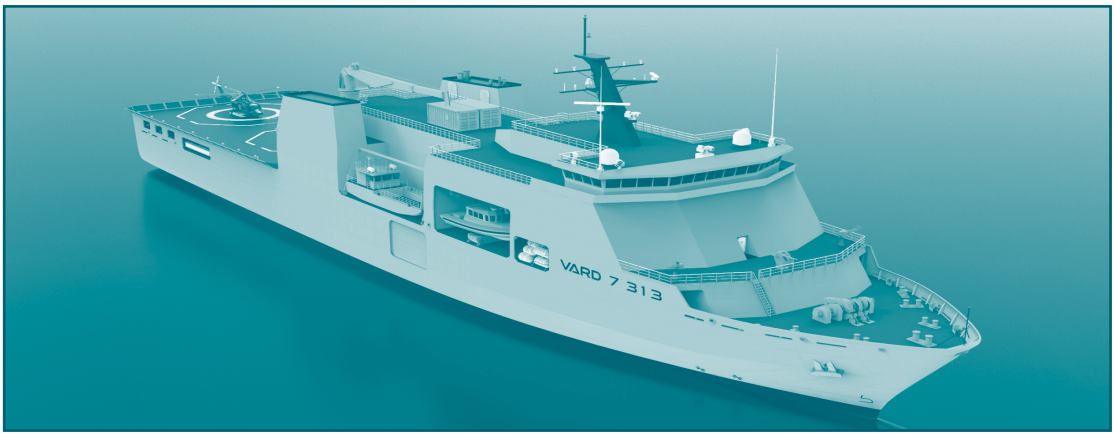
The Royal Institution of Naval Architects

WARSHIP 2019: Multi-Role Vessels



International Conference

Warship 2019:

Multi-Role Vessels,

25-26 June 2019, Bristol, UK

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08.50-09.30 **COFFEE AND REGISTRATION**

09.30-10.05 **KEYNOTE**

10.05-10.40 **ALLIED MARITIME FORCES TRANSFORMATION: TOWARDS A DEFENCE PLANNING PROCESS THAT INCLUDES ADAPTABLE WARSHIPS,** *Richard Logtmeijer, Ministry of Defence, NL, David Manley, Ministry of Defence, UK, Co-authors from NATO partner AUS and NATO countries CA, GE, IT, NL, UK and USA.* Warships have long service lives. During the life of a warship the types of operations that will be assigned to the ship will change (this happened for example at the end of the Cold War), the technology behind the installed systems will advance (e.g., radar performance and miniaturisation) and new technologies will emerge. New technologies are likely to require changes in the way operations are presently conducted (e.g., off-board systems for conducting mine countermeasures operations) and can deliver new operational capabilities to the ship (e.g., directed-energy weapon systems). For these reasons, warships can only maintain maximum operational relevance through life if their operational capabilities can be augmented and adapted to meet changing user requirements. NATO nations and partners, and also their peer competitors, are designing and building more adaptable warships. The future of this trend is transforming the NATO defence planning process so that the future structure of the allied maritime forces will include an appropriate mix of adaptable warships and up-to-date mission packages that can respond to constantly changing operational tasking. The naval architect is already aware that traditional warship design features must be re-worked to accommodate modular in addition to—or even to replace—organic systems. This paper considers the transformation from the engineering and management of mission packages, their deployment and integration into new warship designs towards a new maritime defence planning philosophy and process.

10.40-11.15 **MULTI-ROLE VESSELS: MANNING, DESIGN AND COST DRIVERS,** *Daniel Smith, Naval Design Partnering Team, UK.* Leaning on the Naval Design Partnering (NDP) involvement in concept design for future UK warships and auxiliary vessels, this paper will comment on the technological developments supporting the emergence of multi-role vessels in modern navies, including the autonomy versus manpower considerations and what modularity or flexibility means for the future cost-capability trade space for naval surface ship design. Manning approaches to multi-role vessels will be discussed, considering embarked capabilities and different personnel options, taking a view on technological developments that can assist in the selection of novel approaches. This paper will refer to the future trends in naval surface ship design and technologies, with consideration of the expected proliferation of autonomy (including off-board systems). It will challenge traditional views on deploying a capability, consider the design and cost drivers for multi-role vessels and explore what this might mean in a future maritime context. A key consideration is how well the different roles can co-exist in one vessel and how much concurrency of different capabilities is required onboard at any one time. This paper will discuss these key factors in terms of the complexity that impacts ship size and cost, with examples of different functions that dovetail well together in a multi-role platform.

