



INSTITUTE FOR DEFENSE ANALYSES

**Defense Venturing Process:
A Model for Engaging Venture Capitalists
and Innovative Emerging Companies**

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March 2003

Approved for public release;
distribution unlimited.

IDA Document D-2847

Log: H 03-000840

This work was conducted under contract DASW01 98 C 0067, Task AK-6-2229, for the Office of the Deputy Under Secretary of Defense (Science and Technology). The publication of this IDA document does not indicate endorsement by the Department of Defense, nor should the contents be construed as reflecting the official position of that Agency.

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PREFACE

This paper documents work performed by the Institute for Defense Analyses for the Office of the Deputy Under Secretary of Defense for Science and Technology (ODUSD(S&T)) under the task “Engaging the Venture Capital Community.”

The authors benefited greatly from interaction with the DoD officials who have been leading recent efforts to engage the venture capital community. These especially include Dr. Steven E. King and Richard A. Wilson of ODUSD(S&T), Vivian A. Cocca of the Office of the Assistance Secretary of Defense (C3I), and Mark R. Lewis and Scott C. Buchanan of the Office of Force Transformation. The study also benefited from the participation and insights offered by Bruce Held of the RAND Corporation.

IDA hosted a workshop on “Venture Capital and National Security” on November 5-6, 2002. The authors gained many valuable insights from the discussions among venture capitalists, government officials, leaders of government-related venturing activities, and other experts. The Defense Venturing Process sketched in this paper is not a product of that workshop, but its shape was heavily influenced by the exchange of opinions that took place.

This document was reviewed by Richard Van Atta, Research Staff Member, IDA.

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EXECUTIVE SUMMARY

To maintain technological superiority and achieve its force transformation goals, the Department of Defense needs to take advantage of all potential sources of innovation. There is concern that the Department needs to more aggressively pursue innovations stemming from the world of emerging high-technology companies that are developing innovative products for commercial markets. Information technology and biotechnology are two particular areas where small-company commercial innovation is critically important. Recently, several DoD organizations have explored the use of venture capitalists (VC) and VC methods to gain access to these companies, and insert their breakthrough technologies into DoD systems. This paper sketches a new venturing process that would expand on recent initiatives and enable DoD to engage emerging companies more effectively.

The new process would find, develop, and transition innovative technologies into Defense systems and operations. To bridge the gap between government and industry, this will require operating in an entrepreneurial fashion, including cooperation with the venture capitalists that invest in these companies. Equally important, the process would incorporate mechanisms to transition innovative solutions into actual use by DoD from beginning to end.

A DEFENSE VENTURING PROCESS

This paper identifies a number of options and then sketches one alternative for an end-to-end process that draws on the strengths of several venturing models being implemented in DoD and elsewhere. The new process would perform the following functions:

- **TechFinder and Transition Support:** These brokering functions would enable DoD to more aggressively identify non-traditional sources of technology and match them with user needs. The techfinder activity would focus on identifying innovative commercial solutions with potential defense utility. Transition support would provide funds to foster the application of commercial solutions through active support for experimentation by users, recurring test and evaluation, and seed funding to DoD users and customers.
- **Fostering Commercial Solutions:** A more aggressive approach would augment these brokering functions with a DoD-sponsored external commercial technology center. It would seek to identify potentially useful technologies in the earliest stages and provide resources to accelerate and influence their development for eventual DoD customers.

IMPLEMENTATION

These functions could be performed by two new organizations operating in cooperation with existing organizations and processes.

Internal to DoD, a Technology Liaison Office (DTLO) would act as the techfinder and provide transition support. This could be made operational quickly. With a small initial staff drawn from existing OSD resources, this office could continue and expand DoD's recent cooperative engagements with VCs, working with them to find ready and near-ready solutions that could be fielded quickly by the Services or Defense Agencies. Eventually, a transition support fund of roughly \$100 million would support experimentation, testing, and fielding of innovative technologies.

External to the Defense Department, a Commercial Technologies Center (CTC) would operate opportunistically in the world of VCs and emerging companies; it would focus on a broad problem set defined by the DTLO. In cooperation with wide-ranging VC contacts, the Center would support the tailoring of early-stage technologies for DoD use. Establishing an external technology center would require several months of preparation, including developing an enabling legal framework that would permit it to operate in a flexible, entrepreneurial fashion. Working under contract to DoD, the Center would provide a staff of experts focused on finding, shaping, and transitioning commercial technologies for DoD use. DoD would provide roughly \$100 million per year to support these activities.

Because these new organizations would provide a new channel of innovation that in some sense competes with existing DoD processes, the success of the entire initiative will depend critically on demonstrated support at the highest levels of the Department.

I. INTRODUCTION

To maintain technological superiority, DoD needs to access and insert innovative technologies from all available sources, but the Department is not taking full advantage of the innovative solutions being developed at emerging companies focused on commercial markets. Recently, several DoD organizations have explored the use of venture capitalists (VC) and VC methods to gain access to these companies and insert their breakthrough technologies into Defense systems. This paper examines the rationale for defense venturing, identifies some alternative approaches, and outlines a plausible, end-to-end venturing process.

Emerging companies oriented toward civilian markets constitute a potentially valuable but under-exploited source of defense innovations; we focus on this niche, and does not address other potentially underutilized sources. Our discussion addresses the following questions:

- What is the problem that makes new approaches necessary?
- How could VCs and VC methods contribute to the solution?
- What alternative approaches should be considered?
- What is a plausible, end-to-end process that could achieve DoD's goals?

These questions are discussed, in turn, in the next four chapters. A final chapter offers concluding remarks.

