

HOUSE OF COMMONS DEFENCE COMMITTEE INQUIRY: THE NAVY: PURPOSE AND PROCUREMENT

A RESPONSE FROM THE SOCIETY OF MARITIME INDUSTRIES

The Society of Maritime Industries is the voice of the UK's maritime engineering and marine science and technology sector. With over 120 members from primes to small and medium size enterprises (SMEs), we represent more than 90% of the sector by value. The Maritime Defence and Security Group Council¹ is the council for one of the six constituent interest groups of the Society of Maritime Industries and takes the lead in representing and discussing the maritime defence and security issues that concern the Society's membership. The MDSG Council is made up of 20 elected members drawn from a spectrum of member companies from the largest prime contractor to the smallest SME.

The key themes from our response and points we would like to highlight to the committee include:

- The MOD continues to make great improvements to the way it procures naval equipment and capability, with better pace and grip on its procurement plans, a determination to embrace technology and innovation and desire for a closer dialogue with industry, but there are further improvements it can make.
- There are a number of threats for which we believe the Navy is currently under prepared and further investment in R&D and a more detailed consideration of areas of strategic capability will be required. Early engagement with industry (not just the primes) to explore innovative approaches to capability development, platform design and systems, as well as combat system capabilities will reap rewards.
- The increasing commitments of the Royal Navy, together with the new approach to overseas tasks of persistent engagement will have significant implications in terms of the vessels, capabilities and bases required, but there should also be a focus on availability, system integration and force generation and training. Industry can help provide innovative solutions to all of these challenges.
- Delays to procurement programmes and in-service support problems are caused by a wide variety of factors and issues, but can only be adequately resolved through a close and effective working relationship between MOD and industry.
- The Royal Navy has an ambitious programme of technology exploration and user focussed experimentation, centred on uncrewed systems, but is less clear on the pathway to frontline delivery. MOD and UK industry also need to work together to deliver cutting edge technology more effectively.
- The National Shipbuilding Strategy has had a positive effect on the procurement of naval platforms but has not yet stimulated the renaissance in UK shipbuilding originally envisaged. A wider range of ship classes should be procured via UK-only competition to drive volume into the industry and there should be a greater focus on the incorporation of UK equipment and systems. We believe that it would be better to adopt a design, build and integrate in the UK by default policy, with the UK's capacity/capability tested through early market engagement. Collaborative approaches, such as that adopted through the Aircraft Carrier Alliance should also be considered vice competition as this is likely to deliver better long-term value for money in the constrained naval shipbuilding market.

¹ The **MDSG Council** is the council for one of 6 groups that make up the broad church of the Society of Maritime Industries and UK companies represented on the 2021 MDSG Council are: A&P Group; Babcock International Group; BAE Systems-Maritime; BMT Defence & Security UK; Chess Dynamics; Chesterfield Special Cylinders; Coltraco Ultrasonics; Engie Axima Marine UK; Frazer-Nash Consultancy; Harland and Wolff; HENSOLDT UK; Houlder; L3 MAPPS; Leonardo UK; Lockheed Martin UK; Malin Marine; National Oceanography Centre; QinetiQ; Rolls Royce; Thales Defence Mission Systems; Valmet Automation; Wartsila UK; Whippendell Marine.

- The export of UK warship designs and systems provides a significant opportunity to develop common modular capabilities and doctrine that will enable real interoperability and even interchangeability. More generally, the positive impact on export success of the UK Government buying British designed and built ships, equipment or systems should be more widely recognised.

Part 1 – What is the UK’s ambition for the Navy’s role over the next 20 years?

1. *What naval threats is the UK likely to face and what standing commitments, including for NATO and UK Overseas Territories, does the government intend the Navy to undertake?*

- *In particular what is the implication of a tilt to the Indo-Pacific?*

As the Integrated Review and Defence Command Paper made clear, we are moving towards a more competitive and multipolar world with a wider range of state and non-state threats enabled by technology, with an increasing risk of state on state warfare and increasingly challenging sub threshold activity. The Royal Navy’s reinvestment in underwater capability underway and the intent to develop a capability to protect our undersea CNI are important steps, but **there are a number of threats for which we believe the Navy is currently under prepared and further capability development will be required:**

- hypersonic anti-ship cruise missiles;
- anti-ship ballistic missiles as well as contribution to a wider Ballistic Missile Defence capability;
- electromagnetic rail guns and directed energy weapons;
- Cyber and electromagnetic attack;
- increased risk and proliferation of CBRN threats;
- asymmetric UxVs.

