4 The markets affected by the merger

Contents

Page

Introduction

4.1. Our inquiry is concerned with the merger of VSEL and GEC only so far as it relates to their military activities.

4.2. VSEL's military activities comprise the design and construction of warships, artillery and naval guns. GEC's military activities comprise the design and manufacture of air and land systems and weapons, and (of closest relevance to our inquiry) defence prime contracting, naval warship-building, and the design and manufacture of naval systems and weapons.

4.3. We deal first with the market for warships, and then with the ordnance and gun systems market.

Warships

Developments in the Royal Navy, 1956 to 1995

4.4. Over the last 40 years the Royal Navy has been greatly reduced in size. During the Suez crisis, in 1956, it could call on 14 aircraft carriers, 20 cruisers, 68 destroyers, 186 frigates and 54 submarines. In the next decade its future size and shape was profoundly influenced by the decision to vest in it responsibility for the UK's strategic nuclear deterrent, depending first on Polaris missiles carried in SSBNs of the Resolution class, now progressively being replaced by Trident missiles carried in SSBNs of the Vanguard class. By the time of the Falklands War in 1982 the strength of the Royal Navy had been reduced to 2 aircraft carriers, 60 destroyers and frigates, and 31 submarines. Table 4.1 shows the numbers of ships in the Royal Navy and the Royal Fleet Auxiliary over the last two decades.

TABLE 4.1 **Numbers of ships in the Royal Navy and Royal Fleet Auxiliary, 1975 to 1995**

Type of ship	*1975*	*1980*	*1985*	*1988*	*1989*	*1990*	*1991*	*1992*	*1993*	*1994*	*1995**
Submarines	24	23	24	24	26	24	24	20	18	18	16
Carriers, assault ships	5	3	4	3	4	4	3	3	3	4	5
Frigates, destroyers, cruisers	59	48	46	41	41	43	41	43	38	32	36
Mine countermeasures vessels	40	34	32	35	36	40	35	31	30	18	18
Patrol ships, etc	10	23	30	31	33	32	31	26	24	30	31
Support ships (including Royal Yacht)	3	2	2	3	2	2	1	1	1	1	1
Survey ships	13	13	8	8	7	6	7	4	5	5	6
Tankers		12	13	14	11	11	11	11	9	8	9
Replenishment ships		3	3	4	3	3	4	3	4	5	5
Support and supply		4	2	2	1	1	1	1	1	1	1
Landing ships, logistic		5	5	6	3	5	5	5	5	5	5
Forward repair ships			1	2	2	1	1	1	1	1	1

Source: UK Defence Statistics.

*MMC estimate from *Jane's Fighting Ships*. Not fully comparable with earlier figures.
Note: Excludes ships on refit, standby, etc, except for 1995.

4.5. During the 1980s the number of submarines in the Royal Navy was maintained and a third aircraft carrier entered service. At the end of the decade the MoD put in hand studies, known as `Options for Change', reviewing the needs of the Armed Services in the light of changing circumstances in the Soviet Union and Eastern Europe. The results of those studies have been progressively implemented during the 1990s. Table 4.2 shows the numbers of certain Royal Navy ships in service in 1990; the proposed reductions announced in `Options for Change'; and the numbers in 1995. It will be seen that the reductions have been

even greater than those envisaged in 1990. Most of the ship sales have been of smaller and older ships, but in 1994 it was decided to withdraw all diesel electric submarines from the fleet and four almost new Upholder class submarines have been put on the market. Appendix 4.1 shows the Royal Navy fleet in more detail, at the end of 1994.

TABLE 4.2 **Royal Navy: planned change in strength of certain ships from 1990 to 1995, compared with actual strength at 1995**

Class of ship	*Strength at 1 April 1990*	*Envisaged for 1995 at 1 April 1990*	*Actual strength 1995**
SSBN submarines	4	4	4
Other submarines	27	16	12
Aircraft carriers	3	3	3
Frigates/destroyers	48	40	36
Mine countermeasures vessels	40	40	18
All ships of above types	122	103	73

Source: Options for Change Fact Sheet, 25 July 1990, reproduced in *Third Report of the Defence Committee 1990-91, Options for Change: Royal Navy*, HC 266.

*MMC estimate from *Jane's Fighting Ships*.

4.6. Between 1985 and 1992 total defence spending in the UK reduced from 5.2 per cent of gross domestic product to 4.0 per cent.[1] Table 4.3 and Figure 4.1 show expenditure on naval procurement, corrected for inflation. It includes not just ship platforms but the weapon systems they carry and all other equipment and facilities required for the Royal Navy and for support. Expenditure, corrected for inflation, is now running at less than two-thirds its peak level in the mid-1980s. Expenditure on Trident nuclear submarines, the most expensive vessels ever purchased for the fleet, began in 1981 and will continue until around the turn of the century. There has also been a progressive tendency to procure fewer ships but to spend more on the systems they carry. Warships today carry a more extensive and effective array of offensive weaponry than did their predecessors, and they also carry far more sophisticated computer systems to manage, co-ordinate and control their combat systems. The increasing power of modern weapon systems means that it is no longer appropriate to invest in armouring a ship to survive impact. Modern warships defend themselves instead through stealth, speed and manoeuvrability, sophisticated countermeasures and by intercepting or deflecting incoming weapons. Warships are therefore lightly built to enhance performance. The skills required now of the modern warship-builder are broader, as the task of integrating the ship, its weapon systems and combat management systems has grown in complexity. Responsibility for that task has increasingly been transferred from the MoD to the warship-builder and in future will be carried by a prime contractor (see paragraph 4.38).

4.7. The end of the Cold War has also resulted in extensive defence cuts in most other NATO and former Soviet bloc countries. Many second-hand warships are being made available for sale, and many warship yards are short of work and looking for alternative outlets for their products. UK warship- building capacity freed by recent developments has therefore remained surplus to requirements, as exports have been at a low level. Two UK warship yards, CL and SH, have closed in the last two years.

[1]See *Defence Procurement in the 1990s*, National Audit Office, 390, May 1994, p12.

TABLE 4.3 **UK expenditure on naval procurement,* 1978/79 to 1994/95**

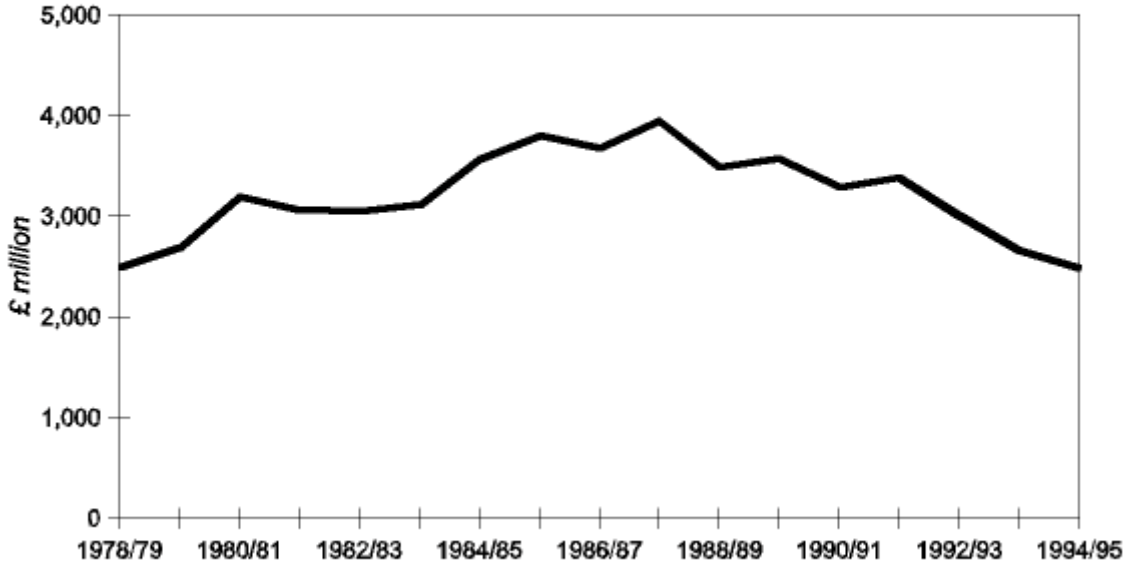
Year	*Naval procurement at original prices* £m	*Naval procurement correct for inflation (RPI)* £m, 1994/95
1978/79	878	2,497
1979/80	1,110	2,688
1980/81	1,513	3,187
1981/82	1,624	3,063
1982/83	1,730	3,054
1983/84	1,849	3,109
1984/85	2,228	3,570
1985/86	2,499	3,796
1986/87	2,494	3,678
1987/88	2,797	3,947
1988/89	2,633	3,491
1989/90	2,890	3,571
1990/91	2,955	3,293
1991/92	3,142	3,377
1992/93	2,891	3,001
1993/94	2,593†	2,655†
1994/95	2,488†	2,488†

Source: UK Defence Statistics, inflation correction by MMC.

*Naval procurement includes warships, equipment, support, and on-shore facilities.
†Forecast.

FIGURE 4.1

UK expenditure on naval procurement (1994/95 prices)



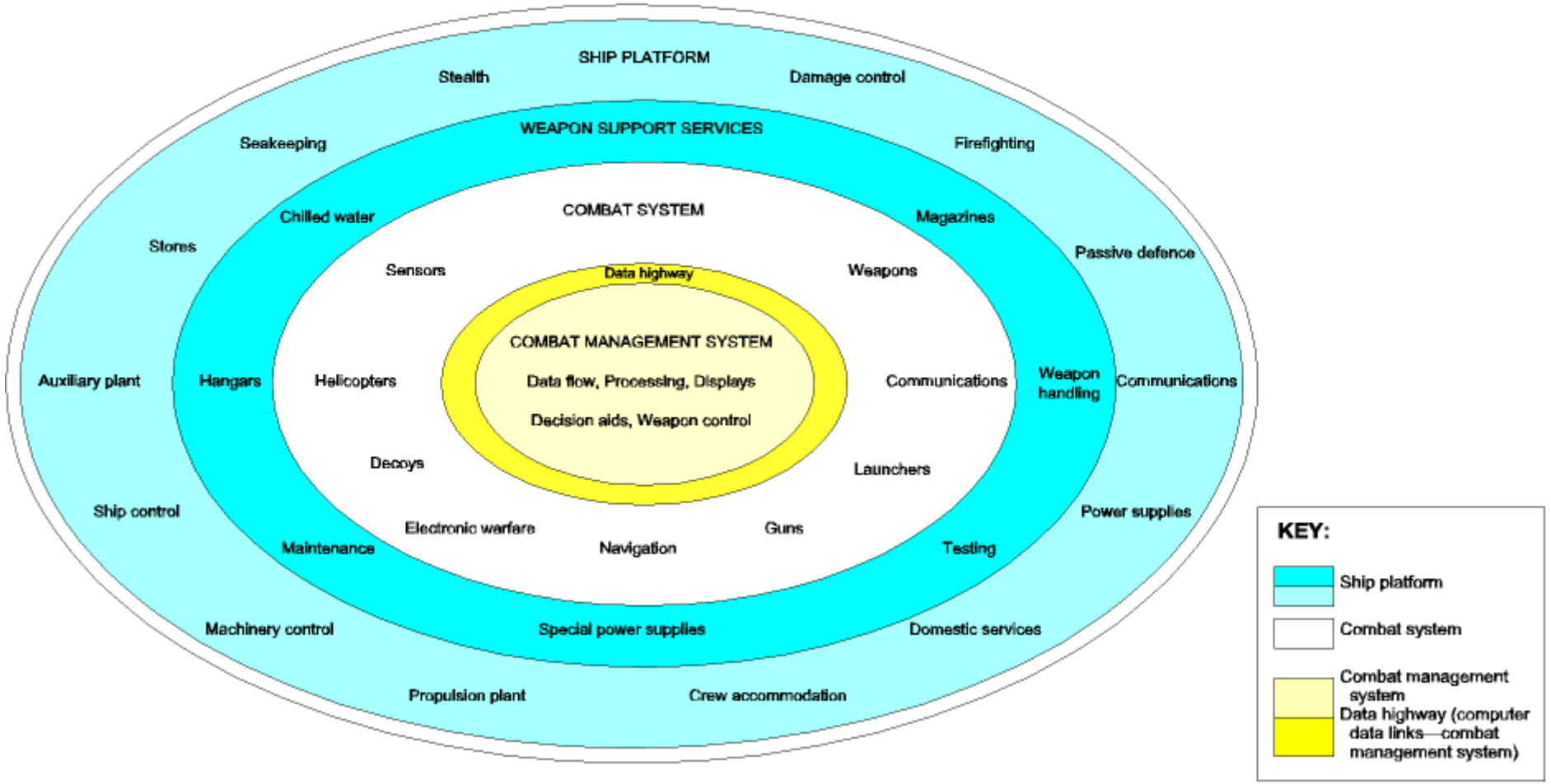
Source: UK Defence Statistics.

Naval procurement process

4.8. The warship is a platform which carries a payload of weapons, sensors and communications systems, and which may provide an operational environment for other forces such as aircraft, landing forces and support services. The whole comprises a complex combat system of personnel, machines, weapon systems, sensor, and communications. Their relationships are illustrated at Figure 4.2. This distinguishes the ship platform, comprising the hull, propulsion and services, from the combat system. Many of the individual parts of the combat system are controlled by complex software, which may produce or require much data, and may need to interact with other parts of the system. Increasing use is made of complex computerized management systems to co-ordinate the whole. Information from many sources must be processed and channelled to the

FIGURE 4.2

Typical warship elements



Source: MMC.

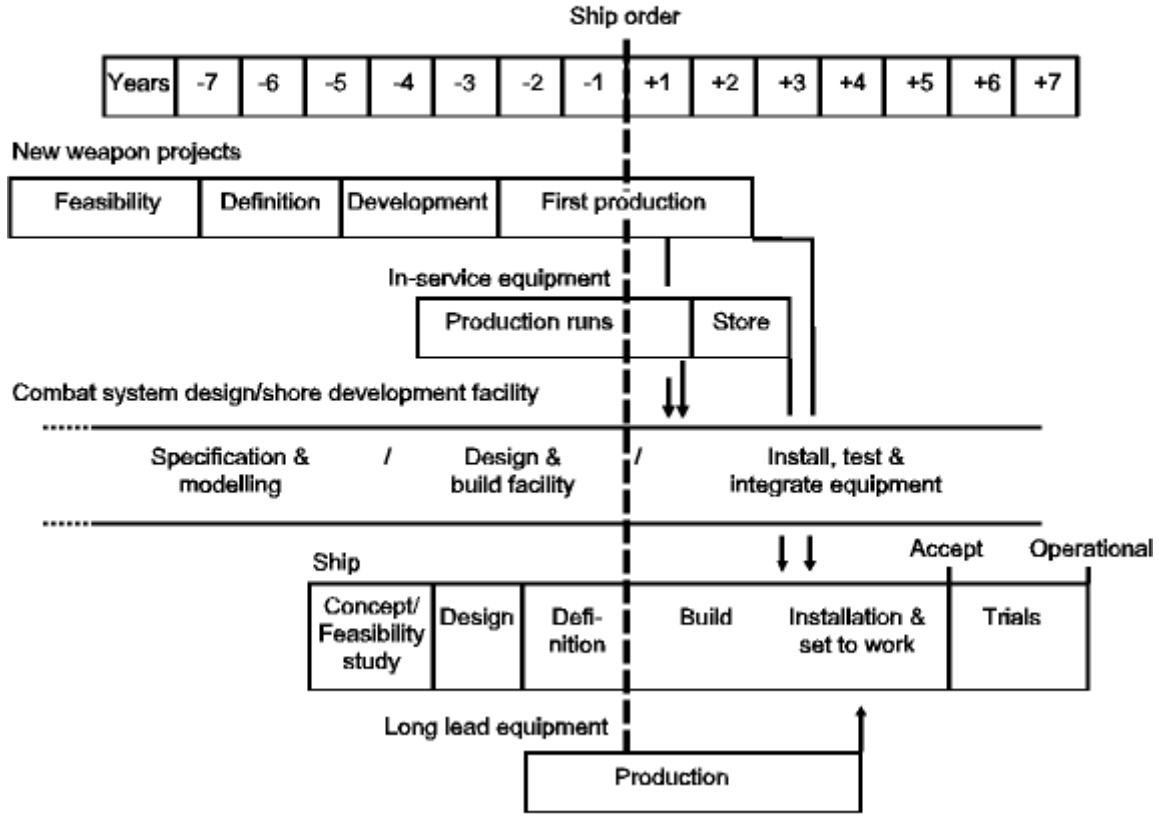
appropriate recipient, whether for human decision and action or automatic response. The term `combat management system', or formerly `command system', is applied to the computerized management system which achieves this, also shown in Figure 4.2. Appendix 4.2 shows a breakdown of the unit production cost (UPC) of some recent warships, and identifies the proportions attributable to combat systems.

4.9. The ship platform is therefore only one element of the task of designing and building a complete warship including its weapon systems, the combat management system and other equipment. Typically the major weapon systems have a longer lead time than the ship which carries them. The development and production of the weapons and other features on the platform are required to be complete in time for confirmed data to be available for use in systems integration, and for those systems to be fitted on the ship at the relevant stage of construction.

