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Maritime construction and sustainment: an industry perspective

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The Australian government is embarked on a major programme of naval shipbuilding over the next 30 years. Chris Lloyd provides an industry perspective on the capability and capacity of Australian industry to deliver that programme and to maintain both Navy's current ships and its new ships in service

Key words: naval shipbuilding; naval ship maintenance; Australian Navy; Australian industry.

The Royal Australian Navy currently operates 54 major naval vessels involving nine types of maritime platform: six Collins-class conventional submarines; eight ANZAC-class general purpose frigates; four FFG general purpose frigates; 14 Armidale-class patrol boats; two amphibious landing support ships; two replenishment support ships; six mine hunters; six landing craft heavy; and six survey ships.

In addition, Australia is now embarked on a major programme of naval shipbuilding which will shortly see the delivery of: two new amphibious landing support ships; three air-warfare destroyers, which will replace the FFG frigates; a new class of twenty offshore combatant vessels (OCV) replacing four existing classes of vessel; and at least twelve modern submarines, replacing the Collins-class submarines. These ships not only have to be built, they, along with the vessels currently in service, need to be maintained and sustained while in service.

Australian defence industry will have a major part in both the construction and in-service maintenance activities. This paper provides an industry perspective on Australia's capability and capacity to meet these challenges.

Naval Shipbuilding

A question often asked is: why does naval shipbuilding take so much longer and cost more than the construction of a major commercial vessel, such as a passenger cruise liner, despite the latter being an order of magnitude larger? An 80,000 tonne passenger ship can be designed and constructed in 18 months, whereas naval ships typically take 8 years. The answer lies in the fact that a passenger ship is built for a single purpose and frequently can use off-the-shelf designs, which require little modification and allow for a high level of re-use of systems from earlier vessels. In contrast, naval ships typically are designed for a multiplicity of roles. Their systems are complex and most need to be duplicated so as to allow for battle damage. Military design standards generally need to be applied from first principles, while their commercial equivalents are rule based. The economies of scale usually achievable with commercial vessels are not achievable with the smaller production runs of naval ships. On-going client involvement in naval shipbuilding, including changing requirements during the construction phase, adds to delays and costs. Finally, government contracting models and supplier business models used in naval shipbuilding are often more complex and time consuming than their commercial equivalents.

To be successful at naval shipbuilding, five key fundamental elements must be established and maintained. These elements may be viewed as integrated cogs in a machine, where the central cog is project delivery and it is rotated by four cogs that surround it, namely: integrated facilities, aligned systems, business models, and experienced people. Like in a machine, if one cog begins to break down or is missing, all the others will also be disrupted.

We have good integrated facilities for naval shipbuilding in Australia. The best facilities for construction are in Adelaide; there are good facilities also at Williamstown, near Melbourne; and some minor facilities in Freemantle and Newcastle. From an efficiency perspective and, given likely future demands on these facilities, a case could be made for concentrating all the facilities in the one location.

The aligned systems involved in shipbuilding are dependent on the engineering toolset available, including: equipment engineering; software engineering; system engineering; verification, validation and accreditation; configuration management; documentation management; and workflow. These engineering services are linked with manufacturing and procurement services such as: process planning; bill of materials; integration and testing; completions management; procurement support; and asset management.

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This core engineering toolset must be aligned with other systems such as business information services, programme management services, and a range of logistics, support and other common services. These aligned systems, in turn, must be accessible through a common portal (a one-stop shop) by the customers, the shipyards, the partner, the subcontractors, the suppliers and the employees.

Today, the design and engineering of a ship is undertaken by building a virtual (computer) model of the ship. Experience suggests construction should not commence until the virtual model has been completed and approved, as development concurrent with production will lead to high levels of delay and expensive re-work. The quality of this model is also a major factor in addressing design for supportability.

There is currently a major skills gap in naval engineering for ship construction. Those most needed are draftspersons and technicians, not conceptual designers. For example, the RAND Corporation[2] has estimated the number of submarine-experienced draftspersons and engineers required by industry to design a large conventional submarine over a period of 15 years and have compared those estimates to the number available in Australia. Of the 917 estimated to be needed during the peak period from about year 6 to year 9, Australia currently has only 475 and demands from other programmes may result in few, if any, being available to support a new submarine design. These are not skills that can be produced quickly.

Naval Ship Support

The maintenance and sustainment of naval ships in service also poses significant challenges for Australian industry. The recent 'Rizzo' report[3] suggested that the problems in naval ship repair and maintenance practices are long standing. The approaches undertaken to support the current naval ships are not working as well as they can and have impacted on operational availability of naval ships.

The five key fundamental elements for naval ship support are the same as those for naval shipbuilding: project delivery; integrated facilities; aligned systems; business models; and experienced people. However, the application of these elements is quite different for ship maintenance.

Australia is also well-placed when it comes to naval ship maintenance facilities. It has excellent facilities in Sydney and Freemantle to support Fleet Bases East and West, respectively. Supplementary facilities are also available at Adelaide, Williamstown and Brisbane.

A new dynamic in Australian ship support facilities has been the proposal by the Commonwealth to

Garden Island naval dockyard, Sydney
[Photo: Sydney City Council]

introduce common-user facilities (CUF). These are government-owned facilities at which one or more industry partners are invited to undertake naval ship maintenance operations on a project-by-project basis. The government takes responsibility for CUF operation and maintenance, but industry provides the project-specific resources. I consider that such arrangements make long-term investment in resources, processes and technology more difficult to justify than at a facility operated and maintained by industry. Contractual arrangements, security, safety and liabilities are also significantly more complex leading to potential inefficiencies.