Many of these issues have been recognised by the Navy and the related problem sets shared with industry in Navy Command’s Maritime Enterprise Planning Groups initiative. This initiative seeks to take a new, problem-led, approach to capability development and is an excellent example of the earlier engagement and closer dialogue with industry called for in the Defence and Security Industrial Strategy.

We note that neither the Integrated Review nor Defence Command Paper announced any reductions in our standing commitments. Indeed, they reaffirmed our commitment to NATO, pledging the full spectrum of capabilities, permanently attributing the nuclear deterrent, a Carrier Strike Group and Littoral Strike forces. They also reaffirmed our commitment to the EU Joint Expeditionary Force, although it is not clear what our maritime commitment to this is beyond the Littoral Response Group deployment currently underway.

The Integrated Review and Defence Command Paper also committed to support our Overseas Territories and Crown Dependencies in deterring and defending against state and non-state threats. For the Royal Navy this includes protecting the territorial waters of Gibraltar, maintaining a permanent presence in the Falkland Islands and Caribbean, and upholding the UK’s Antarctic Treaty obligations, including around the British Antarctic Territory. They also noted the potential for climate change to drive instability and conflict, including the opening up of the Northern Sea route with geopolitical and security implications, which is likely to require a Royal Navy presence in the future. **These commitments, together with the new approach to overseas tasks of persistent engagement have significant implications in terms of vessels, capabilities and bases as described below.**

In particular, the tilt to the **Indo-Pacific** implies an increased maritime presence throughout this vast region, establishing a maritime partnership with India, an enhanced programme of exercises with Japan and closer naval and industrial cooperation with the Republic of Korea. The Defence Command Paper suggests this will be achieved through the deployment of Offshore Patrol Vessels

from 2021, Littoral Response Group from 2023 and Type 31 Frigates later in the decade. Not only will these forces need to provide an enduring presence and credible capability, they will also require an ability to respond to the increasingly frequent occurrence of natural disasters and maintain readiness to evacuate British nationals caught up in events overseas when needed. This will be a tall order.

2. *What naval forces (vessels, capabilities and bases) are required to combat these threats and to deliver these standing commitments?*

- *What are the implications of cooperation with vessels from allied nations, for example allied vessels participating in carrier strike groups?*

In the underwater battlespace, there will be an ongoing requirement for manned submarines for at least 50 years, and these will be supplemented by increasing numbers of novel autonomous systems that will be required to mitigate the increasing threat – both in the North Atlantic and worldwide. This puts significant emphasis on sovereign capability for design, test and evaluation of underwater systems and a partnership with industry for safe delivery and integration. **The maintenance of sovereign capability will require increased investment in R&D and a greater throughput if we are to retain an operational advantage.** The commitment in the Defence Command Paper to fund the next generation of nuclear submarines (SSN(R)) is welcomed.

The requirement to deliver Carrier Strike, Littoral Strike and the standing commitments outlined above and combat the expected threats will require a full spectrum of capabilities and a larger Navy, even with the force multiplier effect expected from increased adoption of autonomous systems and the innovative use of technology. It is good to see the recent investment in replacement Fast Patrol Boats for the Gibraltar Squadron, through the competitive award of the contract to Mersey based Marine Specialised Technology Group for two 19.0m high speed craft jointly developed with BMT. The intent to grow the number of frigate and destroyers through the Type 32 programme is also welcomed and **we would encourage early engagement with the UK shipbuilding enterprise (not just the primes) to explore innovative approaches to ship systems and designs, as well as combat system capabilities.**

In addition to vessels and capabilities, **the UK will need to secure long-term provision of shore support for the forwarded deployed ships to support persistent engagement and ensure the long-term viability of the tilt to the Indo-Pacific.** Forward basing of HMS MONTROSE in the Middle East has demonstrated how such concepts can be made to work very effectively. This will also have implications throughout the supply chain, altering ‘just enough, just in time’ calculations and requiring more agile contractor support. **The long-term forward deployment of singleton units will also provide force generation and training challenges** that will require a novel approach and application of synthetic capabilities.

Cooperation with vessels from an increasing number of partner nations will drive the need for ever greater interoperability, especially when integrated into Carrier Strike or Littoral Strike task groups. This will need to extend beyond communication and information systems (including data links) to combine sensor information and an ability to cue (if not release) each other’s weapon systems. **Successful export of UK designs can also enable real interoperability and even interchangeability.** More routine task group integration may also warrant closer logistical and support arrangements.

