

## MARINE DESIGN 2015- ABSTRACTS

### 1. MARS TANKER 'DESIGN FOR ENVIRONMENT'

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The Military Afloat Reach and Sustainability (MARS) Tanker (Tide Class) was commissioned to replace current Royal Fleet Auxiliary (RFA) vessels which are non-compliant with the International Convention for the Prevention of Pollution from Ships (MARPOL) requirement for double hulling. This is the first high profile Ministry of Defence (MOD) procurement project driven in part by an environmental requirement.

Initial environmental assessments had been carried out at the Concept phase. By working with the MOD and designers Daewoo Shipbuilding & Marine Engineering Co., Ltd (DSME), the opportunity was exploited to create a platform that is "designed for the environment", not only in the finished product but also through more sustainable manufacturing practices. This allowed for environmental considerations to influence design, over and above simply meeting current environmental requirements, and to enhance the ability of the platform to meet future environmental requirements.

A key claim within the Environmental Case is that the platform is "designed for the environment". Gaining sufficient evidence to support this claim has involved close collaboration between the MOD, DSME and BMT. The application of "design for environment", implementation of environmental requirements in design, and closer collaboration has presented challenges and there are a number of lessons learned.

As environmental requirements and the need for more resilient platforms increases within the MOD, it is important that lessons learnt and best practice from projects such as MARS Tanker are shared. This paper discusses the benefits of the "designed for the environment" approach and lessons that can be learned from its application in the MARS project.

### 2. CATAMARAN YACHTS: STYLING TRENDS AND DESIGN PRACTICES

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Over the past two decades both sail and power catamarans, traditional in Australasia, have become increasingly popular in the European pleasure craft sector. To achieve the evident advantages that the vessel platform offers, in terms of space and comfort, catamaran recreational small craft require a holistic Marine Design approach, which implements a User Centred Design informed vessel specification. This paper presents a summary of styling trends, architectural types, layout

solutions and design innovations, for catamarans below 24m in length, based on the extensive experience of Albatross Marine Design. Special attention is given to superstructure configurations, where differences in aerodynamics have been studied. Common design problems are reviewed and the advantageous design parameter ranges, where catamarans show their benefits, are identified. Catamaran design guidelines are delineated with associated rationales for their shapes, layouts and engineering feasibility.

### 3. SUSTAINABLE LUXURY CATAMARAN SUPERYACHT (SLCS)

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This paper reports on a collaborative professional practice project engaging in Design-Driven Innovation. The aim of which was to examine a new market sector of a sustainable luxury superyacht based on a catamaran platform for the South East Asian market, informed by the innovative 'Future Concept Feadships' as well as the DDI insights of EBDIG-IRC. The catamaran platform has recently arrived in the superyacht sector at 40m Loa, by comparison the World's largest superyacht has a 180m Loa (Azzam, 2013). Whereas, in the commercial vessel sector Incat have recently completed a 99m Loa LNG fuelled gas turbine powered catamaran ferry capable of 58knots, which was designed to compete with short air travel routes. Informed by this innovative platform, the SLCS proposal was developed to address the significant market opportunity of the sector between superyachts and cruise ships. The technology innovations of the LNG fuelled gas turbine catamaran platform and the implementation of Passive Design act to reduce CO2 and other emissions, compared to other vessel platforms of comparable size and speed.

The design meaning of the SLCS is that of a floating private membership club for SHNWI in South East Asia, with a strong focus on sustainable luxury. It is informed by the design meaning of Quintessentially One, a new luxury lifestyle membership club on a 220m superyacht platform, which operates as a floating destination. The accommodation in the boutique hotel of the lower deck facilitates up to 36 guests. The optimisation of the SLCS interior volume is achieved through the adaptability of the function of a number of key public space, to facilitate a range of both guest and visitor activities. Essentially the vessel operates as both a high speed superyacht and as an architecturally imposing illuminated floating venue for prestigious events. The interior areas were developed through engaging in an emotional design approach to the cultural specificity of luxury in South East Asia. The innovative beach club

platform and the submerged lounge space communicate the focus that the design has on the experiential value of luxury.

