

**An Independent Report to inform the
UK National Shipbuilding Strategy**

by

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Context

The 2015 Strategic Defence and Security Review (SDSR) set out a number of key decisions for the Royal Navy (RN). It confirmed the Government's intent for 8 new Anti-Submarine Warfare Frigates, 2 further Offshore Patrol Vessels (OPVs), and also committed the Government to maintain a fleet of 19 frigates and destroyers, with the ambition to further increase this force by the 2030s through a new class of lighter, flexible, exportable General Purpose Frigates. It also set out the importance to our national security of promoting prosperity. A new National Shipbuilding Strategy was commissioned to drive the required changes in the naval shipbuilding sector. I was asked in March this year to provide independent leadership for the Shipbuilding Strategy, and report to Ministers before the Autumn Statement. The Government's response to my findings will become the National Shipbuilding Strategy.

The Approach

I have conducted a series of detailed discussions with the shipbuilding and marine industry, the supply chain, Government, trade associations, the Trades Unions (TUs) and key civilian and military officials. I or my team have visited shipyards across the country. I have been supported in my work by a cross-Government Sponsor Group which has provided advice and counsel. I have also been assisted by a small team of officials who have gathered supporting evidence. But the conclusions I have reached in this report are my own. Part of my focus was to determine the drivers of timescale and costs of delivering new naval ships, to ascertain the status and health of the shipyards and supply chains as well as discovering the blockages to creating a more efficient 'Total Enterprise' from concept of a new ship to delivery.

Governance

Initial Observations

There are many highly competent and committed individuals in the various parts of the Ministry of Defence (MOD) but the sheer complexity of "the system" in which they work negates their well-intentioned and individual professional efforts given the extent of silo activity, heavy processes and the challenge of inter-organisational working with insufficient sense of pace.

Ultimately, the current process involves many people and too many 'hand-offs'. Too many think they have a vote, or even a veto, in the process. Current governance is not sufficiently clear. There is no assured "Capital budget" for a RN project which means programmes are subject to arbitrary intervention and delays adding to cost. Senior Responsible Owners' objectives and accountability are not always properly aligned. There is a clear system of financial approvals via the Investment Approvals Committee, but the system is not always applied intelligently to ensure that good quality information and early engagement with decision makers results in well evidenced and timely decisions. The result is a lack of empowered project grip.

Current RN warship programmes take far too long. The innate complexity of modern warship systems and manufacture cannot alone account for the disparity with complex ships in other sectors or with commercial programmes for other Departments, or historic RN programmes (Table 1).

Ship	Start of life Displacement ¹ (Tonnes)	Concept Phase start	Contract	Time concept to contract (years)	Delivery ship 1	Delivery of class	Time contract to delivery of class (years)
'Mega cruise ship'	c180,000 (Gross Registered Tonnes)	2014	2015	1	2018	2020 (4 in total)	5
Polar Research Ship	c15,000 (Gross Tonnes)	2014	2015	1	2018	n/a (1 in total)	3
Military Afloat Reach and Sustainability tanker	31,485	2001 (in a different programme boundary)	2012	11	2017	2018 (4 ships)	6
Type 21	2,750	c1967	1969	2	1974	1978 (8 in total)	9
Type 23	3,386	c1978	1984	6	1989	2001 (16 ships)	17
Type 26 ²	6,900 (Basic)	1997	n/a	>19	n/a	n/a	n/a

Table 1: Evidence that timescales from concept through contract to ship delivery can be dramatically compressed

I judge that the following has happened:

- a) A lack of an overriding Master Plan for each project from the Sponsor with key dates expected to be met by the RN Client;
- b) A lack of assured Capital budget per RN ship series, subject to annual arbitrary change, with accumulative negative impact on time and cost with accompanying increased risk of obsolescence;
- c) Poor linkages across the 'Total Enterprise' including industrial capability and capacity;
- d) A lack of empowered Governance to grip early trade off debates in design and specification to remain within project cost to meet the assured budget, including rigorous evaluation of cost of design standards;
- e) Senior decision-makers have, previously, been engaged too late in the process and not always with high quality information and costing data;
- f) Loss of continuity (as people move on to new roles) with new people naturally imposing their preferential views;
- g) The MOD has lost expertise in both design and project contract management;
- h) Unanticipated cost growth from suppliers;
- i) Delays to projects are accumulative;
- j) Inadequate evaluation of risk contingency in each project;
- k) There is insufficient focus on controlling 'preferential' engineering costs and in understanding costs associated with incorporating key naval standards.

All of this leads to significant growth in specification, scale and end cost of ships, with an associated risk that equipment/systems are technically obsolete before the contract is finalised. An MOD study has estimated that a 1% delay in project time could result in a 0.38% increase in overall programme cost across a broad range of equipment procurement and support projects.

¹ Start of life, light seagoing condition, unless stated otherwise

² Not yet on contract for manufacture

These pre-contract cost and time drivers, together with other factors such as insufficient risk contingency, result in a vicious cycle of fewer and much more expensive ships being ordered late and entering service years later than first planned. This means aging ships are retained in service beyond their planned lifespan resulting in further refit and maintenance costs (and reducing second hand export opportunities). Had project planning and execution been undertaken with pace and with a grip on project time and cost that should have prevailed, this situation could have been avoided.

A wide variety of stakeholders have contributed to exacerbating this situation. All stakeholders have a role in a solution.

Funding

In sharp contrast to the commercial sector, Defence does not own major, capital intense projects at the highest level in the Client organisation. The MOD is also required to manage these projects within their annual cash limits. Capital for shipbuilding projects is not consistently assured (or 'ring fenced' as in the commercial world) as it would largely be when major national infrastructure projects are approved, such as in the case of Highways England.

Cost models lack sufficient maturity and the cost base has to change too often as specifications are not gripped and timescales arbitrarily changed. The current experience is that unexpected/unanticipated cost growth arises from suppliers, with a consequent impact on programme cost. Additionally, risk assessments are not sufficiently robust. Overall there is an unrealistically low level of contingency. Empowered grip on cost is vital and sticking to programme time to contract with no further change in requirements permitted.