Part 2 – Are naval procurement and support plans delivering the capabilities required for this role?

1. Concerns have been raised over some core equipment and enabling capabilities for the carrier strike program: the withdrawal and removal of partners from the F-35 program has led to speculation that the UK will cut its order; the Public Accounts Committee reported in November that the Crowsnest radar system had been delayed by 18 months because of poor contractor performance and inadequate departmental oversight; and the tendering process for the Fleet Solid Support Ships (FSS) has been delayed multiple times with the current Solid Support Ships expected to retire between 2023-2025. How will this affect plans for Carrier Enabled Power Projection?

Following the reduction in the definition of Carrier Strike FOC to two squadrons of **F-35B** (24 jets) operating from one carrier at a time, the reduction in the expected order of 138 jets has been widely anticipated. The MOD has acknowledged that the current order of 48 jets would be insufficient to sustain this capability and in its response to the PAC report on Delivering Carrier Strike² indicated that the future requirement would be determined by the Integrated Review and the future Combat Air systems assessment phase. The Integrated Review and Defence Command Paper did not address this issue and the MOD's ambitions for its Carrier Strike Capability remain unclear. **The MOD will need to ensure that sufficient aircraft are available to support not only the required operational squadrons through life (including allowing for potential attrition), but also deep maintenance, and training and evaluation squadrons.** The MOD's recent Request for Information for an EMALS capability for future UAVs is welcomed.

An initial baseline capability has been provided for **Crowsnest** in time for the Carrier Strike Group deployment now underway and further updates to the system will be incrementally delivered until FOC is achieved in 2023. Use of the system during the Carrier Strike Group deployment will allow a full evaluation of the delivered capability and valuable feedback for future updates. The Defence and Security Accelerator (DASA) competition seeking proposals for the development of innovative technologies to provide novel methods of Airborne Early Warning ahead of the Crowsnest/Merlin HM2 OSD of 2029 is welcomed.

Following the recently announced retirement of RFA FORT AUSTIN and FORT ROSALIE, RFA FORT VICTORIA remains our **only solid support** ship. The recent re-launch of the FSS programme competition which requires three ships to have been delivered by 2032 suggests that RFA FORT VICTORIA will need to be run on further than already expected (2028). This is likely to require increased refit and repair costs and inevitably increase risk to the availability of the platform due to age and obsolescence factors, with potentially significant impact on the Carrier Enabled Power Projection capability and the ability to conduct a sustained operation.

The delays in the **Fleet Solid Support** programme highlight the difficulties in procuring niche military capabilities through competition. Most other shipbuilding nations procure their naval vessels indigenously through collaboration and by doing so support their industry to invest for the long term and achieve success in the export or commercial markets. Despite claims to the contrary, it is our view that **the MOD's approach to require just the integration of the ships in the UK does not fully support the intent of the National Shipbuilding Strategy.** In order to drive long term investment and growth and maximise UK prosperity, it is vital that the ships are built to a UK design and incorporate a high level of UK content in equipment and systems. Requiring them to be built in Britain would also enable a long-term investment in production facilities and skills that assembly alone will not make possible. The MOD's procurement approach for the Fleet Solid Support programme appears to be attempting to balance improving the UK's domestic capacity and capability with driving value for money on a programme basis via competition. We do not believe this is the best way to drive growth and innovation across the UK shipbuilding enterprise, or drive value for money on a long-term basis.

² Delivering Carrier Strike, Twenty-Third Report of Session 2019-21, HC 684, dated 2 November 2020.

2. *Delays to the Astute class submarine program have been a longstanding area of concern, with the late hand over of HMS Audacious likely to have extended delays further down the tranche. How will these delays affect the replacement timeline for the Trafalgar class and the cost of the program?*

- *What impact will delays to Astute have on the Dreadnought program, as some of the same production facilities are required for both models?*

The Defence Command Paper announced, as widely anticipated, that the last two Trafalgar class submarines have had their out of service dates extended to ensure a seamless transition to the Astute class. This will of course incur additional support costs, as well as increased costs to the Astute class programme. **It is possible that some learning could benefit the construction times for the last 3 Astute class** and that any impact on the Dreadnought programme could be containable and may not result in significant delays.