4.10. There is a distinction to be made between the construction of a first-of-class ship and the follow-on construction. A first-of-class ship has novel features, even if it is derived from an earlier design. It can be compared to the production of a prototype, although for reasons of cost, and in contrast to prototypes of most other defence equipment, the first-of-class ship is itself required to be put into service. It is therefore necessary to address and solve design and integration problems during the production of the first-of-class. This must be done in time to allow production work to proceed and to allow confirmed data to be provided to the builders of follow-on vessels. Construction of these is normally started well in advance of the completion of the first-of-class. Most of the technical and financial risks associated with a new ship and new weapon systems are fully comprehended at this stage. In contrast a follow-on ship has these problems only in relation to changes made after the first-of-class work has been done and so is essentially a repeat of an existing design. A specimen timetable for a first-of-class ship, provided by the MoD, is shown at Figure 4.3.

FIGURE 4.3

Typical project phases for a first-of-class warship



Source: MoD.

4.11. The Royal Navy's requirements have their origin in the definition of operational capability required by the MoD, whether for the UK's defence, defence of offshore interests, the operational needs of the Army and RAF, or NATO operations. The need for new procurement arises from newly perceived or increased threats, new operational requirements, worthwhile opportunities for enhancement arising from technical progress, or simply the need to replace equipment at the end of its useful life. Warships are large units of which the Royal Navy has relatively few, compared with, say, tanks. Warships, too, are long lived, with an operational life in the Royal Navy of between 20 and 30 years. The infrequency of demand and large size and complexity of each unit places particularly acute stresses on supplier companies.

4.12. A first-of-class ship is designed to meet the specification set out in the MoD's Naval Staff Requirement. This defines the weapons payload, operational capability and performance characteristics of the vessel. The production of the Staff Requirement requires conceptual studies and feasibility studies. From conceptual studies a document called the Staff Target is produced, which is in effect an abbreviated first draft of the Staff Requirement. This is followed by preliminary design studies which are typically an iterative process as trade-offs are made between desirable capabilities, technical feasibility and risk, and economic constraints. Also taken into account at this stage are estimates of `through life' running costs and maintenance. The underlying Staff Target may need to be redrafted as a result of these trade-offs. The Staff Requirement emerging from this process will specify in outline the characteristics of the ship, its weapon systems, overall performance standards and in-service support requirements.

4.13. Over much of the past 50 years, the conceptual and preliminary design stages would have been performed within the MoD, but in recent years some of these studies have been carried out by consultants working under contract. Shipbuilders may themselves provide consultancy services, and there are also independent consultants engaged by the MoD, such as BMT, Three Quays and YARD (a subsidiary of BAeSEMA). The MoD may seek to involve companies in this work that might become key industrial participants and possibly competing potential prime contractors at a later stage. (Prime contracting is discussed more fully in paragraphs 4.36 to 4.46.)

4.14. After the project has secured interim financial and policy approval, a shipbuilder, or a prime contractor employing a shipbuilder, is selected, either as a single source or by some form of competition. The prime contractor or shipbuilder develops the design and produces sufficiently detailed drawings to allow the work of building the vessel to be fully costed and to demonstrate compliance of the design with the Staff Requirement. The design data at this stage will include the arrangement of the compartments within the ship, the arrangement of equipment, routeing of services and construction strategy. It will also cover risk assessments and design options in some detail. A fully-costed tender for building the ship will then be requested. In some cases the MoD seeks to retain competition between potential prime contractors or shipbuilders up to the end of this stage. It is then able to make its selection based on competing designs as well as competitive bids covering prime contracting services and construction costs.

4.15. With the results of the tenders available, and with the development of systems under the MoD's control sufficiently advanced, approval is obtained from Ministers to place a contract to build the vessel. The chosen shipbuilder (which may be the prime contractor) will build the first-of-class vessel and is called the `lead yard'. The lead yard is often contracted by the MoD to produce a `design package' which allows follow-on construction to be performed by other shipyards.

4.16. Usually the MoD requires construction of follow-on ships to start before the first-of-class is complete. The lead yard must therefore maintain a flow of information to the follow-on yard. The services of the lead yard will also be required for a number of reasons such as advice on interpretation and execution of the design, minor alterations either to achieve an improvement or save construction cost, and matters arising from different construction techniques used in various yards.

Warship-building technology

4.17. In the past, warships were constructed by building the shell of the hull first. As the internal structure was put in, openings would be left so that machinery, pipework, cables, equipment and so forth could be fitted into the basic structure. Much of the fitting out would be carried out after launch. By contrast, modern practice is to build ships in modular blocks typically in the range of 200 to 2,000 tonnes, depending upon the size of the ship and the handling capabilities of the yard. As much of the final equipment

and machinery as possible is incorporated into the modules at this stage. The modules are then fitted together to give a much more complete vessel at time of launch than was previously the case. This has the advantage of allowing equipment to be fitted when conditions of access are most favourable, and maximizes the proportion of work which can be carried out indoors and prior to launch, all of which reduces the cost of and time required for the work. It is not in general essential that modules are constructed on the site where final assembly takes place. Modular construction has been made easier by computer-aided design/computer-aided manufacture (CAD/CAM) systems, which permit the assemblies to be built to a finer tolerance than was previously the case, so that the modules will match and fit together more easily, even if built away from and transported to the site of assembly.

4.18. Great expertise is required to incorporate weapon systems and sensors into the ship. Modern practice is to link up all the weapons and sensor systems in a shore-based development facility prior to installation in the first-of-class ship. This allows them to be tested together and problems identified and corrected in advance of installation in the first-of-class. The facility can be used subsequently to assist with the training of ships' crews in less constraining circumstances than on board ship.

4.19. Recent advances in CAD/CAM technology have considerably reduced design labour and lead time, and also contribute to more efficient management of the construction process. Well-serviced fabrication halls, computer-controlled tools and part inventories have all greatly increased efficiency in construction. Changes in labour practices, most notably the reduction of demarcation, and training in more than one trade, have increased labour productivity. As a consequence of this, the design and construction time for frigates has been roughly halved over the last 20 years, and labour productivity has improved by a similar order of magnitude.

Differences between warship and commercial shipbuilding

4.20. Although commercial ships and warships in principle can be constructed alongside each other in the same yard, normal practice throughout the EU and the USA is to keep the construction of merchant ships and warships separate. For the most part, yards are specialized builders either of merchant or of naval shipping. Where the same yard builds both types of ship, as can be found in Germany, we have been informed that they are built in separate areas of the yard with distinct workforces.

4.21. This arises from the fact that the design and construction requirements of merchant ships and naval ships are quite different. Modern ships are extremely complex and specialized. Merchant ships are built to standards laid down by the Classification Societies, such as Lloyd's, whereas warships are built to distinctive naval standards. The reason for the distinction is that warship designs aim to deliver different standards of performance (eg with regard to speed, manoeuvrability, stealth and performance in combat conditions). The requirement for a naval ship structure to withstand weapon attack and underwater shock results in more complex structural details and overall structural geometries substantially different from commercial ships. Designs to achieve these objectives rely upon construction to more demanding specifications than those necessary for merchant designs, and the use of materials which are more difficult to handle than those used for merchant ships. Warships incorporate more complicated equipment, including weapon systems and computerized control systems, than most commercial ships. This gives rise to the need for specialist design and integration skills, quality control teams, commissioning and testing teams on a much greater scale than is needed for commercial shipbuilding. A higher level of security is required where naval ships are built. This broad range of differences implies that appropriate working practices and the mix of skills needed in a naval shipyard are quite different from those in a commercial shipyard. A shipyard set up for one type of shipbuilding is unlikely to be well placed to obtain work of the other type. (A fuller account of naval construction standards is at Appendix 4.3.)

4.22. There is, however, a recent tendency for the MoD to include elements of commercial standards in warship designs so as to save money and to maintain flexibility of supply. The Type 23 frigate design incorporated commercial construction configurations to a limited extent, and the LPD assault ships, for which an order is expected, will use commercial standards to a large degree. In part this has been facilitated by improvements in commercial standards. However, these ships remain essentially warships. High-performance specifications needed for frigates and submarines are needed to a lesser degree, if at all, for auxiliary and support ships which normally operate out of the combat zone. Commercial standards are

therefore applied with relatively little adjustment for vessels of this nature, notably the fleet tankers and survey ships.

4.23. In the 1970s the EC Commission set up a Shipbuilding Intervention Fund to provide financial assistance to the merchant shipbuilding industry in EC member states. A shipyard which has been designated for assistance from the Fund may apply for assistance in respect of any contract for which it is tendering. The main conditions of application are that there must be competition for the contract from outwith the EU, and that the contract is not for a warship. If the application is successful, 9 per cent[1] of the price of the vessel will be paid for by the Fund. Assistance from the Fund is not available to shipyards designated as warship yards, whatever type of ship they propose to build, and redesignation is not normally permissible. Shipyards designated for assistance from the Fund are permitted to build ships which do not qualify for assistance, including warships, without losing their status. Accordingly it has not been worthwhile for a warship yard to maintain the flexibility to compete for merchant shipping contracts. Proposals in recent years to convert CL back to merchant shipbuilding foundered at least in part upon its ineligibility for assistance from the Fund. No further assistance from the Fund will be granted after 31 December 1995.

4.24. H&W is a Belfast shipbuilder which has built warships but now specializes in commercial ships, particularly stand bulk carriers and oil tankers. In the last decade it has undertaken two contracts for large naval auxiliary vessels. The first, let in 1984, was to convert an Italian-built container ship to become a naval auxiliary vessel, *Argus*. The second, let in 1986, was to design and build a new class of AOR, the *Fort Victoria*. There were three innovations in this contract. First, the AOR was intended to carry vertical-launch Seawolf missiles, whereas previous classes of AOR carried only the lightest weapons. Second, the AOR was to be capable of providing full support for helicopters carried by Type 23 frigates. The ship therefore required a greater degree of warship-building skills than was usual for an auxiliary vessel. Third, this was the first `whole ship procurement' contract let by the MoD, making the shipbuilder responsible for design and build, and for integration of the weapon system. As H&W had not maintained a warship capability, it had considerable difficulties in discharging its obligations under this contract.[2] There were extensive delays both in delivery of design information and delivery of the vessel. In due course, when the company was privatized, the Government paid the new owners £53 million in compensation for expected losses on this and other contracts. After sea trials in 1992 the *Fort Victoria* was completed by H&W at the CL yard. A follow-on vessel was built by SH. We understand that H&W is not for the time being interested in naval work, although it has expressed some interest in re-entering the market for building and refitting auxiliary vessels.

4.25. Despite this experience, two shipyards which normally specialize in commercial ships are currently engaged on naval contracts, but only for those auxiliary vessels where naval standards have limited application. First, in 1993 a contract was placed with VSEL for the LPH (18,000 tonnes), but VSEL subcontracted hull construction to KG, a commercial shipbuilder. The LPH is described in Appendix 4.4. It has extensive merchant features in its design and some limited warship characteristics. However, KG has been able to draw upon VSEL's warship experience and supervision, and fitting out and integration of weapon systems will be carried out at VSEL's own facilities. Second, a contract of about £[*] million for an OSV of approximately 14,000 tonnes displacement was awarded to BAeSEMA in February 1995. ASL of Bideford has been subcontracted to build the hull. The hull is to merchant standards, and BAeSEMA will incorporate and integrate the sonar and other equipment.

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[1]Until about three years ago, the subsidy was 13 per cent. The figure of 9 per cent applies only to ships costing more than 10 million ECUs; for ships of lesser value the figure is 4.5 per cent.

[2]*The 1991 Statement on Major Defence Projects*, NAO, 121, July 1992.

*Figure omitted. See note on page iv.

Refitting

4.26. Warship-building is also distinct from refit and repair. Many of the workforce skills required are similar but the facilities required are different, particularly the basic infrastructure. The traditional approach, still widely used, is to build a ship on a slipway from which it can be launched, and to refit it in dry dock. Modern practice is to undertake both on a level surface, using a ship-lift for launch and recovery: VSEL has an extremely powerful ship-lift, and Rosyth has a small one. Building requires extensive design and fabrication skills, and specialized handling and fabrication facilities. In contrast, refitting involves dismantling, diagnosis, repair, and fitting spares, although some upgrade programmes do require substantial modifications to structure and systems. Refitting nuclear submarines requires specialist licensed facilities and trained personnel to refuel reactors and move irradiated fuel. A specialist refitting company could not enter shipbuilding without substantial investment. A shipbuilder with a suitable dock could undertake refits, but its workforce and practices would not be best fitted for the task and would be subject to strong competition from specialists.

MoD warship procurement policy

National procurement of warship hulls

4.27. The MoD told us it is current government policy that warships (but not their systems) should be procured only from UK shipbuilders, so long as adequate competition is available. It is the location of the shipbuilder, rather than the nationality of its owner, which is significant in this context. In most other areas of defence equipment, including weapon systems fitted on warships, the MoD is prepared to obtain supplies from abroad if they are competitive with domestic products. Most developed countries with warship-building facilities appropriate to their needs have a rigorous policy of national procurement.

4.28. However, the MoD has sometimes bought and had modified second-hand foreign-built ships to act as auxiliaries, and in 1987 it invited tenders for a batch of minehunters to an existing design, opening up the possibility of procurement of the bare GRP hulls from a foreign yard. However, the contract was placed with VT.

4.29. The UK is engaged in a collaborative programme with France and Italy to design the CNGF. It is currently expected that each country will construct its own ships. It is expected, too, that a contract to build the UK first-of-class will be let to YSL in 1997, subject to agreement on price. It is expected that the collaborative design will increase total costs, but reduce the costs for each participant. There is likely to be some difference in the weapons fit of the vessels for each country.

4.30. The MoD does not expect to buy foreign warships in the near future. Its existing policy reflects several factors:

(a) *Mutual reliance for support*. The UK needs to be able to rely upon support, spares and consumables to keep the ship in operation, particularly during an outbreak of hostilities. There have been cases where allies have not provided support services when they were needed. In some cases the UK does rely on allies for support, but the MoD told us that this is only tolerable if there is mutual reliance between the two countries, so making it likely that support will continue to be provided. National construction expertise is an important-though not always essential-component of providing a secure support service.

(b) *Reciprocity of access to market*. As part of strategic trade policy, it is common to refuse to allow imports from a competing country unless reciprocal access to its market is provided. In many European countries warship yards are publicly owned and/or state aided, which can be an impediment to free trade.

(c) *Intellectual property*. A country maintains a military advantage by preserving the confidentiality of its intellectual property. Foreign procurement means relying upon intellectual property that others are willing to sell, and risking the leaking away of UK intellectual property if UK designs are constructed abroad. Foreign procurement is indicated either when the strategic lead is not a material issue, or the country cannot afford to generate its own intellectual property (eg the design and development of a

new fighter aircraft). In the case of nuclear submarines, the UK is bound under treaty to keep certain US-supplied intellectual property within the UK.

(d) *Management of a uniquely complex system*. The MoD argued that the warship-builder has to integrate into a ship a large and varied weapon system, arising from the fact that the warship is a much larger platform than any other armaments platform, such as a tank or an aircraft. The distance of a foreign supplier and, in some cases, its language add to costs. The more complex the management of the system, the greater is the increase in costs from overseas procurement.

(e) *Availability of suitable product*. International defence procurement is normally of established designs that can be used with minimal modification. The Royal Navy has such a small number of warships that they must be carefully matched to particular operational needs and methods. The MoD commented that the costs of modifying a foreign warship design to UK needs would rarely be different from the cost of commissioning a UK design.

(f) *Short production runs*. Significant savings can be obtained where long production runs result in optimization of production methods for standard items with limited variation. This is rarely achievable for ships, thus reducing the cost advantage of international procurement.

Competition and risk transfer

4.31. It is now MoD policy wherever possible to seek a price determined by competition between potential suppliers in the naval sector. This is in contrast to the policy that prevailed until the mid-1980s of directing work to particular shipbuilders. It is hard to quantify the savings achieved by this policy, but the MoD believes it saves about £1,000 million a year, or about 10 per cent of the total defence budget, through use of competition in defence procurement.[1] In the case of shipbuilding, over the past decade there has been a rapid fall in the price for construction contracts of Type 23 frigates and Sandown class minehunters (see Table 4.4 and paragraph 4.67).

4.32. In order to promote efficiency and control costs, risks are being transferred to the contractor. MoD policy is now to require companies to quote a `firm price', or to allow price variation only in line with price indices, in which case it is called a `fixed price'. The advantage of this type of contract is that the supplier takes on the risk of managing the programme and is motivated to manage that risk and find ways of saving costs. Until the mid-1970s shipyards were remunerated on a time and materials basis (`cost plus'). As an intermediate step to achieving fixed or firm prices, a variety of methods were used in which both the supplier and customer shared the risk of any cost overrun, and both benefited from any savings. These contract forms were known as `target cost incentive fee' and `fixed price incentive fee'.

4.33. Where competitive procurement is not available or not used, or the competition is judged to have been ineffective, the MoD has devised a number of methods of making the best of the situation. First, there is the NAPNOC policy. Work will not be authorized until a price has been established and the MoD has satisfied itself that the price is reasonable, in particular by obtaining detailed breakdowns of costs and comparing the costs of individual tasks with work elsewhere, to the extent that such data are available.

4.34. Second, the MoD requires the production of a `make or buy' plan defining which elements of a contract are to be put out to competition. In principle all items with a cost above £50,000 should be incorporated in the plan unless good reason is given. Where equipment is to be procured competitively, competitive tenders are carried out, subject to rules intended to ensure that the selection of the subcontractor is rational and unbiased, including oversight by MoD staff. If the main contractor, or one of its subsidiaries or associated companies, intends to bid for such a subcontract, then the MoD may insist on separation of the parties involved.

