



The Royal Academy
of Engineering

Equipment, Support, and Technology for UK Defence and Security: A Consultation Paper

Ministry of Defence

April 2011

1. The Royal Academy of Engineering is pleased to respond to the government's consultation on Equipment, Support and Technology for UK Defence and Security. This response has been compiled from submissions made by a number of Fellows of the Academy with relevant experience in the field.
2. Below are answers to selected questions in the consultation document. If required, the Academy would be happy to provide further evidence on any aspects of the response.
3. **Q2. What factors should the UK take into account when assessing the national security implications of acquisition in the defence and security sectors?**
 - 3.1. The first key principle laid out in the consultation document's core principles is of vital importance, namely that the UK Armed Forces and associated security services must have the capability to protect the UK and its interests. Central to this is the ability of the national industrial base to support essential equipment and infrastructure for its forces in times of conflict without the risk of undue reliance on others. What is needed is an explicit framework for the planning of science and technology investment within the MOD and an industrial base with the capability to design, build and support key equipment and systems. The proposals in the Green Paper represent the foundation of such a framework.
 - 3.2. Going forward, a number of issues should be taken in account:
 - If the provision of 'operational advantage' and 'freedom of action' is to be the basis for acquisition policy in defence and security, a clear definition is required by Government on the sectors it considers central to these concepts.
 - Security of supply is a key consideration.
 - In many sectors this will require ongoing long-term investment in capital and skills underpinned by research and development.
 - Where there is no stable market or sufficient domestic demand for particular capabilities the government must be willing to intervene.
 - It should be recognised that decisions taken in the formulation of the White Paper will have an impact on industrial investment and training decisions.
 - There can be potential conflicts between the need for short-term solutions to particular needs and the long-term effect on national capabilities.
4. **Q6. How can the UK get the best from working with other nations, whilst avoiding the pitfalls?**
 - 4.1. It is likely that the UK will have an increasingly close relationship with Europe in security and defence issues as well as ongoing relationships with members of NATO.
 - 4.2. There is much that can be learned from how other countries run their defence and security capabilities. A useful exercise would be a comparative analysis of the UK, US, French and German systems; not only the defence organisations and their relationship with their political system, but also their organisational structure and decision making procedures.

- 4.3. In the UK there are few examples of successful collaborations in the past, particularly large-scale projects. The SEPECAT Jaguar is a good example and the Tornado, Eurofighter and Joint Strike Fighter (JSF) are qualified successes but there have been few in the land or marine sectors other than the nuclear submarine and strategic weapons divisions.
- 4.4. When working with other nations there are a number of issues that will help ensure successful collaborations, such as:
- Complete clarity about the UK's requirements in terms of both quantity and quality and a realistic expectation about what can be achieved.
 - All parties involved must be fully supportive of the project.
 - Establish effective management arrangements from the start to isolate the programme from political issues.
 - Set up a clear regime for ownership of intellectual property rights created under the programme. Where the programme will be using products created outside the programme, early national agreement is essential.
 - Ensure that there is a clear rationale for co-operation, specifically that each nation can contribute a major element of the programme without the need to set up special in-country facilities and that the details of final assembly are agreed at the start of a programme.
 - Bilateral collaboration is likely to prove more productive than multi-lateral project. The complexities of requirements, timescales and budget will only increase with the number of countries involved.
 - All efforts must be taken to protect UK intellectual property.
 - It is important to consider the detailed proposals for sharing tasks in any collaborative project so that key engineering capability in the UK is not diluted.
 - There are clear examples, such as nuclear engineering, where domestic skills must be protected and developed to maintain sovereign capability.
 - The government should address concerns raised over the EU Defence and Security Directive, and define broad grounds where the government can use exemptions when they relate to essential interests and industrial capability in defence and security.

5. Q11. What should be the balance of priorities for research investment in science and technology for defence and security purposes?

- 5.1. The priority of science and technology investment should be to maintain a technological edge against the range of threats the country faces both now and in the future. Priorities should be defined in a joint process with the private sector and government to enable the alignment of R&D investment. A number of guiding principles need to inform the investment decisions including:
- Built in flexibility in the structure of funding in order to respond to new threats and technology.
 - Major procurements should be supported by funded technology programmes.
 - Where possible, open systems architecture and modular acquisition should be an integral requirement.
 - Science and technology investment should also support export priorities.
 - MOD contracts with the university sector should be administered through Dstl and have similar objectives.

- MOD staff should be encouraged to attend professional conferences in their specialist fields on a regular basis both to keep abreast of current developments in the field and to present their own work.
 - Systems engineering should be a priority.
- 5.2. The nuclear sector is particularly vulnerable and has the added complexities of international regulations. The UK requires significant investment in this area, particularly in the field of reactor technology, if it is to maintain its independent national capabilities. Mechanisms of technology links with international partners to upskill for the next programme cannot be relied upon in certain key areas and these need continuity of support.
- 5.3. Given the government's stated preference for purchasing off-the-shelf products on the open market, the MOD's own R&D spend should probably be concentrated within Dstl on topics where it is important that the MOD retains its "intelligent customer role" or where government labs need to be able to support the Armed Forces by providing direct support to capability enhancements as is currently the case for UK forces serving in Afghanistan. Long-term cost models should be used to determine whether support to UK industry provides the best balance of capability and cost effectiveness.
- 6. Q26. How can the Government and industry best support responsible defence and security exports by UK-based companies?**
- 6.1. Renewed support from the Government for exports is welcome and strong political leadership is vital to export success. Defence exports have been a great success story for UK engineering. They have made significant contributions to domestic revenue, helped to sustain skills and build the UK's reputation for world-class engineering. This will only be enhanced by developing and maintaining close working relationships between industry and all departments in the MOD.
- 6.2. The support and endorsement of the UK's Armed Forces in an export offering is a crucial component. Furthermore, access to UK facilities and assets should not be overlooked
- 6.3. Developing and embedding the concept of exportability is also welcome. Engineering decisions taken early in the project are more cost-effective. It is important to embed this approach in behaviours as well as processes. It is therefore important that for technologies that have yet to be fully developed the government should run the relevant competitions as early as possible in the development life-cycle.
- 6.4. All the large defence contractors serving the MOD are international in outlook and have options to invest elsewhere. Defence companies will invest in their UK businesses only if they can be confident of an acceptable return on the investment. Investment in the UK will generally only make sense if there is high confidence that the systems concerned will be sold to the MOD. By making an early commitment, after due competitive process, the MOD would acquire a stake in the export success of the product concerned, thereby benefiting from being able to share the non-recurring costs of development with export customers via a licence fee.

