

Re-Envisioning DARPA

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As recently described by Secretary Gates, the defining principle of the new National Defense Strategy is *balance*: balance in timeframe (today's conflicts vs. the future), types of conflict ("small war" vs. conventional war), and culture (change vs. building on existing strengths). The concept of balance is also pertinent to DARPA. Indeed, the central management challenge of the Agency is how to strike the right balance between the immediate problems faced by today's military (e.g., the problem of improvised explosive devices) while simultaneously fostering the kind of long-term exploration essential to maintaining the technological edge we currently enjoy. The fact of the matter is that both are important.

Over the past decade or so DARPA has moved aggressively to understand the immediate problems of the DoD and contribute to solving them. While we would judge DARPA to have been highly successful in this, with the onset of war a kind of destructive "resonant frequency" has been created, leading to an over-emphasis on activities with short-term payoffs. The effect on DARPA's ability to think and plan strategically has been costly, and therefore the Agency's ability to prevent future technological surprise is uncertain. The situation has become unbalanced to the point that key elements of the innovation ecology – including not only university researchers but also industrial R&D communities – are today less able to contribute to the nation's defense than they were 20 years ago.

Having said that, we do not believe it works simply to go back to the style of management that was in place 20 years ago. As the National Defense Strategy amply explains, the threats to national security are too varied and immediate. It is clear that a much more sophisticated coupling of use-inspired R&D with military needs is called for, and that new ways are needed to harness the capabilities of universities and R&D labs.

With this backdrop in mind, we suggest the following three issues for any consideration of DARPA's future.

1. **Clear, compelling, long-term strategic initiatives are essential.** DARPA must develop a clear set of game-changing strategic initiatives. Abstractly, military capabilities can be organized into the three dimensions of omniscience (i.e., seeing and knowing everything), omnipresence (i.e., being and moving everywhere), and omnipotence (i.e., kinetic dominance). While the Agency may or may not accept this particular framework, having *some* clear organizing principle for balancing the research programs as well as explaining the overall strategy is essential. New

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program objectives, for example, can be fit into this context in ways that span timeframes, types of conflict, and ways of doing business.

- 2. Innovation depends on excellent program management.** The front line of DARPA is the program management staff. They perform the critical function of interfacing between researchers and military operators. Most of what DARPA is able to do depends on the quality and quantity of the Program Managers. Besides performing the “translation” between military needs and technological opportunities, PMs – when properly empowered – can create stable innovation communities in which well-funded “skunk works” research teams both cooperate and compete to achieve common objectives.

There are three basic issues here: quantity, quality, and empowerment. The technological problems facing the DoD have expanded dramatically over the past decade and yet the size of the program management staff has not kept pace. DARPA’s budget should be increased by up to 50%, gated by the Agency’s ability to increase the number of PMs by a corresponding amount (from the current 90-100 to as many as 150). Quality is an even more important issue. The DARPA Director should be personally involved in helping Office Directors recruit the best and brightest, with a focus on visionary, energetic academic scholars and military executives (e.g., Army colonels with the magical combination of significant technology development and operational experience). DARPA should not be a haven for academic bureaucrats or non-technical managers.

A key element in attracting the best people to join DARPA as Program Managers is to provide them with the autonomy and resources to realize their research visions. A strong middle-management layer – the Office Directors – is critical to establishing a coherent vision within broad technology areas, and to providing the “top cover” that enables the PMs to operate with a high degree of empowerment. The DARPA Director is thus less a manager and much more an inspirational leader, who provides critical recruiting power, sets the agenda, and marshals the competencies of his staff through empowerment.

- 3. University research is a critical source of innovations and talent.** During the past decade DARPA has shifted away from universities to industrial contractors. Consequently, many of the best university researchers have lost the interest and will to work on DARPA problems. There are several reasons for this. Today’s prevalence of classified programs and the increasing restrictions on participation of foreign nationals have made many DARPA programs inaccessible to universities. Furthermore, many current programs are designed to produce integrated system deliverables, employing “go/no-go” evaluation hurdles on 12 to 18 month timelines. This structure is extremely difficult, even for our best universities.

Why does this matter? Simply put, universities, along with the government labs and the defense industry, are a key element of the innovation ecosystem for the national defense. Engaging the best minds in universities gets the current generation focused

on DoD problems and helps grow the next generation to follow suit. And, as we have seen in numerous developments (particularly in IT, such as networking, VLSI, cluster computing, and so on), engagement with universities also creates impact by putting DARPA-instigated innovations and strategic thinking into civilian practice quickly.

It is essential, therefore, to take affirmative steps to reengage the academic community. This will require a smart understanding of university competencies in long-term, visionary thinking, and a willingness to invest in community building and make bets on people as much as their ideas.

In some cases, research contracts are provided for university-industry partnerships, with a company as the prime contractor and subcontracts given to university researchers. While such arrangements may be appropriate in limited circumstances, the two essential requirements for university-based innovation – funding stability and a vibrant research community – are almost always sorely lacking. In essence, university-based innovation is drastically diminished in today's DARPA ecosystem.

To achieve better results, industry-university partnerships should be turned on their heads, with university primes and industry subs. To take just one example, the recent DARPA Urban Challenge demonstrated (once again) that research challenges that extend beyond the state-of-the-art (exactly where DARPA should be playing) benefit from the vision and single-minded drive of top university researchers. University researchers such as Red Whittaker and Sebastian Thrun led all the winning teams in the Challenge. They were able to marshal the resources of key industry players through subcontracts. Such industry participation helps to accelerate technology transition (for both unclassified and classified purposes) and aids in the rapid mobilization of research manpower.

The challenges facing DARPA are enormous, but so are the opportunities. Advances in information technology, the physical sciences, mathematics, engineering, and the social sciences provide tantalizing possibilities but also heightened risk of technological surprise. As we look to the future, it seems inevitable that DARPA's role in ensuring the nation's defense will become more critical than ever. Meeting the challenges will require strong leadership and investment that reestablishes a focus on long-term strategic initiatives, increases the quantity, quality, and independence of program management, and reengages with the academic community.

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