Naval ship procurement plan

The Type 26 is approaching its main manufacturing decision point. The General Purpose Frigate is in its pre-concept phase, with some indicative design options being assessed. The OPVs are under construction at BAES Govan. The Aircraft Carriers are in their delivery phase in Scotland. The Military Afloat Reach and Sustainability tankers, being built abroad and customised in the UK, are also in their delivery phase. The future Fleet Solid Support ships are in their assessment phase and have an open, international procurement policy.

New build might not always be the best solution. In terms of future support shipping and ships to deliver other capabilities, such as mine countermeasures, a number of successful ships in RN service have been conversions from commercial shipping, a current example being RFA Argus.

Exports

Not enough national, coordinated effort is placed on the export market for ship sales, project management, equipment and sub-systems, and through life support. I am not clear that Defence, and by extension the RN, yet views support to naval exports as a core task. A cultural shift is required to fully align with the direction in SDSR15. Nor are designs sufficiently tested for exportability. The result is that the sales organisation is required to market those vessels that have been procured for the RN, rather than have the opportunity to influence the design to ensure that they are either designed with exportability more

clearly in mind, and have the flexibility to be attractive to the different demands of foreign navies. This should be an inherent design philosophy in all future new series of ships for the RN.

Industrial strategy

BAE Systems (BAES)

BAES' Govan and Scotstoun sites are the only UK shipyards currently used to design build and commission a sophisticated naval warship. This is currently an exclusive position held under the Terms of Business Agreement between BAES and MOD.

The shipyard effectively only undertakes work for the Ministry of Defence, and lacks the diversity of marine work witnessed in other UK shipyards (see below).

As a result, gaps in the industrial programmes at the shipyard and in the total supply chain add significantly to end cost and inefficiencies. Scope clearly exists to drive to much improved levels of productivity in more stable conditions. It also underscores the importance of MOD having well informed oversight of the 'Total Enterprise' incorporating the industrial and supply chain base.

There are significant variations in "charge out" rates at various shipbuilding yards within the UK. Differences in business models, overheads, engineering specialisms and sourcing strategies make like-for-like comparisons between different companies challenging. The MOD should nevertheless seek to harness the economies available within the wider UK shipbuilding supply chain and seek improved value for money through optimising the type of shipbuilding work and the supplier with the most economic costs for that type of work. This approach is likely to yield economic and efficiency benefits and continue to boost competition.

It is not clear that Defence has sufficient and sufficiently expert project contract managers, with suitable commercial expertise, to manage the sophisticated warship contracts with BAES.

BAES does have a talented design team, and expertise in engineering and systems integration. BAES has now started to invest in modern digital engineering and is applying it well at the front end design stage. They need, as part of their "global competitiveness plan" (see later), to exploit the industrialisation benefit of digital engineering to drive shop floor efficiencies in a similar manner as to what has been achieved at Jaguar Land Rover and Meyer Werft (Germany).

Other UK shipyards – A Renaissance in Shipbuilding

A renaissance in shipbuilding is emerging in a range of regional shipbuilding companies competing in the ship and offshore conversions and repair markets plus participating in offshore wind farm structures, and other relevant engineering projects.

There is no single customer dependency culture visible in these shipyards but rather an entrepreneurial attitude and an enthusiasm to embrace change along with flexible skilled labour practices with the ability to manage fluctuating workloads.

The range of “charge out” rates, whilst expected to be lower than a sophisticated naval shipyard, have been driven down via tight overhead cost control. This along with good productivity creates competitive cost outturns.

Productive use of the working day is facilitated by professional management acting with discipline and ensuring manpower matches workload along with good logistics scheduling of piece parts, equipment and components to ensure they are in the right place and at the right time. Moreover, these shipyards are sustained by multiple income streams.

The Babcock – Appledore experience of winning 4 OPVs for the Irish Navy and the winning of the Natural Environment Research Council sophisticated research ship “Sir David Attenborough” by Cammell Laird against International competition is a clear demonstration of competitiveness.

For naval vessels, there are very few UK Companies with sufficient financial and industrial capacity and capability, expertise and naval ship knowledge who could compete for lead shipyard status or could combine with other firms in an alliance for a series of naval vessels.

Overseas shipbuilding experience

Current policy, practice and precedent sees warships being built in the UK. Non-warships are competed internationally and some non-warship shipbuilding is, as a result, undertaken overseas. For instance, Daewoo Shipbuilding and Marine Engineering, South Korea, is building the new MARS tankers for the Royal Fleet Auxiliary (RFA). Overseas build brings its own challenges including potential denial of opportunities for the UK supply chain, higher costs of overseas supervision and potential foreign exchange risks. Nor does the foreign build of ships make the direct prosperity contribution to the UK economy that an onshore build would achieve. There is the opportunity with the Fleet Solid Support ships for UK firms to make competitive bids, and hopefully secure the contract, thus contributing further regional economic benefits in the UK.

Socio-economic

The naval shipbuilding sector is important to the UK economy. As well as making a material contribution to the UK economy, shipyards and their wider supply chain also have a positive impact on the local areas in which they are based. Preliminary work by MOD economists estimates that the MOD spent around £1.4bn on shipbuilding and repair in 2014/15, of which approximately 96% was spent with five UK prime-contractors³. Whilst this work is at an early stage, the MOD have also been able to estimate that the quantifiable impact of the MOD’s shipbuilding and repair spend with UK based firms contributes approximately £1.5bn of added value annually to the UK economy.

The naval shipbuilding sector remains a significant regional employer of both blue collar and white collar workers. MOD estimates, based on data available at the time of writing, that around 15,000 people are directly employed in UK shipbuilding and repair due to MOD spending. It also estimates that, based on this assumption, close to 10,000 additional jobs are indirectly supported through the wider supply chain in the UK.

³ Further analysis would be required to determine the split in value between sub contracts then placed with Small and Medium Enterprises and between UK and foreign companies

There is a split in the UK between shipyards who currently undertake only Defence work; shipyards who currently undertake only commercial work; and those who undertake a mixture of the two. A number of those without direct Defence contract work are prospering.