3. *The time at sea for the Type 45 destroyers has been limited in previous years due to long-term difficulties with cooling, propulsion and manpower. What is the status of efforts to address this, like the Power Improvement Program, and what impact will the Type 45's readiness levels have on Navy capabilities over this period?*

The Navy have embarked on a comprehensive power and propulsion improvement programme (Project Napier) consisting of a Power Improvement Programme (PIP) and an Equipment Improvement Programme (EIP) supported by a number of UK maritime engineering companies. The EIP is now largely complete and has helped to contribute to a substantial improvement in Type 45 availability. The PIP, which seeks to replace the original two diesel generators with three more powerful diesel generators is a more significant undertaking requiring a complex conversion programme fitted into the Type 45 operational and existing refit programme. The first Type 45 to receive the upgrade, HMS DAUNTLESS, entered Cammell Laird on 6 May 2020. The conversion will require a longer period in deep maintenance than a standard refit and repair period, reducing Type 45 availability overall and requiring adjustments to the operational programme. **It will be important to ensure that this programme is a success before committing fully to the rest of the class.**

4. *The UK is likely to face a "frigate gap" until at least the early 2030s. The current Type 23 frigates will begin to leave service on an annual basis from 2023. There are concerns over the extended retirement dates, especially with regards to the integrity of certain hulls and lack of spare part packages across the board. The first replacement Type 26s and Type 31s are not expected to be in service until at least four years later. What capabilities will the Navy lose or need to deliver through other means as a result? How realistic are production plans for the Type 31s (already described as "aggressive" and including an ambitious delivery rate of one every 8-12 months, compared to 18 months for comparable European programmes for similar vessels)?*

With the Type 23 Life Extension programme, managed jointly by BAE Systems and Babcock with support from many UK suppliers, now well underway and due to complete in 2024, plans to manage the transition programme from Type 23 to Type 26 and Type 31 are in place. Inevitably there will still be some impact on frigate availability, largely due to the delays in initiating the Type 26 programme which the National Shipbuilding Strategy has sought to address through establishing better pace and grip on the Navy's shipbuilding requirements. The 5 Batch 2 OPVs are available to make up numbers (albeit with much reduced capability) for the 5 general purpose Type 23 variants which will be retired first. This will limit the impact on the Royal Navy's Anti-Submarine Warfare capability. **There is potential to increase the lethality and survivability of the Batch 2 OPVs which would go some way to further mitigate the impact of reduced frigate numbers.**

The Type 26 programme is also well underway and on track with HMS GLASGOW out of the sheds, with the structure planned to be complete in September of this year and float off next

summer. Steel has also been cut for the second hull, HMS CARDIFF. It is likely that the drum beat of delivery of Type 26 could be increased, with a potential reduction in overall programme costs, but that may cause difficulties for the MOD's overall funding profile.

The Type 31 programme will result in the delivery of five warships in record time with the first vessel delivered in 2025 (with an In Service Date in 2027) and the last in 2028. This delivery rate has been made possible by significant investment in facilities, digital technology and skills by Babcock at its facility in Rosyth. This investment has also resulted in a high level of design maturity which, combined with global benchmarking, has resulted in all contract milestones being met to date and confidence in the delivery schedule.

5. The Navy's Hunt and Sandown Mine Counter Measure Vessels will be replaced by an Autonomous Mine Hunting Capability currently under development. How likely is this to be able to replicate the vessels' full contribution, including to partnerships with allies through deployments like Op KIPION, by the time they reach retirement in the early 2030s and what are the implications if it does not?

- *What other progress is being made on integrating UAVs into the Navy?*

At a high level, the MHC programme appears well advanced and able to replace and improve the RN's mine hunting and countermeasures capability. Partnering with allies will continue and exercises will prove the ability to integrate the autonomous MHC into a wider force. However, the vision for the full capability is not clear, in particular how the offboard systems will be deployed, and from which platforms. MHC will require significant amounts of deck space and it is unlikely that the RN would wish to tie up frigates or amphibious platforms for long periods. **Therefore, dedicated motherships (simple vessels like Rig Support Vessels) will be required, but there were no plans for such vessels in the Integrated Review, Defence Command Paper or Defence and Security Industrial Strategy.**

More widely the RN has an ambitious programme of technology exploration and user focussed experimentation, centred on uncrewed systems, including the Maritime Autonomy Demonstrator for Operational Experimentation (MADFOX), autonomous RIBs and an extra-large underwater uncrewed vessel (XLUUV), but, as with MHC, it is light on the detail of the fielding plans. **Consequently, industry has limited confidence that the RN has established a pathway to frontline deployment, and it is notable that DE&S is largely not engaged beyond delivery of the MHC programme. Addressing this challenge is key if the RN is to reap the benefits of its bold technology strategy.** Equally, an agile development pathway needs to be developed that includes DE&S and regulators which should also include near term deployment goals.