4.35. In the contract for construction of the first-of-class of a vessel, the lead yard is often required to produce documentation specifying the work that a follow-on yard must perform. This assists in maximizing competition and minimizing risk premiums which might be charged by the follow-on contractor. The MoD

[1] *Defence Procurement in the 1990s*, NAO, 390, May 1994, paragraph 3.2.

typically procures ships in batches, for example Type 23 frigates were procured as three batches of three, one batch of two and two single ships. In 1994 an order for a batch of seven Sandown class minehunters was placed. Batch procurement helps yards to reduce the costs of preparing bids costs which otherwise would be returned to the MoD by way of overhead charges in contracts. It generates efficiencies in manufacture, permits yards to invest in cost-saving equipment, and encourages a wider range of suppliers to bid for the contract. Fixing the price for an extended period encourages yards to find ways of reducing costs over the course of the contract, which benefits the MoD in subsequent competitions.

Prime contracting

4.36. Ships and weapon systems comprise many parts. Most new major weapon systems need to be developed ahead of the ship platforms that will carry them. Many of the systems, especially weapon systems and sensors, embody the results of research programmes started some years previously in response to perceived threats or anticipated advances in technology in potentially hostile countries. Typically, a new weapon system or sensor is conceived out of research work undertaken within the Defence Research Agency or more often undertaken by industry in collaboration with the Defence Research Agency. Development progresses in a similar way to that of a warship, with stages including feasibility studies and development contracts.

4.37. All of the systems and equipment required for a particular vessel have to work together satisfactorily and interface not only with each other but with the ship platform in which they are to be fitted. (For a more extended discussion of interfacing, see paragraph 4.106.) There must be an integrated whole which meets overall system performance and reliability requirements. With the growth in the complexity of the end product, the task of managing the development programmes and of integrating all the elements, so-called `systems integration', has demanded strong central control. In the past, the MoD has provided system and equipment design and integration expertise, and provided central control. Contracts were placed by the MoD with industry for all the constituent parts, and the MoD employed project management teams to maintain control. As overall warship design authority, the MoD thus carried the technical and financial risks of achieving a satisfactory end-product which met the overall performance specifications.

4.38. Progressively the MoD has been transferring these functions and responsibilities, and the associated risks, to industry. The concept of `prime contractor' was developed, which required a contractor to be responsible for delivering an entire system to specified performance and reliability standards. Initially, prime contracting was applied to weapon systems, and prime contractors for weapon systems were responsible for delivering the stand-alone weapon system to meet performance specifications. Prime contracting was slower to spread into warship-building. The MoD first developed the concept of `whole ship procurement' which started the process of transferring responsibility for the performance of the ship platform and its systems to the shipbuilder. This quickly developed into the `prime contracting' concept now current. Under the terms of a ship prime contract, the prime contractor is now made responsible as far as reasonably practicable for the design and procurement of the complete product, and must deliver the ship and weapon systems properly integrated and functioning to meet guaranteed performance specifications, on schedule and often within a fixed price.

4.39. The term `long lead equipment' is applied to equipment the development or manufacture of which must be begun before the ship. Long lead equipment may include components of ship machinery as well as weapon systems. It has been the practice for such items to be developed and procured under contractual arrangements between the MoD and the system supplier, and for them to be issued by the MoD to the shipbuilder for installation at the appropriate stage of construction. Information to allow the shipbuilder to complete the detailed design and system integration work was obtained from the weapon contractors and provided to the shipbuilders by the MoD. This process left the MoD open to claims for compensation if the materials were not ready in time or did not conform to the specifications supplied to the shipbuilder, and which it was using to plan the installation and integration task. In extreme cases, ships have had to be accepted into the Royal Navy without all their planned systems.[1] The MoD's current policy to use whole ship prime contractors wherever possible will help to reduce design and integration risks, although it will still be necessary in some cases to start development work before the ship prime contractor has been chosen. The MoD expects that all its major warship programmes in future will involve the appointment of a prime

[1] *The 1991 Statement on Major Defence Projects*, NAO, 121, July 1992, pp 26-28.

contractor, with the prime contractorship responsibility extending to all or most of the ship platform and the systems integrated on to it.

4.40. It may not always be economic to extend prime contractorship to the entire warship. For long lead time equipment the MoD will already have taken responsibility for advance procurement. The MoD's policy appears to be moving in the direction of placing the prime contract for a ship at an earlier stage, so that the prime contractor can take greater responsibility for long lead equipment (which is more significant for major warships (frigates, submarines) and minehunters than for lightly-armed auxiliaries). In other areas, the premium that a contractor might charge for taking responsibility for procurement, and guaranteeing functional and structural integration, might be larger than the MoD believes reasonable relative to the price it could obtain for the equipment and the likely integration costs given its own knowledge of the system. Identified weapons and other equipment are required not only for fitting in the latest ship or batch, but also for subsequent orders and for updating existing ships of the fleet and for spares and repairs. There can be a financial advantage for the MoD in bulk purchasing such equipment. The MoD has therefore taken a mixed approach to procurement of equipment that it will choose, for which these are the main options:

(a) The MoD issues to the contractor equipment that the MoD has procured directly. This is referred to as `free issue' equipment or government-furnished equipment (GFE). Today the MoD tries to minimize the amount of GFE, particularly where prime contractors are appointed, but the practice of free issue is likely to continue for some major systems, particularly in major warships and minehunters. The MoD has continued to supply extensive GFE right through the programme of follow-on construction of Type 23 frigates. This is because in some cases it had already ordered sufficient units of certain equipment for the remainder of the ships of the class.

(b) The contractor is required to accept a novation or assignment of a contract which the MoD has already placed for supply of the relevant equipment. The contractor thus becomes responsible for enforcing delivery and guaranteeing interoperability.

(c) The contractor runs a competition for a subsystem and offers the MoD a choice, which may be subject to price adjustments. Normally these competitions are run before the contract is let, but in some rare cases the MoD may require the contractor to run a competition after the contract has been let. However, it is MoD policy not to interfere with contractors' decisions unless there are strong overriding needs. An example of such a reason would be the need to maintain compatibility with equipment fitted in other ships.

The MoD's decision on which approach to follow depends upon the value for money it offers. For example, if a prime contractor is required to accept novation of a contract and guarantee performance, the charge the contractor proposes to make for taking that risk, whether in single tender or in competition with other potential prime contractors, has to be assessed on this basis. Other issues concerning subcontracting, including the concepts of nominated and preferred suppliers, are discussed in paragraphs 4.105 to 4.111.

4.41. There is a significant difference between the way in which prime contracting can operate in first-of-class and follow-on vessels. For follow-on vessels much of the content has become standard, and so the contractor is not free to choose much of the equipment. However, the fact that the integration has already been performed means that the premium charged by the builder for accepting assignment or novation of a relevant supply contract and taking responsibility for performance may be quite small. In the case of a first-of-class, the scope for a prime contractor to make its own specification and procurement is wider. However, for equipment where the MoD has already initiated procurement, but there is no record of previous successful integration, it is more likely that the MoD will decide to provide the equipment as free issue. In some such cases, the MoD may have to retain responsibility for the performance of the equipment and its suitability for effective integration.

4.42. Because of the continuing free issue element, there are few existing or prospective MoD contracts for warships which can properly be described as whole ship prime contracts. However, suppliers require a much wider range of prime contractorship skills than previously in order to be able to accept the forms of contract in use. Three important characteristics that suppliers need to meet prime contractorship requirements are financial strength, systems integration skills, and project and contractor management skills. Since the prime contractor is taking performance risks in respect of a large element of the ship, it must be able to back this up with sufficient assets to be able to take the consequences of non-performance. Systems integration

skills play an important part in prime contracting because one of the main purposes of prime contracting is that the contractor takes the risks associated with integration. Project management skills are essential to deliver a satisfactory end-product within budget and time constraints. This includes the ability to deal directly with a large number of subcontractors.

4.43. A prime contractor that performs a larger portion of the work itself may be better placed to offer a lower price than one who does less, particularly for more complex contracts which carry greater risks. In theory, a prime contractor needs to do no more than organize and manage the work of subcontractors who perform the work. In practice, such an arrangement is likely to increase the price that he would wish to charge, particularly in the case of more complex contracts, for the reasons which follow. The prime contractor assumes the risk of financial penalties if there are faults with the total product or delays in delivering it, and also the risk of damage to its own reputation. However, a subcontractor can in general be made liable for damages in proportion only to the value of its own subcontract, which may be much less than the impact on the total programme of a failure by that subcontractor. The subcontractor will include a contingency in its contract price for such risk as it bears. But the prime contractor will include in its costs a contingency for risk arising from the subcontract, in particular much of the programme risk. The risk is therefore shared between the prime contractor and the subcontractor. But typically the risk is not shared perfectly, in the sense that the sum of the two contingencies will be higher than the prudent contingency the prime contractor would charge if it did the work itself. This is because the subcontractor, in carrying out the subcontract, will not take into account the entire risk it creates, making it more likely that the risk will be incurred, in turn increasing the prudent contingency the prime contractor will charge. It does not follow that it is best for a prime contractor to perform all the work, for there may be other reasons, particularly technical efficiency, why the prime contractor should not do all of these things. But the performance of a substantial portfolio of the work is a factor which may assist potential prime contractors to offer a lower price. An alternative approach to reducing the prudent level of contingencies against risk is to form a risk-sharing joint venture.

4.44. Appendix 4.2 shows the cost breakdown of recent warship contracts, supplied to us by the MoD. For the Trident nuclear submarines the cost of building the ship platform dominated the total cost of the contract. However, for surface ship contracts, a substantial fraction of the value of the ship may be in the combat system, including the combat management system, and associated integration work.

4.45. The MoD told us that it would be unlikely to accept a prime contractor for a warship unless that prime contractor either had credible plans to build the hull in its own facilities, or had identified a specified hull-builder with whom it had made appropriate contractual arrangements. Such contractual arrangements should give credible assurances that the project would go to completion and reassure the MoD that a hull would be produced to the required quality. Most recent contracts for ships have gone to shipbuilders who have built the hull themselves. In two recent orders of auxiliary vessels (LPH and OSV), the MoD has let prime contracts to parties who have subcontracted the production of the hull, although in one of these cases the prime contractor was itself a shipbuilder. There are also analogous cases of contracts for other defence systems, for example helicopters, where the prime contractor has subcontracted the production of the main hardware. In these cases the prime contractor has invariably provided system integration and project management skills. However, parties to this inquiry have argued that in the case of warships a potential prime contractor would be better placed to offer a lower price if it performed both hull construction and integration, as the contingency costs of carrying risks might be reduced. The likely reasons were discussed in paragraph 4.43.

4.46. To date, contracts for the export of warships have usually placed prime contracting responsibilities on the supplier to a greater extent than have MoD orders. There are several reasons for this:

(a) The importing nation is usually in a weaker position to bear any technological risks than the MoD and will therefore insist upon arrangements whereby the contractor takes responsibility.

(b) The importer will be relying upon the contractor's advice on selecting equipment to a greater extent than would the MoD.

(c) In order to contain risk borne by the contractor, equipment incorporated in an export warship may not reflect the latest advances in technology, and will tend to be competitively procured off-the-shelf

equipment requiring relatively minor technical modification, rather than long lead equipment developed specifically for the importing country.

However, export customers will commonly exercise influence over, or make the final decision on, the choice of equipment, and the price will generally reflect the equipment finally chosen.

Naval shipbuilders and potential entrants

VSEL

4.47. The origin and activities of VSEL have been described in Chapter 3. It has a shipyard at Barrow-in-Furness, where it has a covered facility, the DDH, constructed for the purpose of building nuclear-powered submarines, including Trident. The DDH can hold two complete Trident submarines and sections of a third. Submarines are constructed on a level surface (as opposed to a slipway). They can be completely fitted out in the hall, and are subsequently launched using a ship-lift. The hall is fully serviced and can transfer units of up to 2,000 tonnes. The DDH can also be used to assemble and fit out surface ships of up to frigate size, and to fabricate blocks of larger ships. The DDH is the largest covered warship-building facility in the UK and the best equipped. Its overhead costs are higher than simpler facilities found elsewhere which mean that it is not necessarily economic to use it for all types of work. VSEL has several traditional uncovered slipways upon which large or small surface ships can be assembled. However, these have not been used since the 1970s and would require investment to restore them if a contract were obtained. The majority of the fitting out would be accomplished as part of the construction of blocks in the DDH and fabrication shops, leaving a limited amount to be completed after launch at an uncovered berth. VSEL has owned the CL shipyard at Birkenhead since 1986, but it was closed in 1993.

4.48. In recent years VSEL has produced two Trident nuclear submarines (16,000 tonnes) and has two more under construction. Prior to that it produced Trafalgar class submarines (5,000 tonnes). It was lead yard for the production of Polaris nuclear submarines and Upholder class conventional submarines (2,500 tonnes). If constructing no other ships in the DDH, it could produce Trafalgar class submarines at a rate of one per nine months, with four or five in simultaneous construction. If it were engaged in building Trafalgar class submarines at the rate envisaged for the B2TC programme, sufficient capacity would remain in the DDH to produce at least one ship the size of a Type 23 frigate per year.

4.49. VSEL has in the past built surface ships at Barrow at the same time as submarines, particularly first-of-class warships. Examples include HMS *Invincible*, the first of the Royal Navy's current complement of three aircraft carriers, HMS *Sheffield*, the first-of-class Type 42 destroyer, and HMS *Manchester*, the first extended hull Type 42. VSEL last delivered a surface ship to the fleet in 1989, a Type 22 frigate built at CL. In 1992/93 CL was used by H&W to complete the *Fort Victoria* AOR. VSEL continues to supply design advice to foreign countries on surface vessels. Since privatization, VSEL, and CL while it remained open, have consistently bid for all available Royal Navy contracts for steel surface warships. VSEL has on occasion bid for GRP ships, intending to use an overseas supplier of the bare hull. It obtained a contract for the LPH vessel in 1993; in this case it has subcontracted the construction of the hull to KG but the fitting out of the vessel will be completed at VSEL.

4.50. VSEL has had little experience of prime contracting for warships, although it has successfully managed the prime contract for AS90 guns. No submarines have yet been procured for the Royal Navy on a prime contract basis. VSEL's first ship prime contract is for the LPH (18,000 tonnes), the first-of-class of a sophisticated amphibious ship, to be built to a novel mix of specifications and standards. The LPH does not, however, present the same degree of prime contracting risk as would a frigate or submarine. For the purpose of bidding for future submarine work which is intended to be a prime contract, VSEL intends to use the services of Loral ASIC, a large US company with extensive experience in systems integration and discussed further in paragraph 4.66.

YSL

4.51. YSL and its role within GEC have been described in Chapter 3. Its main facility is a covered module construction hall and slipway at Scotstoun on the Clyde, where ships of up to 7,000 tonnes can be

assembled. The slipway is capable of accommodating three ships together, though only two of these could be of the maximum size. YSL has a facility for constructing GRP hulls, but this has not been used since the early 1980s and would require renovation if it were to be used again. It also has a dry dock capable of taking a ship up to at least 10,000 tonnes, and several uncovered berths where ships of at least 20,000 tonnes can be fitted out after launch.

4.52. Over the years 1990 to 1994 YSL delivered six Type 23 frigates. Three more will be delivered over the next two years (1995 to 1997). YSL will also deliver two light frigates (2,300 tonnes) of its own design to the Royal Malaysian Navy in 1996. Since 1984 it has unsuccessfully bid for three Type 23 frigates (awarded to SH), the last two batches of minehunters (awarded to VT), and the three Upholder class submarines (built at CL). It has also bid unsuccessfully for major refit and conversion work.

4.53. YSL has been prime contractor for the latest batch of Type 23 frigates. YSL has also acted as prime contractor for the light frigates for Malaysia. GMNS is also willing and able to be a prime contractor for ships larger than could be constructed at YSL, provided it could come to a suitable agreement with a shipyard capable of building the hull.

VT

4.54. Britain's third specialist warship-builder is VT, based at Woolston near Southampton. VT was formed from a merger of Vosper and Thornycroft in 1966, each of which had originally been founded in London about 100 years previously, and had independently moved to Hampshire around the turn of the century. VT was in public ownership as part of British Shipbuilders from 1977 to 1985, and during that period constructed mine countermeasures vessels, frigates/destroyers, and small warships for the MoD and for export, having maintained a specialist export sales department since the early 1960s. It has two separate yards at Woolston and Portchester, but in view of their proximity has managed them as a single business with a single labour force. At present the Portchester facility is maintained but little used.

4.55. The main facilities at Woolston are a covered module fabrication hall and slipway where a single ship of up to about 6,500 tonnes can be assembled, and a GRP facility where two GRP hulls can be moulded concurrently. It has berths where the fitting out of ships of up to about 20,000 tonnes could be completed. It has about 1,400 employees designing and building warships. Current turnover is around £250 million per year, of which around 80 per cent is related to the designing, building, equipping and supporting of warships.

4.56. Between 1980 and 1993 VT designed and built 16 minehunters (450 to 750 tonnes) with GRP hulls for the MoD, and in July 1994 it received a contract for seven more to be put into service over the period 1998 to 2001. It has also exported GRP vessels, and is currently building three minehunters for export. The last steel ship VT built for the MoD was a Type 42 destroyer (4,800 tonnes) put into service in 1985; however, it continued to construct steel patrol craft (up to 400 tonnes) for export customers. From 1989 to 1992 it had no construction work on steel-hulled vessels, apart from a cutter, but continued to bid for contracts for vessels up to frigate size and continued to supply design expertise to various customers. In 1992 and 1993 it obtained prime contracts for the export of two corvettes (1,500 tonnes) and four fast strike craft (450 tonnes). VT told us that it provides a complete service to its export customers, including design, weapons integration, training and ongoing support. It has publicly stated its capacity, capability and intention to compete for contracts to build warships up to the size of the CNGF (roughly 6,500 tonnes). Under average workload conditions and subject to modest investment in facilities (if this had not already been undertaken for previous contracts) VT could deliver CNGFs at a maximum rate of one every 16 months. This assumes the use of the VT Portchester yard for related subassembly work. VT told us that considerable investment would be required to expand its facilities to build warships materially larger than the CNGF at its yards.