Many of the shipyards we spoke to expressed concerns about the ageing workforce, and the difficulty in recruiting appropriately skilled staff mid-career. The companies involved have a range of age profiles but we have been advised that the majority have an average age in the workforce around the mid to late-40s, and that the distribution tended towards the upper end. There are some good apprenticeship schemes, the best of which include engagement programmes with local schools to inspire greater take-up of Science, Technology, Engineering and Mathematics (STEM) subjects by the next generation. There is scope for expansion of modern apprenticeship schemes in the regions along with Technician and Graduate recruitment in support of the Digital engineering and modern systems that will be a key part of Industry's efficiency drive. This age profile, and the potential for Type 26 and Type 31e orders for the RN and exports, creates significant opportunities for young people over the next decade.

Centre of Excellence

There is no naval Centre of Innovation or Excellence which would allow Government and industry to work together on innovative techniques to improve productivity, and to develop new standards that would allow cost to be driven out of procurement while retaining safe standards of operation. More broadly, there is a significant dialogue between Government and Industry and a very large number of forums.

Summary

There is a vibrant shipbuilding and marine engineering sector in the UK. Industry is heading in the right direction in terms of competitiveness and innovation. A sector strategy which brings industry and Government together will accelerate the 'Total Enterprise' transforming itself.

For military capability reasons, choice, and freedom of manoeuvre, it is clearly important to have a competitive domestic marine sector, capable of providing the full range of build and support work for the RN and Government more widely. Government is committed to reform and to change to deliver the SDSR ambition for a sustained, and then larger Fleet. Together, this would have clear knock-on benefit in terms of growth and prosperity. My recommendations set out the things that need to be done to address the current problems and build new foundations to ensure that the National Shipbuilding Strategy delivers this goal.

MY RECOMMENDATIONS: A SEA CHANGE IS NEEDED TO DELIVER A TRANSFORMATIONAL FUTURE

Governance

- 1. The Government must drive cultural and governance changes in Defence that inject genuine pace into the procurement process with a clear grip over requirements, cost and time.**
- 2. There should be a new governance model of Sponsor and Client for all ship procurement linked to Industrial capacity (i.e. the Total Enterprise). (See Fig. 1).**
- 3. The MOD Sponsor should establish a transparent Master Plan for naval shipbuilding that lays out Defence's procurement plans for each series of naval ships over the next 30 years. This should be backed by "set and assured" capital budgets for each new series of ships. The Master Plan should be reviewed at each SDSR.**
- 4. The MOD Sponsor should empower an RN-led Client Project Contracting Board to finalise design, cost and time for each class of ship procurement compatible with the Master Plan. (See Fig. 2).**
- 5. Current MOD governance processes and procedures should be simplified and aligned with the new governance recommendations 1 – 4 above, with a degree of financial freedom granted to ensure project pace is not hindered.**
- 6. The RN-led Client Project Contracting Board should appoint a Project Director with extensive modern project management, commercial and technical experience. An integrated project office should be established with a multi-disciplined team drawn from Defence Equipment & Support, Navy Command and the lead shipyard etc. for each new class of ship procurement.**
- 7. The MOD should take steps to ensure it is an intelligent client for warship design and build, to better understand the cost implications of naval standards, preferential engineering and bespoke equipment. This should enable proper trade-offs during development of the specification.**
- 8. In addition, an external technical consultant should provide constructive challenge during trade-offs on the inclusion of specification standards, innovation, the minimising of through life and operating costs, ensuring design has flexibility for export and facilitates modern methods of construction.**
- 9. Once these trade-offs have been agreed, the design specification should be frozen to allow the project to progress rapidly to contract signature. No further requirement changes should be allowed.**
- 10. Contracts should be tautly drawn to properly incentivise Industry to invest in support of their "global competitiveness plan" and deliver to time, within the agreed cost envelope. This should provide a firm cost base and delivery to the milestones laid down in the Master Plan.**
- 11. Post contract management should be driven by a joint project management team (Defence Equipment & Support, Navy Command and the lead shipyard etc.) and a governing Project Delivery Board with an Independent Chairman that will foster discipline and overall effective control. A shipyard Trade Union representative could be appointed to attend the regular progress meetings of the Project Director and his team in order to enhance transparent communications. The post-contract Project Delivery Board is the final authority on any change contemplated post contract. None should be accepted that could impact the programme. (See Fig. 2)**
- 12. The risk assessment process, led by the Client Project Contracting Board, should result in the allocation of risk provision partially to the Project Director**

and partially to the Client Project Contracting Board as the final authority on change.

There should be a new Governance model of Sponsor and Client for all ship procurement (Fig. 1). The Sponsor (DCDS (MilCap)) should own the 'Enterprise' Master Plan that sets clear delivery milestones for the client with expectations of time to define requirements, time to contract and time to build/deliver all ships for the RN. The Sponsor should be supported by a cross-Government Board. Figure 1 sets out the model.

The Master Plan should have a 30 year horizon. Government Departments should align to produce a "set and assured" portfolio Capital budget, encompassing each ship programme. This should aim to avoid 'random' programme changes due to annual cash budget adjustments (whilst a project is progressing to time and budget). The Sponsor should allocate, to the Client, this "set and assured" Capital budget for each new series of ships. This should be set at the outset then adhered to. The portfolio should have freedom to trade between the ship programmes provided that the Master Plan milestones are met. The portfolio should also be permitted to have any necessary derogations from the normal rules of annual cash management sufficient to ensure that delivery can proceed unimpeded by tactical considerations of annual cash management. For this to be effective, a solid cost-base is a pre-requisite.

The approach of protecting the portfolio Capital budget is consistent with the treatment of other major national infrastructure projects. Initially, it will place a specific strain on the Defence budget, effectively hypothecating an assured sum for shipbuilding in each year and across the period. However, this Capital allocation is critical to overcome the project cost driver of annual funding changes, given the urgent need for stability to drive pace and reduce cost over time (breaking the vicious cycle) into the procurement programme. Taking into account the contribution that the sector makes to national prosperity, and reflecting the treatment of other Government capital investment programmes, HMT should recognise these issues by ring-fencing the "set and assured" RN shipbuilding Capital budget from the broader efficiency challenges that are laid on the Defence budget for the life of that Parliament. The overall Capital budget should be reviewed at each SDSR.