II. THE NEED FOR NEW APPROACHES

To maintain technological superiority and achieve force transformation goals, DoD must capitalize on the innovative technologies being developed for commercial markets. This chapter addresses the first question posed above, namely, what is the problem that makes new approaches necessary. Actually, the problem is twofold: the Defense Department does not have ready access to innovative technologies available from non-traditional sources; and DoD has great difficulty transitioning innovations into use.

A. Innovative Technology from Non-Traditional Sources

Since the beginning of the Cold War, one of the central tenets of America's defense strategy has been to create and maintain an unmatched superiority in every relevant field of technology. The Quadrennial Defense Review (QDR) of 2001 reasserted the importance of this principle, stating that DoD "must maintain a strong science and technology program that supports evolving military needs and ensures technological superiority over potential adversaries."¹ To achieve this goal, DoD must field the cutting edge of available technologies and develop those with the potential to transform future capabilities. However, many challenges, both internal and external to the Department, have arisen in recent years.

Over the last few decades, DoD's research and development funding has been relatively constant, but commercial R&D spending has risen dramatically. As indicated in Figure 1, the private sector currently outspends DoD by a factor of eight. This suggests that DoD is no longer the primary driver of innovation in many areas of technology that are "dual use;" i.e., of interest to both military and commercial customers. For example, the private sector drives much of the innovation occurring in information technology (IT), although IT has obvious defense utility.

In the past, innovators were more likely to seek out DoD as a customer because it represented a substantial market; now, however, they are more likely to focus on burgeoning commercial markets. IT is but one example of a technology area where DoD demands are dwarfed by those of commercial markets. This is not a problem when the Department can use commercial off-the-shelf (COTS) products, but there are cases where DoD has special requirements that necessitate expensive and time-consuming

¹ See Department of Defense, *Quadrennial Defense Review Report*, September 30, 2001, 41.

modifications of existing commercial designs. It is cheaper and simpler for the innovator to engineer a product to meet the additional specifications earlier in the development process. But as a lower priority customer, DoD can no longer count on firms designing their products for defense use *from the beginning* without a partnership and support.

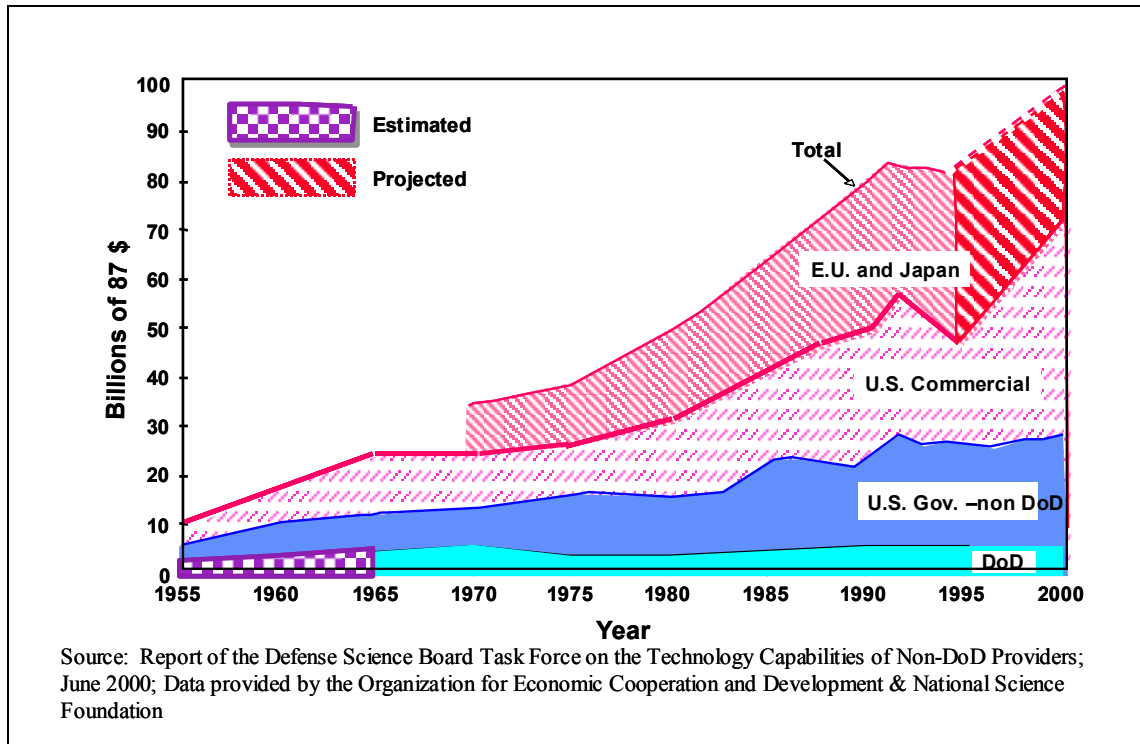


Figure 1. U.S. and Worldwide Research Base since World War II

The Defense Department requires detailed knowledge of advances occurring in commercial market sectors that lie outside of its traditional field of vision and it must explore these technologies for their potential utility in defense applications. Furthermore, it must seek to access and influence these advances at an early stage in order to reduce or eliminate the prohibitively high cost of adapting a fully developed product. The reality is that not only has DoD's dominance as an innovator and buyer of advanced technologies greatly diminished, but also the funding that would be necessary to restore that dominance is not practicable. However, DoD could leverage blossoming commercial innovation to its own advantage.