4.57. VT is acting as prime contractor for the recent order of seven minehunters for the Royal Navy. It is acting as prime contractor for its current export contracts for steel ships. It has expressed a willingness to act as a prime contractor for ships too large to be built at its own yard, subject only to capacity and the availability of a suitable and willing yard able to build the hull.

Large commercial shipyards: KG and H&W

4.58. There are two commercial shipyards in the UK which have the physical capacity to build warships larger than frigates, KG on the Clyde and H&W in Belfast. Although commercial yards can in general be adapted to the task of building warships, we have already discussed the disadvantages commercial shipyards have relative to a specialist warship-builder, and the difficulty H&W experienced in building a hybrid auxiliary vessel, the AOR (paragraphs 4.20 to 4.24). KG is currently acting as subcontractor to VSEL to build the hull of the LPH. This has been described to us as an auxiliary vessel with some limited naval aspects. VSEL acts as designer and supervisor and will complete the fitting out and integration of military systems at VSEL. VSEL has stated its intention of employing KG as a subcontractor in its bid to build a future hybrid vessel, the LPD, although it has stated its intention in this case of constructing the vessel at VSEL, on the grounds that this is basically a warship and the proportion of the content to naval standards is materially higher than for the LPH. H&W told us that it has facilities suitable for building and refitting all types of naval and auxiliary ships, except submarines, but it does not have any interest for the time being in building warships. VT and YSL both expressed considerable interest in acting as prime contractor for the LPD contract, with the encouragement of the MoD, but were unable to make arrangements with a subcontractor able to build the hull which would have enabled them to bid.

Warship yards recently closed

4.59. There are two large warship yards in the UK which have been recently closed, but which remain relatively intact. SH, a yard on the Tyne, is in receivership. SH built two of the aircraft carriers in the fleet. In its last decade it built seven frigates, an LSL vessel (8,500 tonnes) and an AOR vessel (32,000 tonnes). SH is still for sale to anyone acceptable to the MoD who wishes to enter UK warship-building, or for any other purpose. Apart from the costs of putting together a suitable workforce and obtaining relevant intellectual property rights, VSEL has suggested that investment would not only be required to restore facilities, but that if the yard wished to be competitive with other warship-builders additional investment would be required to modernize facilities. VSEL and VT each suggested that the total would be in excess of £20 million. A view expressed by several parties is that the costs would be justifiable only if orders for around five large vessels were expected.

4.60. CL, at Birkenhead, is owned by VSEL. Since 1985, it has delivered one destroyer, one frigate, and three Upholder class diesel-electric submarines (2,500 tonnes), and was used to complete an AOR built at H&W. It had previously built fleet auxiliary ships in excess of 40,000 tonnes, and it built one nuclear-powered attack submarine and two Polaris nuclear submarines. VSEL told us that CL's facilities are excellent and have been maintained in working order. VSEL has tried to sell the yard for its original purpose of merchant shipbuilding, which would require some additional investment. But it is notable that VSEL chose to employ KG as a subcontractor for the LPH, and intends to invest in renovating a slipway at VSEL for the LPD, rather than reopen the existing facilities at CL for warship-building.

Other shipbuilders

4.61. There are a few smaller commercial shipyards in the UK which are still active. They are potential competitors or subcontractors for smaller auxiliary vessels, especially to commercial or near commercial standards. ASL of Bideford is under contract to BAeSEMA to build the hull for an OSV of about 14,000 tonnes. The Ferguson yard on the Clyde specializes in ferries and has not taken any interest in naval orders. There are several shipbuilders able to build small patrol craft and amphibious vessels, such as McTay Marine and Fairey, who have achieved export orders in this area. Brooke Marine, at Lowestoft, and Richards, with yards at Lowestoft and Great Yarmouth, have supplied the MoD with various small ships but both closed their shipbuilding operations in 1994.

The Royal Dockyards

4.62. The Royal Dockyards at Rosyth and Devonport specialize in refitting and updating warships. Both refit submarines as well as surface ships and are nuclear licensed sites. The management of the Royal Dockyards has been contracted out to the private sector since 1987. Devonport Dockyard is currently

managed by Devonport Management Ltd (DML) and Rosyth by Babcock International Group plc. The MoD currently proposes to privatize the Royal Dockyards, and has obtained one bid for each from consortia based on the existing commercial managers. VSEL is negotiating to take a [*] per cent stake in DML if its privatization bid is successful. Currently all submarine work is allocated to the two Royal Dockyards. The majority of warship refitting work is also allocated to the Royal Dockyards, but will progressively be opened to competition. As we noted above, the facilities required for refitting a ship of a given size or type in general fall short of those required for building the same ship.

4.63. The Royal Dockyards built warships until the 1970s, but the facilities have been largely disposed of and only a limited capability now exists. Devonport currently builds ships up to 35 m out of steel, aluminium and GRP. Rosyth also has built ships in steel and aluminium and with little investment has basic infrastructure that could be used for building ships up to 65 m or 1,000 tonnes. A report commissioned by the MoD in 1989 suggested that an existing slipway at Devonport could be brought back into use to assemble vessels of frigate size and above with an investment which DML estimated at the time as being £4.5 million over a period of six to nine months. The same report suggests that similar capacity could be created at Rosyth for an investment of £4 million to £9 million over two years. The MoD pointed out that these are minimum estimates and fail to take account of the need to have the steel and pipework fabrication facilities at an appropriate scale, and a site for fabricating modules. Management and design systems would be needed. All these facilities would need to be comparable to those at other shipyards if the operation were to be competitive. The MoD estimates that the additional amounts would be at least £5 million, and the total would probably exceed £15 million in the case of either dockyard. DML told us that, following recent extensive rationalization, the investment required to enable it to construct major warships (such as frigates) would now be in excess of £30 million, and Babcock International Group plc told us that a figure of £40 million to £50 million would be required in the case of Rosyth.

4.64. Portsmouth Dockyard is a repair and maintenance facility owned and operated by the MoD, and is used for carrying out routine tasks, but not major work. It has docking facilities similar to those of the Royal Dockyards and is occasionally mentioned as a site which might be used for fitting out warships which had been assembled elsewhere. We have not explored the investment which would be required.

Other potential prime contractors for warship-building contracts

4.65. BAeSEMA, a 50:50 joint venture between BAe and the French company SEMA, has recently won a prime contract to build an OSV, the hull of which will be contracted out to ASL. BAe manages the Al Yamamah programme of defence exports to Saudi Arabia, which has resulted in VT obtaining contracts for GRP minehunters. BAeSEMA is an important supplier of combat management systems for warships. It owns YARD, a naval design and research company originally set up by the Yarrow Group in co-operation with the Admiralty. BAe believes that in order for it or BAeSEMA to be credible as a prime contractor for major warships it needs to come to a suitable agreement with a major warship yard. It has not proved possible to come to such an agreement.

4.66. Loral ASIC is a US company; it is a wholly-owned subsidiary of the Loral Federal Systems Company. Its expertise is in the area of defence prime contract management and major systems integration. It has US naval and prime contracting experience, and has acted as prime contractor for the Merlin helicopter programme for the MoD. It has come to an arrangement with VSEL to support, as VSEL's major subcontractor, the bid for the prime contract for the B2TC programme. This arrangement was originally negotiated under IBM's ownership. Loral ASIC will form, and act through, a UK subsidiary in order to comply with security rules aimed at safeguarding UK intellectual property.

Past and future orders for warships

History of UK warship orders

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*Figure omitted. See note on page iv.

4.67. The ships which have been delivered to the Royal Navy over the past ten years and those which are currently on order are shown in Table 4.4. Over the period 1985 to 1989 the MoD ordered about 50,000 tonnes of submarines, 50,000 tonnes of surface warships and 64,000 tonnes of auxiliaries. From 1990 to 1994 the MoD ordered about 32,000 tonnes of submarines, 15,000 tonnes of surface warships and 25,000 tonnes of auxiliaries. Corrected for inflation the price of a Type 23 frigate ship platform ordered in 1992 was 36 per cent less than first-of-class ordered in 1984, and 29 per cent less than the first follow-on order in 1986. The price of a Sandown minehunter platform fell by 13 per cent from the first follow-on batch in 1987 to the second in 1994. In conjunction with Table 4.5, we note that VSEL has orders until the turn of the century; VT has orders for GRP ships until 2001, and orders for steel ships until 1997; and YSL has orders until 1997.

History of warship exports

4.68. Contracts for warships for export from the UK over the past ten years are shown in Table 4.5. A list of the world's principal shipyards, other than in former Soviet Union states, showing their recent exports, is at Appendix 4.5. An analysis of exports of naval ships world-wide in recent years is shown in Table 4.6.

TABLE 4.4 **Numbers, displacement, value, order and delivery dates, suppliers of, and competitors for, ships for the Royal Navy and Royal Fleet Auxiliary, delivered since 1985 or yet to be delivered**

Type	*Supplier*	*Year of order*	*Year of delivery*	*Quantity*	*Displacement at full load (tonnes)*	*Value of ship platforms* (£m, 1994/95)*	*Value of total ships† (£m, 1994/95)*	*Form of contract*	*Competitors*
SSN (Trafalgar class)	VSEL	1981-86	1987-91	4	5,000	[	[	Fixed price	Single tender
SSK (Upholder class)	VSEL	1983	1990	1	2,500			TCIF	Single tender
	CL	1986	1991-93	3	2,500			Fixed price	SL, YSL
SSBN (Vanguard class)	VSEL	1981	-	Design				Cost plus	Single tender
	VSEL	1986	1993	1	16,000			FPIF	Single tender
	VSEL	1987	1995	1	16,000			FPIF	Single tender
	VSEL	1990	1997	1	16,000			FPIF	Single tender
	VSEL	1992	1999	1	16,000			FPIF	Single tender
Type 42 destroyer Batch 3	VT	1979	1985	1	4,500			FPIF	CL, SH
	CL	1979	1985	1	4,500			FPIF	SH, VT
	SH	1979	1985	1	4,500			FPIF	CL, VT
Type 22 frigate Batch 2	YSL	1982	1987	2	5,000			Fixed price	N/A
	SH	1982	1988	2	5,000			Fixed price	N/A
Type 22 frigate Batch 3	YSL	1982	1988	2	5,000			Fixed price	N/A
	CL	1985	1989	1	5,000			Fixed price	Directed
	SH	1985	1989	1	5,000			Fixed price	CL, VT
Type 23 frigate	YSL	1982	-	Design				Cost plus	Single tender
	YSL	1984	1990	1	4,000			TCIF	Single tender
	SH	1986	1991-92	1	4,000			Fixed price	Single tender
	YSL	1986	1991	2	4,000			Fixed price	SH, CL, VT
	YSL	1988	1993-94	3	4,000	‡	‡	Fixed price	SH, CL, VT
	SH	1989	1994	3	4,000			Fixed price	YSL, CL
	YSL	1992	1995-97	3	4,000			Fixed price	SH, VSEL
Minesweeper/Patrol River class	R	1982	1985-96	5	900			N/A	N/A
Mine Countermeasures Hunt class	VT	1980	1985	4	750			FPIF	Single tender
	VT	1982	1986	2	750			Fixed price	YSL
	VT	1985	1989	2	750			Fixed price	YSL
Minehunter Sandown class	VT	1985	1989	1	500			FPIF	Single tender
	VT	1987	1991-93	4	500			Fixed price	YSL
	VT	1994	1998-2001	7	500			Firm/fix	YSL
LSL	SH	1984	1987	1	8,500			N/A	N/A
Aviation training ship (conversion of Italian-built ship)	H&W	1984	1988	1	26,500			N/A	CL
LPH	VSEL/KG	1993	1997	1	18,000			Fixed price	SH
AOR	H&W	1986	1993	1	32,000			Fixed price	SH, CL
	SH	1987	1993	1	32,000			Fixed price	Directed
Survey ship (Roebuck)	BM	N/A	1986	1				N/A	N/A
Antarctic patrol ship	UH	1991	1991	1	6,500			N/A	N/A
OSV	BAeSEMA and ASL	1995	1997	1	14,000	]	]	Fixed price	VSEL/KG

Sources: MoD, *Jane's Fighting Ships*.

*Value of ship includes materials furnished to shipbuilder free of charge.
†Total value includes weapon systems, etc.
‡Figures omitted. See note on page iv.
Key: R = Richards (Great Yarmouth and Lowestoft)
SL = Scott Lithgow
FPIF = Fixed price incentive fee
TCIF = Target cost incentive fee
Directed = Contract awarded by Ministerial direction

TABLE 4.5 **UK warship export orders from 1984**

Type	*Displacement at full load (tonnes)*	*Supplier*	*Quantity*	*Customer*	*Order date*	*Delivery date*	*Value* (£m)*
Patrol boat	180	F	3	Bahamas	1984	1986	[
Fast missile craft	360	VT	2	Kenya	N/A	1987	
Fast missile craft	360	VT	4	Oman	N/A	1982-1989	
GRP minehunter	380	VT	3	Saudi Arabia	1988	1995-1996	†
GRP patrol boat	100	VT	3	[†]	N/A	1989	
Corvette	1,500	VT	2	Oman	1992	1995-1996	
Frigate	2,300	YSL	2	Malaysia	1992	1996	
Fast strike craft	470	VT	4	Qatar	1992	1995-1997	]

Source: VT, GEC, *Jane's Fighting Ships*.

*Approximate value, original prices.
Key: F = Fairey.

TABLE 4.6 **World warship export orders, 1986 to 1993**

Supplier country	*Submarines*	*%*	*Frigates*	*%*	*Missile boats/ corvettes*	*%*	*Patrol boats*	*%*	*Mine countermeasures vessels*	*%*
Australia	0	0	0	0	0	0	28	30	0	0
China	0	0	8	24	0	0	0	0	0	0
CIS	0	0	3	9	8	22	0	0	4	11
Denmark	0	0	0	0	0	0	8	8	0	0
Finland	0	0	0	0	0	0	1	1	0	0
France	3	19	8	24	0	0	11	11	3	8
Germany	13	81	8	24	9	24	12	12	3	8
India	0	0	0	0	0	0	4	4	0	0
Italy	0	0	2	6	4	11	0	0	2	5
Japan	0	0	0	0	0	0	1	1	0	0
Korea	0	0	0	0	0	0	2	2	0	0
Netherlands	0	0	0	0	0	0	2	2	2	5
Singapore	0	0	0	0	0	0	2	2	0	0
Spain	0	0	2	6	2	5	6	6	0	0
Sweden	0*	0	0	0	0	0	0	0	4	11
UK	0	0	2	6	9	24	8	9	3	8
USA	0	0	0	0	5	14	8	9	16	43
Total	16	100	33	100	37	100	93	100	37	100

Source: DTI (submarines column added by MMC).

*See comment in paragraph 4.71.

4.69. The list of shipyards shown in Appendix 4.5 is extensive, but will be seen that only a minority have been active in export markets. The most successful exporter of surface warships has been Germany. Germany has four yards capable of building major warships, of which Blöhm und Voss, Lürssen and Howaldtswerke Deutsche Werft have been the main exporters. Germany has been particularly successful exporting frigates to the MEKO design, which can be easily modified to the customer's desired size and weapons fit. Principal customers have been Turkey, Portugal, Saudi Arabia, the United Arab Emirates and Bahrain. Exports by German warship yards are co-ordinated by the German Government.

4.70. France has been notably successful in exporting frigates, particularly from the naval dockyard at Lorient, which, with other French naval dockyards, is state-owned through Direction de Construction Navale. The main customers have been Taiwan,[1] Saudi Arabia, Oman and Pakistan. The UK has been particularly

[1]UK warship yards are currently barred from exporting to Taiwan.

†Details omitted. See note on page iv.

successful in the corvette and fast missile craft sector where VT is the main supplier; the customers, as noted in Table 4.5, have been Middle Eastern countries. The USA's export strength has been minehunters from Swiftships, the largest single customer having been Egypt. The other major NATO supplier of export warships is the state-owned Bazán of Spain, whose main customers have been Morocco and Venezuela. Australia has exported many patrol boats, mostly of smaller sizes, and mostly to Pacific island states. Those Asian countries which have been successful in building commercial ships (Japan, Korea, Taiwan) do not yet appear to have been able or willing to develop comparable skills in warship-building. Other active customers in recent years not so far mentioned include Singapore and Thailand.

4.71. Germany has also been the main supplier of submarines to the export market in the period covered by Table 4.5, Norway being the largest single customer. Other recent customers for submarines have been Israel, South Korea, Brazil and India. Cherbourg Dockyard has recently supplied submarines to Pakistan. The submarines represented in Table 4.6 are mostly coastal submarines, in contrast to the ocean-going submarines built by VSEL. The table does not reflect an order placed by Australia in the late 1980s for ocean-going submarines and worth approximately £2,500 million, for which VSEL tendered in 1985. This was won by a consortium of an Australian shipyard and Kockums, the Swedish submarine-builder. It is not known what proportion of the contract is being performed by Kockums.

