Fire Safety and Damage Control Warship Design – Now and to the Future

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Lessons from the QEC Aircraft Carriers

Issues Identified

Pipe system performance:

- Spray systems suffering from low pressure due to extensive pipework runs and the need to modify locally to enable integration
- Nozzle locations were decided through an iterative process during build

Software systems:

- System hardware speed at user interface
- PLCs ability to withstand power fluctuations
- Rigorous software configuration control

Gaseous system design:

- New system – Navies confidence to release early
- Compartment pressurisation
- Control of back-up discharges (second shot into protected space)

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Lessons from the QEC Aircraft Carriers

Lessons Applied

Pipe system performance:

- All small bore pipework fully 3D modelled in CAD, including nozzle locations. Full sets of hydraulic calculations performance based on as built geometry
- Nozzle locations reviewed iteratively with relevant authorities
- Detailed build handbooks issued to build yards

Software systems:

- Architecture changes to enhance the Fire Protection Network (FPN)
  - GCS utilises twin redundant PLCs with local UPS in place of Server based system
- Full system factory acceptance tests completed in facility off ship. Issues identified and easy to resolve

Gaseous system design:

- Increased test regime on Aircraft Carrier gain empirical evidence
- Change in pipework material to aid installation and test regime
- Software interlocks to manually control 2nd discharge

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How have the End Users embraced Automation?

- The Navies are on a journey as the fleet undergoes modernisation and more platforms are supplied with integrated SCADA systems
- Offshore Patrol vessels already utilise an automatic Hi-fog system in the main machinery space
- QNLZ and PWLS are the first RN platforms to have fully integrated Fire Protection Network SCADA Systems
- SOPs for Aircraft Carriers modified to utilise automated FF systems to meet 2-minute attack time
- Our continued quest is for the Industry and Navy to gain a high level of trust in the resilience of firefighting control systems
- Lean manning continues to be a vision of the future of Naval Platforms
- Ambition to keep a “human in the loop” of decision making to maintain command control and mission capability
- Goal is to reduce the burden on continuous attack parties

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Why Pursue Automation?

One goal, many motives

Platform Integrator

- Fire safety case integrity improves risk to operator due to ability to fight fires remotely
- Keep pace with off the shelf technology for fire protection
- Smarter, more compact systems – reduction in weight and spatial
- Broaden the market for compliant materials (material compliance)
- As SCADA systems advance, the data gathered can be used to inform digital twin models

Platform Operator

- Reduced exposure of crew to potential harm
- Leaner manning
- Allows the Navy to prioritise Mission Objectives (lethality) over continued efforts to preserve survivability
- Limits collateral damage of suppression system and fire damage
- Reduced margin for human error in high stress decision making scenarios

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Case Study: HMAS Westralia and Explorer of the Seas

HMAS Westralia

- Fire caused by flexible hose failure spraying diesel onto hot fuel rail
- Fire and smoke overcame crew within compartment resulting in a number of fatalities
- Command decision was to delay activation of CO_2 Drench System due to uncertainty of personnel still in compartment

Royal Caribbean Cruise – Explorer of the Seas

- Fire caused by loose fuel connection on main engine
- Early activation of the water fog fixed suppression system effectively suppresses the fire, preventing it taking hold of the compartment
- Zero fatalities (including maintainer within metres of ignition) and ship returned to service within a matter of weeks

Message

- Early activation of fixed fire suppression systems saved lives and prevented material damage
- Improved FDN capability gave command a clear picture of extent of fire
- Life preserving suppression media key to early intervention

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Near Term Vision - MMS Fires

- Foam systems (AFFF or High Expansion) have become the norm in machinery spaces to fight Cat B fires
- Empirical evidence from both testing and real world application shows that a water mist or fog system activated early will effectively suppress hydrocarbon fires
- The vision we hold is that an automated water system, combined with advanced Fire Detection technology would significantly improve the safety, survivability and recoverability of a platform
- This could still be used in conjunction with a continuous attack party to full extinguish but would decrease the risk to personnel upon re-entry
- Due to the reduction in foam distribution, compartment and machinery recovery would be a simpler, faster exercise