10.15-11.40 **COFFEE**

11.40-12.15 **THE MULTI-ROLE COMBATANT - JACK OF ALL TRADES MASTER OF NONE?,** *David Andrews, UCL, UK.* The paper commences by revisiting the case for Adaptability nearly two decades on from that first consideration and whether the same drivers for Adaptability and advances in Modularity have made the case for multi-role combatants more convincing or whether they are still prone, if they are not truly “First Rate” designs, to be “Jacks of all trades yet masters of none?” Next the paper reviews past warship designs which have been inherently Adaptable, which leads on to consideration of "margins", the traditional way naval ship designers have been able to incorporate a measure of adaptability. However, non-ship design aware procurement authorities, have continued to squeeze seemingly generous margins as a short sighted means of achieving "savings" in the procurement element of defence budgets. There are of course other features, necessary to achieve Adaptability. Thus the paper explores how an adequate consideration of the ship architecture might provide an adaptable design and, specifically, how adopting Modularity to achieve this, can be explored early in ship design. Finally, leading on from the exploration of Adaptability, the paper concludes by a considering the Trimaran configuration. This configuration remains as a highly attractive overall Style and ship configuration choice for future warships, precisely because it readily provides so many of the features that are seen to be appropriate in an Adaptable Multi-role Warship, which can be configured to avoid the Second-Rate “master of none” trap.

12.15-12.50 **WHEN IS THE ADAPTABLE OR MULTI-ROLE SHIP THE RIGHT ANSWER?,** *Charles Moss, Andy Kimber, BMT, UK.* The rise of the multi-role ship, often envisaged with modular bolt on capabilities, has been the stable of conferences for most of this decade. However, the question for the naval architect is “do these represent the right solution for a given individual project” or has the concept been overstated as a vision of the future and used as the template which is not quite the panacea that it promises. They will explore some of the lessons learnt in delivering multi-role and modular designs, including those developed by BMT such as Venator, Veneri and Aegir. The underlying themes that are fuelling the interest in multi-role ships along with the typical roles considered are also discussed. From a designer’s perspective, the impact that standards and Classification have on designing flexible ships and including the use of modular capabilities is discussed, highlighting the potential conflicts and difficulties. Case studies from the BMT concepts designs are used to identify how the designs could be driven by adopting a multi-role or a modular approach and the potential limits to practical adaptability. Ultimately it is the balance of investment between fewer multi-role ships versus potentially simpler (and cheaper) but less flexibility designs, overlaid with the scale of adaptability and potential to compromise on some of the operational performance in some capabilities that guides a project towards multi-role or not.

12.50-13.45 **LUNCH**

13.45-14.20 **PUSHING THE LIMIT: THE ROLE-LESS MULTIROLE WARSHIP,** *Dr Rachel Pawling, Dr Nick Bradbeer, UCL, UK.* Designing effective multirole vessels, particularly warships, is complicated by the potential for the roles, and the mix of roles, to change. Modularity is frequently suggested as an approach to addressing this problem. However, in most extant or near-term modular surface combatants modularity only provides a limited multi-role capability and flexibility, with much capability inherent to the core vessel, and they might be described as “conventional vessels with modular characteristics”. This is in part due to the fact that military capability is not only provided by weapons, but by the crew and supporting systems and modularising those items is difficult, although it has been a feature of construction-oriented approaches such as MEKO. This paper reports on a study conducted at UCL into the possibility of maximising the modularity of a warship to allow both flexibility in role and infrastructure but also the ability to customise the mix of capabilities of the vessel in multi-role configurations. What differentiates this concept is that the seaframe by itself is not a viable ship; the various support systems, accommodation etc. all intended to be modularised. The design implications of this deliberately extreme choice will be discussed, along with how to trade-off capabilities and roles.

14.20-14.55 **A COMMON HULL DESIGN METHODOLOGY FOR MULTI-ROLE SHIPS,** *Dr Ibiba Emmanuel Douglas, Rivers State University, Nigeria.* The paper is presented in three parts; the first part gives a general description of the design procedure and the analytical techniques used in the structural and stability/sea keeping analyses. The differences between the conventional design procedure and the new method are highlighted and discussed. The second part of the paper describes the various design aspects of two conversion projects that were recently completed. In the third part of the paper, the applicability of the method is illustrated with the preliminary design of a coastal general cargo ship that can be readily converted to container or CNG/LNG/LPG vessel without significant modifications to the structural arrangement of the vessel.

