THE FOUNDATION FOR SCIENCE AND TECHNOLOGY

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DINNER/DISCUSSION SUMMARY

How does science and technology support the defence of the UK and what are the implications for the wider economy?

Held at The Royal Society on 21st May, 2008

We are grateful to QinetiQ and Rolls-Royce
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Chair: **Dr Robert Hawley CBE DSc FRSE FREng**
Deputy Chairman, The Foundation for Science and Technology

Speakers: **Paul Stein FREng**
Science and Technology Director, Ministry of Defence
Alison Wood
Group Strategic Development Director, BAE Systems
Professor Ron Smith
Professor of Applied Economics, Birkbeck, University of London

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MR STEIN said that investment in R&D in defence had given the UK a capability advantage of 12 years, equal to France and second only to the US (18 years). We must seek to maintain this advantage. World War 2 had initiated a step change in the use of Science, Technology, Engineering and Mathematics (STEM), through the development e.g. of radar, nuclear weapons, IT and perhaps most important, production technology and skills. STEM was now fundamental to current projects such as Typhoon, Astute (submarine), unmanned devices, vehicle drive technology and the Osprey Body Armour. Funding for STEM research and development came not only from the Ministry of Defence (MOD), but also from the Research Councils and companies in both the defence and civil worlds. The aim of all work was to deliver the combat advantage, whether through information, weapons or procedures. Major future challenges were implications of climate change and globalization, cyber security, skills shortages, and the proliferation of new and uncertain threats. The MOD, through its Defence Technology Board planned to identify priorities, tap into emerging concepts and ideas, development, international and civil sector partnerships, widen and strengthen supply chains and preserve wealth creation in the UK. Overriding priorities were securing a good supply of STEM graduates and stimulating innovation in both the MOD and defence industries.

MS WOOD said that the future environment was both more uncertain and more dynamic. A central question was whether we are thinking sufficiently broadly about the meaning and impact of defence and security; it was not a matter just for the MOD, but also for the Foreign Office, Home office, HM Treasury and other government Departments, such as those involved with utilities and education. STEM was vital, not only in developing products but also in designing and developing sustainable business models. These needed to take account of, for example, the relationship of security to civil markets, the interaction between financial services information systems and security, the demands of energy supply and power management. It was crucial not to be obsessed by national boundaries; STEM was international, supply chains were international, and a very difficult task was training, managing and motivating staff working internationally and interdisciplinarily. MOD were absorbing new business models which included the fusion of technology, partnership arrangements and systems innovation. The Defence Technology Board should set priorities which were affordable and seek all ways of delivering it - which will include academia, businesses, particularly SMEs, who will bring innovation to the market. The UK was good at the rapid demonstration of innovative technology (a key competitive advantage), but there was much to do in developing and retaining the skills base we needed. Good graduates need to be shown that Defence R&D contributed to the wider civil and global security agenda and was itself work of great interest.

PROFESSOR SMITH said that the two questions, how does STEM support defence and what were the implications for the wider economy, could not, in effect, be disentangled. The links were too close and the feedbacks too complex. As a start, while the military's role was to preserve the security of civil society, it was civil society (i.e. the taxpayer) who paid for the military. Assuming democracy, civil society would never pay for the total security the military would like to aim for, but what was spent fed into the ability of civil society to flourish. There were, of course, many examples of STEM moving from the military to the civil arena - mapping, meteorology and GPS - but military expenditure was always small compared with the civil sector. It had been much greater during World War 2, but had declined. Systems such as GPS, developed by the military, had been marketed by the civil sector and then bought by the military in its developed form. An important element in this was the procurement cycle - some seven years - in relation to the development timescale for new STEM products - some 18 months. It was always difficult to quantify the spin-off from military to civil - economists, surprisingly, cannot agree. Perhaps it was more helpful to consider such questions as, if the military doesn't produce the product, who will? or, would one get better returns from developing different products. Defence spending is only 2½% of GDP. It is not all that vital for the economy even in employment terms, as the experience of countries with very different defence spending patterns - Japan, Germany, Taiwan, Korea - shows. It is equally difficult to quantify the effects on balance of payments. The message might be, pursue the aim of procurement policy as trying to get the best value one can, but don't overcomplicate or overload the system by trying to factor in civil applications or uses - although one should always bear in mind the linkages.