#### **4. DESIGN-DRIVEN INNOVATION: A NEW DESIGN MEANING FOR SUPERYACHTS AS A LESS EGOCENTRIC USER EXPERIENCE**

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This paper examines the relationship and commonality between contemporary cruise ship technologically innovative interior concepts and the possible future evolution of the megayacht. Due to significant investment in developing new entertainment pathways from a multicultural perspective, the cruise sector is more progressive than the superyacht industry, which primarily focuses on exterior aesthetics and bespoke client luxury informed by cultural specificity. Moving beyond LY3 to the use of SOLAS PYC 13-36 on a larger interior area vessel platform than current superyachts, either monohull or catamaran, greater than 100m Loa, facilitates the opportunity to use the interior design meaning of a cruise ship with an atrium stairwell as a design focal point inspired by the emotional design of luxury hotels and a range of lounge variations to be used as an adaptable space.

This paper presents a Transfer of Innovation (TOI) of a conceptual design approach to support the evolution of the megayacht towards a less egocentric product, informed by the design practices of the cruise ship industry. Addressing the market sector between superyachts and ultra-luxury cruise ships, through a new design meaning informed by technological innovation through the process of Design-Driven Innovation. Contemporary trends in cruise ship are rapidly evolving towards spectacularization and dematerialization. Entertainment is a core focus for cruise companies, immersing the passengers in a range of emotionally engaging experiences, which continuously change in space and time, resulting in the ever growing investments in entertainment technology. The passenger is attracted in an emotional path, constructed to give surprise and delight at every corner, through formal stereotypes, pop culture, and live shows. The main key trends of which are discussed, such as the use of large adaptable spaces, and the creation of a continuous passengers' flux along the ship in an urban-like environment, where different design languages meet.

#### **5. A GUIDE FOR DESIGN-DRIVEN FIELD RESEARCH AT SEA**

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Designing ships and marine equipment to be used onboard are challenging tasks, mainly because the situation to design for is unfamiliar to most designers. For this reason field research is essential in marine design. The paper will present a guide for design-driven field research at sea. The guide is based on the experiences with field research derived from the Ulstein Bridge Concept design research project, as well as other field studies performed at the Ocean Industries Concept Lab at the Oslo School of Architecture and Design. The basis for the guide is the model for design-driven field research. This model is specifically aimed at the needs of a design project and emphasises three focus areas in field research for design: 1) data mapping, 2) experiencing life at sea, and 3) on-site design reflection. The practical aspects of how to plan and carry out field research at sea are stressed in the guide, which can be applied directly in design projects. In the paper the guide will be presented in detail and its value for design will be discussed.

#### **6. EMOTIONAL DESIGN AND THE EXTERIOR STYLING DEVELOPMENT OF A WFSV**

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Exterior styling is responsible for that visceral response of 'love at first sight'. The fact that styling is as important for a vehicle's marketing success as its technical performance has been known since the 1930s. The recent exterior design developments by leading companies in the commercial vessel sector, shows that they are developing an appreciation of this realisation. In considering the relationship of commercial vessel exterior form language aesthetics and emotional design, it is useful to first consider the automotive industry where this relationship is firmly established. Perception of a new car by a potential customer usually happens from the outside to the inside through different levels of detail. The first characteristic of a car that catches a potential customer's attention, engaging their emotional perception is the aesthetic appearance of its exterior styling. Studies from the defence sector indicate the implementation of Marine Design, which includes exterior styling, would represent about 2.5-4% of acquisition costs with a potential return on investment of

between 40-60:1. This paper reviews current examples of exterior styling in the commercial vessel industry and the associated benefits to both brand and user (crew). Several exterior styling proposals for a WFSV are presented and reviewed in the context of manufacturing process and associated costs.

**7. DESIGN-DRIVEN INNOVATION: A PROPOSAL FOR IMPROVING THE SUSTAINABILITY OF FREIGHT TRANSPORT IN IRELAND THROUGH A MODAL SHIFT TO COASTAL VESSELS**

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**G Lynch**, EBDIG, NMCI, IRL

Increased awareness of an over reliance on fossil fuels and the need to reduce transport CO<sub>2</sub> emissions (formalised in EU and national directives) has brought into sharp focus the need for energy efficient transport modes for passengers and freight. An IEA report proposed that shifting freight from energy intensive modes such as road and air to rail and shipping should be a priority for many countries. Comparing energy use by sector for EU-28, Ireland has the highest percentage energy consumption for transport at 40% compared to an EU-28 average of 33%, as it has the highest reliance on road infrastructure for freight transport at 99.1% compared to the EU-28 average of 75.5%. Ireland does not use the inland waterways for freight transport compared to an EU-28 average of 6.7%.