Likewise, the Type 26 Global Combat Ship and Type 31 frigates were designed to exploit modular offboard uncrewed solutions utilising flexible mission bays. As yet, there has been little progress on the development of the modular mission packages that will exploit these platforms. **The UK has a significant opportunity through the 5-eyes community and particularly the sale of the T26 design to Australia and Canada to establish an international collective around these modular and potentially interchangeable solutions.** The current strategy seems to focus on the host platforms at the expense of any activity in the modular mission packages. Positive steps have been made on the core information architecture (notably through the Naval Strike Network), and this could usefully form the core of an international focus on achieving new momentum. Early action would present a significant opportunity for British industry.

Finally, industry is evidently willing to make investment in this increasingly important area. The Unmanned Surface Vessel (USV) Halcyon, developed by Thales and L3 Harris ASV at Turnchapel in Plymouth, has been extensively used as a research and development platform. It has been used to explore different ways of controlling an autonomous boat, including bio-inspired routing. Halcyon has also been used to investigate the opportunities for hosting other platforms, for example, Unmanned Air Vehicles (UAV).

The RN has established an experimental air squadron (700X NAS) to develop the role of UAVs. They are currently trialling the Puma Remotely Piloted Air System from naval platforms and the smaller Phantom survey drone with the Royal Marines. As noted earlier, the MOD's recent Request for Information for a carrier based EMALS capability for future, more substantial, UAVs is welcomed.

The key message is that MOD and UK industry need to work together on these autonomous projects to deliver cutting edge technology. Constant competition in the acquisition cycle carries the risk of stifling innovation rather than promoting it as companies compete with each other rather than collaborate.

6. Is the UK's domestic shipbuilding industry able to fulfil its role in delivering the country's naval capabilities? What has been the effect of the National Shipbuilding Strategy? Does the government's decision in the Defence Industrial Strategy to determine whether to invite foreign competition on a case-by-case basis (rather than just for warships) increase or decrease the opportunities for UK shipbuilding? What will industry need to see in the government's forthcoming update to the National Shipbuilding Strategy and 30-year plan for Naval and other government-owned vessels?

As stated in the 2017 National Shipbuilding Strategy (NSbS), for reasons of national security, the UK will need to retain the ability to design, build and integrate warships to enable the UK to sustain the RN without interference from a foreign power. This is a rather limited and incomplete view of the role of the UK's domestic shipbuilding industry. In order to sustain the RN without interference from a foreign power, the UK also needs to be able to design, build and integrate other naval vessels, fit them with the necessary equipment and systems and be able to support them through life. Whilst the ability to design, build and integrate warships would also provide an ability to design, build, integrate and support through life other naval vessels, it does not necessarily sustain sufficient capacity, or sufficient expertise in the design, build and integration of the necessary equipment and systems. The 2017 NSbS recognised that demand from the RN alone was insufficient in volume and too cyclical in nature to sustain a globally competitive industry alone and sought to address³ this. The policy it introduced, to build all RN warships, narrowly defined as destroyers, frigates and aircraft carriers in UK yards and to openly compete all other naval vessels, however, has proved to have been insufficient. Whilst it has successfully generated a second production line of Type 31 frigates in record time and at fantastic value for money, it has **not yet stimulated the renaissance in UK shipbuilding originally envisaged**. In his 2019 review of progress, Sir John Parker recommended that **'a wider range of ship classes should be procured via UK-only competition to drive volume into the industry, supporting efficiency and sustainability of a competitive bidding capability'**. The 2017 NSbS also, did not give sufficient recognition or focus to the necessary equipment and systems, where the majority of value and significant UK expertise lies, or on the necessary testing and development facilities, such as the hydrodynamic facilities at Haslar. The refresh of the NSbS currently underway is seeking to address some, but not all of these deficiencies. The MOD's new naval procurement policy, announced in the Defence and Industrial Strategy will provide the MOD with the flexibility to take into account the long-term industrial impact and should increase the opportunities for UK industry, but deciding on a case by case basis is not likely to provide industry with the necessary confidence required for long term investment. **We believe that it would be better to adopt a design, build and integrate in the UK by default policy with the UK's capacity/capability tested through early market engagement. Collaborative approaches, such as that adopted through the Aircraft Carrier Alliance should also be considered vice competition as this is likely to deliver better long-term value for money in the constrained naval shipbuilding market.**

³ generate a UK 'shipbuilding enterprise that, encouraged by a clearer grip by Defence, and with greater certainty about the Royal Navy's procurement plans, has the confidence to invest for the long term in its people and its assets to raise productivity and innovation and improve its competitiveness in the domestic and overseas markets. In this way, the sector can become more resilient to the peaks and troughs of Royal Navy business, bringing more sustained growth and prosperity in the regions those businesses are based'.