B. Obstacles to Transitioning Technology into Use

The Department has several large, well-funded mechanisms for encouraging and influencing external R&D. The Defense Advanced Research Projects Agency (DARPA),

the Service laboratories, and the Congressionally mandated Small Business Innovation Research (SBIR) program all work with private innovators and provide funding to advance technologies of interest to DoD. However, funding from these science and technology (S&T) sources generally ends when the developer produces a successful prototype. It is then up to customers and programs within DoD to fund further development and potential acquisition. Even if potential DoD customers are aware of the S&T innovations, there is no guarantee they will have a defined requirement or the available funding to transition them into use. These discontinuities lead to the very real possibility that DoD-funded innovations will lie dormant, unable to cross the gap between S&T and actual use in DoD programs, systems, and operations.²

Traditionally, the Department has relied on prime contractors and system integrators to incorporate the latest technology advances into their platforms and tailor the end products to meet DoD requirements, but there are several concerns with this approach. One is that prime contractors often develop their own technologies in order to increase their business base, differentiate themselves, and build competitive advantage. In such cases, they may have little interest in using technologies developed by other companies, especially those developed for commercial markets. They may be particularly reluctant to use technologies developed by commercial startups if that would pose a risk to their ability to honor the terms of their contracts with DoD. In addition, DoD program managers may prefer to rely on traditional prime contractors thanks to the length and reliability of their relationships and the overriding culture of risk aversion in the acquisition community; neither defense contractors nor DoD program managers have a natural inclination to seek out innovative solutions from non-traditional sources.³ Finally, defense contractors may not be aware of emerging technologies as their business and investment profiles are often very divergent from those of commercial firms and venture capital groups.

For their part, commercial companies may be reluctant to do business with defense contractors because the market is small and many of them regard DoD as a very difficult customer with specialized requirements. Modifying products to meet DoD needs may not represent the most profitable use of their engineering resources, especially if

² The problem is not unique to DoD. For a broader discussion, see Geoffrey A. Moore and Regis McKenna, *Crossing the Chasm*, Revised Edition, August 20, 2002 and Clayton M. Christensen, *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*, June 1997.

³ See, for example, Department of Defense, *Report of the Defense Science Board Task Force on the Technology Capabilities of Non-DoD Providers*, June 2000.

they are small, emerging firms. Contracting officers accustomed to dealing with prime contractors are notorious among smaller commercial firms for their inflexibility in demanding intellectual property rights. Some companies also fear that their ideas will be expropriated by the prime contractors.

Contracting directly with DoD under existing regulations can be problematic as well. For example, firms may be locked into long-term contracts with obscure performance requirements that lead to delays in payments from DoD, and financial lapses of even short duration can cause small firms to fail.

Further, DoD's acquisition management process and its Planning, Programming, and Budgeting System (PPBS) are designed around the development cycles for integrated platforms such as armored vehicles, ships, and aircraft that typically run from five to ten or more years. This kind of timescale is an eternity in the world of commercial technology, especially in areas such as IT where whole generations of platforms and architectures obsolesce in three to five years, at most. Small firms whose profit potential relies on the viability of their intellectual property can ill afford to wait so long.

But the problems expounded above are not insuperable. The Defense Department has shown itself to be capable of accelerating research and development efforts in partnership with private sources, as well as swiftly procuring and fielding the products of those efforts, especially in high-priority, critical applications. To preserve its technological advantages, DoD must replicate such successes on a much broader scale.

III. WORKING WITH VENTURE CAPITALISTS: VALUE FOR DOD

Venture capitalists are strategically located in the world of emerging commercial companies that DoD needs to tap. While these companies are focused on commercial markets, their innovative technologies may also have utility for defense. This chapter addresses the second question posed at the beginning of the paper, namely, how could working with VCs help DoD address the problems discussed in Chapter II above. The answers to this question influence the design of the Defense Venturing Process discussed in Chapter IV below.

A. How Venture Capitalists Operate

Venture capitalists are engaged in the risky business of financing small, privately held startup companies that generally are too immature to obtain funding through banks or public markets. The risks of failure are high, and only a small minority of VC investments has truly large payoffs. Many VCs nevertheless earn substantial returns by sharing risks with other investors, involving themselves deeply in managing their portfolio companies, and cutting their losses quickly when prospects dim.⁴

A VC firm typically is a general partnership, with a small number of principals managing one or more venture funds. Limited partners invest in venture funds, while general partners select and manage investments in emerging companies. The limited partners are usually passive investors but may be given some visibility into the companies in which their fund invests.

Venture capitalists select companies for investment after reviewing many proposals and discussing them with wide-ranging contacts. Typically, VC firms specialize in companies working in particular technology fields, markets, or geographic regions, and they may specialize in funding companies at early or late stages of development.⁵ There also are systematic differences in the interests of large and small VCs. All of the successful VCs develop a fast, thorough, and efficient vetting process to examine and assess the prospects of emerging technologies. This capability to filter new transformational technologies from vast selection pools is a key capability DoD very much needs.

⁴ For a lucid discussion of venture capitalists, see Paul A Gompers and Josh Lerner, *The Money of Invention*, Harvard Business School Press, 2001.

⁵ Uncertainty regarding the viability of a new company and its technology are typically greater at the earlier stages. Investing in such companies may require specialized VC skill sets.

Venture capitalists typically make multiple, successive investments in a company. Each tranche is sized to meet the company's near-term needs and is provided only if the company has made satisfactory progress in developing its business and product. In return, the VC receives equity in the company, often one or more seats on the board of directors, and other negotiated rights to influence or veto management decisions, including the selection of company officers. The VC firm uses these tools and its own experience to mentor and guide its portfolio company. Thus, the VC firm is an insider with excellent visibility into the portfolio company's technology, its business strengths and weaknesses, and its prospects for success. This insight is unique and of great value to DoD in identifying critical emerging technologies and their anticipated viability.