14.55-15.20 **COFFEE**

15.20-15.55 **THE IMPORTANCE OF ONBOARD INFRASTRUCTURE TO ENABLE FUTURE VESSEL ENHANCEMENTS AT BUILD AND THROUGH LIFE,** *Simon Willmore, BMT, UK.* The future infrastructure of warships and submarines will need to enable the rapid development and deployment of innovations whether these be new hardware or software only capabilities. The design of these platforms and the role of the Systems Integrators and platform designers will need to expand to provide greater capacity in networks to support future physical and functional integration of components. The above and below decks infrastructure will need to allow for the addition of new networked equipment as communications links either ashore or to networked autonomous platforms. New communications links for communicating with new satellite information feeds will require a change of emphasis on the top side of platforms as will the need for communicating with assets nearer to the host platform in localised wide area networks. The rapid creation of new intelligent applications will affect the way platforms are supported as well as providing enhanced operational advantage to war-fighters. All of this requires platform design to embrace new levels of adaptability where networks and connections will need to be reconfigurable or interchangeable without the need for lengthy maintenance periods to enable flexibility through life.

15.55-16.30 **THE USE OF CAD SYSTEMS TO MANAGE MODULARITY IN MULTI-ROLE WARSHIPS,** *Rodrigo Perez, Erno Peter Cosma, SENER, Spain.* The implementation of new tools to handle modules in warships is particularly important since it simplifies the analysis, which leads to a high potential in the improvement of the coordination among design areas and disciplines, and consequently to a more efficient design. The goal will be to define a limited number of standard modules, which allows exploiting serial effects and containing a significant part of outfitting in order to achieve savings from pre-outfitting. But the concept of modularization has even a wider meaning for warships when thinking in modularity, not only oriented to the design and construction advantages but also in the future evolution of these ships in order to be reoriented easily for different uses, future upgrades or changes that should be realized to be able to undertake different kind of missions through an efficient “Plug and Play” system. The aim of this paper is to develop concepts and design solutions for modular machinery space, on-board automation and warship equipment. To achieve those possibilities, not only the modularity concept will be necessary, it also needs a clear vision of what will be the lifecycle of the warship and its present and future purposes or possible upgrades in order to create a design.

16.30-17.05 **A CONTROL SYSTEM TO ENHANCING THE OPERATIONABILITY OF AUTONOMOUS PLANING CRAFTS IN SEAWAYS WITH THE AID OF VISION SENSORS,** *Hima Bindu Hallaka, Debhorah Levy, Asaf Levy, Tali Treibitz, Morel Groper, University of Haifa, Israel.* Traditional manned planing crafts may present a high risk to crew onboard when operated in harsh and hostile environments, consequently, the use of Autonomous high-speed Planing Crafts (APC) is a promising alternative for fast operations in littoral and blue waters. However, the seaworthiness of APCs presents a significant challenge, particularly in regard to large vertical motions developed in seaways. The extreme accelerations and motions pose a hazard to payload and to the craft's structure. Therefore a near real-time prediction and estimation of vertical accelerations in waves and a throttle control system to maintain those at a safe limit are considered as one of the principal methods for safe operations of autonomous high-speed planing crafts in seaways. In the present study, a control algorithm to enhance the operationality and seaworthiness of APC by employing an autonomous speed setting mechanism as a response to the APC behavior when operating in real seaways is developed. The complete development of the vision-aided speed modulation system (VSMS) for the APC’s autonomous navigation is elaborated. To validate and test the VSMS a manned Jet-Ski was retrofitted to an APC platform and instrumented with required sensors and operated in seaways.

17.05- **GENERAL DISCUSSION & EVENING DRINKS RECEPTION**

DAY 2 PAPERS:

08.50-09.20 COFFEE AND REGISTRATION

09.20-09.55 KEYNOTE

09.55-10.30 DESIGN OF A MULTI-ROLE OFFSHORE VESSEL, *Romain Le Nena, Naval Group, France.* The Multi-Role Offshore Vessel is an oceanic ship dedicated to border surveillance, shipping safety, maritime environmental protection, fishery activity control, search and rescue operations and customs enforcement. The technical challenge is to integrate a number of technologies (pollution fighting systems, aviation means, ROV operation capability, large handling systems, etc.) onboard without dramatically increasing their complexity - which would increase also acquisition and operational costs.The complexity of the ship depends strongly on early design phases, where main particulars and performance assessed in line with end-user needs. In order to manage uncertainty at very early design phase to reduce life cycle cost of the ship three approaches are tested in the vessel design loop: Operational scenario-based approach to analyse stakeholder needs: typical main missions are textually described and used to refine the ship owner specification. The aim here is to contextualize driving requirements and to discuss the design trade off in the operational frame. Global system architecture modelling: systems and subsystems are mapped and described in a graphic model. The architect is then able to navigate among vessel components via physical interface to perform functional and dysfunctional analysis. Simulation based design: hull shape and propulsion architecture are parametrized in Caeses platform. From these inputs, batches of simulations are launched to explore the space of solutions.

