and falls.

So how do you build a ship that is - at the same time - cheap, safe, comfortable, easy to maintain, easy to operate and environmentally friendly?

Rules, regulations and recommendations issued by IMO, ILO and classification societies help to a certain extent, but they do not in themselves solve the problem. The professional knowledge and skill of the designers and builders of ships is of paramount importance in order for us to get ships that are really usable.

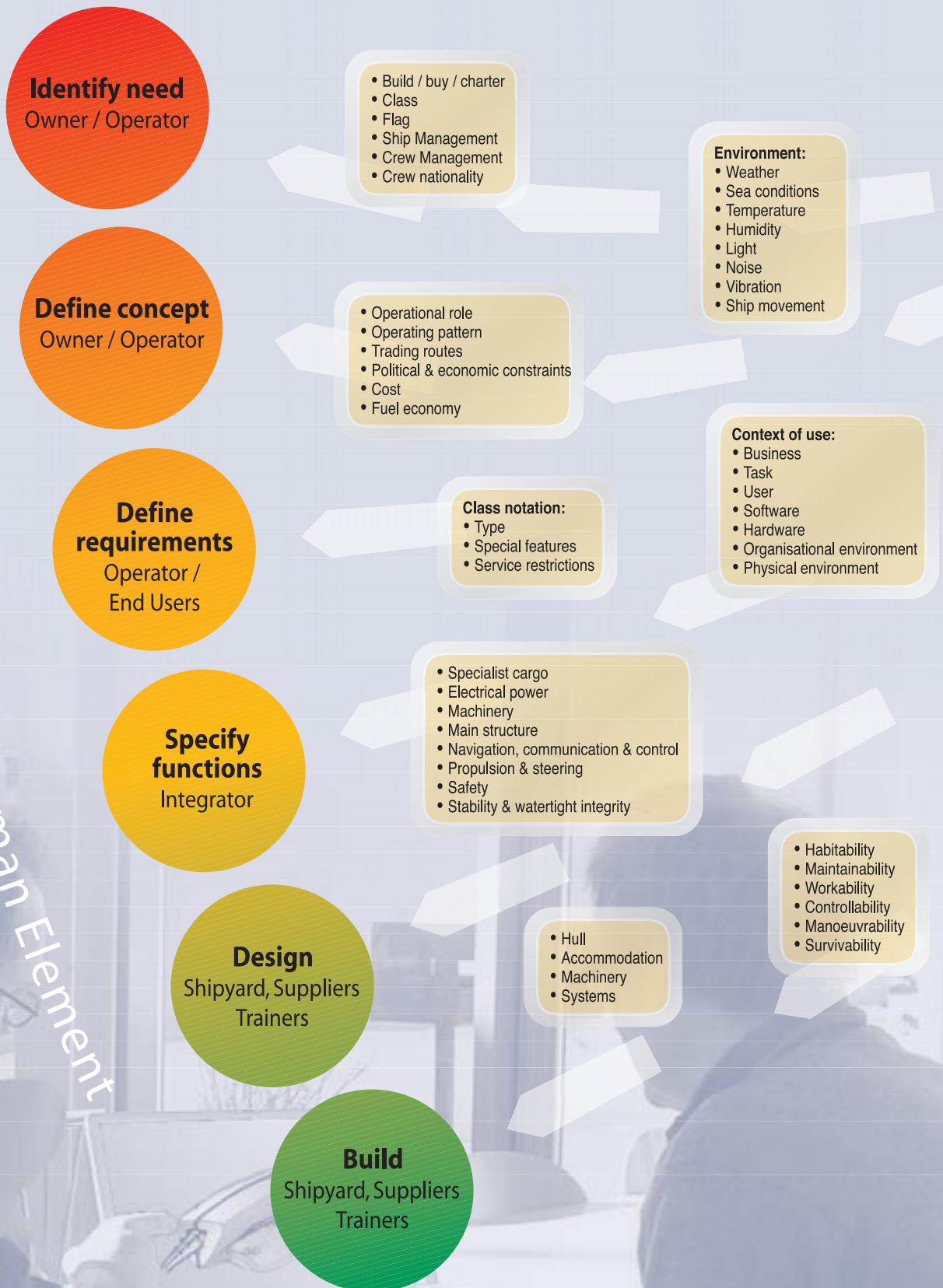
Simple things like making sure that surfaces, ladders and staircases do not invite slips, trips and falls; sufficiently lighted work areas; avoidance of noise and vibrations; layout of crews' accommodation; etc play a very important role for the persons on board and should be addressed already at the design stage. There is a wealth of information available from other industries on human factors and ergonomics - why not use it?