The investment payoff comes when the company's prospects for success are strong and clear enough that it can sell equity on public markets or be acquired by other companies or investors. Some 20 to 30 percent of the resulting gains for the venture fund are assigned to the general partners, giving them a strong incentive to make good investment decisions and guide their companies to success.

B. Attitudes toward Doing Business with DoD

Venture capitalists are not a monolithic group; their operations vary regarding targeted technological sectors and the maturity of the technologies, as well as their target markets. Some VC attitudes can nevertheless be taken as given. For example, VCs will encourage their companies to work with DoD only if that increases the prospects for success; in most cases, that means success in the intended commercial market. Further, VCs and their portfolio companies are lean organizations that do not have the time or the resources to spend accommodating difficult, low-payoff customers.

Venture capitalists' views also change in line with the VC business cycle. In the year 2000, VCs had a multitude of promising investment targets. Now, in the midst of an enduring high-technology recession, they have more patience and are more willing to test the value that relationships with DoD might bring. In addition, they look for trends and strategic indicators to guide investments during periods of low market activity. By communicating its interest in key technologies, DoD can indirectly steer VC investments toward its areas of interest.

Generally, DoD would be a niche customer for emerging companies focused on commercial markets, but a relationship with DoD nevertheless could provide several advantages. DoD's strong interest in innovative technologies makes it a good prospect for being a beta tester or early customer. DoD's technical expertise as a smart customer and

technology developer could help a company improve its product. Development funding from DoD also might be welcome. The relative value of a relationship with DoD would decline as a company began to succeed in large commercial markets. The best opportunity for DoD involvement occurs prior to that, while the company still needs the kind of help DoD can offer in the early stages of development.

However, there are obstacles – some perceived, some real – that make doing business with DoD seem difficult. The Department may insist on contractual red tape that imposes burdensome restrictions and intrusive oversight, or it may demand intellectual property rights that limit a company’s future access to government markets. It may keep a company waiting for months or years for a firm yes/no decision, thanks to competitive solicitation requirements and slow-moving budgetary processes. And while DoD regulations include provisions that can ameliorate most of these burdens, risk-averse contracting officers may not take advantage of such flexibility in practice.

There also are more substantive obstacles that can lead a company or its VCs to refuse a relationship with DoD. Premature disclosure of innovative technologies and ideas can eliminate a company’s competitive advantage. An emerging company will guard against revealing such information to any untrusted outsider. Further, working with the Defense Department could distract a company from its primary pursuit of success in commercial markets. The company may have neither the time nor the engineering resources needed to accommodate DoD requirements if they differ significantly from commercial requirements.

In general, DoD could bring positive value to some of these emerging companies, but is not a natural customer for many of them. To work with them, they must make special efforts to understand their circumstances and flexibly negotiate agreements that are mutually beneficial.

C. What Venture Capitalists Can Offer DoD

Fundamentally, what VCs can offer is help in finding and doing business with innovative emerging companies. It is widely believed that small companies account for a disproportionate share of breakthrough innovations. Often, these companies make incremental improvements to technologies developed by academia or the government and envision innovative ways to use the results in products that serve markets.⁶ One study that used patents as a measure of industrial innovation found that venture capital funded

⁶ See, for example, The National Academy of Sciences, *Risk and Innovation: The Role and Importance of Small, High-Tech Companies in the U.S. Economy*, 1996.

less than three percent of total corporate R&D in the U.S. while VC-backed firms accounted for about eight percent of patent activity.⁷

Over the past year, DoD made exploratory contacts with a number of VCs. These contacts generally suggested that there is, in fact, a valuable untapped source of innovative technologies available at emerging commercial companies. For example, meetings with a group of leading VCs in Menlo Park, California, resulted in the identification of six important commercial solutions that DoD is now evaluating or using. A recent Irvine, California, meeting sponsored by the Tech Coast Angels included presentations by emerging companies that drew interest from potential DoD customers. In-Q-Tel, a not-for-profit venturing organization associated with the CIA, has transferred 12 solutions from its portfolio companies to the Agency since 1999 and has provided information on at least 17 more innovations.

Venture capitalists have unique insider information about their portfolio companies. They also are strongly motivated to help their companies succeed and are likely to cooperate when DoD offers positive value. DoD can thus collaborate with VCs to find innovative companies with potential solutions for its problems. Table 1 lists a number of additional advantages to working with VCs.

Table 1. Potential Value of Working with Venture Capitalists

Finding Technologies	Vcs have insider information about companies in their own portfolios and wide-ranging contacts in their areas of specialization. They could help find potential solutions to DOD's problem set.
Funding	VC funding supports technology development at portfolio companies. This can reduce DoD's own development costs, whether the company is developing its own ideas or technology originated by DoD.
Due Diligence	Vcs are strongly motivated to evaluate proposals carefully and invest in potential winners. DoD must do its own due diligence but may find that VC backing of a company is an important positive signal.
Mentoring	Guidance from a skillful VC should materially improve a company's chances for success. This can be an added benefit from working with VC-backed companies.
Overcoming Obstacles	Vcs that gain experience working with DoD can help portfolio companies deal with unique government practices.

⁷ See Paul A. Gompers and Josh Lerner, *The Money of Invention*, Harvard Business School Press, 2001, 77. Of course, even if VC-backed firms are unusually innovative, one would not want to ignore the other sources that account for 92 percent of patent activity.

Relationships with VCs have much to offer when their interests coincide with those of DoD. However, when interests diverge, VCs can be expected to act on their own behalf. Table 2 lists a few examples. Generally, DoD should protect its interests by working with a wide range of VCs and by building trust through long-term relationships.