The new Client Project Contracting Board should be led and chaired by the First Sea Lord. It will be empowered to meet contracting timescales and the target cost within the assured budget (Fig. 2). Its members should include the Chief Executive Officer of DE&S and ensure high-level, authoritative decision making. It should drive Enterprise delivery via an integrated multi-disciplinary team, empowered by the Client Project Contracting Board which should be responsible for:

- The procurement process from 'Requirements' to Contract signature with senior leadership directly engaged with the enterprise, driving pace and removing unnecessary process, ensuring adherence to the master plan and design/specification 'trade-offs' to match capital budget and exportability testing;
- Realistic trade-offs between desirable requirements and essential ones. The inclusion of some specific RN standards, whose cost may not be well understood, needs further review. The independent technical challenge consultant should test the inclusion of all standards in each new class of ship procurement. The virtual Innovation Centre (see below) should review the cost of all standards. The aim should be to arrive at optimum technical capability solutions balanced against an affordable budget and then 'design freeze'.
- Establishing well informed links across the total enterprise to avoid delinking the industrial base.

There should be a tightly controlled number of high level decision makers in order to eliminate preferential⁴ engineering. Current procurement processes should be simplified and streamlined to the maximum extent possible, compatible with the new arrangements of governance and the empowerment of the Project Contracting Board, to ensure that the programmes can be driven forward at pace. Adherence to the disciplines of Initial and Main Gate approvals should form part of the discipline that the Project Director should pursue. But work should be undertaken to ensure that all internal processes support and enable delivery under the new governance.

All key major subcontractors should be present in the Project Team during the detailed engineering phase at least until their information is fully captured to finalise systems design work and the key inputs to the preparation of working drawings for outfitting and commissioning information.

Post contract management for all ships should be driven by a joint Yard project management team comprising key customer and shipyard personnel, led by an experienced/professional shipyard Project Director, to lead project execution day by day at the shipyard and speed up decision making.

For both pre- and post-contract, it will be important to ensure that the Project Director has significant relevant modern project management, commercial and technical experience.

A Project Delivery Board (Fig. 2) should be constituted as the project moves to the contract phase. This overall governance board should have an Independent Chairman to ensure discipline and overall effective control. Clear terms of reference (including the objectives of avoiding disruption to the schedule and avoidance of “change”) need to be established and promulgated. This approach should draw from the successful lessons of the Aircraft Carrier (QEC) build. To smooth transition, the Independent Chairman should sit on the Client Project Contracting Board (in an ex-officio capacity) in the period immediately before contract signature. This period should be sufficiently long to help the Independent Chairman take forward their new responsibilities at pace on contract signature. There should be TU representation on the shipyard project management team at the quarterly update meetings.

This new construct will place new demands on both Navy Command and DE&S. Close attention should be paid to ensure that there are the right mix of skills and experience at all levels to deliver this new approach. Additional support will likely be required in the early phase (see below on “Client Friend”). Teams need not, and should not be large, but they should be skilled, in order to ensure the most appropriate and successful commercial models with industry to support the proposed governance approach. The teams, regardless of the organisations from which they are drawn, should be fully integrated (“organisationally agnostic”, as one discussant put it) and each wearing the same Project Team T-shirt, solely focussed on the delivery of the procurement. The wider Defence implications of the procurement, for example infrastructure, training etc, need to be managed separately but in parallel to ensure the key focus of the Client Project Contracting Board and Project Delivery Board is the delivery of the platform and systems. Again, the processes that are applied should be as simple as possible, consistent with the need for good governance and following directions from the Client Project Contracting Board.

⁴ Preferential engineering is defined herein as 'specifying unnecessarily exquisite standards in design by technically-focussed project teams, often at limited or no accurate knowledge of the true cost, operating in an environment of weak financial/ commercial challenge'.

The General Purpose Frigate

- 13. The new Type 31e should not set out to be a complex and sophisticated warship based on traditional design approaches. It should be a modern and innovative design on a standard platform which should provide a menu of choice to support exports and beat the competition. It should be termed Type 31e. The 'e' means that export flexibility is inbuilt, not a variant.**
- 14. The Type 31e should be prioritised, and act as a pathfinder project to pilot this new governance and Virtual Shipbuilding (VSb) industry approach (see recommendation 19 and Figure 4). It should be rapidly procured and placed into service as early as possible in the 2020s. If necessary, wider Government financial support should be provided to allow early build of the vessel. This will enable the new governance approach to be embedded in order to deliver medium to long-term savings in ship procurement.**
- 15. Type 31e should be designed so that the price/capability point is an attractive export proposition and then it should be delivered to a hard target cost**
- 16. The MOD should determine the optimum economic service life for a naval ship and then replace ships with new vessels at that point, rather than operate longer and thus avoid expensive major refits. As a pathfinder, Type 31e should also be procured as a RN asset that stimulates exports including via sales from the Fleet.**

The General Purpose Frigate should be treated as an urgent project. It gives Defence the perfect opportunity to apply the new approach. Leaving aside the obvious capability needs of the RN (to maintain and then by the 2030s further increase the total numbers of frigates and destroyers) the vessel offers the opportunity – if procured as I recommend – to a) deliver potential savings, and avoid cost growth in subsequent ship procurements, and b) provide significant work for a range of competitive regional UK shipyards.

The design of the Type 31e (Fig. 3) should have inherent flexibility in capability and be built on a standard platform. The design should incorporate a 'menu of choice' which will enhance appeal to Export markets and allow a tailored competitive response which is not for most markets possible with the sophisticated design(s) currently being procured. This will require a non-traditional approach to the design of the Type 31e, which the Client will need to incorporate and recognise as it develops the design. It should also provide choices for the RN, e.g. in extent of combat fit (at time of build or retrofit) on some selected ships in a series to match changes in the varied tasks that RN ships must undertake. One example of this philosophy is the design approach BMT has undertaken in their Venator design. It is critical that this flexible/modular approach, and design for modern production processes, is incorporated in the Type 31e final design. The design must break with tradition and beat the competition.