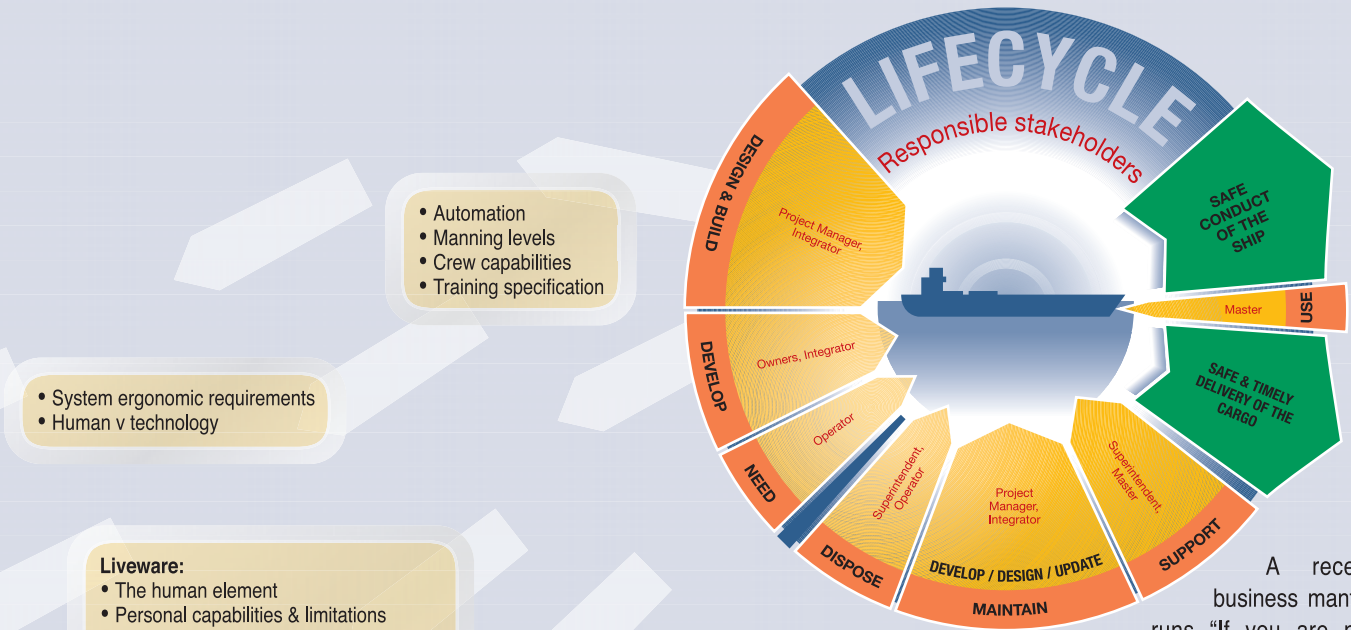
Common sense should be used when designing a ship. This would and should certainly include consulting the people who are actually going to spend a lot of their time on board - the seafarers. And by this I do not only mean the master!

A full version of Jorgen Rasmussen's paper on Designing Usable Ships can be downloaded from www.he-alert.org (Ref: HE00360)

A human-centred approach to ship & system design

Mitigating risk to the Human Element





- Automation
- Manning levels
- Crew capabilities
- Training specification

- System ergonomic requirements
- Human v technology

- Liveware:**
- The human element
 - Personal capabilities & limitations
- Human factors:**
- Job, person, organisation & management
- Human-human interactions:**
- Management
 - Supervision
 - Crew interactions
 - Communications
 - Training

- Hardware:**
- Workstations
 - Displays
 - Controls
 - Accommodation
 - Galleys
 - Recreational spaces
- Software:**
- Organisation
 - Policies
 - Procedures
 - Manuals
 - Checklists
 - Charts
 - Drawings
 - Publications
 - Information Technology

An A to Z of Ergonomics
(Alert! issue 3)

Exploring Human Factors
(Alert! issue 2)

Mind, body & spirit
The 7 needs of the mariner
(Alert! issue 4)

The development and maintenance of the human component of ship systems
(Alert! issue 6)

A recent business mantra runs “If you are not managing risk, you are managing the wrong thing”. System engineering is the process by which systems are decomposed and specified to a point where they can be acquired with acceptable risk.