Table 2. Potential Divergence in VC and DoD Interests

Selection Bias	VCs have an incentive to promote their own companies, even when other companies have better solutions. Further, VCs may not be aware of solutions at non-portfolio companies or in fields that lie outside their technical or geographic areas of specialization.
Selling Lemons	VCs have an incentive to help their portfolio companies, including those whose prospects have turned dim. They may encourage a DoD relationship with a troubled company without necessarily disclosing the company's weaknesses. While working with troubled companies could prove mutually advantageous, DoD must be cautious and conduct its own due diligence.
Hiding Companies	VCs may have strategic reasons for blocking a DoD relationship with certain companies. They may prefer to keep sensitive information secret or protect a company from undue attention and distraction. VCs thus may not always bring their best ideas to DoD's attention.

D. DoD-sponsored Venturing

DoD could sponsor its own venturing activity rather than working only at arms length with existing for-profit VCs. Presumably, the Department would contract with a dedicated private-sector entity rather than perform the activity itself. This section considers whether DoD-sponsored venturing would be useful.

The principal arguments favoring DoD-sponsored venturing are that it could give the Department more insight into emerging technologies and more influence over their future development. Particularly for early-stage companies, equity investment may be the only way for DoD to gain insider information and influence. Other approaches such as funding development contracts may be premature. By buying equity, DoD (through its contractor) could signal to a company and its VCs that it had a serious, long-term interest and could be trusted to follow through on its commitments. As an insider, DoD could more reliably track a company's progress, reduce its own uncertainty, and make more informed decisions as a customer.

Investing as a conventional limited partner in a venture fund seems much less worthwhile. A passive limited partner generally has little or no influence over investment decisions and gains little insight into the activities of the invested companies.

Unconventional approaches might have more appeal. For example, a lead investor buying 20 to 30 percent of a venture fund sometimes gains extraordinary privileges as a special limited partner.

There also are arguments against DoD-sponsored investment in equity. For one thing, it is a very risky business requiring a specialized, entrepreneurial skill set not typically found in government-related activities. Moreover, the Department has other, more conventional tools at its disposal; for example, funding development contracts and acting as first customer.

On balance, the Defense Department's best approach would be to work with a wide-ranging set of VC contacts to find innovative companies and to develop a mix of tools that would enable it to do business with them. The mix should include flexible contracting for development, acquisition of prototypes, first buys, and licensing of DoD technologies. The mix also should include DoD-sponsored equity investment in emerging companies, where appropriate.

IV. VENTURING OPTIONS

New approaches are needed to help DoD find and utilize innovations from emerging firms focused on commercial markets. Many alternative methods and structures are worth considering. This chapter identifies some of the possibilities. In it, we outline a plausible comprehensive process that draws on the options presented here.

A. Needed Functions

In designing an approach, it is important to visualize the complete, end-to-end process that is required. A number of interdependent functions must be performed to achieve the ultimate goal of transitioning innovations into use. The most important of these include:

- Identify and communicate DoD needs
- Find potentially useful innovations
- Match innovations to potential DoD customers
- Support development of key technologies
- Test and evaluate potential solutions
- Experiment with prototype products
- Support rapid transition within DoD
- Oversee and champion the end-to-end process.

The Defense Venturing Process described in this chapter assumes that all of these functions are necessary and require specific attention. Of course, under alternative approaches, one or more of the listed functions might be viewed as unnecessary; alternatively, an initiative might address only some of the functions, assuming that existing programs would perform the remaining functions adequately.

For each function to be addressed, many different methods of performance can be devised. Some of the more interesting methods are discussed below. Note that the methods listed for a given function are not necessarily mutually exclusive.

Identify and communicate DoD needs

- Issue annual data calls for requirements to be addressed in specific technology searches.
- Maintain a continuous data call to gather immediate and emerging requirements at any time. One variant would be a unified repository of needs statements from those DoD elements with an interest in selected areas of technology.

- Proactively integrate and prioritize DoD needs for the relevant planning horizon based on the inputs of users, customers, and the S&T community.
- Establish a comprehensive and continuously updated database of technical experts and technology initiative leaders within DoD.

Find potentially useful innovations

- Leverage VCs to find and identify promising emerging technologies that offer potential solutions to problems articulated by DoD. The Department could engage with groupings of VCs (e.g., Menlo Park Group) and angels (e.g., Tech Coast Angels), as well as individual VCs. Long-term partnerships might be established.
- Invest as a special limited partner in a venture fund managed by an existing VC. If DoD were the dominant investor in the fund, it might be accorded special privileges, including insight into investment proposals and portfolio companies.
- Contract with an intermediary organization to monitor selected fields of technology and identify emerging companies with potential solutions.
- Contract with an intermediary organization to employ VC methods to find potential solutions at emerging companies. In particular, the intermediary would review proposals and make selected equity investments.

Match innovations to potential DoD customers

- Inform emerging companies and DoD customers participating in a specific search when a potential match is found.
- Maintain a unified repository of potential solutions and relevant DoD activities..
- Proactively market interesting solutions to potential DoD customers.

Support development of technologies

- Contract with emerging companies to develop their technologies. This could include supporting the development of products of use to both commercial and defense users, as well as specific work to enhance defense utility.
- Provide incubator services for startup companies with interesting technologies. This effort would focus especially on developing products based on licensed DoD technologies that could be of future use to the Department.
- Establish and fund a dedicated venture fund, managed by an existing VC general partnership, to provide equity capital to emerging companies developing technologies of interest to the Department.
- Contract with an intermediary organization to support technology development at emerging companies, using work contracts and equity investments as appropriate. Equity investment might be particularly useful for companies at early stages of development, for which work contracts would be premature.
- Use and enhance existing programs that support emerging companies, including the Small Business Innovation Research (SBIR) Program, the Dual-

use S&T (DUST) Program, and Small Business Investment Companies (SBIC) Program.

