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Sustaining Key Skills in the UK Naval Industry

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Summary

To preserve its ability to design, build, and support complex warships and submarines, the UK Ministry of Defence (MOD) will need to preserve and sustain several key technical skills in the maritime domain. In particular, it needs to nurture detailed designers and professional engineers involved in various stages of surface ship and submarine acquisition and support. Although MOD has taken into account its need for these skills, its significant future maritime programme likely will have to be modified or augmented to sustain these technical skills in the long term.

This is the key conclusion of a study of naval technical skills that RAND Europe pursued on MOD's behalf between 2006 and mid-2007. The study, the second investigation of demand for maritime labour in the UK that RAND has performed for MOD, is the first to investigate specific technical skills that the UK's maritime industry will need to sustain to preserve the country's ability to design, build, and support complex warships and submarines.

What Is the Problem?

The UK is pursuing several shipbuilding programmes—including the *Astute* submarine class, the Future Aircraft Carrier (CVF), the Future Surface Combatant (FSC), Military Afloat Reach and Sustainability (MARS) vessels, and the Type 45 destroyer—that may stress the UK's domestic shipbuilding and maritime support industry capacity over the next 15 years. Motivated by that possible overcapacity, MOD

asked RAND in 2006 to help it better understand issues surrounding the UK's ability to sustain technical skills in its maritime sector.[1] In particular, it was interested in exploring the relationship between the demand created by its ship and submarine acquisition programme and the technical workforce needed to design, build, and support those war vessels.

MOD's future shipbuilding programme involves acquiring more than 50 ships and submarines over the next 30 years, according to official announcements and publications. To ensure that industry has the capability and capacity to fulfil this programme, MOD published its Defence Industrial Strategy (DIS) in December 2005.[2] This document established guidance for policymakers with respect to industrial goals and capacity that the UK will need to fulfil its military acquisition programmes over the next several decades.

The section of the DIS pertaining to maritime industrial issues is referred to as the Maritime Industrial Strategy (MIS). The MIS identifies six strategic capabilities that the UK will need to retain to preserve the domestic ability to design, build, and support complex warships and submarines onshore: maritime systems engineering, shipbuilding and integration, submarines and nuclear propulsion, maritime combat systems, maritime support, and maritime systems and technologies.

What Was RAND Asked to Do About the Problem?

Previous RAND studies for MOD have taken a macro look at the types and numbers of professional and nonprofessional skills that MOD will need to fulfil its shipbuilding programme. But in this case, the MIS raised a set of related questions at the micro level about key capabilities, prompting MOD to seek RAND's further assistance on this project.

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[1] In addition to the 2005 study (Arena et al., 2005), this research drew from several other studies that RAND conducted for the MOD on maritime industrial strategy issues, including John F. Schank, Jessie Riposo, John Birkler, and James Chiesa, *The United Kingdom's Nuclear Submarine Industrial Base: Sustaining Design and Production Resources*, Santa Monica, Calif.: RAND Corporation, MG-326/1-MOD, 2005.

[2] UK Ministry of Defence (2005).

Specifically, MOD sought assistance identifying the following labour implications of its shipbuilding programme:[3]

- technical industrial skills needed to design, build, and support the vessels outlined in the programme
- how these skills are represented in the UK's maritime industry
- how these skills are used to meet the demands of the programme.

How Did RAND Study the Problem?

We pursued our research using a variety of qualitative and quantitative approaches. Our qualitative efforts involved reviewing relevant research done by RAND and others, interviewing key industry personnel to obtain information about their technical workforce, and conducting a qualitative survey of industry. Our quantitative efforts entailed creating and conducting a quantitative survey of industry to seek estimates of the technical workforces that would be required to meet the estimated demand of the future MOD maritime programme under a variety of conditions.

We reviewed work performed by RAND and others about maritime industrial issues, both in the UK and the United States. In a linked path, we interviewed experts from a cross-section of the UK maritime industrial base using a survey instrument that we designed. Our initial qualitative explorations produced a list of key maritime skills used by industry, most of which were of a technical nature.[4] We used that list, shown in Table S.1, as the basis for the rest of our project.

The survey was extensive and sought qualitative and quantitative data from each company about their workforces and their views of the industry.

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[3] It was beyond the scope of this study to analyse the relationship between demand and supply of the technical skills.

[4] Throughout the rest of this monograph, we refer to this skill set as *technical skills*.