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Near Term Vision – Enhanced Automation

- C2 can be eased by improving the overall sensor suite available to operators, which in turn reduces the overall number of personnel required for compartment monitoring, boundary searches and picture compilation
- Use of technologies such as fibre-optic based temperature monitoring, CCTV, smoke / heat detection, door monitoring, flood rate monitoring and electrical / fluid system fault monitoring
- The increased use and number of sensors will require more data fusion, management and intelligent interpretation within the DC control and management systems, to ensure that the operator is not overwhelmed
- The value of fixed fire-fighting systems eases manpower demands
- Increased flood rate monitoring
- Policies and doctrine updates

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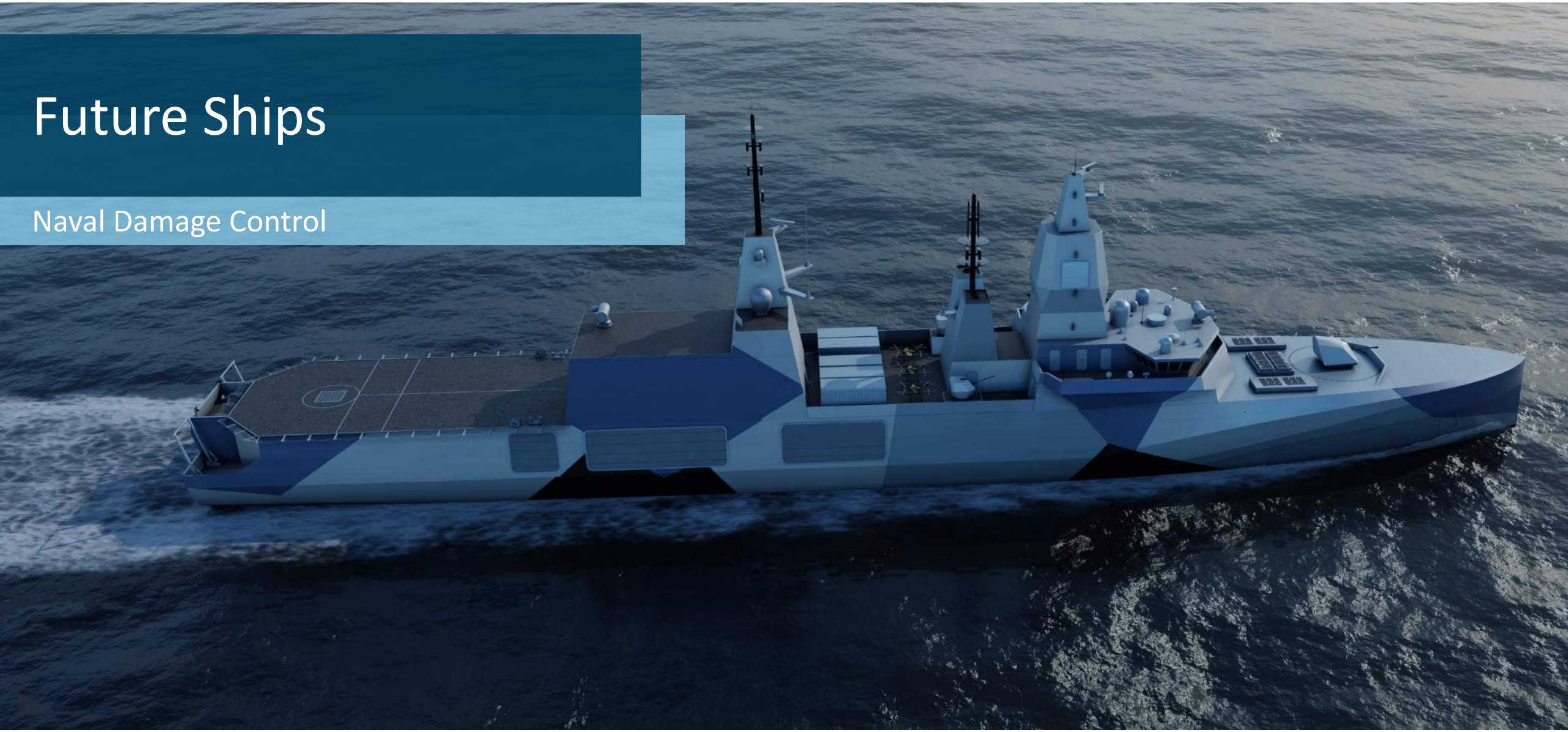
Future Ships