4.72. The chart at Appendix 4.6 shows how warship imports, measured in ship-tonnes[1] (by countries to which the UK could export) varied between 1986 and 1993. Such imports fell rapidly from 1986, and by 1991 were only about one-quarter of the 1986 level. They rose again rapidly to 1993, approaching the level experienced in 1987. In the interim period, the market may have been affected by the large number of second-hand ships which became available as a result of defence cuts in NATO and Warsaw Pact countries. The total new build export orders which were potentially available to UK shipbuilders over the eight years 1986 to 1993 shown at Appendix 4.6 come to a total of only about 87,000 tonnes, an average of about 11,000 tonnes a year. Of this total of 87,000 tonnes the UK won orders for about 11,000 tonnes, roughly one-eighth. Over the same period, the MoD placed orders for about 125,000 tonnes of warships and 80,000 tonnes of auxiliary vessels. The total potential export market, which will (inevitably shared with two dozen other shipbuilders, as shown in Table 4.6) was therefore far smaller than the domestic market of the UK alone. If the available export market does not grow this situation will persist, for the MoD's forward programme (Table 4.7) shows orders for the five years 1995 to 1999 of around 60,000 tonnes of warships and perhaps a similar tonnage of auxiliary vessels. Unless there is a change in the structure of the market, domestic orders will continue to form the major part of UK output of naval ships.

Prospects for MoD work

4.73. Table 4.7 shows the Royal Navy's forward programme for procurement of new warships and auxiliaries identified by the MoD. A description of their roles is in Appendix 4.4. No contracts have yet been placed for any of these vessels. Other work which could be placed with a warship yard or a Royal Dockyard includes refits of eight minehunters (costing about £[*] million in total) and refits of four LSLs (costing about £[*] million per ship).

4.74. The contract for the final batch of three Type 23 frigates (4,000 tonnes) is described as a prime contract, but is essentially requiring a repeat build with little scope for modification or innovation. The amount of GFE has been steadily reduced from previous batches, but will remain a major component and many preferred subcontractors will be identified.

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[1]Ship displacements given in this chapter are shown, wherever possible, as full load displacements rather than bare ship displacements, as the former gives the better indication of the size of the ship. The basis of construction of these tonnage data is not clear.

*Figures omitted. See note on page iv.

TABLE 4.7 **Royal Navy forward programme**

Type	*Expected or possible shipbuilders*	*Tender date*	*Expected year of order*	*Expected year of delivery*	*Quantity*	*Displacement at full load (tonnes)*	*Total value of ships* (£m, 1994/95)*
Type 23 frigate	YSL, VSEL, VT	13 June 1995	1995	1999-2001	3	4,000	[
B2TC	GEC/RR, VSEL	29 June 1995	1996	2004-2007	3	6,000	
B2TC follow-on	‡	§	2001/2	2009-11	2 }		
LPD	VSEL single tender	§	1996	2000-2002	2	14,000	
Hydrographic survey vessel	VSEL, ASL, VT	§	1997	1999	2	N/A	
AO	VSEL/KG, VT/?, YSL/? KG, H&W	§	1997/98	2000-01	2	20,000-30,000	¶
CNGF first-of-class	YSL single tender	§	1997		1	6,500	
Oceanographic vessel	VSEL, ASL, VT	§	1998	1999	1	N/A	
CNGF follow-on	YSL, VSEL, VT	§	2000		3	6,500	
CNGF follow-on	YSL, VSEL, VT	§	2002		3	6,500	
CNGF follow-on	YSL, VSEL, VT	§	2004		3	6,500	
CNGF follow-on	YSL, VSEL, VT	§	2005		2	6,500	]

Source: MoD.

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*Total value of ship includes weapon systems (except in the case of the Type 23 frigates) and all GFE.
[*Details omitted. See note on page iv.*]
‡See paragraph 4.76.
§To be announced.
¶Figures omitted. See note on page iv.

4.75. The role of the LPD assault ship (approximately 14,000 tonnes) is described in Appendix 4.4. The current invitation to tender (ITT) covers two ships. VSEL has been asked to give a price for two ships ordered together, as well as a price for the first ship and an option price for the second. This is a prime contract for design and build of a new class and, with the exception of the combat system, will include little specified or GFE. The prime contract will embrace much more than was included in the Type 23 frigate order or that may be included in the B2TC order. The ITT was issued to three potential prime contractors, but two withdrew leaving only VSEL able to bid. VSEL has now been asked to submit a bid under single tender arrangements. The original tender deadline is no longer applicable and a new date has yet to be decided.

4.76. The B2TC tender covers not only the construction of three nuclear-powered hunter-killer submarines (6,000 tonnes), but also a prime contract to manage the procurement of an updated weapons package for the existing Swiftsure and Trafalgar class submarines undergoing mid-life update in the Royal Dockyards. There may be a follow-on order for two more submarines, and bidders have been asked to quote an option price for those. The new build part of the contract is described as the first UK example of a prime contract for a submarine. Performance requirements are firmly based upon the existing Trafalgar class submarines, although the contractor is free to offer alternative equipment provided performance is not compromised, but in practice most of the major equipment is likely to come from the same suppliers as the existing Trafalgar class. The prime contractor may, and is likely to, choose the same weapons as those specified for the Swiftsure and Trafalgar update programme, taking advantage of the experience and development work already undertaken by the MoD in taking that programme forward. Although this is a competitive tender, the MoD has required the bidders to produce a `make-or-buy' plan, as though it were a single tender, perhaps in anticipation of an eventual negotiated contract.

4.77. The two AOs which are currently planned to be ordered will be simpler vessels than the two *Fort Victoria* class AORs received from H&W and SH in 1993. Given that these are auxiliary support ships to be built mainly to commercial standards, it is likely that a commercial shipbuilder will be well placed to win a competition for their construction. The role of auxiliary ships is described in Appendix 4.4.

4.78. The first-of-class CNGF will be procured from the IJVC, which will subcontract the construction of the UK first-of-class on a single tender basis. It is currently expected that there will be a programme of 11 follow-on CNGF orders over the period 2000 to 2006, in three batches of three and one of two, though, as with all future plans, it remains to be seen how many will ultimately be ordered. The frigate's main capability will be anti-air (aircraft and missiles), although it will have some anti-submarine capability. In service in the Royal Navy it will act mainly as a replacement for the Type 42 destroyers. It is intended to be rather larger than existing frigates, having a displacement of approximately 6,000 to 6,500 tonnes.

4.79. Looking beyond the forward programme, the MoD is soon expected to commission design studies for replacement aircraft carriers. The currently planned acceptance date of the first replacement is 2010. The MoD expects to begin studies around 1997 for a submarine to replace the Trafalgar class, aiming to place orders around 2007. There is also speculation that orders for replacements for amphibious auxiliary LSLs will be required before 2010.

Prospects for exports

4.80. As noted in paragraph 4.72 and shown at Appendix 4.6, warship exports to markets to which the UK could export appear to be on an upward trend. VT's impression is that the demand for export warships in the Gulf and Far East is likely to continue at roughly the same average level over the next five years as over the past five years. However, the quality and number of active competitors has increased because of world-wide naval cut-backs. BAe told us that substantial opportunities exist for the export of warships, which have not to date been fully realized by UK warship yards, with the exception of VT. BAe believes there is no reason why a UK warship yard (given the ability to make the investment) could not, in principle, produce a design for a frigate or other warship as successful in export markets as the German MEKO design. But, as noted in paragraph 4.72, if the world export markets remain at the same level as in recent years the amount of work to be shared among all the world's builders is likely to be smaller than the amount in the UK domestic market alone. Even if the UK greatly increased its share, of this world export market warships for the MoD would continue to form the bulk of UK warship output.

4.81. The export of warships is sometimes undertaken by contract direct from supplier to customer, and sometimes based upon and made within the framework of an agreement between the governments of supplier and customer countries. The latter is commonly referred to as a Memorandum of Understanding. For example, arms sales to Saudi Arabia are made pursuant to the Al Yamamah agreement, and HM Government has appointed BAe as administrator of that arrangement. The export of frigates to Malaysia by YSL is also within the framework of a Memorandum of Understanding.

4.82. We have been told that target countries for UK warship exports must satisfy the following criteria:

(a) HM Government must approve of exports of such equipment to that country.

(b) The country must have a requirement for and be able to pay for warships.

(c) The country must be sufficiently sophisticated to be able to operate and maintain the ships.

(d) The country must not have indigenous shipbuilding capacity which would preclude an export order. However, this does not preclude orders involving technology transfer or prime contractorship services.

The main countries which satisfy most of these criteria are:

(i) Middle Eastern oil states: Saudi Arabia, Oman, Qatar, United Arab Emirates, Kuwait, and Bahrain.

(ii) Association of South East Asian Nations (ASEAN) countries: Malaysia, Brunei, Indonesia, Thailand, and Singapore.

(iii) Other Commonwealth countries: India, South Africa, Australia, New Zealand, and Canada.

(iv) Latin American countries: Chile, and Brazil.

(v) Other: Turkey, Egypt, Morocco, South Korea, and Portugal.

In cases where the countries have only partly developed indigenous warship-building capacity, such as India, South Korea and Latin America, the export potential may lie only outside the indigenous capacity (for example, should there be a requirement for a submarine or aircraft carrier), or in design expertise, where at most the first-of-class would be exported. For developed countries, the export potential lies only in large ships and submarines for which they do not have indigenous capacity. For surface warships, the main export potential currently lies in the Middle East, the ASEAN group, South Africa and Turkey.

4.83. We have been told that factors which contribute to achievement of successful exports include the following, although not all are necessary in every case:

(a) the reputation of the supplier;

(b) a long-term presence in the importing country to build up contacts and influence with decision- makers;

(c) the ability to influence the importing country's perception of its needs so that these correspond with what the UK is able to supply;

(d) the willingness of senior UK political and military figures to meet correspondingly senior figures in the importing country at appropriate times;

(e) the support and assistance of the MoD;

(f) the ability to offer training by, and joint operations with, the Royal Navy;

(g) the existence of comparable ships built by the prospective supplier, especially if they are in service with the Royal Navy, to demonstrate to the prospective buyer;

(h) the ability to make barter or offset arrangements; and

(i) the possession of a design which is, or can be modified to be, within the importing country's budget.

4.84. VT is the UK's most successful exporter of warships in recent years. It has maintained a continuous marketing activity in target countries since the early 1960s. It has developed suitable export designs and succeeded in exporting ships to those designs although they differed materially from those of the ships which it builds for the MoD.

4.85. YSL has recently obtained export orders for two light frigates from Malaysia, Britain's only export of frigates for a considerable period of time. It has developed its own design for an affordable light frigate for export markets, loosely based on the Type 23, which formed the basis of its export order. There has also been some interest in the Type 23 design. YSL is currently competing with Bazán for an order of frigates for South Africa. YSL did not obtain new export orders during its period of nationalization, and it took about seven years from privatization to achieve an export order.

4.86. Various international obligations prevent the export of nuclear-powered submarines from the UK, most significantly the licence under which the USA passed nuclear propulsion technology to the UK. The prospects for exports of new build conventional submarines are limited by the fact that the MoD is currently trying to sell four nearly new Upholder class submarines. It is unlikely any construction work for submarines of this size and sophistication would be available until these are sold. However, the sale, if achieved, would generate work for VSEL in modification and support. There are not many countries with the wealth and operating expertise to be interested in submarines of this class, but interest has been expressed by a few countries. In order to appeal to a wider range of customers VSEL would need to develop a less sophisticated, smaller design. Rather than incur the cost of this, VSEL has chosen instead to form an association with RDM, a Dutch submarine-builder which has a design for a simpler vessel, for joint exploitation of whatever opportunities may exist. VSEL has suggested that for it to develop its own `export design' submarine and advance production sufficiently to demonstrate it to potential buyers would cost in the region of £50 million.

4.87. VSEL believes it may have medium-term prospects for exporting ships of the form of LPH or LPD once it is re-established as a supplier of such ships. [*Details omitted. See note on page iv.*] It has claimed that the development of such a network would be rapidly advanced and made more affordable by combination with the existing sales network of a large defence exporter such as BAe or GEC. BAe, which is Europe's largest defence exporter, believes it is unlikely that VSEL will be able to secure significant export orders without a prior marketing effort of at least [*], even if it is owned by an experienced defence exporter.

UK warship and related market sectors

4.88. The UK market for warships, auxiliaries and refitting can be broken down into a number of distinct areas. In this case, the distinction between the separate market areas is driven mainly by the potential for substitution on the production side, rather than substitution on the demand side. For example, two ships may have entirely different roles in the fleet, and therefore be only a poor substitute for each other as far as the Royal Navy is concerned. But the production facilities and skills required may be substitutable within supplier companies, in which case any competition between suppliers will range over the two types of ship.

4.89. We have identified seven separate areas of business which are relevant in this merger. The distinctions between them are not necessarily clean cut or symmetrical, for the skills and facilities required to be a participant in one area may be adequate for a second area, but not vice versa. For example, a GRP facility can be used for assembly of hull sections of a steel ship, provided no GRP ships are under construction, but a GRP ship cannot readily be fabricated in a steel facility. The market distinctions are in some cases the result of history rather than inherently present in the technology, depending upon what significant differences in facilities and skills exist between companies, and the barriers to reproducing or extending them. In particular, the distinction between warships above and below about 6,500 tonnes arises only from the fact that there are existing warship yards with a capacity limitation of approximately this amount, and which, in the view of their owners, it would not be economic to expand.

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*Details omitted. See note on page iv.

Conventional submarines

4.90. The construction of submarines is distinct from surface ships mainly because the pressure hull and some systems are subjected to diving depth pressures, and because of the inevitably extreme congestion of services and equipment inside the vessels. The skin of the pressure hull is made of heavy grades of special steel which a surface shipyard would have little experience of working. It must be fabricated to higher standards than are required for surface ships. The pressure hull shell is supported by ring frames, whose fabrication requires equipment not normally found in a yard for building surface ships.[1] Specialized design skills are required for submarines, because of the difficulty of creating a stable, livable, working environment in a contained vessel underwater, and unique operational considerations.

4.91. VSEL is now the only UK shipyard equipped to construct conventional submarines but YSL, when owned by British Shipbuilders, tendered to build the follow-on Upholder class submarines (recently withdrawn from service in the Royal Navy). However, since there is no longer an MoD requirement for conventional submarines it is unlikely that any UK shipyard other than VSEL would contemplate equipping itself to build them.

Nuclear-powered submarines

4.92. Apart from CL, now closed, only VSEL has ever built nuclear-powered submarines. It is, too, the only warship yard licensed by the Nuclear Installations Inspectorate to commission the power plant. (The Royal Dockyards at Devonport and Rosyth are licensed not only to commission nuclear submarines but also for the more demanding task of refuelling them. However, they are not equipped to build submarines.) Obtaining such a licence is a formidable barrier to entry to this market. VSEL is moreover the only extant warship yard with facilities sufficiently large to construct, by proven methods, a nuclear submarine suitable for the Royal Navy's needs. If the next generation of British nuclear-powered submarines were smaller (which we were told is a possibility) the physical limitations of other yards would not be a constraint, but the other barriers to entry we have mentioned would still apply.

4.93. The MoD has announced a competition to construct an improved version of the Trafalgar class submarine, B2TC. Three ships will be ordered, and suppliers will be asked to give option prices on two more. Notwithstanding the previous comments concerning the uniqueness of VSEL as a builder of nuclear-powered submarines, the MoD has so far paid about £6 million (of a contract which may be worth £[*] million) to a consortium comprising BAe, GEC, Rolls-Royce and Associates (RR&A, the subsidiary of Rolls-Royce plc with expertise in nuclear power) and VSEL for studies to establish whether the B2TC might be procured competitively and at an affordable price. Arising from these studies, a consortium of GEC and RR&A is planning to make a bid for the B2TC in competition to VSEL. In the process of preparing their tenders, the two bid teams, led by VSEL and GEC respectively, are conducting risk reduction studies. Methods of the recovery of the costs of these studies have been agreed with both parties. This is the first attempt at introducing competition at the main contract level in the construction of Royal Navy nuclear-powered submarines. The scope of the contract leans heavily towards prime contractorship, including requirements for shore training facilities and early years' support. GEC told us that it has so far spent about £[*] million of its own money in addition. It is understood that GEC has devised a build strategy which does not require the use of VSEL's facilities, but could utilize AMEC's fabrication yard on the Tyne for module building and hull assembly, and Devonport Dockyard, a licensed nuclear site, to install and commission the nuclear power plant. However, GEC has stated that if it became the owner of VSEL then it would intend, at the least, to assemble the hull and install the nuclear core at VSEL, as it believed it would be more economic to perform that stage by using facilities available to VSEL. If GEC did not become the owner of VSEL, it nevertheless anticipated offering work to VSEL by competitive tender, and believed VSEL may be capable of offering prices which would win extensive amounts of subcontract work.

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[1]The shell/ring frame units can be procured from fabricators outside the shipbuilding industry, and VSEL has on occasion done so.

*Figure omitted. See note on page iv.

*Figure omitted. See note on page iv.

Steel-hulled warships up to 6,500 tonnes

4.94. This sector is delineated by the maximum size of ship that VT and YSL can produce, which is approximately 6,500 to 7,000 tonnes. For the Royal Navy, this class of ships mainly covers frigates and destroyers in the 4,000 to 6,500 tonnes range. The Navy has no warships in the 1,500 to 4,000 tonnes range of light frigates and corvettes, although export orders have been obtained in this area. The Navy has only a small number of warships in the 700 to 1,500 tonne range and none of these were acquired in the last decade. Future orders until 2000 amount to three Type 23 frigates, and the first-of-class CNGF, which is planned to be allocated to YSL. Thereafter the current plan is for orders of up to 11 follow-on ships.

4.95. All UK warship yards have claimed an ability to build steel-hulled ships up to approximately 7,000 tonnes. Ten of the 21 frigates and destroyers launched over the last decade were built by YSL; of the rest only one, a Type 42 destroyer from VT, was built at an extant warship yard. Despite the lack of recent experience at VSEL, the DDH is entirely suitable to the application of modern practice in frigate-building. VT last completed a frigate in 1985. However, it is currently building two corvettes (1,500 tonnes) for export, and is bidding for the current Type 23 contract.