I have advised earlier that the MOD should take steps (recommendation 7) to rebuild its capability as an intelligent client for warship design and build. This will not be quick or simple and so, to ensure pace is maintained on Type 31e procurement, I would advise that additional technical expertise in the form of a Client Friend (or Friends) is procured early, in particular to assist in the development of a detailed specification.

There is a point where the cost of refitting/repairing ageing vessels is not cost effective when compared to the price of a new vessel. The MOD should undertake an assessment of this "cross-over point" and factor this in when determining the optimum economic service life of any new class of vessels. This should be kept under review (vessels that are worked harder may reach the optimum point sooner). Specifically, the Type 31e

should be kept in service for its economic service life or for a lesser period if an alternative sale in support of an export campaign is required. This approach should create attractive export opportunities for the UK and will also provide the greatest flexibility to the RN, to update the vessel batch by batch and introduce new capabilities over time per ship.

Exports

17. There should be a stronger national co-ordinated effort, including Government to Government trade deals, placed on the exports effort for ship sales, project management, design, equipment and sub-systems. This should be driven by the Department for International Trade, with support from the Foreign Office, Department for Business, Energy and Industrial Strategy, and Defence. A dedicated professional should be appointed to concentrate on the national effort.

The Government should support delivery of Export success through:

- ‘Export testing’ as part of the development of requirements (integrated with planning before the finalisation of Requirements), Standard Design Platform, with optionality on choice of defensive capability and naval standards to provide genuine choice for an overseas Navy;
- The RN endorsement and use of the ship and its key equipment as an invaluable marketing tool for British naval Exports;
- Marketing support and intelligence gathering via Defence / Naval Attachés in our overseas Embassies co-operating with shipyards and wider Government in advocating the quality and characteristics of a class of ship;
- On occasion, if there is an urgent requirement for a new ship for an overseas naval customer which is key to the sale of a series, the RN should be willing to support the Export drive by releasing a ship for sale, earlier in the cycle than they normally would;
- The availability of second hand (ex-RN) vessels which have only served a limited number of years before being replaced, to boost the export drive rather than being disposed of at the end of their working life.

There should be a single, senior official based in the Defence and Security Organisation in the Department for International Trade responsible for providing advice and support to the RN on all ship exports (Fig. 5). This Defence and Security Organisation individual should sit on the Client Project Contracting Board to ensure that exportability is sufficiently understood and factored in at the design stage.

Industrial Strategy

18. Warships should be built in the UK for reasons of National Security and the sustainment of National Sovereign capabilities.

19. Industry and the Government, as part of their Industrial Strategy, should establish a Virtual Shipbuilding (VSb) industry model (Fig. 4) that harnesses the UK regional shipyards that have demonstrated their cost competitiveness and the capability to build fully outfitted “blocks”. The intention should be to build these in series and in parallel to capture the learning curve productivity benefits.

20. The VSb construct should be used to build and integrate the Type 31e via a lead shipyard or alliance with sufficient financial and industrial capacity and capability to construct and to enter into the key sub contracts. Contracts should be taut, eliminate cost growth, and incentivise delivery while allowing reasonable profit.

- 21. UK industry, utilising the VSb approach, should be able to compete effectively, against international competitors for RFA procurement (starting with the Fleet Solid Support programme), and should be strongly encouraged to put forward strong bids for this work.**
- 22. “Global competitiveness plans” should be developed by each shipyard, and the supply chain, with a focus on tight scrutiny of overheads and targeted investment in skills, modern working practices, digital systems, and modern tooling.**
- 23. Industry and the Government should invest in a small, specialised virtual Innovation Centre to challenge existing naval standards and introduce new ones, and to force through advances in design, new materials including composites and manufacturing/assembly methods that contribute to productivity improvements and cost of build. The leader of the Innovation Centre should oversee the “global competitiveness plans”.**
- 24. Companies will need to invest and embrace the full potential design and production benefits of digital engineering technology in the same way as world leading manufacturers, for example Jaguar Land-Rover in the car industry and Meyer Werft (Germany) in the cruise ship industry. These targeted investments should attract Government support. Local Enterprise Partnerships, Scottish Government and Invest Northern Ireland should be encouraged to support the transformation of the industry.**

The VSb Industrial Model (Fig. 4) should be based on a strategy of a lead shipyard or alliance and ‘series - block build’ operations in a number of shipyards in UK Regions that will deliver high productivity, competitive cost and a dramatic reduction in the conventional build time for the project if it were built solely in one shipyard. The shipyards should compete for the modular build. The vessel should be assembled in a shipyard, backed by a company or alliance with sufficient financial and industrial capacity and capability to construct and commission and enter into the key sub-contracts. Contracts should be taut, and properly incentivise delivery (with a suitable profit incentive to enable further investment). But they should incentivise the management to avoid cost growth, rather than this being passed onto the customer. If deemed successful, this VSb model can be applied beyond the Type 31e, on future RN and future RFA ships.

All shipyards should develop “global competitiveness plans”. These should focus on tight scrutiny of the shipyards overheads and establish targeted investments (in skills, modern working practices, digital systems, jigs, robotics & tooling etc.) that will drive series build productivity improvements to world class standards. All shipyards should be encouraged to generate other revenue streams and not rely solely on MOD work. This will support / iron out the volatility in MOD-only work and can only help maximise chances of winning export orders.

In particular, the “global competitiveness plans” should aim to:

- Install modern digital engineering systems and reap the industrialisation benefits as per Jaguar Land Rover and Meyer Werft (Germany);
- Maximise modular construction and a method of build that ensures production facility capability is maximised – e.g. block size, automation opportunities in welding, etc.;
- Examine all opportunities to introduce modern robotics and digitally adjusted jigs for shaped units;

- Target high percentages of advanced outfitting at earliest production stage (e.g. panel outfitting as per the Meyer Werft (Germany) approach);

In ship design, the plans should aim to:

- Maximise the utilisation of proven engine room automation to reduce on board manning;
- Ensure hull form and propeller design is optimised for lowest powering/fuel consumption;
- Ensure automation is maximised in other on board operations: eg laundry and galley;
- Ensure the minimisation of through life costs and the ease of physical withdrawal of equipment and handling space from engine room etc. supports the maintenance friendly approach;
- Use off the shelf equipment and modular accommodation, toilet/shower, and galley compartments;
- Ensure 'open architecture' systems' engineering is deployed, especially within combat systems.