Two main themes emerged in the following discussion. The first was, had the MOD followed through its aim of thinking about future threats, - such as climate change - by thinking widely enough and devoting sufficient resources to coping with them and second, the effects of defence STEM demands on the very limited number of STEM graduates entering the economy.

On the first, there were divergent views. One must never give up worrying that there were unknown unknowns which could threaten one and that meant devoting some resources to calming such worries. Otherwise complacency would set in. But the downside was that resources were limited; there were known unknowns and known which must be dealt with and distributing resources too widely would lead to ineffective developments. More important, perhaps, was trying to identify what only the military could do and what other agencies or sectors might do, if there were sufficient incentive. For example, there was little point in the MOD assuming that it could make unilateral advances in aviation research on fuel use or aerodynamics - all planes use fuel and fly in accordance with the same physics. So look to other countries or sectors for new ideas. But on sea, where the military has a unique role, it has a task which only it can perform to secure efficiency and environmental benefits. Just as important was considering how to make the best use of what was already there. Modelling alternative uses and alternative patterns of expenditure was crucial. Obstacles to doing this were the lengthy procurement timetables, which would inevitably be upset if new thoughts about how equipment was to be used were considered and the understandable reluctance of military in the field, accustomed to certain procedures and equipment, to change their ways. The most important element in seeking to cope with inevitable uncertainties about future demands and circumstances was to build in as much flexibility as possible into business models and equipment. There were occasions when what were needed were rapid responses to threats; there were others when a longer term strategy could be pursued. The different timescales - e.g. between commissioning a new submarine (seven years) and responding to innovations in IT (18 months) had both to be factored in. The key to trying to cope with long term procurement and short term response was therefore, systems engineering - ensuring that new techniques could be fitted into the basic architecture, without the overall structure being affected. But along with this must come a new approach to budgeting - ensuring that there was enough resource to enable new technologies to be adopted and that the whole budget had not been spent on the initial structure. The question was, in essence, how to deal with obsolescence; the problems were not only in design, but also in operational commands. The MOD was getting better at this, but there was still some way to go. It was easy to say, do not be too risk adverse, but not easy to sell that to people risking their lives.

On the second theme, the possible squeeze on STEM graduates by the requirements of the Defence sector, there was a stronger view that the effect was not likely to be great, but that, in essence, the question was unanswerable, because of the impossibility of knowing what graduates would do if they did not go into defence related work. How did one judge the opportunity cost? Did it, in fact, matter? Defence spending was small in relation to GDP, it absorbed only those resources which the taxpayer was willing to give it and STEM graduates would go, either to areas which paid them high wages (e.g. the City) or gave them interesting jobs to do (academia). The public sector could never match the first, but often did provide work of deep interest for the second group. For that group it was often irrelevant whether the work was defence related or not - and it was often difficult to tell. But what was important, particularly for the corporate sector, was to publicize the interest of the work - and this could not start too early; it was school pupils, not just graduates who needed to be drawn in. The basic problem, so often heard in FST meetings, was the national shortage of STEM graduates. But this was challenged by one speaker, who said she could not get job offers for her very good STEM post graduates. Large corporate research centres had cut employment and were simply not recruiting. This was, not unexpectedly challenged, but there might well be problems in understanding where job opportunities existed and how best to approach them.

There was strong support for the MOD's strategy of looking at capability requirements, not just at platforms. Industry had already moved in this direction and would be willing to support MOD efforts. Central to this was the assurance that MOD had a rigorous assessment of all the different ways capabilities might be improved - training, ground organization, processes - before resources were put into new equipment. Regulatory problems could sometimes hamper this - such as environmental impact assessments. If there was an Urgent Operational Requirement (UOR) it had to be met as a single priority quickly. But, once the UOR was delivered the equipment might not meet common standards and would sometimes be difficult to support.

Procurement processes, risks on advanced technology and cost overruns were also discussed. The MOD's analysis of different procurement models, their understanding of systems engineering and their acceptance of new business and leadership models were all welcomed, although it was suggested that they might also consider looking at the different procurement models in the health sector. The interaction of accepting risk in developing cutting edge STEM techniques and strategies and inevitable cost overruns had to be understood. This was not an interaction unique to the MOD, but surfaced in many other areas. The MOD's problem was that as it did not order, say, new submarines, in the same volume as Nokia did mobile phones, it could not smooth the cost on STEM over a large number of units.

Sir Geoffrey Chipperfield KCB

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