Submission to Inquiry on the capability of Defence's physical science and engineering (PSE) workforce

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I noted with interest and bemusement that the Senate Committee on Foreign Affairs Defence and Trade has announced an inquiry into the capability of Defence's physical sciences and engineering (PSE) workforce. I'm interested because in my previous working life in Defence I first worked as a scientist and later managed engineers on a major Defence project. But the two experiences had so little in common that I'm bemused as to why the two groups have been lumped together in this inquiry.

It's a bit like a state government deciding to inquire into the capability of its teaching and firefighting (TFF) workforce. Both professions are critical parts of the workforce, but there's not a lot of synergy between them, and there doesn't seem to be much point to trying to manage them collectively. In fact, trying to do so would likely conflate the roles to the detriment of both. I think that might've already happened in Defence's PSE workforce. In that sense the parallel focus of the enquiry might work, if only to disentangle the issue.

Just as states need teachers and firefighters, Defence needs engineers and scientists. It needs engineers to help identify and manage risk in projects and to manage its fleets of complex platforms and its complicated data and communications architectures. It needs scientists to collect data and conduct operations research that help inform operations and force structuring decisions, and to investigate novel and promising technologies. [See note 1] To draw on another term that conflates two different things, scientists are best at the 'R' part of 'R&D' and engineers at the 'D' part.

Sometimes the two groups work together in 'upper R/lower D' activities, such as identifying and solving problems that arise in managing platforms when existing techniques and materials aren't adequate. Examples include the composite patching developed for aircraft skins (PDF) and solutions for the hydrodynamic problems during the development of the Collins class submarines. But working together isn't the same as being parts of the same profession, and we shouldn't conclude that scientists and engineers can seamlessly transition to each other's jobs.

Take for example the role played by the Defence Science and Technology Group (nee DSTO) in technical risk assessments (TRAs) (PDF) for major projects, a role they took on as part of the Kinnaird recommendations for the management of Defence projects. TRAs are important, given the difficulties that systems integration can pose for projects, especially when immature technologies are involved. It's important to have a realistic and robust sense of the potential difficulties ahead so some serious thinking can be done about the benefits and risks associated with various options.

Underestimating risk at the early stages of a project has consequences for schedules, costs and sometimes capability later on.

But TRAs aren't really a scientist's forte, and it's not what they're trained to do. As NASA has found, there's no substitute for a systems engineering approach to project risk and technological maturity, and it's now a specialised field of engineering in its own right. (I wrote about how this applies to Defence projects here.) In fact, DSTO had to grow a systems engineering capability to perform this task. It would probably have been preferable for the systems engineering work in support of TRAs to remain in DMO, where it would also support the post project approval project management and through-life engineering support, as well as helping to keep a critical mass of skills in an organisation that has suffered badly from a shortage of engineers. Conversely, there's a risk that tasking Defence science with becoming a technical advisor will detract from its core defence research effort.