Shipyards will need to work even more closely with the RN customer, TUs and employees to map out a clear company Industrial strategy that creates a world competitive industry by pursuing technical and systems innovations, sound project management and quality operations. The Government and industry should look to make targeted joint investments in productivity improvements, in particular in planning and digital engineering systems, that will pay back on Defence programmes but that will then have broader benefits to Industry's competitiveness thereafter.

Funding should be taken jointly from a contract price (no more than 0.1%) to support a virtual national Joint Innovation Centre for the marine industry and its customers. This should draw on the existing infrastructure, which includes the manufacturing catapult centres, Innovate UK and the Knowledge Transfer Network. The returns should be measured in 3-5 years and should be impressive. The Innovation Centre should:

- Look to critically examine current RN design and production standards and cost them to provide a menu of choice;
- Introduce new RN – industry standards in design and production to reduce cost;
- Seek out new production methods and standards that can provide good robust quality but with reduced man hours, costs of fittings and materials and fit out;
- Seek out 'off the shelf' good robust quality equipment versus high cost bespoke e.g. galleys; laundry (include high degree of automation), pantry equipment etc. as used by the cruise ship industry and other commercial operators;
- Encourage the exchange of global best practice on new production methods between shipyard(s) / customer that yield savings on the cost of naval ships;
- Identify new opportunities via pooling expertise (cross industry/customer workgroups) to explore areas in design – design for production – production innovations – commissioning approaches etc. that can yield cost benefits;
- Examine via working groups – drawn from refit/maintenance shipyards, new building teams and the customer – how through life costs could be reduced via design, specification and choice of equipment/fittings etc.;
- The merits of ships with an earlier resale point for export should be evaluated versus major refits and longer life in service;
- Examine the case for greater modularity in new ships to accommodate:

- flexible choice of capability at contract (some fitted “for” but not “with”)
- options to upgrade some vessels later

Given their design expertise, BAES, BMT, Houlder and Babcock Marine should play a leading role in participation in and secondment of specialists (project to project) to the new Innovation Centre to drive world class performance.

- 25. BAES has the breadth of technical and engineering talent and the most recent experience of building sophisticated warships. They should build the Type 26 series with adherence to schedules supported, if required, by the VSb shipyards via block build. BAES' immediate operational priority should be to use the build of Type 26 to maximise productivity in order to be competitive in future and win sophisticated warship, and other naval ship, design, build and systems engineering work for the RN and exports customers. Their “global competitiveness plan” should focus on capturing the industrialisation benefits of digital engineering and ensuring, with the TUs, flexible skills in the workforce that are compatible with what can be achieved in a digitally engineered driven production world.**
- 26. There is no precedent for building two ‘first of class’ RN frigates in one location in the UK. Type 26 is a critical project for the RN and the Nation. Type 31e is urgently required to maintain RN frigate fleet numbers and to establish a UK exportable light frigate. Against this background risks need to be assessed and evaluated in a responsible way by all stakeholders. A separate lead shipyard or alliance appears to be the best way forward for Type 31e to minimise overall risk. Regardless of choice, BAES would remain in a position to compete for Type 31e work on combat systems, design support and in block build if capacity is available.**
- 27. Given the export potential of design, technical engineering and consultancy services, Industry should consider combining their Maritime Design and Combat Systems Engineering resources into separate subsidiary Companies to make these more visible to the world.**

BAES has now invested in modern digital engineering and is applying it well at the front end design stage. The focus for BAES, on the back of being awarded a series of Type 26 contracts should increasingly be on investing to increase overall productivity and cost competitiveness, via:

- Extend investment in the application of Digital systems (to Jaguar Land Rover and Meyer Werft (Germany) standards) that drive Industrialisation of the total shipbuilding process – particularly in advanced outfitting and the logistics management of piece parts and components;
- This needs to be accompanied by ease of access to the right tools and equipment;
- For series ship runs, such as Type 26: there needs to be a significant focus on modern hydraulic jigs; Robotic applications, and designing build strategies to facilitate significant module build and maximum advanced outfitting for blocks;
- Laser dimensional and location checks at the end of the e.g. the manufacturing panel line with the capability to confirm or otherwise, not only dimensional accuracy but the positioning of all outfit parts compatible with design;
- Training and Education of a wide range of the workforce to ensure the right skill mix and competence and understanding of what is possible with these new digital systems to advance productivity in cooperation with TUs and the workforce is crucial.

- Leading International competitiveness and innovation in design and production processes has to be the clarion call particularly if a homogenous series of Type 26 workload is contracted;
- Driving down overheads to achieve reduced forecast outturn costs for Type 26.

Such innovations would enable BAES to become globally competitive via reduced cycle time and direct labour productivity gains supporting their potential to win export work.

BAES has a considerable opportunity via the Type 26 programme to drive real change into the way in which they work. They, and the TUs, should be encouraged to make maximum use of this opportunity and build success to be a world leader in sophisticated warship design and construction. BAES would then be in a position to demonstrate their capability to continue to be selected as the lead shipyard of choice for sophisticated warships.

The complete series of Type 26, subject to finalisation of contract negotiations, should therefore be contracted to BAES. Adherence to schedule could be supported, if required, by a block build as per the VSb model. The Type 26 volume of work, plus nuclear submarine build and potential export wins, should allow BAES to protect Sovereign capability through retaining sufficient skilled engineers and designers.

If the Type 31e is prioritised and brought into service early in the 2020s (as I have recommended) it will be under construction at the same time as the Type 26. Given the importance of Anti-Submarine Warfare support to Carrier Strike and Continuous at Sea Deterrence, Type 26 is a priority for the Nation. Type 31e is critical to future fleet numbers for the RN and to establish a competitive light Frigate design for export. There is a national urgency for both. There appears to be no UK precedent for the construction of two different first of class Frigates in the same shipyard. Constructing both first of class simultaneously in one facility significantly heightens the risk for both the shipyard and the RN Client. I recommend that this factor is borne carefully in mind as Government competes the build of the Type 31e which should be integrated by a lead shipyard, either acting as a prime contractor, or as part of an alliance, using the VSb model of building blocks in series and in parallel that will deliver high productivity, competitive cost and a dramatic reduction in the conventional build time for the project.