7. Q37. How can the Government ensure that SMEs are better able to fulfil their potential and contribute to the UK's defence and security requirements?

- 7.1. SMEs are a hugely valuable part of the defence and security supply chain, providing the basis for much engineering innovation.
- 7.2. Typically SMEs find their route to market through prime contractors who have a greater reach and are able to manage complex programmes and carry substantial risk. In many cases, SMEs find the administrative requirements for becoming an MOD contractor too arduous. Relaxing these requirements need not compromise the necessary safeguards and would help SMEs enter the market.
- 7.3. Original equipment manufacturers need encouragement to lead up their value systems for UK supplies, particularly where sovereign capability lies within UK SMEs. This will be increasingly important as the MOD relies more heavily on off-the-shelf products.
- 7.4. It is in the interest of prime contractors to ensure there is a healthy and agile supply chain and to work together to mitigate vulnerabilities.

8. Q55. To what extent should the Government take wider economic considerations into account when taking decisions about fulfilling its defence and security requirements?

- 8.1. There should be a clear mechanism for taking into account broader economic considerations, especially in the current climate. Engineering and manufacturing are significant contributors to the UK economy, especially in the defence and security sectors, sustaining hundreds of thousands of jobs directly and, in some cases, whole communities because of their location and role in local commerce.
- 8.2. This contribution is underpinned by skills in science, technology, engineering and maths (STEM). It is becoming clear that the UK is now beginning to face a skills shortage in this area. The Government should take urgent action to increase the number of people studying STEM subject and encourage skills development in the private sector.
- 8.3. Currently, wider economic considerations are taken into account at Ministerial level and are often caught up in inter-departmental priorities. Greater coordination between the relevant departments is needed if the economic advantages of the defence industry are to be optimised.
- 8.4. Defence and security exports by UK based companies often depend on prior UK government orders or a viable home market for the same, or similar, equipment.

9. Q64. Is the MOD's sector-based approach, based around a dual strategy of competition on the global market and intervention where necessary, the best way to meet the UK's defence capability needs?

- 9.1. The industrial and engineering capabilities that underpin the UK's capability in defence and security are dependent on programmes. Once lost they are either very expensive or impossible to recover. It is vital to consider the

capability lifecycle across the sectors and ensure maintenance of design skills through service report.

9.2. Early decisions that clarify the Government's approach in each sector will reduce the risk that engineering capability cannot be sustained, for example:

- In the air sector, the development of unmanned air systems is necessary to sustain the engineering capability that underpins the ability to design, build and support combat aircraft in the UK.
- In the maritime sector, the mechanism to sustain the capability to design, build and support complex warships exists through the Terms of Business Agreements. The capability to design, build and support nuclear submarines is renewed through the commitment to the Astute and Successor programmes, although there are significant challenges to naval nuclear skills retention.
- In the land sector, the UK's engineering capability has been significantly eroded over recent years due to a number of procurement decisions.

10. Q69. Does the MOD involve industry sufficiently in providing support to the Armed Forces?

10.1. Through deepened involvement in supporting the Armed Forces it is clear industry can provide capabilities and services that deliver efficiencies. Much progress has been made in this area over the past two decades but existing dialogue with industry should be continued to pursue even greater efficiency.

10.2. There are many examples of where industrial engineering capability in defence support has successfully delivered efficiencies and enhanced military capability such as depth maintenance, simulation and synthetic training, forward logistics management, and software support.

10.3. Engineers deployed forward to support the Armed Forces must have sufficient legal protection under any new manning and employment models.

11. Q85. Have we adequately identified the key industry-related challenges for cyber security?

11.1. The biggest industry-related challenges for cyber-security arise out of the very many security vulnerabilities that exist in commercial and industrial software. Despite forty years of progress, most software is still written using methods that make it easy to make mistakes and hard to find the errors that result. Typical software therefore contains around 10 errors in every thousand lines, after acceptance testing, and many security vulnerabilities are caused by trivial programming errors.

11.2. Any strategy for cyber-security needs to address the problem at its root, by setting a medium-term goal to greatly improve the disciplines, analysis tools and programming languages used across the software industry. This could take around a decade to achieve but if we do not start now it will always be ten years away and the legacy of insecure software will continue to increase.

11.3. In addition:

- The scope of what needs to be protected needs to be clearly determined if the private sector is expected to provide a level of engineering capability in response.
- Companies should be encouraged and incentivised to protect themselves from the cyber threat.
- Corporate and professional accreditation and standards in cyber security should be introduced.

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