Steel-hulled warships over 6,500 tonnes and large auxiliaries

4.96. The distinction between larger warships and auxiliaries is blurred because there is increasingly an element of hybrid commercial and naval standards in their design (see paragraph 4.22). The main factor which distinguishes the construction of larger warships and auxiliaries as a separate market sector is that YSL and VT are unable to build them in their existing facilities. The main limitations are the physical dimensions of the sites, and the availability of cranage and transporters to lift and move larger panels and modules. Four vessels of this nature have been delivered in the last decade, two from SH and two from H&W (see paragraph 4.24). The bulk of another such ship, the LPH, is being built by KG under subcontract to VSEL, but this ship has limited naval content. With the closure of SH and CL, only VSEL, KG and H&W have the physical capacity to build such vessels. Although such a vessel has not been built at VSEL in the last two decades, and some investment would be required to restart operations, VSEL maintains design skills and intellectual property in this area. VSEL claims it is likely to have a considerable advantage both in terms of cost and speed of delivery over the two commercial yards for vessels which incorporate substantive elements to naval standards.

4.97. There is some diversity of opinion as to the extent to which some of the larger types of naval vessels required by the MoD can be most efficiently built in a warship yard. The experience of H&W's contract in building *Fort Victoria* (paragraph 4.24) indicates that commercial yards may not always be well placed to build ships that contain substantial elements of warship design, even if they are intended as auxiliary vessels. However, a team made up of a large commercial shipbuilder, an experienced naval prime contractor and/or a warship yard might on occasion provide credible competition to VSEL for large warships. The willingness of a specialist commercial shipyard to make such an offer would appear to depend upon its ability to protect itself from problems raised by naval aspects to the design, and the availability of work in the commercial sector. Identified future UK requirements are for two LPDs and two AOs. Longer-term requirements may include aircraft carriers and LSLs.

4.98. VSEL and KG have come to a formal arrangement to co-operate in supplying ships of mixed commercial and naval standards. The arrangement is currently due to end in [*], but it may be extended. Under this arrangement, VSEL presented a successful bid for the LPH and an unsuccessful bid for the OSV (see paragraph 4.100 below). In these cases, the hull is being, or would have been, built at Govan. VSEL will submit a single tender bid to build the LPD, intending to build the hull itself with some support from KG.

4.99. Neither VT nor YSL was able to come to a suitable agreement with a commercial shipyard to allow them to bid for the LPD. However, the active participation of a commercial shipyard may be more likely in future competitions for AOs and LSLs, since they are likely to be built predominantly to commercial standards.

Survey ships, other auxiliary vessels and small boats

*Details omitted. See note on page iv.

4.100. Survey ships are built mainly to commercial standards. This sector is best served by shipbuilders specializing in commercial hulls. ASL, under contract to BAeSEMA, is currently building an OSV of approximately 14,000 tonnes. The only other competitor for this contract was VSEL teamed with KG. For smaller vessels there may be several other shipbuilders able to supply a hull. McTay Marine and Fairey have built patrol boats for export within the last decade. The MoD has purchased second-hand foreign vessels for use as auxiliaries.

GRP ships

4.101. GRP is a technology used for ships especially where the absence of magnetic signature is desirable or essential for their mode of operation, such as for mine countermeasures vessels and certain patrol craft. Low magnetic steel may be a practical alternative in some cases. A special facility is required for GRP ships, with higher standards of temperature control, cleanliness, ventilation and specific services. However, the facility can also be used for making steel ships if no GRP hulls are being fabricated and relevant equipment is available.

4.102. VT has built all but two of the GRP ships in the Royal Navy, exported three GRP patrol craft (of about 100 tonnes each) in 1989, is currently building three minehunters (of about 380 tonnes) for export, and has a contract from the MoD for seven minehunters. YSL last completed a GRP ship in 1984 and has mothballed its GRP facility. YSL has competed for all recent GRP minehunter orders, but has been unsuccessful. The cost of maintaining YSL's GRP facility is not large but some investment would be required to bring it back into use.

Refitting

4.103. The Royal Navy has a repair and maintenance facility at Portsmouth Dockyard which performs routine and minor work. However, major repair and refitting work is put out to commercial suppliers. Most naval ships undergo a major mid-life refit after 10 to 15 years in service. The process typically takes 6 to 18 months, but 24 to 36 months for major ships such as aircraft carriers and large submarines. The traditional method is to put the ship into dry dock. A more capital-intensive method with certain advantages is to lift the ship from the water and transport it into a hall. In the course of a refit, virtually all systems and machinery in the ship will be dismantled to evaluate the extent to which replacement is necessary, or to make way for inspection, maintenance and repair of underlying systems and structures. Much of the propulsion system is refurbished at this time. Weapons and sensor systems may be replaced or upgraded. Furnishings are renovated. A vessel also undergoes minor refits and repair work at intermediate stages in its life.

4.104. However, much of this work has been pre-allocated to the Royal Dockyards as part of the process of putting them into private ownership. The proportion of work which is pre-allocated has necessarily increased, since the total amount of work available has been dramatically reduced from the plans extant in 1987. However, as noted in paragraph 4.62, the MoD currently intends that by 2007 the bulk of surface ship refitting should be competed for by warship yards and other ship-repair yards. The Royal Dockyards, which specialize in such work, have so far obtained a large fraction of it, and indeed needed to secure it for their commercial survival. All refit work on nuclear submarines, after completion of current contracts, has been pre-allocated to Devonport.

Subcontracting

4.105. The contract placed on a prime contractor is intended to make that contractor responsible in all respects for the proper performance of the contract and to give it the task of managing the many procurement operations that flow from this top level responsibility. The prime contractor must ensure that the whole procurement is properly planned and the design and system integration work is carried out to meet the prime contract performance specifications. A large proportion of the work is usually carried out by subcontractors. These subcontractors may include the shipbuilder if the shipbuilder is not the prime contractor (eg as with the LPH). As the work is cascaded down to finer detail, many subcontractors may receive work from suppliers who are themselves subcontractors, and so forth. Certain subcontractors may themselves be prime contractors for the delivery of their particular item, for example a particular weapon system supplier may be fully responsible (either to the MoD, or to the prime contractor for the vessel) for delivery and performance to

specifications of that weapon system. The prime contractor for the vessel would remain responsible for the integration of that weapon system.

4.106. An important aspect of systems integration is the specification of technical interfaces between different systems. These interfaces must all be properly matched to achieve satisfactory systems integration and performance of the whole. The number of interface requirements between systems, individual pieces of equipment, and between equipment and its environment in a product as complex as a warship is very large. Simple examples include size, shape, mass, operating voltage, power consumption, and cooling requirements. Electronic equipment in particular has to meet complex specifications, including communication protocols, operating frequencies, electromagnetic emission standards and tolerance of operating conditions. For some requirements, interface specifications can run to several volumes. In practice complete compliance with all aspects of the original interface specifications is rarely necessary, and most equipment does not comply exactly. For example, a piece of equipment may not be tolerant of all the operating conditions thought likely to be placed upon it, but in practice it may be possible to arrange other equipment so that its actual operating tolerances are not exceeded. Or if some pieces of equipment take less power or space than specified, more power or space is available for others. In other words, interfacing requirements are often not absolute. The prime contractor must control interface requirements, and thus has the opportunity to adjust the balance of the interface specifications so as to favour equipment produced by its own subsidiaries and associated companies, if it so wished. However, the prime contractor must also evaluate the risks of using specific products, which could prejudice the operation of extensive parts of the system if they fail to work as intended. The prime contractor may not be willing to take the risk of using equipment that is either unproven, or untried in a relevant context. Such considerations may restrict the choice of equipment so as to exclude certain products, whether manufactured by the prime contractor and its associated companies or by other companies.

4.107. In past and current ship contracts which are not prime contracts, eg for the Trident submarines, the shipbuilder has typically been the authority charged with obtaining most of the necessary materials and equipment to support the build of the ship platform, and managing the procurement processes with the relevant subcontractors. The MoD bears some of the cost or risk in certain subcontracts where the design authority rests with the MoD. Other equipment to complete the fit has been procured by the MoD and issued to the shipbuilder to integrate into the vessel.

MoD regulation of subcontracting

4.108. The MoD's attitude to subcontracts differs according to the circumstances which give rise to the contract. If the main contract to procure the ship is put to competition and results in a competitively determined price, then, with certain exceptions, the subcontracts are considered to be the private business concern of the main contractor. Those exceptions include non-competitive contracts and contracts including price variation clauses. But in general the MoD considers that effective competition for the overall contract is sufficient discipline on the supplier to ensure that the subcontract arrangements are efficient. Bidders are requested to provide detailed breakdowns of their bids including their subcontracts for the purpose of assessing the validity of the bid, but private business arrangements are not scrutinized, except as mentioned earlier. Contractors are exhorted to maximize the use of subcontract tendering, but there is no compulsion and bidders may in practice devise whatever strategy they choose. If the MoD runs a competition, and it appears from the bids that it was ineffective, the MoD reserves the right to cancel or re-run the competition, or to carry out post-tender negotiations with one or more of the tenderers. For example, when it became clear that there was only one bidder offering to build the LPD, the MoD cancelled the competition and initiated single tender procedures.

4.109. The construction of a competitive bid will require the bidder to contact potential subcontractors and come to agreements in principle as to what their contribution and price will be. The MoD does have a concern as to the quality and performance of items which will be procured from subcontractors, just as it will have the same concerns over the work to be done by the main contractor. In appropriate circumstances, the main contractor may offer the MoD choices over what equipment is procured, and adjustments to the price may apply according to which choice is made. In many cases, the MoD will already have suppliers of specific equipment in mind. The supplier may either be nominated, or named as a `preferred supplier', in which case the bidder is required to seek a bid from that source but has an option to offer an alternative. In cases where the MoD has already come to contractual arrangements with the nominated supplier, the MoD will typically seek to novate the agreed arrangements with the supplier to the successful bidder. As noted in paragraph 4.40, in some cases the MoD procures the equipment directly from the supplier, and issues it to the shipbuilder.

4.110. Where there is not effective competition, either for a main contract or a subcontract, the MoD operates `single tender' arrangements under which it scrutinizes every aspect of a bid in detail in order to agree the overall price. The MoD requires single tender contractors to construct a `make-or-buy' plan for every item above a materiality level. The materiality level is typically £50,000, but varies according to the value of the contract. Unless the MoD accepts it is plainly economic for the item to be procured within the prime contractor's company, a competitive tender is required to be run before the contract is let. Exceptionally, if the prime contractor intends to bid for the subcontract, then the tender selection team is kept separate from any in-house potential subcontractor. If appropriate, a formal competition is run with sealed bids, and the bids are opened in the presence of MoD officials. In some cases the MoD may influence the selection criteria, for example if the tenders meet the requirement in different ways rather than build to a specified design. In some rare cases it does not prove possible to hold these subcontract competitions prior to letting the contract. In such a case the overall price is subject to adjustment pending the outcome of a future competition. These subcontract competitions can be thought of as a form of market testing, and have proved to be an important method for controlling the costs of single tender contracts. They are, however, less than a perfect substitute for competition at the prime contract level, as the overall strategy of a single tender contract is not tested by competition.

4.111. Whether there is competition for an overall contract or it is let by single tender, there are some subcontracts which are within the scope of the prime contractor's responsibility but which are not competitive, because there is only one feasible supplier for a particular part of the ship. The most important example is the nuclear steam-raising plant for a submarine (see paragraph 4.114). In this case the subcontract itself, if it exceeds a specified value (typically £100,000 according to the value of the prime contract), may be made subject to single tender rules. Such areas are usually identified before a bid is accepted, so that in the case of a competitive tender for the prime contract, subcontract details and pricing information required by the MoD from single source suppliers can be included in the main tender submission.

Competition in subcontract markets

4.112. In order to help assess whether the merger might affect competition in the supply of equipment we have looked at a number of markets covering a wide range of equipment subcontracts. We have restricted our attention to 13 equipment markets which we understand form the major part, by value, of subcontracts for warships in the future programme. For convenience we have divided them into three groups: equipment that may cost over £20 million per ship (in some cases including the sonar, the combat management system and weapons); equipment that may cost over £5 million per ship (in some cases including optronics, gearboxes, radar systems and communications systems) and the remainder, costing at least £1 million per ship.

4.113. We have not been able to analyse each of these markets in detail or to calculate companies' market shares. We have focused instead on identifying the companies that either do or can act as suppliers of those particular types of equipment and on an examination of the companies' records. Percentage shares are in any case not a good indicator of the importance of particular suppliers in markets where there are only a few large orders and where considerable R&D is often needed to win new orders, irrespective of what orders have been won in the past. In some areas there is a sole provider. We now consider the 13 markets one by one, concentrating on areas where the parties are suppliers or potential suppliers.

Nuclear steam-raising plant

4.114. Rolls-Royce is the sole provider of the nuclear steam-raising plant (ie the reactor and primary systems) for UK nuclear-powered submarines.

Submarine main propulsion

4.115. GEC-Alsthom, has supplied the steam turbines for all the Royal Navy's existing nuclear submarines. No alternative supplier for the B2TC requirement has yet been found. The cost will be in the region of £[*] to £[*] million per vessel.

Submarine condensers

4.116. GEC-Alsthom has provided the condensers for all the Royal Navy's existing nuclear submarines. Other suppliers could include [*Details omitted. See note on page iv.*]. GEC is conducting a competition between suppliers to satisfy the requirement for its own team's bid for the B2TC. The cost will be in the region of £[*] million per vessel.

Submarine optronics

4.117. GEC-Marconi is competing against [*] and [*] for the supply of optronics for the B2TC. The supplier will be chosen by the prime contractor, but in the context of a `make-or-buy' plan to be approved by the MoD. The cost will be in the region of £[*] million per vessel.

Marine gas turbines

4.118. Most UK surface warships are powered by marine gas turbines. Rolls-Royce is the sole European source of suitable turbines.

Diesel generators

4.119. Diesel generators are used in nuclear-powered submarines and many surface warships as secondary systems. They can be adopted with little modification from generators used for other applications, such as railway locomotives. All diesel generators in existing Type 23 frigates and nuclear-powered submarines were supplied by GEC-Alsthom, or its GEC predecessor Paxman Diesels Ltd. There are several possible suppliers for the diesel generators for Type 23 frigates, but GEC-Alsthom expects to supply them on a single tender basis as its design is established equipment in this application. GEC is conducting a competition to satisfy the requirement for its own team's bid for the B2TC; bidders include [*Details omitted. See note on page iv.*]. The cost will be in the region of £[*] million per vessel. For the LPD, competitors to GEC-Paxman are W H Allen, Ruston, Caterpillar (USA), Wärtsilä SACM (France), and MTU UK (Germany). The cost will be in the region of £[*] million per vessel.

Naval gearboxes

4.120. There are four main UK providers of naval gear boxes, GEC-Alsthom, VSEL, David Brown Group plc (David Brown) and NEI Allen. Other providers of suitable gearboxes can be found in Germany, France, Switzerland and the USA. The figures provided by David Brown in Tables 4.8 and 4.9 give an indication that the company is dependent to a considerable degree upon naval orders, and that this is a costly element, particularly for a submarine. Gearboxes in the past have been selected by the shipbuilder with close oversight by the MoD. VSEL has supplied all submarine gearboxes in recent years. David Brown has supplied substantial elements of those gearboxes. GEC won the competition for the supply of gearboxes for the Type 23 frigate and GEC-Alsthom will supply the gearboxes on a single tender basis for the final batch. [*Details omitted. See note on page iv.*] RR&A is a member of the GEC team responsible for awarding the contract. NEI Allen (a Rolls-Royce company) will be competing with GEC-Alsthom, David Brown and several continental companies for this work. GEC-Alsthom is competing with several companies to provide the main gearboxes for the LPD, costing about £[*] million.

Combat management systems

4.121. There are now three UK suppliers of combat management systems, GMNS, BAeSEMA and Siemens Plessey, though Siemens Plessey provides them only for small ships. There are overseas suppliers, but if they were used the MoD would wish to be satisfied that UK intellectual property would be safeguarded and that continuing support would be available. The great majority of older combat management systems in operation in the Royal Navy were supplied by Ferrantie, now owned by GEC. The system to be fitted to the LPH will also be supplied by it. The systems to be fitted to the frigates for the Royal Malaysian Navy will be supplied by

*Details omitted. See note on page iv.

GMNS. A GEC combat management system has been specified for the LPD following a competition with BAeSEMA. The LPD also requires a command support system, costed at about £[*] million, for which GEC-Marconi is competing with EDS Defence Ltd, a subsidiary of General Motors. However, BAeSEMA has obtained the majority of recent orders for combat management systems, in particular for the Type 23 frigate and Trident submarine. A BAeSEMA combat management system has been specified for the future order of Type 23 frigates (about £[*] million per ship) and for the Swiftsure and Trafalgar update programme, and it therefore seems highly likely that it will be fitted to the B2TC. BAe estimates that it will cost about £[*] million to develop, plus about £[*] million per vessel. We do not know whether GEC intends to offer a combat management system for B2TC. The Joint Project Office for the CNGF, representing the UK, French and Italian Governments, has in hand studies concerned with options for procuring a combat management system for the CNGF, and will shortly be placing competitive project definition studies with two international consortia. It has not yet been decided whether responsibility for selection and procurement will be passed to the IJVC or whether it will be specified by the Joint Project Office.