This paper presents a Design-Driven Innovation scenario for the use of the coastal waterways of Ireland for both freight and passengers, based on the EU MoS (Motorways of the Sea) proposal. There are two key objectives of the EU MoS proposal, to reduce road transport congestion by direct replacement with water based transport routes and to reduce transport CO<sub>2</sub>. The congestion aspect relates to the cost of motorway infrastructure and the delays in journey time. A preliminary business model was developed to determine the feasibility of the proposal for a range of vessels. This was based on estimations of vessel cost, infrastructure costs, as well as their associated operating costs and CO<sub>2</sub> emissions. These being offset by the average indicative motorway infrastructure costs and reduction in annual road freight transport volumes enabled the potential CO<sub>2</sub> and operational cost reductions to be identified, with a sensitivity analysis of changes in operations costs and fuel taxation. Statistical analysis of national annual road freight transport was carried out using the EU Eurostat database to determine potential freight volumes that this integrated transport proposal could support. Several vessel platforms and concepts were evaluated, including high-speed catamaran ro-ro ferries and a new vessel sector the Cruise-Logistics-Ferry (CLF).

**8. LANDLUBBER TO SEAMAN – AN INDUSTRIAL DESIGN IN THE PROCESS OF GETTING HIGHLY SPECIALISED ONSHORE PERSONNEL TO WORK OFFSHORE**

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With the growth of the industries to offshore areas and industries working further offshore, the demand for highly specialised personnel grows respectively. Consequently, the past year trend of a shortage of qualified offshore personnel is becoming more of a problem as the availability further decreases. Highly qualified personnel are to be recruited from originally land-based industries. Getting these land-based specialists to change their 9-5 routine to long shifts offshore, requests a lot from them. A high salary is no longer sufficient to keep the qualified personnel. This stresses the need to fulfil the employees' needs by implementing a new design approach; an Industrial Design process tailored towards the users. The process needs to focus on making their working and leisure time as comfortable and pleasant as possible.

This paper describes the user centred design process of creating an offshore work and leisure solution. By means of qualitative research methods, such as interviewing, creative sessions and story boarding, design insights were established. In turn, these insights were used to create a design solution concept for an offshore vessel. The design concept is based on user experiences and tailored towards the user to provide with the needs for land-based specialists in an offshore environment.

**9. SETTING THE STAGE FOR FUTURE SHIP DESIGNERS' UNDERSTANDING OF CONTEXT OF USE**

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Adopting a Human Centred Design (HCD) process during ship design offers the potential to address usability concerns to reduce the cost associated with re-design, work-arounds or later, accidents. HCD is a process of systematically applying Human Factors and Ergonomics (HF&E) knowledge and techniques during design stage which can improve the overall safety, efficiency and wellbeing of the seafarer. One foundation of this process is an understanding of the situation in which the product will be used; the context of use (COU). Thus ship designers' COU knowledge plays a paramount role within the ship design process.

A "COU in Ship Design" workshop was conducted with 50 final year undergraduate students in the Australian Maritime College (Naval Architecture, Marine &

Offshore, and Ocean Engineering) to investigate their COU knowledge. Students were asked to build low fidelity prototypes of selected work contexts on ships, and to prepare mobile phone videos. A team of 7 experts were available as end users, for consultation. The team also provided feedback on the design prototypes, contributing to the students' knowledge of COU.

Observation and questionnaire findings show that the students' understanding of situations on ships could be improved, although it did contain key elements of the context in many cases – more on general layout and crew members present, less on crew roles. Furthermore, the findings demonstrate the need of including HF&E theoretical underpinnings in undergraduate maritime design engineering syllabi.