Test and evaluate potential solutions

- Support the test and evaluation of solutions from emerging companies using existing government or private-sector test facilities.
- Establish dedicated test beds and expertise to support this function.

Experiment with prototype products

- Make potential solutions available and support their use in DoD experimental exercises and activities.

Support the transition of solutions within DoD

- Establish and fund a centralized transition support fund to aid DoD activities implementing solutions from emerging commercial companies. This effort would focus on supporting infrastructure and related needs. In a variant, it might also support the acquisition of products from emerging companies.
- Establish and fund a revolving fund to provide transition support funds that DoD activities would repay in the future.
- Assign high-level, proactive ombudsmen within the Services or development commands to support the transition of solutions from emerging companies. For example, an ombudsman might facilitate the reprogramming of Service funds to support transition.

Oversee and coordinate the end-to-end process

- Establish a high-level board to set goals and monitor progress.
- Assign the mission to a specific office with high-level support and adequate resources.

B. Organizational Approaches

A number of organizational options should be considered. A venturing initiative could rely on existing organizations or require the establishment of new organizations. The organizations utilized could be located within DoD or the private sector. The choice of organizational approach depends particularly on the functions to be performed and the methods to be used. This section discusses some of the key organizational issues:

1. Private-sector versus DoD Organizations

Some of the functions and methods discussed above seem clearly suited to performance either (both) within or outside the government. Finding potential solutions and supporting technology development at emerging companies could be done by DoD itself, although a private, not-for-profit entity might prove more effective at working with companies oriented toward civilian markets. If the initiative includes equity investment, then an outside entity is almost certainly required. It would be very difficult for the

government to build the VC-like skills needed for equity investment, and any attempt to do so would be politically controversial. At the same time, some of the functions and methods are inherently governmental or can be performed effectively only by an insider. These considerations particularly apply to transition support and internal DoD coordination. Other functions could be performed within or outside DoD; for example, specialized support for test and evaluation.

2. New versus Existing Organizations

If an organization outside the government is needed, DoD could contract with a new entity or work with an existing group. For example, In-Q-Tel, Rosettex, and the Homeland Security Consortium perform at least some of the functions listed above. Working with one of these groups could reduce startup and overhead costs and delays for DoD. However, each of these entities has its own agenda and structure and it is an open question whether they could effectively implement whatever program DoD might design. A new organization dedicated to DoD's initiative might prove more responsive.

For the functions to be performed within DoD, a key consideration is how to overcome the inertia that has limited the Department's access to innovations at emerging commercial firms. A new, high-level, independent organization outside the traditional structure might be needed to ensure that proper attention be paid to this niche. Such an entity might be needed to ensure continuity and success.

3. Single versus Multiple Organizations

A venturing initiative might include one or more entities in the private sector, as well as one or more within DoD. Establishing one outside and one inside organization would reduce coordination problems and help maintain a critical mass of resources and efforts. On the other hand, multiple DoD organizations might be established, including several within each Service; each of these organizations might work with a different outside organization. This approach could be more costly, but might also prove more responsive to individual DoD customers.

4. Integrated versus Distributed Responsibility

The Defense Department might choose to assign DoD functions to a single organization or to assign different functions to different entities. The latter approach might be advantageous if DoD wants to avoid establishing a new Defense organization. A high-level board would coordinate across the various offices. However, this approach may dilute responsibility for the overall process. To ensure an end-to-end perspective and fix accountability, it might be preferable to assign all DoD functions to a single office.

V. A DEFENSE VENTURING PROCESS

This chapter addresses the fourth question posed at the beginning of the paper, namely, what end-to-end process would enable DoD to capitalize on innovative commercial solutions. The Defense Venturing Process sketched here is a plausible approach that performs the needed functions identified earlier, and incorporates the strengths of a number of venturing models being implemented in DoD and elsewhere. Appendix A summarizes the features of some of those approaches. The process described here should provide a basis for further discussion.

A. Objectives and Scope

The Defense Venturing Process is designed to complement existing DoD processes. It addresses the difficult but potentially rewarding niche of acquiring innovative solutions from emerging companies whose primary focus is on commercial markets. Part of the process is dedicated to finding technologies with potential defense utility and nurturing them until they are mature. The other – and perhaps more difficult – part is effecting the transition of those technologies into DoD systems and operations. These two parts are addressed in parallel: from the beginning to the end of the process, the mandate for transition influences the selection and nurturing of technologies. Potential DoD users and customers are involved at all stages.

The process is designed to be entrepreneurial – to seize opportunities and make deals when the timing is right and the business case warrants. In that sense, the process is attuned to enabling DoD to do business with VCs and their innovative portfolio companies. More than that, the process engages VCs directly in the hunt for companies with relevant technologies; in some cases, the process itself would generate equity investments in emerging companies. The entrepreneurial spirit propelling these efforts means that some failures would occur in pursuit of transformational improvements in DoD capabilities.

The process outlined here is not specific to any particular area of technology, although the initial focus is likely to be on such areas as information technology, information assurance, and sensors. The process could be applied to other fields as well as long as there are innovative emerging companies developing products in those fields for commercial markets. However, expanding the process beyond the emerging-company niche is unlikely to be useful. DoD has an existing structure for working successfully with large corporations, defense contractors, and systems integrators.