Human-centred design is the means by which the risks arising from a mismatch between seafarers, their ship, its systems and operational procedures are mitigated. Being human-centred entails early and continued focus on the requirements of people who are going to use a system throughout its life.

User requirements are derived from human factors data considered in the context of the particular ship, its manning, outfitting and operation. A large amount of human factors data is already captured in Regulation, Standards and organisational knowledge.

This centrespread includes a set of checklists for the type and location of human factors data required during the planning and specification of a new ship or ship system. For novel situations, new equipment or unusual manning, new data may be needed. Who collects this data depends on what it is about and how it can be most beneficial. For example, manufacturers are best placed to collect information on the use of equipment, owners for workspaces, and operating companies for training and manning.



Stephen M. Payne,
OBE, FRINA, CEng,
BSc Eng (Hons)

In a passenger ship it is the comfort, safety and pleasure of the passengers that comes first, which can present the designer with a number of interesting challenges. Stephen M Payne OBE, the Chief Naval Architect of Carnival Corporate Shipbuilding (and designer of Queen Mary 2) reflects on some of the design aspects of this ship.

During her first year of operation the Queen Mary 2 has shown off her paces and has been universally acclaimed as 'the only way to cross'. She embodies all the latest technology and passenger comforts and is set to maintain the transatlantic ferry initiated by her predecessors hopefully for the next 40 years. All aspects of the design relate to passengers. Cruise industry practices contribute to operational efficiency only where they do not impact on the passenger transatlantic experience.

Fit for purpose - Designing Queen Mary 2

The size of the ship at 150,000 grt (the largest passenger ship ever built) enabled a superlative array of signature public rooms to be provided as well as 1,310 cabins ranging from modest insides to magnificent bi-level duplexes. To justify the return on investment Queen Mary 2 has to maximise her earning potential by increasing the proportion of premium rate balcony cabins above that of normal cruise ships and by taking full advantage of the axiom of 'economy of scale'. To maximise the number of balcony cabins the public rooms were placed low down in the ship with a much larger than cruise ship normal tween deck height to provide sufficient volume to enable some impressive public rooms to be incorporated. This was especially the case where the two adjacent public room decks were combined into double height rooms, some with domes extending into the cabin decks above.

Time is also critical. The QM2 is designed for a six-day transatlantic crossing with a ten-hour turn around at each port. It is

crucial that her schedule is maintained. To offload her passengers and luggage on arrival, dispose of garbage, refuel and embark her new passenger load and their luggage requires a minimum of ten hours. If the ship is delayed this can seriously impact on her departure with a cumulative knock on effect through the season resulting in cancelled flights, hotel bookings and reimbursements to passengers etc.

On her maiden transatlantic crossing in April 2004, Queen Mary 2 encountered two North Atlantic storm systems. Despite these, her reserves of power in combination with her strength and overall design enabled her to maintain her schedule and arrive in New York on time. This performance is delivered silently without the knowledge of the passengers and, even at full speed, noise and vibration levels are almost non-existent.

For further information about the Queen Mary 2 go to:
<http://www.cunard.co.uk/cruise-ships/queen-mary-2/>

Closing the loop - feedback from the user modulating the designs



Jagmeet Makkar,
FICS, FIMarE(I)
Vice President,
KC Maritime Ltd,
Hong Kong

Ships and ships' engine rooms are not new. The cumulative experience of designing, operating and maintaining ships is so enormous; but, if used properly, it can bring about a much-desired positive change in the equipment capacities, layout of the engine rooms and space for maintenance.

This has not happened however. Every time a new building supervisor interacts with the design department personnel of the shipyards during the technical discussions and day-to-day onsite supervision, he wishes that they had a better understanding of onboard operation and maintenance. While there are exceptions, the experience has been that the designers, in general, have none or

bare minimum practical experience and are not in a position to appreciate the difficulties that are encountered after the delivery of a vessel.