**Keywords:** human factors, human centred design, ship design, education

#### **10. MULTIMODAL INTERACTION FOR MARINE WORKPLACES USED AS STRATEGY TO LIMIT EFFECT OF SITUATIONAL IMPAIRMENT IN DEMANDING MARITIME OPERATIONS.**

**Dr. Kjetil Nordby,** Oslo School of Architecture and design

Constant changing conditions such as weather, operation type, time of day and fatigue are part of everyday life at the sea and lead to considerable challenges for the design of ship bridge interfaces and workplaces. Such conditions lead to users experiencing situational impairments where users cannot operate equipment optimally due to temporary, operation caused, limited mental or physical ability. To limit the impact of situational impairment in ship bridges the article report on a design project, Ulstein Bridge Vision, exploring alternate ways doing interaction for ship bridges. The project demonstrate how multimodal interfaces might show a way forward towards better interfaces more in line with the changing needs of marine operations. I show examples of multimodal design for ship bridges and discuss the possible implications of such design in the future. Finally, we suggest that it is important to better understand multimodal interfaces in context of the changing conditions at sea to be able to design next generation interfaces for demanding marine operations.

#### **11. CONNECTING THE SHIP SYSTEM DATA TO MARITIME OPERATIONS AS MEANS FOR DESIGN.**

**Snorre Hjelseth, Kjetil Nordby;** The Oslo School for Architecture and Design

During field studies it is a challenge to see and connect the ship data displayed in ship bridges with the operation being performed. This is a problem since data from systems such as conning systems, dynamic positioning

(DP) and integrated automation system (IAS) are a crucial part of getting a full understanding of the performed operation. To meet this challenge we have developed a technique to visualise ship system data captured from real operations as an overlay on video captured simultaneously. The technique has been used to understand the engine and propulsion effects, and fuel consumption in relation to the ship contextual factors such as wind, current and motion in different operational settings. We have found that the technique enables ship designers to explore their designs and it has led to insights that can have impact for decision-making during ship design. In this article we describe the technique in detail combined with a case study where it is used as part of field studies supporting ship design. Finally, we suggest possible improvements to the procedure and the implications of using such field data for ship design.

#### **12. WITHDRAWN**

#### **13. DESIGNING FOR THE INITIATION OF PROJECTS IN THE MARITIME INDUSTRY**

**Etienne Gernez, Snorre Hjelseth and Kjetil Nordby;** The Oslo School for Architecture and Design

Human collaboration is a challenge in multidisciplinary, complex projects such as ship design. The actors involved in the design and decision-making processes have different level and direction of expertise and the frameworks for understanding separate parts of ship design activities can be hard to share across disciplinary gaps. This is a serious challenge since miscommunications and un-inclusive design processes can lead to suboptimal or even unsafe ship design solutions. This is especially important in the very early stages of the design process where the design strategy is formed and a number of design solutions are agreed upon among the participating actors.

This article examines how projects in the field of ship design are initiated and how they can build on knowledge and innovation transferred from already concluded projects.

To investigate this we apply concepts from service design and systems-oriented design. We are particularly attentive to the meeting points between potential project collaborators along the ship design process (called "touch-points"). In doing so we adopt the perspective of designers whose mission is to assist potential project collaborators in understanding each other's way of thinking and working, with the aim of co-creating a framework for collaboration that is robust to different types of design projects. By applying service and system oriented design we argue that there is an opportunity to better shape the collaborative processes in action in ship design related projects.

#### **14. LIGHTWEIGHTING OPTIMISATION OF A TRIMARAN HIGH SPEED CRUISE LOGISTICS FERRY (CLF)**

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The proposed study is researching the opportunities for lightweighting of a high speed multi-purpose trimaran ferry, which is complying already with the Lloyds Registrar regulations. The purpose of the study is to generate a lighter structure in order to improve fuel economy and reduce costs of running such vessels, as well as clarifying whether Lloyds Registrar rules over-engineer such ship design architectures.

The study has generated a computer algorithm of a wave which has been applied on the vessel, in sagging and hogging, on a full 3 dimensional finite element model of the ferry. Using these wave loadings, the study compares the level of over-engineering of the vessel and proposes a lightweighting method which will fulfil vessel fatigue loads which will be present during its service.

The research has concluded that some areas of the ship mass could be reduced and still meeting fatigue life of the material, leading to a mass reduction of 96 tonnes.