Table S.1
RAND Maritime Technical Skill Categories

Group	Skill Category
Detailed designers	Electrical and control
	Mechanical/fluids
	Hull/structural/arrangements
	Other detailed design
Professional engineers	Acoustics/signatures/dynamics
	Combat systems and integration
	Electrical and control
	Mechanical/fluids
	Naval architecture/marine
	Hull/structural/arrangements
	Testing, commissioning, and acceptance
	Safety/environmental
	Welding/metallurgy/materials
	Propulsion
	Nuclear specific
	Other engineering
Technical managers	Programme management
	Planning and production support

We used data that we obtained from the survey to populate a computer model, which we employed to project shipyard industry demand for labour under a variety of conditions in the future. The model that we used was a labour demand model that RAND has employed in many projects, but we modified it to incorporate technical skills identified in our qualitative survey.

During the course of the project, it became apparent that it would not be possible to incorporate the data from the support organisations

and key suppliers that we surveyed. We omitted these data because they did not fully represent the support yards and suppliers across the maritime sector and could be misinterpreted. Although this meant that we had to exclude support, repair, and upgrade activities from the detailed demand analysis, presented in Appendix A, some analysis on how the limited data we collected may be added to the wider analysis.

What Did RAND Find Out?

What Did Industry Tell Us About Their Technical Workforce?

RAND sent the survey to key UK maritime industrial firms. The survey asked them to report how many detailed designers, professional engineers and technical managers they employ on UK maritime programmes. They reported that they employed a total of 3,525 personnel in technical fields within the maritime industrial base in 2007. Of these, 998 were employed as detailed designers, 1,842 were employed as professional engineers, and 685 were employed as technical managers.

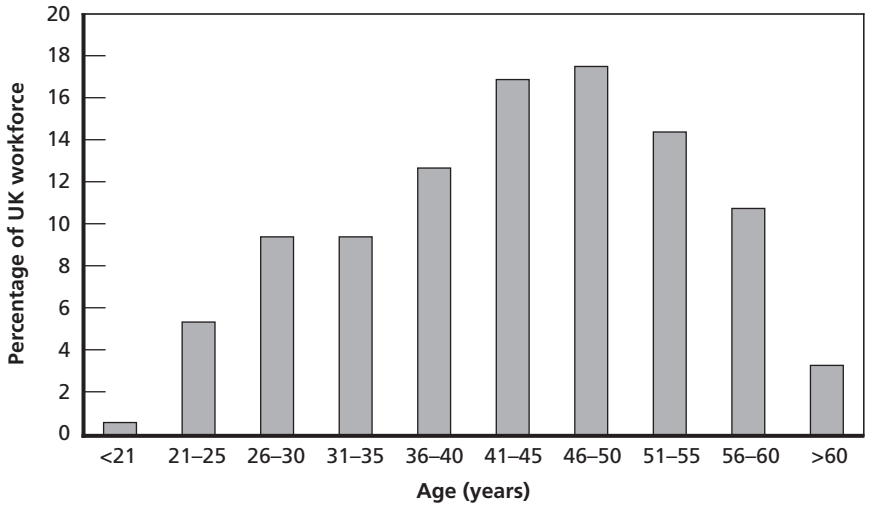
The age distribution of this workforce was skewed toward older workers, with about half (46 percent) being older than 45 years of age. See Figure S.1 for more detail.

According to the survey, industry recruited this workforce in a variety of ways. Inexperienced technical labour tended to come predominantly from universities. Experienced technical workers came from a far greater variety of sources, including the aerospace, civil nuclear, and oil and gas industries. In addition, the maritime industry turned to former military professionals to fill certain experienced roles.

In the survey, the firms indicated that a number of specific technical skills were difficult to recruit: naval architects, electrical engineers (especially power engineers), systems engineers, and mechanical engineers. They qualified their answers, however, with the proviso that *experienced* holders of these skills were difficult to recruit, rather than that the skill was difficult to recruit per se.

The survey also asked how many years it would take technical skilled workers to achieve their optimum level of productivity. Although