10.30-11.05 NORWAY'S NEW MULTI-ROLE SUPPORT SHIP AND HUMANITARIAN ASSISTANCE AND DISASTER RELIEF, *Simon Jones, Alex Aitken, BMT, UK.* The Royal Norwegian Navy will soon bring into service HNoMS Maud a true multi-role Logistics and Support Vessel. The vessel will be able to contribute to a wide variety of national and international operations, including Replenishment at Sea, provision of alongside support to Norwegian Task Group (ships and submarines), while offering a capability to support low-intensity maritime security/counter-piracy operations, Humanitarian Assistance and Disaster Relief tasks, and peacetime support missions. Maud's primary function is replenishment at sea (solids and liquids) but she also has a significant sealift capacity supported by a large heave compensated deck crane and side ramp. She can act as a mothership to smaller vessels and submarines with facilities to support vessels moored alongside. Maud also has a large role 2 medical complex for up to 48 patients and a large aviation complex focused on NH-90 helicopter operations. She therefore can fulfill the roles of a number of vessels found in other fleets, including AOR, forward repair, and hospital ship. This mix of capabilities offers significant flexibility and value for money. This paper will describe the key capabilities and features of HNoMS Maud and discuss the benefits and drawbacks of a multi-role vessel considering some typical operational scenarios. It will describe some of the design challenges encountered due to the multi-role nature of the vessel and the implication of standards on the design.

11.05-11.30 COFFEE

11.30-12.05 THE MULTI-ROLE SUPPORT SHIP AND HUMANITARIAN ASSISTANCE AND DISASTER RELIEF OPERATIONS, *Derek Buxton, VARD Marine Inc., Canada, Linton Roberts, Cammell Laird Shiprepairers and Shipbuilders Ltd, UK.* The paper will examine the emergence of the contemporary multi-role platform as an increasingly sought-after military capability and how they make high-value additions to naval fleets, highlighting the key operational capabilities and how they fit into modern naval doctrine. A humanitarian assistance and disaster relief (HADR) operational scenario will be used to illustrate the versatility of this type of platform. The motivations that drive acquisition decision makers to consider this type of capability will be examined: operational flexibility, resilience and affordability. The contrarian view, with a look at the pitfalls and challenges with multi-role platforms will also be discussed. A typical modern multi-role vessel will be presented with an overview of the VARD 7-313 Multi-Role Vessel design. The VARD 7-313 is a multi-purpose logistics vessel designed as a flexible platform that incorporates modern off-board mission systems to support amphibious force projection, special operations, EEZ patrol, and humanitarian assistance. A case-study will then be used to outline how modern design and construction techniques offer operators a range of options that are easily tailored to their unique needs in an affordable package. It will be argued that a set-based design approach, combined with modern modular construction processes, and the exploitation of commercial standards, and procurement practices, can deliver better value outcomes.

12.05-12.40 THE DEVELOPMENT OF A MODULAR MULTI-ROLE VESSEL FOR NAVAL AND COASTGUARD OPERATIONS, *Andrew Humphries, Les Davies, Chris Browning, John Fox-Robinson, Vectis Marine Design Ltd, UK.* To deliver the full range of operational and support roles naval and coast guard forces typically employ many different types of specialist craft. Generally more than one craft of each type is required to ensure availability as when planned maintenance or breakdown takes the craft out of service the specialist capability is no longer available, and conversely unavailability of the specialist capability renders the otherwise operational craft impotent. Their specialist nature and the need for redundancy means that specialist craft are often under-utilised, spending much of their lives waiting for a particular requirement or incident to occur. As a result these critical and expensive assets can deteriorate and become increasingly expensive to operate. A modular multi-role solution has been developed to address this. The system comprises a standard platform that can be fitted with one of a number of specialist modules. These self-contained modules can be rapidly exchanged to enable the craft to meet planned and unplanned operational and support requirements. With this solution large fleets of different specialist craft can be replaced by smaller numbers of the standard platform that can be employed in a range of specialist roles and hence are much more highly utilised. Furthermore platform and module maintenance is de-coupled and operator and maintainer training requirements and spares inventories reduced. This paper describes the development of the modular multi-role vessel and the specialist modules that form an integral part of the system.