#### **15. THE ROUTE TO VIRTUAL HYDRODYNAMIC MODEL TESTING**

**Sam Hill**, Programme Manager IMCS, QinetiQ, UK

Hydrodynamic model testing remains the route to demonstrate at the earliest stage that designs are suitable for their intended role and demonstrate first stage compliance with standards such as EEDI. The industry has long talked of being able to simulate these tests computationally but physical test facilities remain well utilised. Computational Fluids Dynamics methods have matured significantly in recent years, to the point that it is believed that now a feasible roadmap can be developed. This paper will describe the potential roadmap, and the technologies and alliances which are necessary to achieve it.

#### **16. REJECTED**

#### **17. INJURY PREDICTION MODELLING IN THE GA DESIGN OF A TRIMARAN HIGH SPEED CRUISE LOGISTICS FERRY (CLF)**

**C Bastien and S McCartan**, EBDIG-IRC, Coventry University, UK

**D Boote, T Colaianni, and T Pais**, EBDIG, DITEN, University of Genoa, ITALY

Crash in high speed vessels has more in common with automotive accidents than those of slower larger vessels. Using the crash pulse established in previous work of the authors, a computer simulation model was developed to predict the risk of injuries to ship crew and passengers for a range of locations in the GA, in the event of a 40knot crash of the CLF with a harbour structure. The work involved reviewing and implementing established crash modelling and occupant simulation methodologies from the automotive sector. In terms of an injury prediction model, a number of key areas of the GA were modelled as discrete spaces, to which the crash pulse was applied, this facilitated a computationally efficient analysis. A number of the discrete spaces were validated against a full vessel model crash simulation. For each of the key GA areas, both standing and seated occupant models were used to simulate injuries and trauma, for a range of positions in each area. The results were used to inform the GA development process in order to improve evacuation and propose innovative active safety technology, to mitigate the risk of fatalities in these next generation high speed vessels.

#### **18. BOUTIQUE EUROPEAN RIVER CRUISE VESSEL**

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**B Verheijden**, Academy Minerva, Groningen, NL

This design proposal engages in Design -Driven Innovation to create a new market sector through the use of within the river cruise industry in Europe. The current average age and target market in the river cruise industry is 55+, however this target age group has less than 10% of the luxury tourism market. By designing a new era of River cruise vessel that appeals to 25-50 year olds it would attract more than 80% of the luxury tourism market each year. The design of the current vessels does not appeal to this new design conscious. This concept is more minimalistic and has a quirky aesthetic allowing it to be classed as boutique (trendy and design oriented). It is more exclusive and design experience focussed allowing for a memorable and comfortable experience. The exterior is inspired by superyacht styling and architecture. The cabins are larger than current vessels allowing for more relaxation space after a long day exploring the cities along the rivers. The furnishing is simple and well design with a high emphasis on craftsmanship. The feature wall will vary in each room, so that frequent travellers can have a different experience on each subsequent holiday. The roof terrace has been designed so that in the warmer month there is shading and a small bar to relax. The implementation of Passive Design and solar panels significantly reduces the auxiliary power requirement, thereby addressing the sustainable luxury agenda.

## 19. DESIGN-DRIVEN INNOVATION: SUPERYACHT VERTICAL TENDER

S McCartan and M Bryden, EBDIG-IRC, Coventry University

Since the creation of the market sector speedboat platform tenders have been the vernacular accessory for superyachts. Where higher end tenders are designed to embody the DNA of the mothership, conveying a signature relationship in port, superyachts are conventionally fitted with helipads for touchdown use only, with a charter helicopter transporting clients. Megayachts have parking and refuelling capability for helicopters, which has significant design implications due to more significant fire safety regulations. Current helicopters in the industry are based on conventional commercial or military platforms, with a degree of interior customisation. This project engages in Design-Driven Innovation to change the design meaning of the relationship between tender and mothership by developing an Aston Martin helicopter as a Superyacht Vertical Tender, where the mothership superyacht has the VVIP helicopter as a focal point of the user design experience. The project's core aim was to create a design that embodied the exclusivity and convenience of helicopter travel with the emotional appeal of the Aston Martin brand. With the future of high-end transportation becoming more individual, the design was tailored for a specific client user application. The final design proposal was a low carbon helicopter designed specifically for the VVIP market. Proportions are key to the exterior design of any Aston Martin, which are juxtaposed to those of conventional helicopters. Ensuring the exterior design has Aston Martin was a challenge addressed through the technological innovations of coaxial rotors and hybrid drive. These also reduced the CO<sub>2</sub> footprint of the helicopter to support current developments in sustainable luxury trends. The main inspiration for the interior design was equestrian craftsmanship, specifically the Hermès Talaris saddle. This piece combines traditional craftsmanship with advanced materials as it has a carbon and titanium structure making it lighter than traditional saddles.

