Senate Inquiry into Australia's naval shipbuilding capability

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Introduction

The Australian Maritime College (AMC) presents specialist research development and educational services of relevance to Australia's naval shipbuilding capability. In particular, the AMC asserts that these services can develop and retain Intellectual capital in Australia obviating the need to outsource services (e.g. Collins Class submarine experimental studies). The following therefore addresses the terms of reference:

- The **capacity of the Australian industrial base** to construct large naval vessels over the long term and on a sustainable basis;
- the comparative economic productivity of the Australian shipbuilding industrial base and **associated activity** with other shipbuilding nations;
- The comparative economic costs of **maintaining, repairing and refitting** large naval vessels throughout their useful lives when constructed in Australia vice overseas.
- The broader economic development and **associated benefits** accrued from undertaking the construction of large naval vessels.

The AMC seeks to demonstrate that Australian Research and Development (R&D) capability is critical to the economic viability of a domestic naval shipbuilding industry. Accordingly R & D is relevant in the following context:

- R&D capability includes
    - Facilities – infrastructure
    - Experienced researchers
- R&D to meet industry training requirements
    - R&D provides more comprehensive training than basic degree qualification
- to enable evaluation and development of innovative concepts;
- to enable evaluation of technological advancements;
- to develop and retain Intellectual capital relevant to Australian Defence needs.

In particular, experimental hydrodynamic infrastructure, recently augmented at AMC with a major national research facility grant to establish the Australian Maritime Hydrodynamic Research Centre (AMHRC), presents formidable capacity for the design and modification of Australian naval vessels. The presentation by the AMC will focus on this capacity.

The Australian Maritime College

The Australian Maritime College (AMC) was established in 1978 as the national provider of maritime education, training and research servicing Australia's maritime industries. Since then it has established an international reputation as a leading centre of education and research with alumni servicing maritime industries world wide. The AMC is a self-accrediting dual sector institution with campuses in Launceston and Beauty Point (Tasmania) and at Point Nepean (Victoria). It receives approximately $10 million annually in commonwealth funding and attracts a similar amount each year from fee-paying students, consultancy and research activity.

The AMC is a member of the Association of Commonwealth Universities and a member of the International Association of Maritime Universities. The academic programs at the AMC range from certificate level programs to research masters and doctoral degrees. Of relevance to naval shipbuilding capability is AMC's status as a leader in Naval Architecture, Marine Engineering, and Marine simulation. AMC's courses in maritime business and logistics are also relevant to consideration of developing and maintaining project management skills relevant to naval applications.

Courses are recognised by professional organisations such as the Institution of Engineers (Australia), the Institute of Maritime Engineering, Science and Technology (UK), and the Chartered Institute of Logistics and Management. In 2005, the AMC enrolled about 1500 students of which approximately half were Higher Education students. In 2005, students from approximately 50 countries were enrolled in AMC courses.

The Australian Maritime Hydrodynamics Research Centre (AMHRC)

The Australian Maritime Hydrodynamics Research Centre (AMHRC) is a major research facility encompassing the Towing Tank, Cavitation Tunnel, Integrated Marine Simulator, Flume Tank, and Model Test Basin. It is governed by an independent board comprising representatives from the collaborating institutions (AMC, University of Tasmania and DSTO). In addition, there are industry representatives including Mr Hans Wicklander, Manager Submariner Strategic Development ASC Pty Ltd.

The AMHRC is located at AMC's Launceston campus. Specific activities facilitated by research in the AMHRC include the development of underwater and surface naval platforms, the advancement of high speed craft design, increased realism in the modelling of simulated port areas and navigation channels, an improved capacity to undertake calm water and sea-keeping experiments within a controlled environment, and an advanced capacity for research into the hydrodynamic performance of underwater vehicles.

Towing Tank

The Towing Tank is the largest and only commercially operating facility of its type in Australasia. It is a fundamental tool used by naval architects and other engineering professionals for undertaking physical model experiments within a controlled environment. The primary capabilities of a Towing Tank are to:

- measure the resistance of ship hulls in order to provide powering predictions or investigate ways to reduce fuel costs or environmental damage;
- measure the motions and/or manoeuvrability of ship hulls when operating in either calm water or in a seaway;
- undertake physical modelling of various other types of behaviour in different environmental conditions.

A major upgrade of the AMC Towing Tank was completed in 2005 increasing the length from 60 m to 100 m. The Towing Tank has been used to test more than 400 models including Navy vessels, high speed vessels, semi-submersibles, submarines among other applications.