B. Process Overview

The general flow of the process is illustrated on Figure 2: A new government organization, the DoD Technology Liaison Office (DTLO), would coordinate the flow of DoD problems and needs to a new not-for-profit organization, the Commercial Technologies Center (CTC). The CTC would work with venture capitalists and other sources to find innovative solutions at emerging companies. As necessary, CTC would support technology development at these companies and would assist the Department in transitioning solutions into systems and operations. DTLO itself would provide internal transition funding within DoD. The new organizations would act as catalysts for building direct business relationships between the companies and DoD customers.

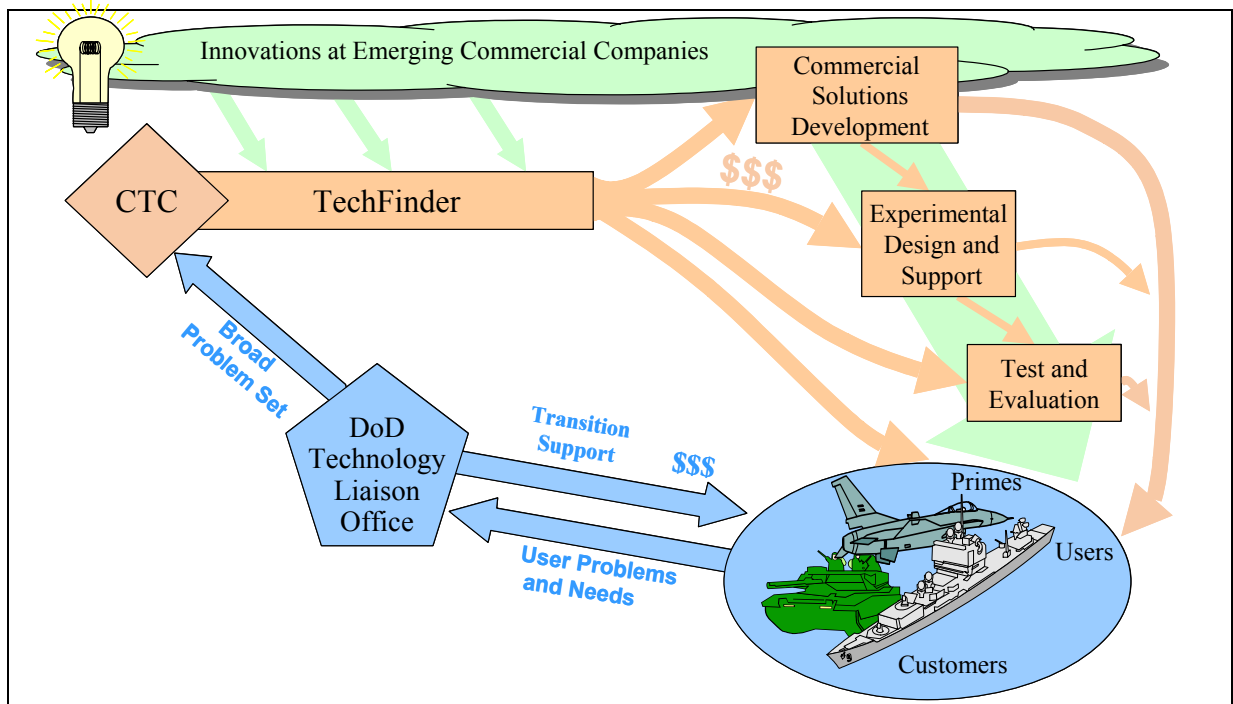


Figure 2. Functional Process Flows

The process is outlined broadly in Table 3. While specific functional responsibilities would be assigned to the new organizations, the process would require collaboration among CTC, DTLO, and existing DoD organizations. Primary responsibility for coordination would be assigned to DTLO. The functions assigned to CTC and DTLO are discussed in greater detail in subsequent sections.

Table 3. Functional Process Overview

	CTC	DTLO	Other Organizations
TechFinder	--Finds and evaluates solutions at emerging companies --Matches solutions to DoD users and customers	--Manages process to define DoD problem set for CTC --Coordinates communications and relationships	--Users and customers identify needs, examine solutions --S&T community collaborates on defining problem set
Commercial Solutions Development Support	--Provides contracts and other support to accelerate and shape development	--Coordinates communications and relationships	--Users and customers advise companies on specific needs
Transition: Experimental Design and Support	--Supports DoD experiments and coordinates company participation	--Coordinates communications and relationships	--Users conduct experiments --S&T community and system integrators support
Transition: Test and Evaluation Support	--Tests and evaluates commercial solutions and supports DoD tests	--Coordinates communications and relationships	-- Customers test and evaluate solutions --S&T community, system integrators provide support
--Transition: Support Fund	--Coordinates communications and relationships	--Funds users and customers to support transition, bridge budget gaps	--Customers contract with companies --System integrators and users integrate

To succeed, the process must operate in an opportunistic mode. Continuous efforts to match solutions to problems will, from time to time, create opportunities to improve DoD capabilities substantially. The process must enable the Department to seize those opportunities when they present themselves, to “make the deal” when the business case is strong. The process must operate in an entrepreneurial fashion at a commercial tempo, with wide-ranging relationships, readily available funding, and flexible acquisition practices. Participants must have the experience and support necessary to recognize opportunities and conduct adequate due diligence. At the same time, the process must allow decision makers to risk failure when justified by the potential payoff.

DTLO and CTC would drive the process as new organizations outside DoD's traditional acquisition process. With sufficient tools and an entrepreneurial bent, they would enable the end-to-end process to seize the opportunities that arise.

C. CTC: Outside Organization

CTC would provide a service to DoD, helping it acquire innovative solutions from emerging commercial companies. This section briefly considers how it would be organized and perform its functions.