## 20. MEDICAL SUPPORT VESSEL FOR 2025

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Currently there are significant challenges for humanitarian aid provision in developing countries regarding disaster and disease, such as: cholera; ebola; floods; drought. This project proposes a pontoon based medical support vessel concept for 2025, informed by the design of the Bibby Challenge offshore accommodation pontoon. The vessel is towed along the coast of a

developing country by tug to the location of major disasters to provide support, otherwise it is used as a portable medical centre provision with a defined annual route. It would be operated by NGOs for humanitarian aid as a cost effective alternative to a hospital vessel. It uses the principles of Biophilia to enhance the interior environment, in order to improve the recovery of patients and the stress levels of staff. In the three days that it would take to erect a field hospital and the additional time and significant cost to transport the associated required infrastructure, the medical support vessel could travel a significant distance along the coast. The use of Passive Design significantly reduces operational costs of the vessel, and reduces the risk of air borne infection. The implementation of a modular adaptable interior, allows the vessel to be reconfigured in order to be optimised between the disaster relief role and a humanitarian aid provision in developing countries. Advanced HMI and communication technology support the effective management of the vessel as a resource.

## 21. DESIGN-DRIVEN INNOVATION: SUSTAINABLE LUXURY HIGH SPEED RIGID WING HYDROFOIL

S McCartan, E Stubbs, N Crea and M Hopper,  
EBDIG-IRC, Department of Industrial Design, Coventry University

This paper reports on a new sector for leisure superyachts, building upon the high profile implementation of rigid wing and hydrofoil technology in the recent America Cup boats. The design meaning is that of a motoryacht with effectively a zero carbon footprint, achieved through the use of an automated control system for the rigid wings as the main form of propulsion. The hydrofoil provides significantly reduced drag and improved seakeeping in higher sea states. The technology is common on small boats, but due to the hull drag challenge of larger vessel an innovative implementation of gas turbine powered water jet was used to get the vessel foil borne, which also charges the battery system. The use of solar cells and nature fibres for the construction of the vessel further enhances the sustainability. The vessel has a modular interior based on an aircraft track system, for which 3 distinctive GAs have been designed. This offers a significant level of configuration flexibility for charter and also creates a new charter market sector between charter and ownership, whereby the client can own an interior which is stored and transported in TEUs. The modular nature of the interior enables it to be fitted in 1/2 day rather than a conventional refit which can take months. The exterior styling is informed by motoryacht trends. The LCA issues are addressed by extending the life of the vessel through ease of refit and significantly reduced operating CO<sub>2</sub> footprint, effectively engaging in sustainable luxury

## 22. TRANSATLANTIC WIG: ULTRA ECO-LUXURY TRAVEL

**S McCartan, E Stubbs, N Crea and S Quilter,**  
EBDIG-IRC, Coventry University

This project proposes a transatlantic WIG vessel to address the market opportunity between air freight and sea freight, as well as providing a positive user experience for luxury travel to compete with conventional aircraft first class travel. This design proposal offers the business traveller a personalised pod space with global connectivity to make the journey a seamless extension of the working environment. It is specifically targeted at CEOs and ultra-luxury travellers seeking new and exciting travelling experiences. The WIG technology and logistics role of the vessel gives the luxury and business travellers a significantly lower carbon footprint than a conventional aircraft, thereby engaging in current sustainable luxury agenda. The vessel is based on the Fischer Flugmechanik HW400 platform, scaled up to compete with large commercial aircraft capacities. The innovations of counter rotating engines and the air cushion system to support take-off significantly reduce the required installed power.