Designers get the opportunity to get a feel of the practical difficulties through the feedback from the ship owners' technical teams during technical negotiations, new building supervisors during construction of the ships and later from the guarantee claims from a series of sister vessels. It has been noticed that even after such feedback, there is a strong resistance to changes or modifications probably for commercial reasons. In the highly competitive business of shipbuilding where some shipyards have the advantage of using cheap labour, others try to compete through increased productivity to compensate for the expensive cost of production. They do not like to disrupt the assembly line production and hence are inflexible to changes, even though they may appreciate the usefulness of the changes asked for.

An example here is of the shipboard incinerator. In a regime where the

shipboard staff is threatened with imprisonment and heavy personal liabilities and the ship owner subjected to severe financial penalties, the ships are provided with bare minimum capacity incinerators in the name of compliance with the requirements. Another important issue is treatment or preparing the sludge mixture prior burning. This is the part where further difficulties are encountered due to poor tank arrangements as designers provide for only one tank for incinerator service.

Thus, inadequate handling capacity of incinerators, lack of proper agitation arrangements and in some cases improper drainage to get rid of water, coupled with poor tank arrangements present severe difficulties for the users onboard the vessels. More often than not, the designers resist the increase in capacities even though a ship owner is willing to incur a reasonable additional cost. This is either for commercial reasons as mentioned above, or because of sheer lack of understanding of the severe implications resulting from less than adequate practical capacities of such equipments.



*Captain Eion W Lyons FNI
Marine Director
and Head of Technical
Department
FT Everard & Sons Limited*

Identify the good and build upon it

Wuhan, China, the first of which is MV Speciality, due for delivery mid-2005. Whilst the vision for this project originated from senior management, its development into reality benefited greatly from the contribution and involvement of sea-staff at every stage of the process. By ensuring that the needs of the operational seafarer are properly taken into account, it becomes possible to design vessels providing a comfortable working environment, fitted with state-of-the-art equipment, which is effectively integrated to permit the greatest potential for efficiency. This cannot be achieved without focussing the design on the users – seafarers.

It would be highly complimentary, but wholly inaccurate, to suggest that the Everard philosophy is based entirely on altruistic principles. Far from it! The defining tenet is that of survival in an increasingly competitive marketplace. This is coupled with an absolute conviction that, by combining the best available equipment, the most appropriate advanced technology and a user-friendly environment, high quality seafarers will aspire to be associated with such vessels. And, once on board will perform to their professional potential thereby operating the vessels to optimum efficiency – in complete safety.

With the obvious exception of Noah's involvement with the ark, seafarers have historically had little involvement in the design of the vessels on which they are engaged. Naval architects designed, shipbuilders constructed and successive generations of seafarers were then left to operate vessels that frequently failed to meet the legitimate expectations of the professional mariner.

This situation is widely perpetuated today, but the problem is not universal. Visionary shipowners, conscious of the beneficial experience of the end-user, have for decades been directly involving sea-staff in the design process for newbuild vessels. How short sighted it is that this practice is not more widespread.

Within the family-owned tanker fleet of F T Everard & Sons, a long-standing philosophy of consultation between sea-staff and shore-based management has benefited the development of concepts for new vessels. Sea-staff have consequently been directly involved with equipment manufacturers and software developers, and have been embedded as members of the newbuild supervision team at the shipyard. A new development? Not really, it is just enlightened thinking in the late 1970s that has evolved into a design process that consistently delivers vessels surpassing their contemporaries, and has more recently produced vessels that are the most advanced of their type in existence.

After deciding to construct new vessels, this process of consultation (which is ongoing even without such a project) is conducted in various ways, the ever-present cornerstone being the close

professional relationship between sea-staff and shore-staff. Ship visits regularly provide a conduit to introduce comment and criticism into the design process and also allows for the identification of those seafarers with a tangible interest in the project, coupled with the underpinning aptitude to provide a positive contribution. From that cluster, a representative group is selected to advise the in-house design team.

The initial challenge is always to conduct an operational review of current vessels (especially the most recent) with particular emphasis on cargo control and monitoring, navigational activities, power generation and propulsion, ergonomics and quality of on-board life. The intention is to identify the good and build upon it; but, equally important, is to eliminate mistakes or oversights in previous designs. Whenever possible, these areas for improvement are incorporated within the new design.

Everard currently has four vessels under construction at Qingshan Shipyard,



What's new... IMO Maritime Safety Committee 79th session

Goal-based construction standards for new ships. The development of goal-based standards for new ship construction has moved forward. It was agreed, in general, that work on goal-based new ship construction standards would be based on the premise that the standards should be broad, over-arching goals against which ship safety should be verified at design and construction stages and during ship operation. They are not intended to set prescriptive requirements or to give

specific solutions. The main objective is to introduce a system whereby the standards would be a measure against which the safety of a ship could be assessed during its design and construction, as well as later on during its operation.