Weapons

4.122. GEC-Marconi and BAe are the main UK suppliers of weapons and weapon systems for ships and submarines, though other suppliers in specific segments include VSEL. Weapon systems are also procured from foreign suppliers. Harpoon, Exocet and Trident missiles are examples. When there is a requirement for a new weapon system or major upgrade of an existing system, development work will usually begin before the award of the contract for construction of the ship, and therefore the MoD will in practice specify the main elements of the weapons fit. The weapons for the Type 23 frigate are now established. The weapons for the Swiftsure class and Trafalgar class update are specified by the MoD, and are virtually certain to be carried through to B2TC. These can be costly items for both submarines and surface ships. For example, the vertical launch Seawolf missile system excluding the missiles, costs about £[*] million per frigate, or about [*] per cent of its UPC.

Sonar

4.123. GEC-Marconi and Ferranti-Thomson are currently the main UK suppliers of main sonar systems for both surface warships and submarines. GEC has agreed to purchase the 50 per cent share of Ferranti-Thomson held by the receivers of Ferranti. Thorn EMI Electronics Limited (Thorn EMI), whose sales figures are given in Table 4.8, supplies certain specific sonar systems, but not main submarine sonar. BAeSEMA, with various partners, is active in certain areas of sonar, to date only for export. There are possible US suppliers of main submarine sonar. When there is a requirement for a new sonar or major upgrade of an existing system, development work might begin before the ship, and therefore the MoD will in practice specify the main elements of the sonar fit. Although Ferranti-Thomson is the design authority for part of the sonar on the Type 23 frigate, production orders have historically been put to competition, and GEC-Marconi hopes to supply part of this (under £[*] million) as part of a free issue order by the MoD. The main sonar on the B2TC is likely to be supplied by Ferranti-Thomson (about £[*] million), since it won a competitive contract for the development of a sonar for the Trafalgar class upgrade. Certain other sonar (about £[*] million) will probably be supplied by GEC-Marconi.

Radar systems

4.124. There are various types of radar systems fitted upon a ship, and currently the competitors in each area are different. The principal UK suppliers are GEC-Marconi, Siemens Plessey, Racal Electronics plc (Racal) and Smiths Industries (Smiths). The sales of two of these are given in Tables 4.8 and 4.9. US suppliers are also active in the market. Radar systems are provided for a wide range of other applications, both civil and military, and providers of these systems remain potential suppliers of naval radars or of other military radar systems which they are currently not supplying. When there is a requirement for a new radar system or major upgrade of an existing system, development work will usually begin before the ship, and therefore the MoD will in practice specify the main elements of the radar fit. The tracking radar for the Seawolf system (about £[*] million) on the Type 23 frigate is supplied by GEC-Marconi and will be GFE.

*Figures omitted. See note on page iv.

Communications systems

4.125. The main suppliers of ship-mounted communications systems have been GEC-Marconi, BAe and BAeSEMA, Redifon, Racal and Siemens Plessey. There may be other potential suppliers, as there is a wide range of both civil and military applications of communications systems. Redifon, owned by Thomson-CSF, has been selected as supplier for the main communications systems for the Type 23 frigate. If a satellite communications system is required, then Matra-Marconi, a joint venture between GEC-Marconi and the French company Matra, could satisfy the requirement, as it has in the past (costing around £[*] million), in competition against US suppliers. The communications system of the LPD is particularly costly, about £[*] to £[*] million. A team of Redifon, BAeSEMA and BAe has been selected by the MoD to supply the communications system for the LPD against competition from GEC-Marconi. We understand that GEC-Marconi, Nortel, Redifon and Ferranti-Thomson are competing to supply the communications systems for the B2TC, costing about £[*] million. The prime contractor will make the selection. The CNGF Joint Project Office, representing the three governments, recently announced that it will select the communications equipment, though responsibility for procurement may be passed to the IJVC.

Electronic warfare

4.126. The term electronic warfare covers a range of systems which process information from sensors (eg, distinguishing enemy from friend) or which send confusing information to enemy sensors (eg to deflect incoming guided missiles). The main UK suppliers of electronic warfare systems are GEC-Marconi and Racal. There are some smaller UK suppliers and also suppliers in France, Italy and the USA. Electronic warfare systems are now used in all areas of military operations, and established suppliers in one area are potential suppliers in other areas. For example, GEC-Marconi had not historically been a supplier of naval electronic warfare systems but has recently obtained substantial orders in this area. Up to now electronic warfare systems have been selected by the MoD as GFE, and this approach will be used for the next batch of Type 23 frigates. Contracts for project definition studies are shortly to be placed with two competing consortia for the electronic warfare system for the CNGF.

Overview of subcontract markets

4.127. In three of the 13 markets we looked at there is effectively only one supplier. These markets are nuclear steam-raising plant, submarine steam turbines, and marine gas turbines. In the near future, too, there may be only one UK supplier for main submarine sonar systems, although there may be overseas competition. In combat management systems, weapons, sonar and radar the MoD exercises considerable influence over the choice of equipment and is likely to continue to do so.

4.128. The markets where there is more than one supplier and where the MoD is less likely to exercise a direct influence over the choice of equipment are submarine condensers, naval gearboxes, optronics, communications and (potentially) electronic warfare. Four UK defence contractors which are active in these areas gave us a breakdown of some of their UK sales. This is set out in Table 4.8.

TABLE 4.8 **Certain UK naval equipment sales of some UK defence contractors, 1990/91 to 1994/95**

£ million

Company	*Product*	*1990/91*	*1991/92*	*1992/93*	*1993/94*	*1994/95 (f)*	*UK competitors*
David Brown	Submarine gears	[					VSEL, GEC, NEI Allen
	Other naval gears and spares						VSEL, GEC, NEI Allen
	Total						
Racal	Surface EW*						GEC, Thorn
	Submarine EW						GEC, Thorn
	Airborne EW†						GEC, Thorn
	Small Ship Command						

*Figures omitted. See note on page iv.

	Systems					GEC, BAeSEMA
	Helicopter navigation*†					GEC, Smiths
	Navigation radar*					Smiths
	Total					
			Figures omitted.			
Siemens	Surveillance		*See note on page iv.*			GEC
Plessey	Various					Various
	Total					
Thorn EMI	Avionics*†					GEC, Smiths, Racal
	Underwater sensors					GEC, Ferranti-Thomson
	Radar					GEC (Siemens Plessey: some)
	Data handling					GEC, Ultra
	Electronic warfare					GEC, Racal
	Fuzes and tracking radar					GEC, Royal Ordnance
	Infra-red surveillance					GEC
	Power conversion					CEGELEC, HOLEC, Gresham
	Total				]	
	Total	176.2	273.1	327.4	186.5	

Sources: Companies named in left-hand column.

*Mainly for naval purposes, but may include some other sales to the MoD for non-naval purposes.
†Sales of aircraft products are for naval aircraft.
Notes: EW = electronic warfare.
(f) = forecast.
[‡]

4.129. The same companies also provided information on their sales of similar equipment used other than in warships. This is shown in Table 4.9 (with the companies' UK naval sales, shown in Table 4.8, included for ease of comparison). The contractors for gears and electronic warfare equipment appear to be particularly dependent upon UK naval orders.

TABLE 4.9 **Sales of naval and similar equipment by some UK defence contractors, 1990/91 to 1994/95**

£ million

Company	*Sector*	*1990/91*	*1991/92*	*1992/93*	*1993/94*	*1994/95 (f)*
David Brown	UK naval	[				
	Other similar*					
	Total					
Racal	UK naval					
	Other similar*					
	Total			*Figures omitted.*		
Siemens	UK naval†			*See note on page iv.*		
Plessey	Other similar*					
	Total					
Thorn EMI	UK naval					
	Other similar*					
	Total					]
Totals	UK naval		176.2	273.2	327.4	186.5
	Other similar*		273.3	221.4	302.9	209.2
	Total		449.5	494.6	630.3	395.7

Source: Companies named in left-hand column.

*`Other similar' sales covers export sales of products similar to those sold for naval purposes and also total sales of similar products for non-naval purposes.
†Mainly naval sales, but other sales to the MoD for non-naval purposes are included here rather than under `Other similar' sales.
Notes: (f) = Forecast.
[‡]

Scope of the prime contractor's discretion

4.130. The costs of all of the contracts needed for the production of a complete and fully functioning warship are aggregated for the purposes of assessing its UPC, but a large part of the contract value reflects work performed by subcontractors. With the move towards whole ship prime contracting, a greater proportion of the UPC resides in the contract with the shipbuilder (or other prime contractor). Recent examples where the process has reached maturity are the LPH and OSV. Table 4.10 shows the approximate value of the shipbuilder's contract and the amount which the shipbuilder put out to subcontract, both figures excluding all GFE, but including the MoD's nominated and preferred suppliers. By way of comparison, Appendix 4.2 shows a breakdown of the UPC into the parts of the ship for four recent and continuing orders. The MoD estimates that the proportion of the total contract available for competition managed by the prime contractor will be about 25 per cent for the LPD, worth perhaps £[‡] million per ship. For the B2TC contract, 90 per cent of the value of the contract will be formally left to the prime contractor's choice, and the responsibility thus transferred to it. But in practice most of the weapons and some other systems for the Swiftsure and Trafalgar updates have already been selected by the MoD and the possibility of the prime contractor suggesting an acceptable alternative solution for the B2TC seems remote. Taken with considerations relating to hull construction and the likely existence of sole sources for other equipment, this last figure greatly overstates the amount open to effective competition by systems suppliers.

TABLE 4.10 **Values of shipbuilder's contract and subcontracts for certain warships**

Contract	*Shipbuilder's contract* £m	*Shipbuilder's subcontracts** £m	%
4 x Trafalgar class submarines, VSEL	[	[	36
4 x Upholder submarines, VSEL/CL			33
4 x Trident submarines, VSEL			25
1 x Type 22 frigate, CL			32
2 x Type 23 frigates, YSL (1986)			30
3 x Type 23 frigates, YSL (1988)	†	†	35
3 x Type 23 frigates, YSL (1992)			50
2 x Malaysian frigates, YSL (1992)			[†]
1 x LPH, VSEL			80
5 x Sandown minehunters, VT (1985)			N/A
7 x Sandown minehunters, VT (1994)	]	]	N/A

Sources: VSEL, GEC, VT.

*Subcontracts include contracts with the MoD's nominated and preferred suppliers. In the Type 23 programme, the proportion put to subcontract increased over time as GFE was replaced by equipment from nominated and preferred suppliers.

Note: Prices quoted by shipbuilders are to the nearest £5 or £10 million, in current prices.

4.131. Figure 4.4 shows GEC's and YSL's shares, by value, of the work in VSL's recent contracts. GEC told us that for the Type 23 frigate order for HMS *Argyll*, ordered in 1988, YSL was free to select subcontractors for only 5 per cent of the total value of the vessel, and of that 5 per cent only one percentage point was won by GEC. The total GEC content of the vessel was [†] per cent. For HMS *Somerset*, ordered in 1992, YSL was free to select subcontractors for only 6 per cent of the value of the vessel, and GEC supplied only 0.5 percentage points of this. The total GEC content was [†] per cent.[1] In the case of the frigates ordered by the Royal Malaysian Navy, GEC told us that [†] per cent of the value of the ships was in the form of subcontracts at the choice of YSL. GEC companies competed for contracts worth [†] per cent of the ships ([†] per cent of available subcontracts), and were successful in [†] per cent ([†] per cent of available subcontracts), a [†] per cent success rate. In all, GEC supplied [†] per cent of the value of the ships. [

Details omitted. See note on page iv.

]

4.132. Figure 4.5 shows GEC's estimates of the amount of work it would be capable of obtaining in the Type 23 and B2TC contracts. Its estimate for the Type 23 contract, if it is won by YSL, and based upon a value for the vessel of £[†] million, is a GEC content of [†] per cent, but with very little of that at the prime contractor's discretion. VSEL has given us its view of the amount of work GEC might obtain, but it had

[1]The MoD has noted that the figures for certain ships will be distorted by unusually large amounts of free issue equipment owing to batch ordering policy for equipment procurement.

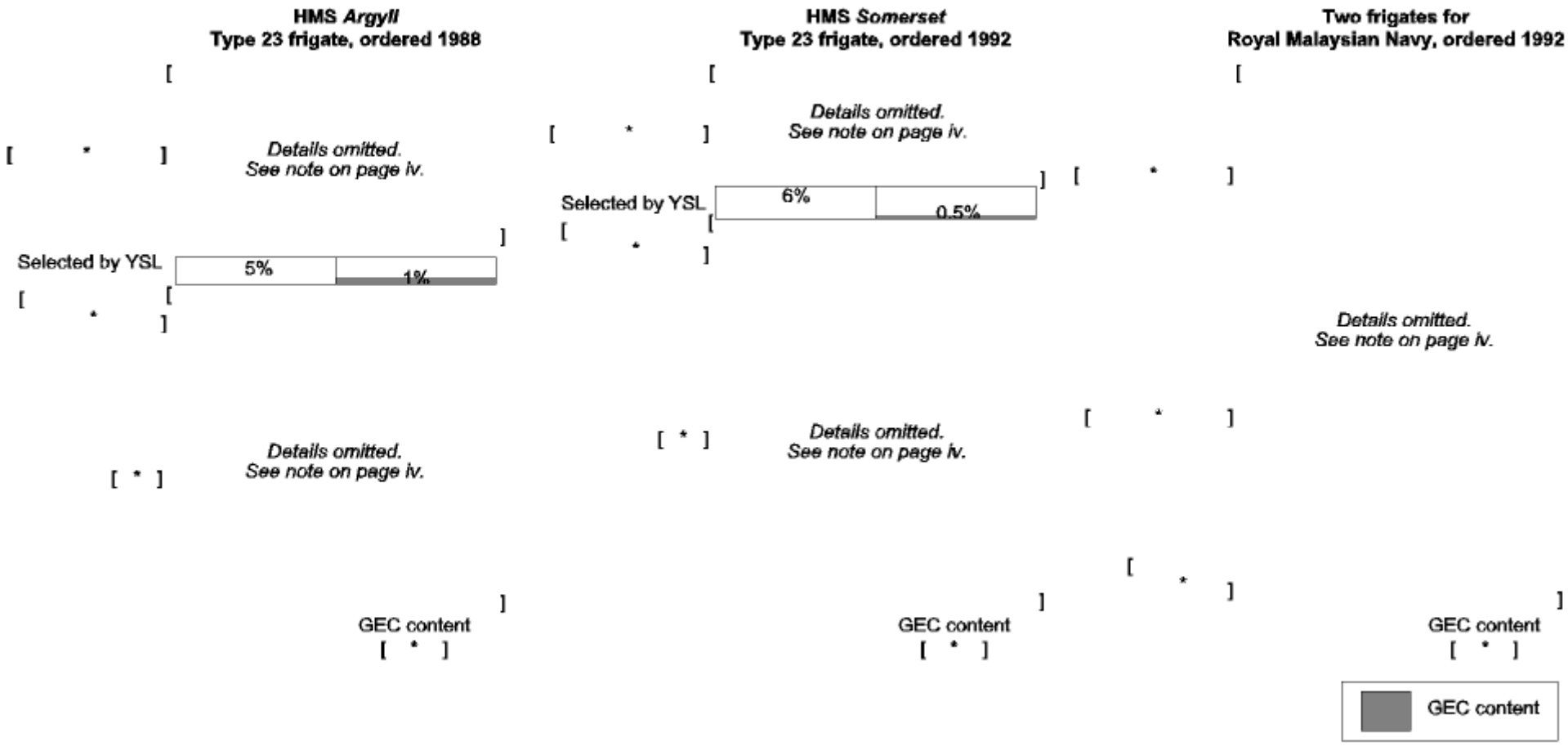
†Figures omitted. See note on page iv.

insufficient knowledge of the GFE to provide comparable figures. However, VSEL concurred that very little in the way of contracts at the prime contractor's discretion would be available to GEC.

4.133. GEC's estimate of how much work it might obtain for its team's bid for the B2TC, in relation to the MoD's estimate of the total build cost of £[†] million per vessel, is [†] per cent, of which 3.8 per cent is at the discretion of the prime contractor. This excludes the main sonar (which GEC estimates at about [†] per cent of the value of the vessel, and which will be supplied by Ferranti-Thomson, in which GEC has agreed to buy a 50 per cent share) and the charge for prime contractorship and support services. RR&A will have overall responsibility within the consortium for all the elements of the propulsion system. [*Details omitted*. *See note on page iv*.] VSEL estimated that in respect of its own bid for B2TC GEC might provide £[†] million per vessel (including the main sonar). This is [†] per cent of the estimated build cost of £[†] million, a markedly higher proportion than GEC identified, even when the adjustment for sonar is made. However, VSEL concurred with the amount which would be at the discretion of the prime contractor.