Industry's priorities for the refreshed NSbS are articulated in Maritime UK's priorities for the National Shipbuilding Strategy Refresh⁴.

7. How realistic are proposed exports of Type 26 and Type 31 frigate designs and what effect would they have on costs of the frigates for the UK? Since most foreign buyers will seek to produce ships domestically, how much value are these export deals likely to deliver to UK shipbuilding?

Significant export opportunities exist for both the design and build of Type 26 and Type 31⁵ frigates. Babcock's Arrowhead 140 (AH140) frigate in particular is drawing very considerable interest from the export frigate market. A highly attractive price-point, coupled with significant adaptability is making the AH140 a compelling consideration for international navies. Working closely with DIT/DSE and other Government departments Babcock is currently pursuing a number of active opportunities concurrently for AH140 design licences with engineering and shipbuilding support services. Several other countries have expressed interest in the platform, for indigenous build, UK build or a combination. All of these options deliver direct economic benefit to the UK.

Export of UK designs provides the opportunity for decreases in RN unit price and, through economies of scale in the supply chain, lower total cost of ownership and through life costs of the vessels in service. The build of additional Type 26 hulls in the UK would also allow an acceleration of the overall build programme and potentially reduce UK programme costs without significantly impacting delivery schedules or funding profiles. The build of additional AH140 hulls would need to follow the completion of the RN programme but experience in adapting the AH140 for international customers could also provide the opportunity for an adapted version of the design for the Type 32 requirement. This would save considerable cost and risk in the Type 32 programme, and create the ability to make further productive use of the infrastructure already invested in for the Type 31 programme. The export of the designs for domestic build would still deliver significant value for the UK. It has been estimated that the licensed build of the Type 26 design in Australia and Canada will generate in the region of £6Bn of value to the UK economy, largely through the export of the equipment and systems included in the design. Export of the AH140 design could generate some similar benefits, although at a reduced scale due to the lower level of UK content in the Danish design. **Export of UK warship licenses to friendly nations should therefore be strongly encouraged**, regardless of whether or not any of the ships would be built in the UK.

More generally on the subject of exports, **the positive impact of buying British designed and built ships, equipment or systems should be more widely recognised**. Not only does it secure high-skilled jobs in the UK maritime sector, but it also signals to export markets that the Royal Navy has confidence in the shipbuilder, design, equipment or system. The importance of the "seal of approval" from the Royal Navy should not be underestimated as it still carries considerable weight around the globe.

8. The government's Defence Industrial Strategy promises up to five Type 32 frigates and a new class Type 83 destroyer but no further details on these ships' designs and roles have been provided: how can the government learn from previous programs in designing and delivering these two ships?

There are many lessons from previous programmes that the MOD has already incorporated. The Type 31 procurement has been an excellent example of the value of early market engagement and a more flexible approach to requirements management, with exportability considered from the outset. These lessons should be carried through into all future programmes. But there are also other lessons that can be applied, including the benefits of **a more collaborative approach such as that used in the Aircraft Carrier Alliance and the industrial benefits of a block build strategy**. The potential for international collaboration, with Australia and Canada in the development of the Type 83 destroyer should also be considered.

⁴ [News: Maritime UK publishes priorities ahead of National Shipbuilding Strategy refresh | Maritime UK](#)

⁵ It should be noted that it is the Arrowhead 140 base design that will be offered for export, adapted as required for the customer.

There are also lessons of a more technical nature that should be applied. The pattern of using a long time (many years) for developing a ship design and soliciting shipyard quotes and then upon contract signing rushing ahead with a tight schedule before the design is adequately mature has resulted in re-work and delays. Cost overruns could have been avoided by **spending more time pre-production to properly plan and develop the design and incorporate suppliers' equipment into the design**, even if that would mean starting steel cutting later. Problems are better avoided and easier to solve in the computer pre-production rather than later in a workshop or onboard a semi-finished vessel. **Modularising the design, obtaining independent assessments of key aspects (such as the power and propulsion systems design) and fully exploiting the opportunities presented by digital twin technology** should also be incorporated.