12.40-13.35 LUNCH

13.35-14.10 STANDARDISATION OF NAVAL CONTAINERISED MODULES - ENABLING INTEROPERABILITY ACROSS NATO, *Hayden Cole, Julia Alvarez, Naval Design Partnering, UK.* This paper explores the work carried out in the Naval Design Partnering (NDP) team to develop the new proposed NATO standard covering containerised modules outfitted with mission systems. The purpose of the standard is to facilitate interoperability of containerised modules across NATO navies, and to future proof the design process both for supply-chain and vessel designers. Drawing upon the experience of the offshore world in the use of containerised modules, as embodied in the current certification standards, the proposed standard provides a uniform set of safety-related construction requirements, standardised interfaces, and a set of requirements applicable to the construction of new platforms to enable the deployment of containerised modules. The paper covers the overall philosophy behind the standard, the background research conducted, and the rationale behind the requirements chosen across the structural, electrical and mechanical/marine disciplines. Finally, it explores the impact of the standard on platform design, discussing the key enablers for the deployment of containerised modules, and future work to develop international inter-operability.

14.10-14.45 A REVIEW OF UCL MSc WARSHIP DESIGNS, *Cat Savage, Dr Rachel Pawling, Dr Nick Bradbeer, UCL, UK.* It is more than 50 years since the UK MoD teaching of warship design moved from Greenwich to UCL, and the course has evolved into MSc Naval Architecture and MSc Marine Engineering courses covering both warships and other complex service vessels, with students from navies, governments and industry worldwide. This presentation will describe this years' designs, outlining the technical solutions proposed to a diverse set of user requirements set by the academic staff. Some of the educational aspects and challenges of the design exercise course will also be described.

14.45-15.10 COFFEE

15.10-15.45 MISSIONEASE BOAT HANDLING SYSTEM FOR MULTI-ROLE MISSION SHIPS, *Rolf Andreas Wigand, Atle Klave, Vestdavit AS, Norway.* A growing number of modern specialised ships - including those deployed for naval, coastguard and other patrol duties - need the flexibility to handle multiple boats, special loads and containers. Until now, most multi-boat handling solutions have involved use of overhead cranes. Such systems involve swinging loads, which can be influenced by ship's motion and braking; slinging and unslinging boats can also be hazardous, as well as involving a time penalty. Increasingly, mission ship designs are incorporating the mission bay – a sheltered 'hangar' located within the vessel's freeboard that is accessible from both sides of the ship to allow boats to be stored, prepared and launched in a safe and dry environment. In addition to the challenges outlined above, the use of overhead gantry cranes in a mission bay can demand reinforcement of the upper section of the mission bay, reducing deck height and raising the vessel's centre of gravity. Vestdavit has addressed these challenges through developing MissionEase, a unique storage and handling system working within the mission bay to transfer boats and other equipment. Rather than overhead gantry cranes, MissionEase uses a patented multi-boat cradle system in the bay deck to feed boats between the storage area and the davits on either side of the vessel.

15.45-16.20 DEVELOPMENT OF A TWIN STERN RAMP LARS FOR RAPID RESPONSE CRAFT ON A MULTI-ROLE NAVAL VESSEL, *N L Koh, D B Wong, Y M J Tan, B H Chew, T S Gan, Defence Science and Technology Agency, Singapore.* Deployment of fast response craft at sea is essential for a range of littoral missions including maritime security and search-and-rescue. Traditional launch and recovery of fast response craft like rigid-hull inflatable boats (RHIB) employed side davits and cranes. In light of evolving technology, multi-role navy ships like the Independence-class Littoral Mission Vessel have incorporated stern ramp launch and recovery systems (LARS) to replace or augment cranes and davits. Twin stern ramp LARS have increased the potential for multi-RHIB operability, and reduced the turnaround time, manpower, and safety risks associated with crane and davit operations. The goal of this paper is to provide a design baseline for twin stern ramp LARS and recommend future research areas for more efficient launch and recovery operations. This paper identifies the design considerations, system safety analysis, and qualification process for twin stern ramp LARS.

16.20- GENERAL DISCUSSION

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