Naval Damage Control



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Future Projects – The Modular Warship

1. Lifecycle of a ship is now much longer than the lifecycle of the technology installed or embarked (e.g. UXVs, Future Commando Force)
2. Recent conflicts including Ukraine highlight the need for a ship to adapt rapidly to new threats, including drones, long range missiles, littoral operations and fast attack craft
3. RN “Persistent Operational Deployment System” (NavyPODS) concept requires traditional ship design to be turned *inside out.* To optimise use of modules, the ship must be designed around the concept of use
4. Experience of River Class and Type 26 GCS export shows that modularity in build provides flexibility/efficiency
5. Sustainable energy management for NZC targets and increasing combat systems loads against a backdrop of evolving future fuels, energy generation and energy storage demands a modular approach

A modular, system-of-systems approach to the design and operation of a warship will increase its relevance through life.

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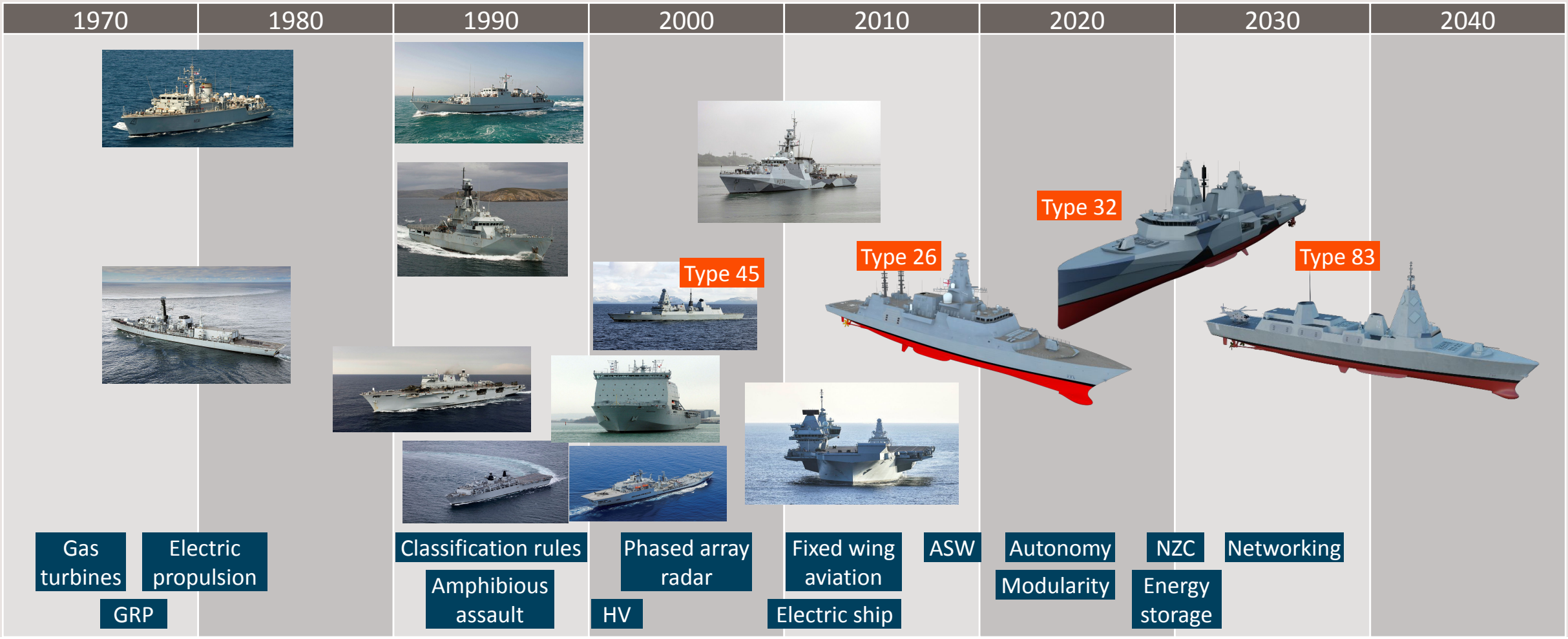
Heritage and Future Warships