Information management remains a key driver, but in the case of maintenance, it relates to planned maintenance schedules, condition surveys and fault rectification. There are also quite different processes applicable, some of which include sophisticated feedback loops. For example, commercial ships now have systems in place which allow condition-based monitoring and maintenance, which have largely replaced maintenance at regular defined intervals. When a computer-based monitor on a commercial passenger ship, for instance, identifies that one of the ship's systems will need maintenance at a specific time, the ship's operators schedule this work at the next convenient port of call. This ensures that only systems needing maintenance receive it and that they receive it when needed. This approach reduces time spent in maintenance and optimises the utilisation of the ship. Such approaches have not yet been implemented on Australian naval ships.

As with naval shipbuilding, finding the experienced people to do the work is the biggest challenge. Those most needed are support engineers and trade technicians. Unlike ship construction, the current pool of resources appears adequate, but there remains a threat of losing these resources to the mining, oil and gas sectors.

Recently, the Defence Materiel Organisation has started to introduce new business models for naval ship

[2]Birkler, John, *et al.* (2011). *Australia's submarine design capabilities and capacities: challenges and options for the future submarine* (RAND Corporation: Australia), Table 10.2.

[3]Rizzo, Paul (2011). *Plan to reform support ship repair and management practices* (Department of Defence: Canberra).

support. This is an attempt to move to long-term contracts based on performance incentives. While I support this initiative, there are concerns that they are being implemented in a complex web of other contractual support arrangements with a multitude of stakeholders: DMO project offices, technical support agencies, classification societies, original equipment manufacturers, and ships repairers. The danger in these arrangements is that more time will be spent on contractual negotiations and administration than on actual ship maintenance. The United Kingdom has also been developing new support models based on alliancing principles. That model is simpler than the Australian model and avoids some of the Australian stakeholder boundary difficulties, but it lacks a competitive element. Overall, the business models in Australia are immature, bureaucratic and lacking a focus on output deliverables.

Conclusion

Australia is well endowed with naval ship construction and support facilities, although some level of rationalisation of them would be desirable. Significant investment, however, is needed in resources and tools. There is currently a major skills gap in naval engineering to support major ship construction that will take some time to fill. Some rationalisation of the business models used by government is also needed so as to achieve a balance between competition and strategic partnering with Industry.

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The Author: Chris Lloyd is a naval architect who trained with the Ministry of Defence Royal Corps of Naval Constructors in the United Kingdom. He has spent his entire career in marine construction and engineering, in organisations such as the United Kingdom Ministry of Defence, British Maritime Technology (BMT), Marconi and BAE Systems. He has been technical director of Yarrows (Glasgow) and Vickers (Barrow-in-Furness) Shipyards involved in the development of nuclear submarine, frigate and amphibious ship programmes; and was engineering director for the Type 45 Destroyer. He was also instrumental in the development of the maritime consultancy, BMT. Mr Lloyd transferred to Thales Australia in 2007 to head up the Australian Navy's frigate (FFG) upgrade programme. He is now leading Thales' naval interests in Australia, comprising underwater and above water systems businesses as well as the company's expanding naval support services.

BOOK REVIEW

House adaption: design choices in adapting a family home for accessible living

by architect Harry Sprintz

Published by Harry Sprintz, Kiama NSW[1]; 2012; 168 pp.; ISBN 978-0-646-57532-2; RRP $39.50 (hardcover); Ursula Davidson Library call number 360 SPRI 2012

This book is directed at those, including veterans, who are seeking assistance to continue to live in their existing homes, despite injuries (including those resulting from military service) and/or physical deterioration, by modifying the existing facilities and access.

Harry Sprintz is a member of the Institute. He has used his experience as a military engineer in his design work for disabled veterans and others. He was awarded a Medal of the Order of Australia in 2012; and holds a Master of Arts in Disability Design/Research (London Guildhall University). He has been a consultant architect to NSW Department of Veterans' Affairs and has assisted many ex-service personnel to design critical areas of their homes, so as to avoid having to move to a retirement home.

In this book, Sprintz has assembled relevant information from diverse sources, including *Housing for Life* by the Master Builders' Association (ACT), Australian Standards on 'Adaptable Housing', the *Disability Act* and the Building Code of Australia. The text is enhanced with case studies. The Table of Contents, however, lacks page numbers and it would help readers if a detailed index were added to the rear of the book. The text probably achieves two of its objectives: assisting development consultants and real estate professionals. The third aim, assisting non-professionals, may be only indirectly met because the first nine of the 21 chapters tend to be for professionals. While the remaining chapters contain much material for professionals, there are many coloured illustrations and dimensioned aids for the disabled which should be readily understood by non-professionals.

Overall, this book is a valuable summary of the adaption of family housing for accessible living for the disabled, including veterans. It will be a useful guide for professional builders, designers and sellers of 'houses for life'. It also will help the disabled and their carers to appreciate how their facilities can be built or modified, including kitchens, bathrooms, home offices, access *etc.* Readers will be assisted by some guides on the costs of such modifications.

John M. Hutcheson

[1] Available from Harry Sprintz, 4/44 Manning Street, Kiama NSW 2533, for $39.90 (hardcover) plus $11.70 postage; or as an e-book for $27.00 from www.harrysprintzarchitect.com.