Passenger ship safety. The guiding philosophy, strategic goals and objectives for passenger ship safety have been agreed. This philosophy is based on the premise that the regulatory framework

should place more emphasis on the prevention of a casualty from occurring in the first place and that future passenger ships should be designed for improved survivability so that, in the event of a casualty, persons can stay safely on board as the ship proceeds to port.

Grounding of a High Speed Craft ... whilst on Builder's Sea Trials

A twin hulled 180gt high speed passenger craft, while conducting Builder's Sea Trials at night, grounded during a turn at high speed. The investigation report highlights a number of failings in navigation, planning and Bridge Resource Management but it also focuses on some significant design problems.

This was the first of three identical vessels to be operated by a long-term charterer, who provided the shipbuilder with the detailed design specification for the vessels, based on their expected operating requirements. During the design and build stages, the shipbuilder's trials master was given copies of the vessel's operations manual and details of layout of the operating compartment. Despite the trials master bringing some deficiencies to the attention of the builders, the charterers subsequently directed that no changes should be made to the layout.

The report concludes that the vessel's operating compartment was poorly designed and equipped and did not comply with the High Speed Craft Code. Further deficiencies included: poor

instrumentation layout, light pollution from the passenger cabin, faulty instrumentation and control station window demisting difficulties.

In addition to the problems and faults found with the bridge design and instrumentation before and during the trials, no Electronic Chart Display and Information System (ECDIS) or Electronic Navigational Chart (ENC) system was fitted to the vessel.

The report makes a number of important recommendations, not least one for the Flag State to take forward - with the appropriate committees and subcommittees of the IMO - the introduction of requirements for:

- All high speed craft to be fitted with navigational instruments designed to cope with the unique requirements of high-speed craft. In particular, a display such as ECDIS or ENC, which gives an instantaneous indication of charted position, to be fitted on all vessels except those solely engaged on line-of-sight voyages.

- A minimum of two type rated people to be required to navigate a high speed craft except where the vessel's voyage is a short line-of-sight passage. Each of the navigators should have navigation/control stations within the operating compartment.
- A global standard layout of navigational instrumentation for the operating compartment of all high speed craft.
- Measures to ensure that the administration has early involvement in the design approval of all high speed craft operating compartments.

Flag Administrations, owners, designers builders and operators involved with the design, build and commissioning of high speed craft are strongly advised to read the full report which can be downloaded from:

<https://assets.digital.cabinet-office.gov.uk/media/547c70caed915d4c0d0000cf/Katia.pdf>

Reports & Studies

IMO GUIDELINES FOR THE PRESENTATION OF NAVIGATION-RELATED SYMBOLS, TERMS AND ABBREVIATIONS

(SN/Circ.243 dated 15 December 2004)

The purpose of these guidelines is to provide guidance on the use of appropriate navigation-related terminology and abbreviations intended for presentation on shipborne navigational displays. These are based on terms and abbreviations used in existing navigation references. They have been issued to ensure that the terms and abbreviations used for the display of navigation-related information on all shipborne navigation equipment and systems - including, radar, ECDIS, AIS, INS and IBS - are consistent and uniform.

Downloadable from: www.imo.org/blast/blastDataHelper.asp?data_id=10988&filename=243.pdf



ABS GUIDE FOR CREW HABITABILITY ON SHIPS

Developed with the objective of improving the quality of seafarer performance by improving their working and living environments in terms of ambient environmental qualities and in some instances the physical characteristics on board cargo vessels and passenger vessels. These habitability criteria have been chosen to provide a means to reduce crew fatigue and to increase crew retention.

Downloadable from: http://ww2.eagle.org/content/dam/eagle/rules-and-guides/current/other/102_crewhabitabilityonships/HAB_Ship_Guide_e.pdf

THE HUMAN ELEMENT IN SHIPPING

Commodore David Squire, CBE, FNI (February 2005)

A paper outlining the various Human Element issues that can affect the ability of the master and his crew to ensure the safe conduct of the ship and the safe and timely delivery of its cargo. Downloadable from:

www.he-alert.org (Ref: HE00350)