Figure S.1
Age Profile of UK Maritime Technical Workforce



RAND *MG725-S.1*

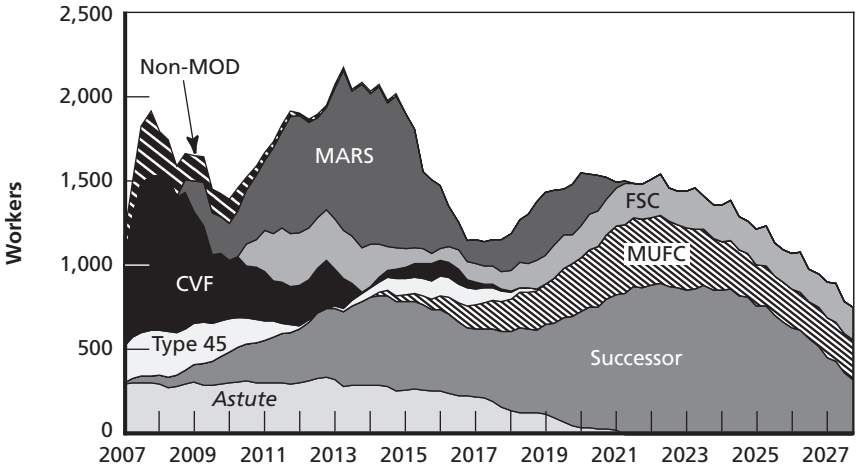
the speed varied among different technical skills, firms reported that, on average, it takes six to eight years for all skills to reach 90 percent of the optimum level of productivity.

Finally, the survey revealed that industry anticipates a growing demand for IT design and electrical engineering skills in the coming decade.

What Is the Demand for Labour at the Aggregate Level?

We found that total labour demand for *all* skills required by MOD's future shipbuilding programme will rise steeply until 2013, reaching a level that will be two times the long-term average demand. Demand created by the complex surface ship programme is dominated by CVF in the near term, and decreases considerably in the longer term. The submarine programme places a more constant demand at the total labour level of analysis, though this demand varies over time. Total demand for all *technical* skills generally mirrors demand for all skills. However, technical skills are generally used in the earlier stages (the design and build processes) of maritime vessel programmes. Figure S.2 shows skill demand for detailed designers and professional engineers.

Figure S.2
Total Detailed Designer and Professional Engineer Demand, by Ship Class



NOTE: MUFC = Maritime Underwater Future Capability.
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What Is the Demand for Labour at the Individual Technical Skill Level?

After looking at labour demand at the aggregate level, we looked at demand for the specific technical skills listed in Table S.1. In the context of complex surface ships, we found that sustaining detailed designer skills will be difficult after the design work connected with the first-of-class FSC is completed. Figure S.3 shows this potential skill gap.

We also found that MOD's complex warship programmes have a continuing, variable demand for professional engineer skills. An initial peak in demand from the CVF programme will be followed by a trough as that carrier programme winds down and as the final hulls for the Type 45 programme are completed. The FSC then provides a constant demand. Figure S.4 depicts this demand profile.

For the submarine sector, the CVF programme could be a vital bridge, providing demand both for submarine detailed designers and for professional engineering skills prior to the start of the Successor new design. Without demand from the CVF programme, there would

Figure S.3
Technical Labour Demand for Detailed Designer Electrical and Control Skills, Complex Surface Ship Programmes