Dates indicative!



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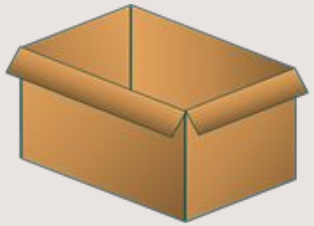
Features of the Modular Warship

Modular Build

- Designed with UK & export in mind
- Main mast designed with SWaP for large radars
- Functional arrangement

Modular Energy

- Power and propulsion within an agreed envelope
- Options to suit a range of needs
- Margin to power modules

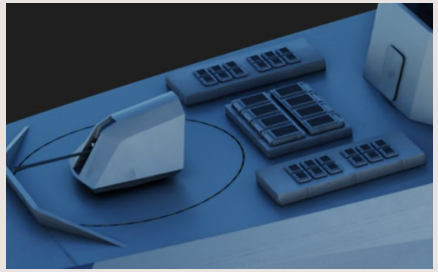


Modular Combat

- Modular for a wide range of operation types
- Utilises off-board systems
- Prepared for Integration of future modules

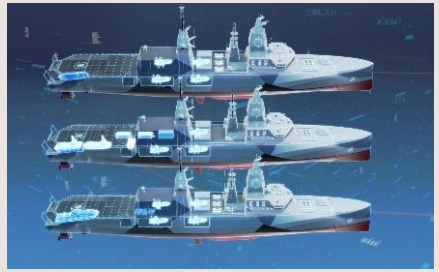
Modular Weapons

- Gun and missiles in modules
- Capable of supporting Littoral Strike and self protection
- Upgradable



Modular Cargo

- Huge mission bay and deck
- Carries a wide range of boats, TEUs, drones (UAVs, USVs, USuVs) and land vehicles



A modular ship, system-of-systems approach to a design concept.

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The Challenge

Cost

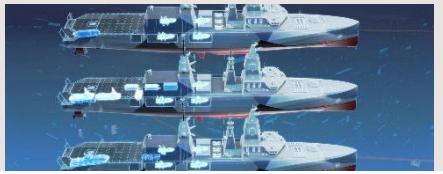
- The need for low cost ships
- Extended life and low through life cost with greater availability
- Low cost modular integrated capability

Automation

- Driving reduced or lean crewing – the need to continue to fight
- Culture & training
- Greater complexity, increased costs
- Pull through of commercial technologies

Modular Systems

- Creating an integrated modular system for a wide range of operation types
- Greater integration with the Combat System, IPMS & DSAC
- Wholeship Safety – Safety and approvals
- Transversals
- High power demands and management
- Variable power demands from NZC generation
- Integration of modular energy storage and generation
- Large open mission bays – flooding, stability
- Con Ops - Integration of the on board & off boarding assets
- Augmented crew - roles and responsibilities
- The needs to be upgradeable, flexible & adaptable
- Open and shared infra structures – SIL & Security



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Questions?

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