## 23. DESIGN-DRIVEN INNOVATION: ULTRA-LUXURY RIVER CRUISE NETWORK FOR COLOMBIA INFORMED BY SUSTAINABLE LUXURY

**S McCartan, A Atkinson and A Phillimore,** EBDIG-IRC, Coventry University, UK  
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Poverty, social injustice and violence continue to hinder the process of sustainable rural development in Colombia. The main problems the country faces are concentrated in rural areas, where about a quarter of its nearly 47 million people live. Rural women and men are held back by limited access to social services, education, technical assistance and skills training. Lack of infrastructure prevents them from engaging with competitive markets. Infrastructure challenges of both the tourism and transport sectors have impeded the growth of tourism in Colombia, which has significant potential for ecotourism. This paper presents a Design-Driven Innovation proposal of an ultra-luxury river cruiser network for ecotourism, based on the principles of sustainable luxury. This proposal provides river logistics and infrastructure to support the development and security of rural communities along the rivers of Colombia, funded by the income from ultra-luxury cruising ecotourism. Research established the needs of small farmers and rural communities around the river networks. In response to which an ultra-luxury river cruiser with TEU logistics capability and a smaller higher speed vessel for local public transport and logistics were designed, along with infrastructure to

support ecotourism and local social needs. The estimated cost of the proposed system compared favourably against the infrastructure cost of road and rail transport.

## 24. TURKISH MARITIME INDUSTRY, TODAY AND TOMORROW

**S Isik, and S Sernikli,** Piri Reis University, Istanbul, Turkey

In parallel to the contraction in the global shipbuilding industry during the 2007-2008 economic crises, the Turkish shipbuilding industry was affected deeply and suffered considerable losses. The total number of shipyards in Turkey is 145 today with an installed shipbuilding capacity of 4.2 billion DWT. In accordance with the recent studies that carried out by Turkish Shipbuilders Association, only 93 of those shipyards are in operation currently and providing employment in the region of 20 000, which is well below the total capacity. The recovery is slow, and due to the fact that the existing capacity of global shipping industry in the supply end is likely to exceed the actual demand in the near future, the Turkish shipping industry needs to adapt its structure to sustain its existence. An initial step in this direction is the implementation of new and innovative methods in design, construction and management of the current shipbuilding practices. In this regard, the outcomes of the EBDIG-WFSV project can prove to be valuable to the Turkish Maritime Industry in designing and building of the new generation marine vessels. There are also domestic initiatives to expand the R&D and innovation capacity of the shipyards and design offices in the Ship Building Industry. A project called "Shipbuilding Industry R&D and Innovation Capacity Developing Centre and Certification Program" by Piri Reis University has been recently completed with a successful outcome. This paper gives an overview of the Turkish Maritime Industry today and its prospects for the near future.

## 25. DESIGN-DRIVEN INNOVATION: NEXT GENERATION WIND FARM MOTHERSHIP FOR THE NORTH SEA

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In response to the specific requirements for UK Round 3 far shore wind farm maintenance operations, a new mothership concept design proposal is presented, that challenges perceptions of the working and living

environment on commercial vessels through the implementation of Design-Driven Innovation. The interaction between innovation of design meaning and technology innovation can transform the market within an industry and even create new market sectors. An analysis of the offshore wind market identified the challenges of vessel financing compared to the oil & gas sector, as a unique opportunity for a common platform technology vessel. The concept presented has an innovative WFSV launch/recovery system enabling a conventional OSV platform to be adapted into a mothership role, resulting in a more cost effective O&M solution.

**26. A SWATH MOTHERSHIP CONCEPT FOR THE FAR SHORE WIND FARMS USING THE ENVIRONMENTAL PSYCHOLOGY NETWORK MODEL**

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The Toyota Production System (TPS) is a continuous improvement philosophy. It became the basis for the LEAN and Six Sigma manufacturing philosophies. A significant element of TPS is automation, or "automation with a human touch". In the same way that lean techniques have been applied to automotive manufacturing, the principles of automation can be applied to offshore wind farm maintenance practices to improve turbine availability. This paper presents a mothership concept design to support an automation approach to offshore wind farm maintenance practices, developed through an implementation of the NetWork model of Environmental Psychology and biophilic design. The NetWork model encompasses both how and where work is done and how workers, processes and places are supported. It differs from previous Environmental Psychology models by focusing on the work that is to be done and how to enable it to be done most effectively. This knowledge informs the specification of furnishings, technologies, equipment and infrastructure that enable workers to make the best of wherever they work, to develop effective work practices, and to continue to adapt. This contrasts with the more traditional focus, which addresses only the places of work, and their efficient delivery and maintenance. The evolutionary basis for biophilia is that contact with nature is a basic human need: not a cultural amenity, not an individual preference, but a universal primary need. The biophilia hypothesis and supporting research tells us that, as a species, we are still powerfully responsive to nature's forms, processes, and patterns. The design process presented is a Transfer of Innovation from

interior architecture where it is a well established approach to produce highly productive and low stress working environments. The potential of this Human Factors focused approach to reduce risk and hence operational costs such as insurance is significant