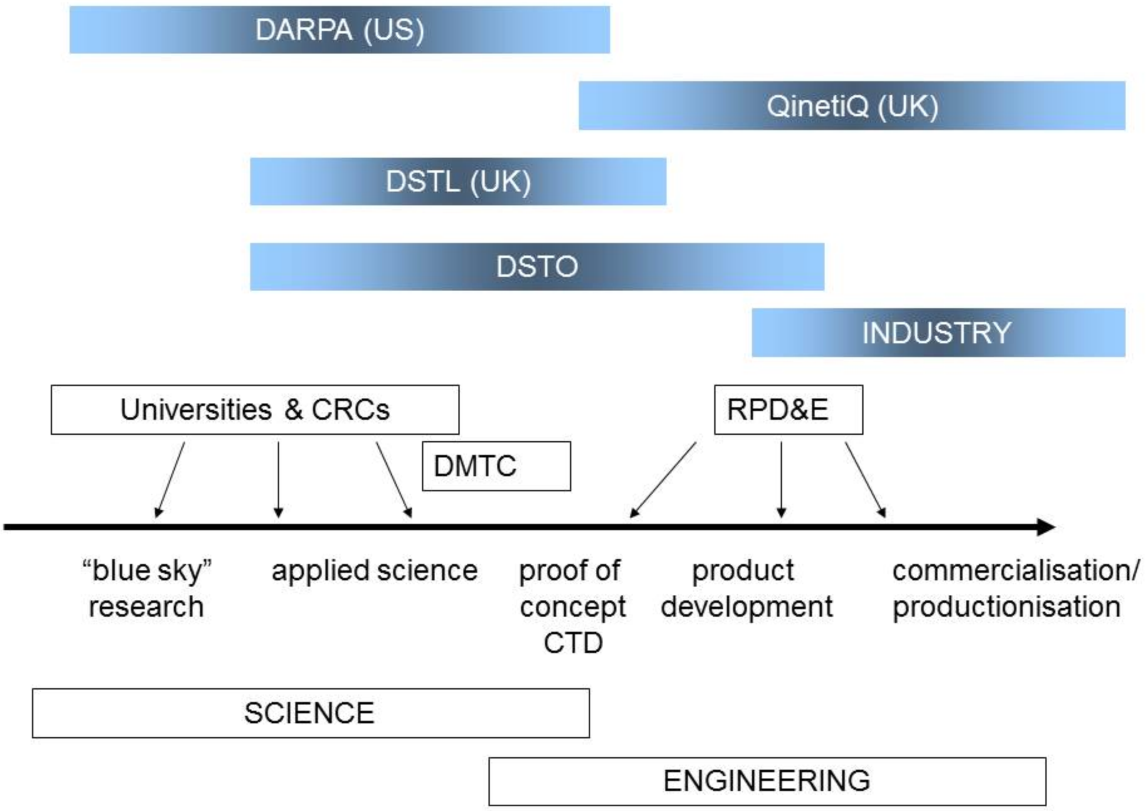
And even if the Defence science body can establish a viable systems engineering cell, there's still a problem that traces back to the overlapping but fundamentally distinct roles of the two professions. Engineers in Defence are mostly about managing and reducing risk and uncertainty [see note 2], while scientists require uncertainty to have sufficiently worthwhile problems to examine. There's a subtle but real conflict of interest here. The incentive is for a TRA to find that the technical problems are manageable enough to not put the kibosh on a project option, but substantial enough to require continuing input from Defence scientists. Scientists are as responsive to incentives as anyone else. Hugh White identified this problem years ago, when he was the chair of the old Force Structure Policy and Programming committee. After one particularly unfortunate project experience, he concluded that 'what I saw as risk, DSTO saw as opportunity'.

With the implementation of the First Principles review still a work in progress, and as the roles and staffing of the new Capability, Acquisition and Support Group Defence are fleshed out, Defence has an opportunity to revisit the organisational structures and arrangements in place to provide engineering support for projects and through life support. Separating out the roles of scientists and engineers would be a good start.

—Published material ends—

Additional notes for the Committee

Where Defence science sits inside the wider spectrum of scientific activities is a worthwhile question for the Committee to consider. There is a spectrum of scientific activity ranging from 'blue sky' research into fundamental aspects of the natural world through to applied science in the development of practical devices—which is where science and engineering tend to overlap. Australia has strengths virtually everywhere along the continuum, in Universities, Cooperative Research Centres and other collaborative organisations, and in industry itself. A question the Committee might usefully ask is where Defence's science and engineering workforce can most usefully add value in that picture. I've sketched a schematic (see figure below) that shows my judgement of where Australia's defence science sits, and how the US and UK organisationally manage the same space. Note that the US DoD has a presence in the blue sky space through DARPA, something I'd argue that Australia doesn't need to do. However, it's worth thinking how innovation in our university sector can be picked up for application in defence when applicable. Similarly, the transition of technologies from innovation centres such as CRCs to industry is probably fertile ground for inquiry. As I've indicated, I see scientists working towards the left of the diagram and engineers to the right, with some overlap in between.



Engineering in its broader sense involves problem solving, design work and dealing with the unexpected as well, but Defence has mostly outsourced those parts of its engineering requirements to private sector contractors. In practice, Defence engineers spend little of their time engaged in exploratory or research work and instead are helping Defence be a 'smart buyer' of goods and services from the private sector—as envisaged in the First Principles Review. That's a challenge for managing the Defence engineering workforce. Defence needs experienced and skilled engineers to be a smart buyer, but doesn't offer the same professional opportunities. In effect, Defence engineers have to second guess the work of their private sector counterparts in areas that they have little ongoing exposure to. When dealing with state of the art technologies, currency matters.

One possible way to manage the engineering workforce would be to have lower transitional barriers between Defence and private sector employment, so that part of an engineering career could be spent in government service, bringing high level private sector expertise with it. Perhaps the biggest impediment to such movement is the salary differential between private sector and government positions. During the resources boom in particular, it was very much one way traffic in engineers from Defence to the private sector. Today it's probably easier to have a two way flow—the trick will be to make a stay in Defence attractive enough to entice the best engineers.