BAES should however compete for 'open architecture' combat systems, other design work and block build (if capacity is available) on Type 31e for RN and export customers.

BAES, and other companies, should examine their organisational structures to ensure they are agile, enabling them to put their best foot forward in export markets. One example of this could be for companies to exploit more the export potential of design, technical engineering, project management and consultancy services, by combining their Maritime Design and technical resources, including Combat Systems Engineering into separate subsidiary companies to make these more visible to the world as UK exporting capabilities. Those companies should seek work competitively at home and overseas and their design teams should strive to stay ahead of new, emerging technology demands in the global market place in order to sustain the capability to design and integrate the most advanced ships.

28. Industry and the Government should recognise the importance of the UK maritime supply chain as a provider of specialist equipment and services, through the opportunities offered by a series of Type 31es which further enhances export opportunities given RN selection and endorsement of UK (or

UK-based) equipment manufacturers (thereby stimulating new product and manufacturing investment).

The Type 31e will represent a considerable opportunity for the regional shipyards and the supply chain, especially if developed for export in the way recommended (and be sold in volume). An indicative example of a potential UK supply chain, based on Type 23 and Type 26, is at Chart 1). More broadly, the greater transparency of ship procurement plans, and the greater certainty that would arise from the Master Plan and the associated set and assured funding, should give industry the confidence to invest in this sector.

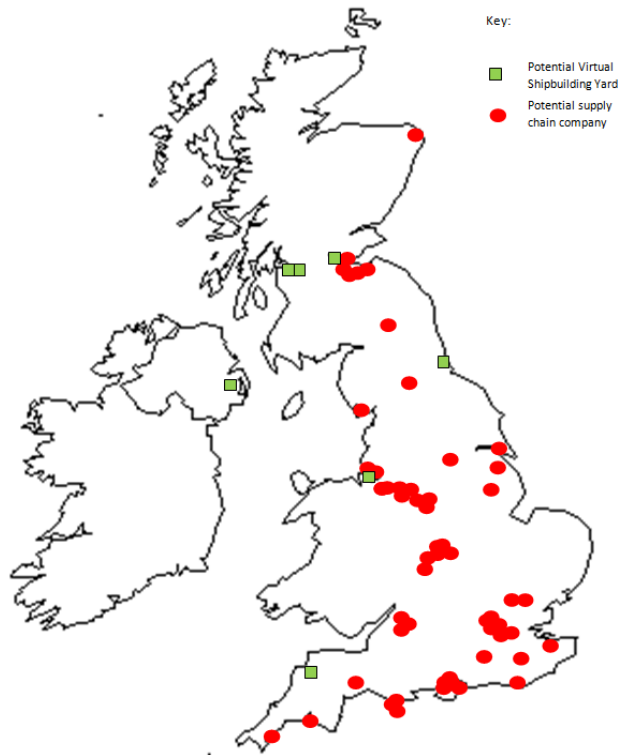


Chart 1: Indicative representation of a Potential Type 31e UK Supply Chain

29. To address future affordability challenges, the MOD should consider conversion of commercial shipping to meet certain support shipping needs (as was the case with RFA Argus), hire commercial vessels to meet low threat tasking and for other duties, such as minesweeping through using frigate or OPV platforms to host capabilities, including unmanned vehicles, rather than procuring bespoke vessels.

A number of successful ships over the years in RN service have been conversions from commercial shipping. MOD should continue to explore this route to meet its support and non-warship needs. It may not always be the right solution. But it should always be examined, and there is no reason why these ships could not be built in competitive UK yards. Similarly, the RN should explore the use of commercial shipping for routine and low threat support tasks. Finally, given the dramatic advances in technology, and as a principle, some future hydrographic and mine sweeping tasks could be undertaken from the General Purpose Frigate (or other platforms), with unmanned vehicles.

Socio-economic benefit

30. Industry and the Government should, with the TUs, support the creation and sustainment of high skilled jobs along with modern apprenticeships, and expansion of Technician and Graduate recruitment, to drive performance, particularly via digital engineering, and to address the age profile of the current workforce at the shipyards.

31. The MOD should seek to better understand the socio-economic benefit of awarding work to UK shipyards, or UK suppliers, and should give this more weight in non-warship building and all ship outfitting procurement decisions.

The shipbuilding sector is a traction engine for its long supply chain and for the regional economy in the areas where shipyards are significant employers. The sector provides high wage / high skill employment in relatively deprived areas of the UK. Taking the MOD's initial estimates of around 15,000 direct jobs (and c. 10,000 indirect supply chain jobs) in UK shipbuilding and repair due to MOD spending, and the preliminary estimate of £1.5bn added value to the UK economy, this implies each directly employed shipbuilding and repair worker contributed an average of approximately £59,100 to the economy annually.

Further extending the MOD's initial analysis on Defence spending on shipbuilding and repairs (subject to further work, data gathering and validation), it could be estimated that if the MOD decided to spend an additional £200m p.a. on a new shipbuilding contract in the same distribution as it spent £1.4bn in 2014/15, (this was considered a Value for Money item of additional expenditure, and all other factors remained constant), this would support / sustain between approximately 2,000 and 3,000 additional direct UK jobs.

There is a clear onus on Government and Industry to ensure that local people are given the opportunity to upskill and work in the regional shipyards. Much good work is already being done and ONS data suggests that UK shipbuilding and repair workers earn more than the local median wage. But the following skills agenda should be used as a hand rail by the shipyards and the Local Enterprise Partnerships in each area:

- Local universities/technical colleges should work with the shipyards on the skills of the workforce. Consideration should be given to setting up a diploma in the wider benefits and aspects of exploiting 'digital engineering' in driving production efficiency;
- Management, supervisors and TU representatives should be trained in the power of digital engineering, design for manufacture and the above support systems to boost productivity etc. Management and supervisors remain key to driving change in the sector. Industry should continue to invest in leadership of both groups;
- TU representatives should work with management and supervisors to maximise the benefits from these modern technology driven approaches with the aim of increasing export success;
- The shipyards, and the MOD, should look to ensure a continued flow of high quality graduates, including by offering more young undergraduates the opportunity to develop practical experience in holiday periods to assist attracting them to the industry;
- Apprenticeships should be designed to enable a progressive career from shop floor experience to the most senior levels;
- Incentive systems for employees should reward visible productivity target/quality improvements in line with Government Apprenticeship Trailblazer standards⁵;

⁵ <https://www.gov.uk/government/publications/future-of-apprenticeships-in-england-guidance-for-trailblazers>

- Employees (regardless of original training/apprenticeships) should work to the skill sets to which they are trained to maximise flexibility of working;
- There should be more regular exchange of personnel between Industry and Defence (mainly DE&S) to share skills and experiences.