**27. FAST CRAFT CRASH AND REPEATED SHOCK SAFETY ENHANCEMENT THROUGH THE IMPLEMENTATION OF HSI**

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There have been many examples of fast craft occupants suffering serious injury and sometimes, unfortunately, fatal consequences. Even with these results little has been done to address the risks to the occupants in terms of design regulations. In contrast to this the automotive and aviation sectors have invested significant resources in crash safety for many years, resulting in innovative technological solutions to mitigate the risk of injury to the occupant. Currently, crash in a fast craft is reminiscent of a 1960's car crash, where seat belts were not mandatory and the occupant envelope had hard surfaces with not consideration of occupant impact. This is illustrated in accident reports where multiple injuries resulting in severe internal bleeding are consistent with a heavy impact against a hard surface, such as a cockpit or wheel. Similarly, where occupants are exposed to the harsh repeated shock environment there are many examples of accident reports, where musculoskeletal injuries are experienced as the individual's impact with the internal structures of the vessel. By using the crash analysis matrix (Pre : During : Post vs. Human : vehicle : Environment) the nine interaction areas were examined to identify issues. The results of which were used to develop design and operational solutions. Technology transfer from the automotive sector demonstrates the ability to utilise design features from road vehicles within boat design to enhance occupant safety. This paper describes how designers can utilise the crash analysis matrix to understand how safety can be designed into a craft through a systems design approach. Design features that help reduce the risk of injury of the user impacting the crafts structure are delineated.

**28. MODELLING PASSENGER SHIP EVACUATION FROM A PASSENGER PERSPECTIVE**

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Current evacuation modeling is mostly based on mechanical simulation, which tends to ignore passengers as active agents. However, maritime safety doesn't

concern only the technical side of ship safety and more attention should be paid to the fluent interaction between environment and people. Because human survival in emergency depends on their perception and interpretation of the environmental and societal cues. This study uses passenger ship accident investigation reports to map environmental factors impacting on human behavior under emergency. Comparing and contrasting the subjective perception of passenger with the physical environment helps us understand the safety environment more comprehensively during an accident. Our research revealed that in emergency people trust more in their own perceptions and intuition than given instructions by the crew. Human behavior is guided by instinctual urge to get away from the danger, while rational thinking needed in way finding is secondary. Furthermore, if there's a lack in safety instructions people tend to follow each others, which often results in crowding in places that should be untrammled in order to ensure efficient evacuation. Current evacuation modeling doesn't consider human-environment interaction in acceptable level and given insight to human cognition affects on the evacuation process can be used to develop evacuation analysis towards reality.

boarding. They also gave significant insight in the phenomenon and occurrence of slamming events under platforms, and in the probability of incoming water.

## **29. BEACH CLUBS VS. WAVES; A QUANTITATIVE STUDY ON IMPEDIMENTS IN USE**

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Modern superyachts are increasingly equipped with large beach clubs. These lounge areas close to the waterline have platforms that open downwards. While at anchor, owners and guests use the beach club as a lounge area and they board and leave the yacht by tender at the platforms. The use of the beach club as a lounge area is hindered by the probability of water coming in the beach club and the occurrence of slamming events under the platforms, resulting in vibrations and noise. Embarking a tender is already limited at low swell by the vertical relative tender motions.

This paper presents a study, the aim of which was to gain insight into the impediments hindering the use of the beach club. Embarking a tender, the occurrence of slamming events and the probability of incoming water are all dependent on the relative waves. A quantitative study has been carried out on the relative waves around beach clubs. These were evaluated through the performance of both mathematical modelling and model tests. During the model tests slamming events were examined through video recordings and vibration measurements on the modelled platforms. Incoming water was also observed during model tests and was subsequently modelled using CFD analysis.

The results of this study enabled determination of the most favourable circumstances or location for tender