FIGURE 4.4

GEC's and YSL's shares of the value of YSL's recent warship contracts

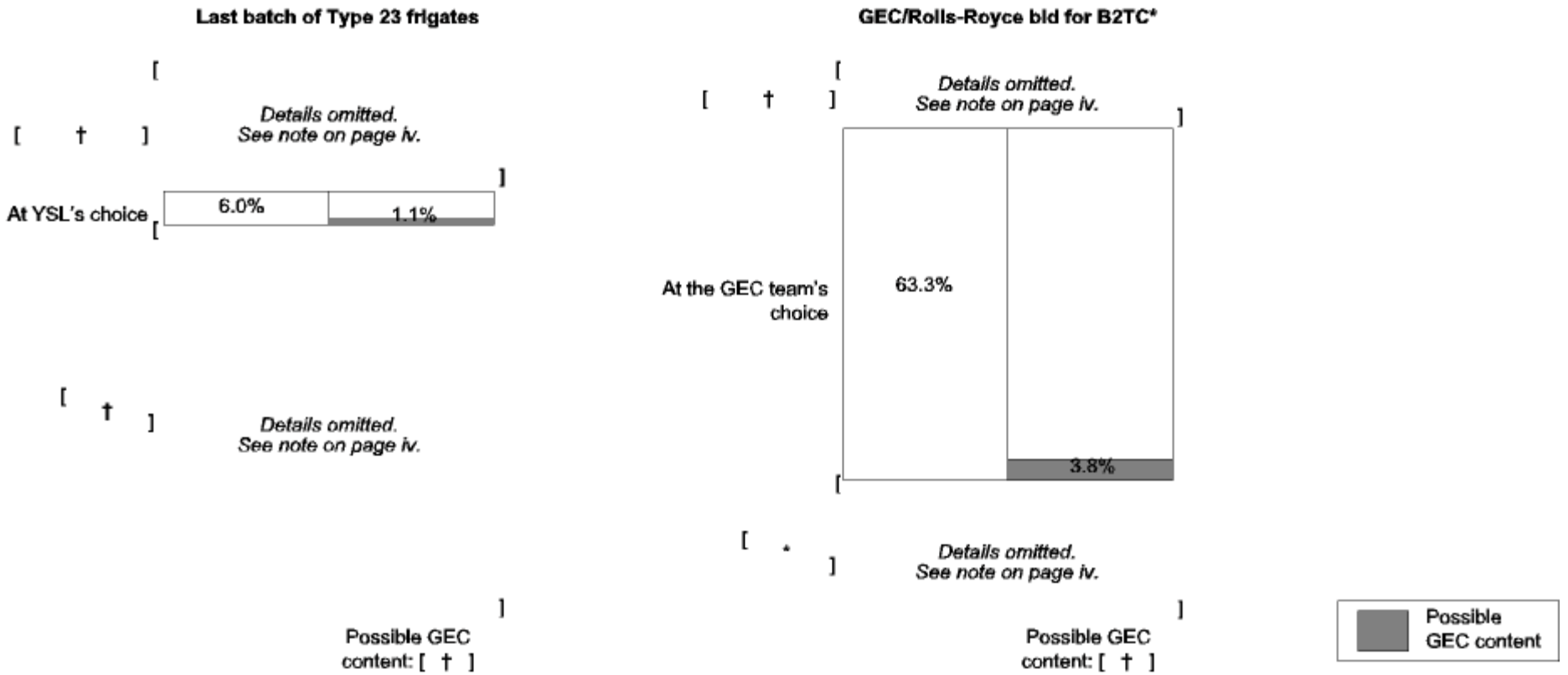


Source: GEC.

*Details omitted. See note on page iv.

FIGURE 4.5

GEC's estimates of the amount of work it might secure from Type 23 and B2TC contracts



Source: GEC.

*Excludes prime contractor and support costs and sonar contract to be placed with Ferranti-Thomson (in which GEC has agreed to acquire a 50 per cent interest).
†Details omitted. See note on page iv.

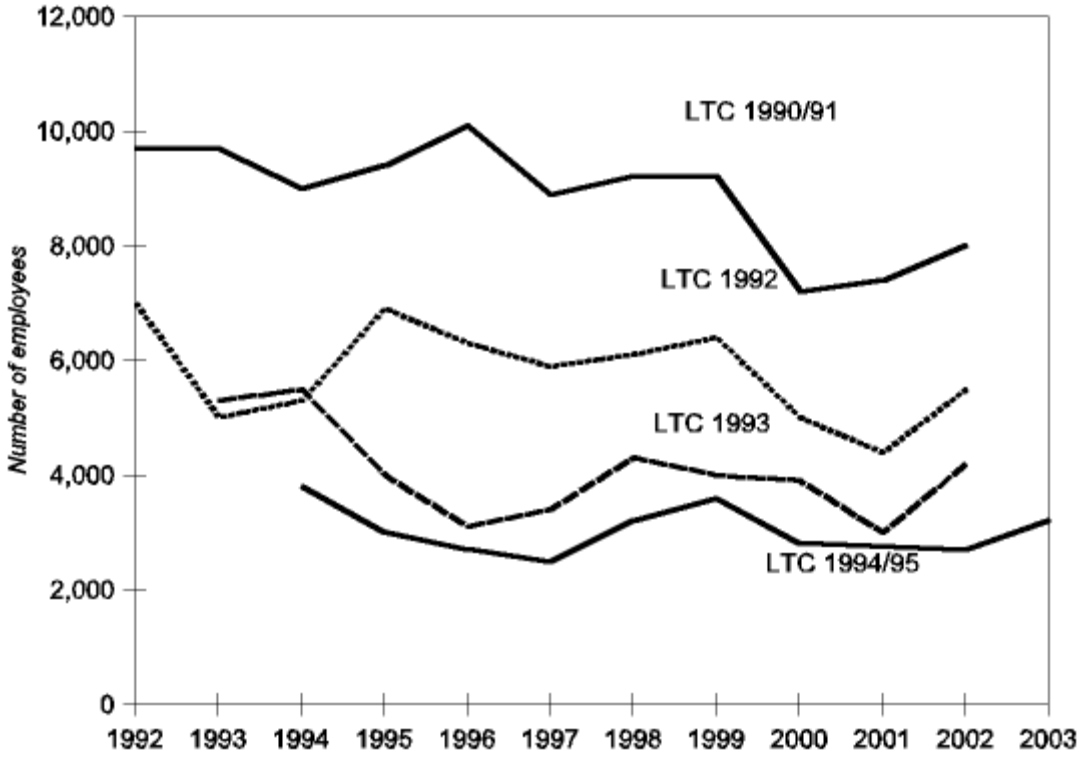
4.134. GEC was unable to provide such detailed information on the LPD, as it was not bidding to be prime contractor. On the basis of a unit cost of £[*] million, it believes it could supply up to [*] per cent by value of the total vessel, nearly all to be won in competition. However, GEC points out that it has already lost the competition to supply the communications system, which comprises [*]. VSEL's estimate that GEC could supply at least £[*] million per ship is comparable, although it excludes the communications system and is based upon a rather higher proportion of free issue equipment.

Shipbuilding capacity to meet orders

4.135. The current total of UK employment in warship-building is about 9,000. Of that total, nearly all of the employees at VT are engaged upon export work, since construction of minehunters under the most recent MoD order has not yet started. A substantial fraction of YSL's employees are engaged upon the Malaysian frigate order as the MoD's Type 23 frigate order approaches completion. The number currently engaged on MoD warship-building contracts is therefore of the order of 6,500. Shipyards' estimates of the number of warship-building employees required to fulfil the MoD's requirements in the latter half of the decade range from 4,000 to 5,500. The MoD thinks it might be fewer. VSEL's own employment projections, based upon participation in various projects, are shown at Appendix 4.7.

FIGURE 4.6

MoD long-term costing projections, 1990/91 to 1994/95, in terms of employment in UK warship-building (excluding exports), 1992 to 2003



Source: MoD.

4.136. Figure 4.6 shows the MoD's `long-term costing' (LTC) projections in terms of employment in UK warship-building (excluding exports). The graph shows not only the current projection, but also the path of

*Details omitted. See note on page iv.

revisions from earlier projections. This shows the number of skilled shipyard workers that the MoD estimates would be required to carry out its forward programme at Table 4.7. The figures are not directly comparable to those given above as they exclude office labour (management, design, etc) and unskilled labour. However, they give an indication of trends. Looking at the latest LTC projection, we note that the figure of 4,000 in 1994 falls to 3,200 by 2003 (the last year of the MoD planning period for this purpose), with a minimum of 2,700 in 2002. If the same relative changes were applied to the current total employment on MoD work of about 6,500, one would project 5,200 in 2003, with a minimum of 4,400 in 2002. This is broadly comparable to shipbuilders' forecasts. If, in addition to the MoD work, exports were projected forward at the same level as at present, overall employment on warship work (before taking account of any productivity gains) would fall to 6,900 by 2002 before rising to 7,700 in 2003, ie reductions of 23 per cent and 14 per cent respectively compared with the present.

4.137. However, the relative smoothness of aggregate employment figures disguises underlying lumpiness created by a few well-spaced-out orders. Different types of labour are required at different stages of the production process. If VSEL obtains the B2TC contract there will nevertheless be a substantial gap in employment of many skills following the Trident project. If YSL obtains all the available MoD frigate orders over the next five years the timing of the orders is not sufficiently close together to give continuous employment to many skills. Export orders would be valuable to it in reducing costs by allowing for more continuous employment of resources.

Costs and benefits of the closure of VSEL or YSL

4.138. We received evidence from several sources on the costs and benefits that were likely to arise if, following an acquisition of VSEL by GEC, either VSEL or YSL were to close. A large number of factors would need to be taken into account for a full assessment (including, in the case of a closure of VSEL, the implications for the national nuclear capability), but we focus here first on the possible financial effects and second on employment.

Financial issues

Closure of YSL

4.139. The financial impact of the closure of YSL is not easy to determine. In October 1994 GEC's advisers, Lazards, prepared some discussion materials covering several alternative scenarios if GEC were to acquire VSEL. That material included a hypothetical non-discounted cash-flow analysis of the costs of closing YSL, provided by GMNS on the basis that the current Type 23 contract and the Malaysian frigates would be completed at by early 1997 and that the continuing obligations for the support of the Malaysian frigates and the CNGF design team moved to VSEL. This analysis contemplated that, in the absence of further MoD or export orders, YSL would be closed in early 1997 and its workforce laid off. It estimated total costs of closure of £[*] million, comprising:

- relocation costs of [*] staff;
- redundancy costs of remaining staff;
- transfer of equipment to VSEL;
- provision for disturbance to contracts;
- site closure and clean-up; and
- asset write-down/off.

*Figures omitted. See note on page iv.

This analysis did not include any restructuring or rationalization costs for the VSEL yard that might be necessary as a result of the merger.

4.140. No allowance was made for expenditure required at VSEL to enable it to complete the surface vessels transferred from YSL. We have been told that the costs of upgrading VSEL's facilities to be able to construct surface warships would be approximately £8 million, although this is likely to be spent in any case for the purpose of the LPD.

4.141. In its evidence to us GEC explained that the acquisition would be likely to lead to a number of benefits for the VSEL yard including:

(a) elimination of duplicate overhead activities (eg sales and marketing) and co-ordination of purchasing activities;

(b) improved efficiency in use of direct labour through the introduction of flexible working practices and YSL's IMPACT programme; and

(c) improved capabilities in the field of CAD/CAM.

4.142. In the material prepared by Lazards, GEC estimated that the total of such benefits would be £[*] million per annum for five years. However, the analysis did not distinguish between benefits that would derive from the merger of GEC and VSEL regardless of the closure of YSL and the incremental benefit that would occur purely as a result of the closure.

4.143. The total benefits for VSEL as a result of the merger may well be substantial in financial terms (perhaps larger than GEC's estimated £[*] million per annum). But it is likely that were GEC to acquire VSEL without closing YSL, the efficiency of the VSEL yard would be improved anyway through measures introduced by GEC (especially *(b)* and *(c)* paragraph 4.141 above). In other words a substantial portion of the total benefit (in financial terms) would not arise directly as a result of the closure of YSL. However, the additional benefit to GEC from closure (largely through the elimination of overheads) would still be substantial, perhaps as high as £[*] million per annum, the figure originally included in the Lazards material. GEC would also benefit from any proceeds received from the disposal of the YSL site or from its redevelopment.

4.144. This analysis suggests that, in financial terms, the costs to GEC of closing YSL would marginally outweigh the benefits but that the difference would not be substantial. However, it would be possible to construct a number of alternative scenarios to that used above which might produce a different result, although it seems unlikely that under any such scenario it would clearly be in GEC's financial interest to close YSL in the short term.

4.145. On the other hand, if at some point in the future it became clear that there were insufficient orders to keep more than one yard at work and the existing contracts had been completed, the position would be different and it seems likely that there would be a clear economic benefit to be derived from closing YSL.

Closure of VSEL

4.146. It has been put to us that the closure of VSEL (and the creation of equivalent facilities at YSL) is far less likely than the closure of YSL given the nature of VSEL's facilities. Nevertheless we have considered the costs and benefits to GEC were closure to take place, initially on parallel assumptions, namely that GEC would wish to maintain the VSEL capability but transfer it to YSL. The position might be different if the alternative construction methods proposed by the GEC team for B2TC were to prove acceptable in which case no alternative facilities would be required at YSL.

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*Figures omitted. See note on page iv.

4.147. The costs to GEC of closing VSEL would then comprise two elements:

(a) the cost of closing the site, redundancies, and relocation costs; and

(b) the capital costs of upgrading YSL's facilities to handle large surface vessels and small or medium-sized submarines.

Both elements would be large and would be far greater than the equivalent costs of closing YSL. They also do not take into account the question of DDH which would become redundant under this scenario.

4.148. The difficulties of establishing submarine and large surface warship-building facilities at YSL would be great. It is, therefore, unlikely that any immediate efficiency improvements would be realized and indeed it seems likely that such a facility would be substantially less efficient than VSEL's for many years after the transfer.

4.149. Against this background it seems unlikely that closure of VSEL would be contemplated unless GEC were prepared at the same time to contemplate the loss of its hull-building facilities for submarines and larger ships. The level of uncertainty concerning the costs and benefits of closing VSEL mean that the estimation of the sums involved is not practical.

Employment

4.150. We set out in detail in Appendix 4.8 the possible effects of closing VSEL and YSL on employment in Barrow-in-Furness and in Glasgow respectively. Simulations of the likely scenarios have been provided by the Department of Employment (DE) and the Scottish Office Industry Department (SOID). Table 4.11 summarizes the possible impact on employment.

TABLE 4.11 **Comparative effects of the impact of direct and indirect job losses resulting from shipyard closures in Glasgow and Barrow**

	SOID	*DE*	
	*Glasgow**	*Glasgow**	*Barrow*
Direct impact of closure (job losses)	2,400	2,400	2,400
Indirect (suppliers) impact	233	} Not explicitly shown	
Induced impact	311		
Total impact (job losses)	2,944		
Likely increase in registered unemployed	1,969	1,553	1,663
Current unemployment in region (jobs)	63,441	63,441	4,306
Current unemployment (% of workforce)	9.8	9.8	9.5
Increment to unemployment (%)	0.3	0.2	3.7
Ex-post unemployment (%)	10.1	10.0	13.2

Source: MMC based on Scottish Office and DE.

*Glasgow travel-to-work area.

4.151. Whether we accept the DE model or the SOID model, the regional consequences of a comparable level of job losses at VSEL or YSL are more serious in Barrow than in Glasgow. The effect of a 2,400 loss of jobs would increase unemployment by 0.2 to 0.3 percentage points in Glasgow, but by around 3.7 percentage points in Barrow. We believe the DE figures probably understate the likely effect upon Barrow.

The market for artillery and naval guns

4.152. The market for naval guns is small and specialized. Artillery guns are ordered in larger volumes, for example VSEL is currently producing 179 self-propelled howitzers for the MoD. However, artillery guns have a long life and once a production run is complete it may be some extended time before the MoD

identifies a similar new requirement. The flow of domestic orders for artillery is if anything even more uneven than for warships. In contrast to the policy on the procurement of warships, the MoD has been prepared to import guns, and there is a greater variety of export opportunities than for warships. The market for artillery and naval guns can also be thought of as part of a wider market which includes land armament systems having common features, such as tanks.

Artillery and naval guns produced by VSEL

Mark 8 4.5 Inch naval gun

4.153. The Mark 8 4.5 Inch gun, produced by VSEL, is the only naval gun produced in the UK. The main customer for these guns has been the Royal Navy, and some exports have been achieved. The total production over 25 years has been about 70 guns. The main competitors for naval guns are OTO Melara of Italy, which has designs for 76 mm and 127 mm guns, FMC of the USA which has a 127 mm design, and GIAT of France which has a 100 mm design.

AS90 155mm self-propelled howitzer

4.154. The AS90, produced by VSEL from 1989, is the only self-propelled gun currently produced in the UK. It is a 155 mm gun carried on a tracked armoured vehicle similar in appearance to a tank chassis. VSEL developed the AS90 at its own cost, and won an order from the MoD for 179 units, which is now nearly complete. The AS90 turret can be attached to alternative vehicles. The vehicle without the turret can be modified for use as a platform for alternative land systems, which brings it more generally into the market for armoured fighting vehicles, where there are a number of UK suppliers and a wide range of foreign suppliers.

FH70 155mm towed howitzer

4.155. The FH70 is a 155 mm towed gun, developed as a joint venture between VSEL, Rheinmetall of Germany and OTO Melara of Italy in the 1970s. VSEL is not currently manufacturing the gun but could reactivate production in response to an order. It is in service with the British Army and many other countries world-wide, and is still being manufactured under licence in Japan. Further UK orders are not anticipated. RO is the only other UK producer of towed artillery, but there are a wide range of foreign suppliers.

UFH 155mm towed howitzer (under development)

4.156. The prototype Ultralightweight Field Howitzer (UFH) has been developed by VSEL, at its own expense, and under contract to the USA, in response to US requirement for a 155 mm towed howitzer capable of being lifted by a helicopter. The only competitor for this requirement is a design under development by RO. If the US order was won, the design would be a major contender for the MoD's currently planned LIMAWS programme, which may result in a requirement for lightweight 155 mm towed howitzers with an in-service date of around 2006.

GEC's activity in the market for naval guns and artillery

4.157. GEC is a subcontractor to VSEL for certain machinery associated with the Mark 8 4.5 Inch naval gun. It also provides a range of products which contribute to artillery systems in general, rather than being specific to a particular gun. Most notably these include the Battlefield Artillery Target Engagement System (BATES), the Artillery Meteorological System, and the Muzzle Velocity Measuring Device.