The MOD should seek to better understand the socio-economic benefit of awarding work to UK shipyards, or UK suppliers, and should give this more weight in non-warship building and all ship outfitting procurement decisions. But not at any cost; there is a need to maintain the true reality of competition to drive efficiency onshore. The value for money assessment should include all benefits and costs to the UK, including where these might offset modest increases in overall cost. But the MOD should not be additionally penalised by HM Treasury for selecting “inefficiently” modestly more expensive UK equipment – those parts of the budget that have done this should be spared from the usual efficiency challenges.

32. The Defence Growth Partnership, as part of the Government’s sectorial Defence Industrial Strategy should, bearing in mind the demands on busy Executives’ time, take the lead and work with the extensive network of Industry and Industry/Government discussion and lobbying forums in order to galvanise the maximum national effort on the implementation of this strategy.

There is a vibrant and extensive set of Industry only and Industry/Government lobby and interest groups working on the maritime sector and maritime exports. Given the importance of the sector, and the time pressures on all seniors in Industry and Government, there is merit in ensuring that the groups are as agile, and as well integrated as possible. The landscape should be reviewed by the Defence Growth Partnership. This may result in a rationalisation of the groups in order to maximise focus and galvanise the national effort on the implementation of the National Shipbuilding Strategy. They could also be the focus for the supply chain’s version of a “global competitiveness plan”, which should complement that of the shipyards. This would have to include MOD’s forums as well as the overlap with the Ministerial Working Group for Maritime Growth.

Support

33. Work will need to be commissioned to assess the detailed effects, if any, that these recommendations may have on naval ship support solutions.

I have focussed, in this report, on the shipbuilding side of the Defence marine enterprise (consistent with the task I was given). But my recommendations, if accepted, will have an obvious impact on the support side. I recommend that Defence undertakes further internal work to understand and plan for the downstream impact on ship support in the UK and the potential for the sale of UK support expertise on the international market.

Reporting

34. The Government should appoint a senior civil servant to ensure that the accepted recommendations are embedded within the ‘Total Enterprise’ and to place the Secretary of State in a position to report on delivery against these recommendations annually.

To sustain the confidence in industry and the public at large, it will be important that Government is transparent about progress with the recommendations. The implementation of the recommendations that the Government chooses to accept will need

to be properly resourced, and led by a suitably experienced senior civil servant. There should be an annual, published, report on delivery against these recommendations by MOD (on behalf of Government).

Conclusion

The views and recommendations in this report are my own. They are submitted for Government to consider and review. That response will formulate the National Shipbuilding Strategy. But I am clear that there is the potential for a 'sea change' in the way Government procures ships for the RN, and how they can be designed to support exports – meeting our Defence needs, and as a consequence driving increased prosperity and growth for the UK. Government will need immediate focus and re-tasking of key individuals, simplifying processes to align with the new governance and have the right leadership in place to drive the change. The piloting of Type 31e will need to ensure that appropriate and adequate investment is made available.

This of itself is an important project to be the Pathfinder for the new governance model, implementation of the industrial strategy and export potential. The new governance model should benefit (and drive savings) across all ship programmes.

But there is also a challenge for Industry to ensure that all of the sectors of the marine sector are competitive in a global market. This will require continued investment in innovative techniques and training to drive productivity improvements.

Should both Government and Industry rise to the challenges that I have set, there is, I believe, a real opportunity for a growth in apprenticeships and skilled jobs across the UK, both in the shipyards themselves, and in the supply chain, with a clear benefits to the nation in terms of skills, employment, growth and prosperity.

My hope too is that the many talented people I have met in the MOD will feel empowered, by the proposed simplification of process and the clear authority and discipline of the new governance arrangements, to drive through the changes with enthusiasm with a united team spirit.

Similarly within Industry and the TUs I hope this new Industrial strategic approach, to create the potential to transform the Industry to compete with the best and contribute to ensuring our RN is supplied with the number of ships it needs, will be an opportunity that will be jointly seized.

I believe we can establish a new era of collaboration and drive for success across the 'Total Enterprise'.

This will create savings over the coming years within MOD, renew the RN fleet and take shipbuilding on a transformational journey similar to that experienced by our rejuvenated car industry.

Finally, I should like to place on record my personal thanks to all who have provided input and views across Government, Industry and the TUs. In particular I wish to thank Ian Gibson, Jenny McGhee and Cdr Paul Richards RN as the in-house support team. They have done a sterling job. I would also like to thank John Coles CB FREng RCNC for his invaluable counsel over the period.

Annex:

A. List of Shipyards Visited and Companies, Trade Associations and Trades Unions engaged by Sir John Parker or Officials as part of the National Shipbuilding Strategy.

LIST OF SHIPYARDS VISITED AND COMPANIES, TRADE ASSOCIATIONS AND TRADES UNIONS ENGAGED BY SIR JOHN PARKER OR OFFICIALS AS PART OF THE NATIONAL SHIPBUILDING STRATEGY

ORGANISATION
Thales UK
Harland & Wolff
BAE Systems
BMT DSL
Rolls Royce
Cammell Laird
Babcock Marine
A&P Group
Ferguson Marine
Society of Maritime Industries
Defence Growth Partnership
UK Naval Engineering, Science and Technology Forum (UKNEST)
Northern Defence Industries
Stevens Marine Ltd
Lloyd's Register
Maritime Industries Liaison Council
Confederation of Shipbuilding and Engineering Unions (CSEU)
GMB
Unite