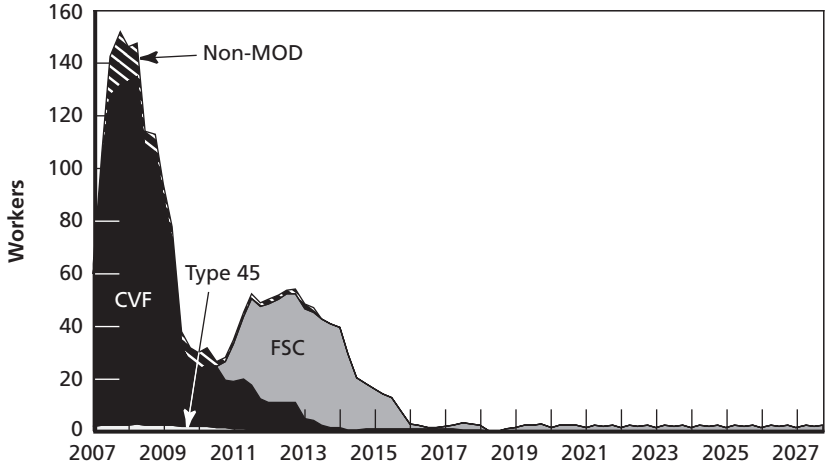

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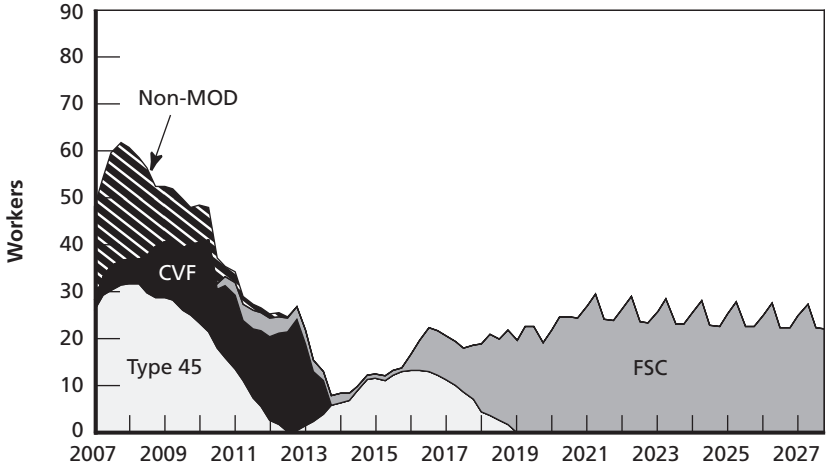
Figure S.4
Technical Labour Demand for Professional Engineer Mechanical/Fluids Skills, Complex Surface Ship Programmes



RAND *MG725-S.4*

be insufficient demand for most individual technical skills to sustain the capabilities that MOD desires to fulfil its requirements for a deterrent submarine design.

What Policy Conclusions Can the UK Ministry of Defence Draw from RAND's Findings?

Looking at this analysis more broadly, some general trends emerge with regard to future demand for design and engineering technical skills in both the submarine and surface ship sectors.

- *The MOD baseline programme will need some modification to help sustain the technical skills that support key industrial capabilities. The nature of the modification and its implementation require further investigation.* In the complex warship and submarine sectors, there are periods of low activity (such as a lack of work for detailed designers post–FSC design) which will not sustain those technical skills. Some technical skills may require programme additions or targeted initiatives if they are to be sustained.
- *Overall, there is sufficient demand from the submarine programmes to sustain design and build technical skills until 2027, although beyond this, the situation is less clear.* There are no gaps in technical labour demand from design/build submarine programmes for the next 15 years. The difficulty in this period will be to manage the increases in skills needed to deliver the Successor and MUFC programmes. The relationship between the end of these programmes and the start of any future submarine programmes will affect the demand that will sustain these skills. The CVF programme serves a valuable "bridging" function by providing additional workload to technical skills at the submarine shipyard. In the support sector, the demand on technical skills is much more variable.
- *The complex surface ship sector is more fragile than is the submarine base with regard to design/build skills.* Demand for detailed designer skills varies greatly in the near term and, following the FSC first-of-class design work around 2012–2016, there is little

future activity to sustain these skills until the start of a (postulated) Type 45 replacement programme. Should MOD decide to change the maritime surface programme and trigger, for example, reductions in new hull numbers, gaps in demand for professional engineer skills will develop quickly and may make them difficult to sustain. However, when one examines the support programme, the demand for technical skills in the complex surface ship sector is much more steady.

- *A specific maritime programme demand sustains detailed designer and professional engineer technical skills in different ways.* Detailed designers are in most demand during the design process of first-of-class ships or submarines. Professional engineers are involved more equally across the design and build processes, but demand varies for any given hull and between successive hulls. Both sets of skills work together during the design process, and demand for one invariably affects the other.
- *Examining MOD labour demand requirements at different levels of aggregation highlights different trends and challenges.* By looking at labour demand at a variety of levels (total labour, technical labour, detailed design/professional engineer, and individual skills), different trends are revealed. This ability is important, as it allows those making decisions about the future shipbuilding programme to better understand how they might affect the maritime industry.
- *There is a need to review technical labour demand requirements as programme assumptions change.* Any changes to MOD's ship or submarine programme assumptions will affect technical labour demand. Sometimes, changes that may be made to solve one problem may exacerbate another. The model that RAND has developed allows MOD to investigate and understand the industrial consequences of changes to the maritime programme and so aid longer-term planning; it should be used when programme assumptions change.
- *Recruiting certain technical skill sets will be challenging for industry.* Our industry interviews and survey highlighted the challenges of recruiting technical staff of the appropriate skill type and expe-

rience. Specifically, respondents highlighted difficulties finding and recruiting experienced professional engineers who are naval architects, electrical (power) engineers, systems engineers, and mechanical engineers.

- *As processes develop and technologies mature, the required mix of technical skills will change.* The technical skills needed today may not be required in the future. In our interviews and survey responses, industry anticipates increasing requirements for IT skills and electrical engineers. Working practices are also forecast to change, leading to, for example, greater remote working and a need for wider language skills. Again, MOD may wish to engage with industry to stay attuned to these trends so that its industrial strategy can sustain the skills that will be needed in the future.