Model Test Basin

The Model Test Basin (35 m by 12 m) provides an experimental facility for the examination of maritime operations in shallow waters such as ports, harbours and coastal regions. Equipped with a multi-directional wave maker capable of generating a wide array of wave spectra, the Towing Tank is useful in improving ship handling, and examining the interaction of ships with banks, waves, and swell. It can also be used to assess the structural integrity of offshore structures under various wave and swell scenarios.

Integrated Marine Simulator

The Integrated Marine Simulator encompasses:

- the Shiphandling Simulator with full-scale ships bridge and visuals; and
- the Ship Operations Simulator with 6 cubicles with 120 degree visuals each simulating the bridge of an individual ship.

The hydrodynamic models used in the Integrated Marine Simulator (IMS) react realistically to the environment in which they are operated an to the engine, rudder, thruster, anchor and winch orders of the pilot or master. The IMS is one of the most advanced of its type in the world, invaluable for research and investigation into port development, ship manoeuvring, and the improvement of ship and port safety and efficiency. It has been used to train the US Marine Corps in high speed vessel pilotage (following their acquisition of an InCat high speed catamaran).

Flume Tank

The Flume Tank is a circulating water channel facility used to evaluate flow dynamics of towed bodies. The facility has been used in design applications for towed bodies including underwater vehicles, mine sweeping arrays, and other defence applications. The Flume Tank also includes a range of sophisticated instruments for data acquisition including a horizontal planar motion mechanism (to determine force profiles on towed bodies), a 3D velocity probe, flow visualisation equipment, and video cameras. The Flume Tank is particularly useful in addressing design challenges for autonomous underwater vehicles (AUVs) including the reduction of drag to increase underwater endurance.

Cavitation Tunnel

The Cavitation Tunnel is a fundamental tool for research and development in fluid mechanics. It is used to examine phase transition (liquid to gas) which occurs with pressure changes (causing cavitation). Cavitation is of particular concern in the design of propellers and in addressing noise reduction for hydroplanes and other exposed surfaces on submarines. This is of particular application in the design and modification of naval vessels. The AMC Cavitation tunnel is unique to Australia and presents advanced capabilities of world standing. It extends existing capacity (based on French technology) and includes advanced specialist instrumentation which present the Cavitation Tunnel as world-leading experimental infrastructure.

High Performance Computer Network

The suite of facilities presented above are integrated with a high-performance computer network presenting formidable data acquisition capacity. For example, wave wake studies conducted in the Model Test Basin following design of models trialled in the Towing Tank can be used to provide improved realism in the Integrated Marine Simulator

Examples of Research and Development projects relevant to Australian naval shipbuilding capacity

Underwater vehicles

The project investigates flow of remotely operated vehicles (ROVs) and unmanned underwater vehicles (UUVs or AUVs). These vehicles are used in naval applications in mine detection and disposal. Improved flows in designing these vehicles will improve control and manoeuvrability. Experimental studies of design prototypes has been undertaken in the Cavitation Tunnel and in the Flume Tank (e.g. DSTO's experimental Unmanned Underwater vehicle *Wayamba)*

Submarine Design

There is a need to improve performance of submarine propellers addressing vibration, noise, structural fatigue and hydrodynamic performance. The testing of design prototypes in the Cavitation Tunnel presents a cost-effective service to DSTO in

improving the performance of Australian submarines and potentially has application in the design of new generation submarines.
Improved hydro-elastic response of submarine control surfaces results from experimental evaluation of 2D and 3D foil models tested in AMC's Cavitation Tunnel. Similarly, development of Computer Fluid Dynamic models applicable to Submarine Hull geometry and Submarine Hull appendages results from the empirical evaluation of hull configurations in the Cavitation Tunnel.

The study of submarine manoeuvring is of fundamental interest in evaluating the effects of modifications and potentially contributing to future submarine design. DSTO has recently expressed a desire to develop this capacity using both experimental and numerical tools. The Cavitation Tunnel can be used for flow field investigation and the towing tank can be used to measure forces acting on a manoeuvring submarine.

Naval Ship Design

A current and relevant example is a comprehensive series of physical model experiments within the Model Test Basin to determine the wave climate within the well dock of two vessel designs competing for the RAN's new amphibious ship(s). In addition, the motions of landing craft operating within the well dock were evaluated. Other applications include the examination of naval ships operating in close proximity. Experimental evaluation using models was conducted in the Towing Tank and in the Model Test Basin.