Organizational highlights for CTC are presented in Table 4. In general, it should have the independence and flexibility necessary to operate effectively in the commercial world of venture capitalists and innovative emerging companies. Placing CTC outside the government is a key enabler, but special attention must also be given to the design of its legal and contractual framework. DoD would exercise high-level control over CTC through its annual contracts and would evaluate performance based on the actual benefits brought back to DoD. Collaboration with DTLO would be essential to CTC's success.

The Department would make a solid commitment to support CTC for its first five years, giving it time to nurture investments and bring them to fruition. Funding initially would be sufficient to underwrite around 20 deals per year and gradually expand from that base. Average VC funding per deal since 1992 has been \$7.8 million; CTC would need somewhat less since it would co-invest with VCs and would leverage the commercial development expenditures of the companies.⁸

CTC would be organized to focus on specified areas of technology, e.g., information technology, information assurance, and sensors. It would develop contacts with VCs and others who specialize in those fields. It would recruit its own specialists and gain experience by working in those fields. All of this suggests that expanding CTC's focus to encompass other fields in the future should be done in a modular fashion. CTC would need to add or change its contacts and staff specialties rather, than simply refocus existing resources.

Four major functions would be assigned to CTC. As indicated on Table 3 above, CTC would perform these functions in collaboration with DTLO and other DoD organizations. Following are additional details on what CTC would be asked to do.

⁸ See PricewaterhouseCoopers, "Venture Economics: NVCA Money Tree Survey," July 25, 2002.

Table 4. CTC Organizational Highlights

Not-for-profit	CTC would be established by contract with an independent, not-for-profit corporation. Being a private-sector entity is a key enabler for CTC, giving it flexibility and independence that a government office would not have.
Governance	CTC would be governed by a board of directors/trustees drawn from the private sector. Members would be eminent representatives of the VC, S&T, and non-government defense communities.
	The board would select and hire a chief executive officer whose qualifications would include the ability to work effectively with venture capitalists and emerging companies.
Success Criteria	DoD would evaluate its relationship with CTC based on the commercial innovations actually transitioned into DoD systems and operations. DoD would consider both the number and significance of the transitions that occur, taking into account the multi-year gestation period required for many investments. Failures would be accepted but should eventually be offset by major successes.
Funding	DoD would provide annual “no-year” funding to support CTC’s operations and investments.
Investments	CTC would independently determine how funds would be used in support of its contract with DoD.
	A DoD mechanism coordinated by DTLO would offer advice from DoD stakeholders.
	Any profits or royalties resulting from CTC’s activities would be re-invested to support its program.
Personnel	CTC would operate with a lean staff – maybe 40 to 50 individuals – with a mix of venturing, business, and technical skills.
	CTC would use flexible commercial approaches to hire and motivate qualified personnel.
Contracting Practices	CTC would use commercial practices when contracting with technology companies. It would negotiate flexibly on intellectual property rights and other matters.

Descriptions of how CTC would perform its functions are provided on Table 5. CTC’s overall role would be analogous to that of a DoD program manager, except that CTC would focus on commercial technologies. It would find them and oversee their progress through development, experimentation, testing, and eventual integration by DoD. This is a key role that serves the interests of both companies and DoD customers. From a company’s perspective, CTC would provide access to the Defense Department market, opening doors, removing obstacles, and forging relationships. From the perspective of a DoD customer, CTC would manage the difficult and risky process of developing commercial solutions until their benefits and risks were reasonably clear.

Table 5. CTC Functions: Concept of Operations

TechFinder	<p>CTC would continually seek innovative solutions that address DOD’s problem set.</p> <ul style="list-style-type: none"> • It would maintain wide-ranging contacts with VCs and other organizations, informing them of DOD’s needs and soliciting information about relevant commercial technologies. • It would consider technologies at all stages of development, including late-stage products ready for rapid insertion as well as early- and mid-stage innovations with breakthrough potential • CTC would screen proposals based on innovative quality, potential defense utility, requirements for further development or militarization, and commercial viability
	<p>CTC, in coordination with DTLO, would help companies with innovative solutions build relationships with potential DoD users and customers—and with system integrators where appropriate.</p> <ul style="list-style-type: none"> • For mature technologies, this could lead DoD customers to acquire products for near-term insertion
	<p>CTC would build systematic processes to support its TechFinder role, including data repositories, access mechanisms, and cognizance of technological developments at other commercial, academic, and government sources.</p>
Commercial Solutions Development	<p>CTC would provide support to accelerate and influence the development of immature but promising commercial technologies.</p> <ul style="list-style-type: none"> • It would independently select technologies to support, based on its understanding of DoD needs. It would also consider the potential for successful transition to DoD, including the interest of specific customers and users. • To support development, it would emphasize the use of contracts for development work, prototypes, test articles, and licensing of government technology. • It would also acquire equity in emerging companies, e.g., where that will enable CTC to gain early visibility into innovative technologies • It would promote early relationships between companies and potential DoD customers and users who can offer development guidance.
	<p>CTC would also support companies in commercializing government technologies that DoD will need to use in the future.</p>
Experimental Design and Support	<p>CTC would support experimentation with commercial technologies by DoD users and customers, to discover and validate their potential utility. This effort would facilitate the transition of commercial technologies to DoD.</p> <ul style="list-style-type: none"> • CTC would identify suitable technologies and make prototypes available for experimentation. • CTC would offer expertise on experimental design and conduct, and would arrange for participation by companies.
Test and Evaluation Support	<p>CTC would support the test and evaluation of commercial technologies</p> <ul style="list-style-type: none"> • It would maintain test beds and expertise to enable test and evaluation support for its TechFinder and Commercial Solutions Development functions. It would also maintain access to test beds managed by other organizations. • CTC would offer its capabilities as an inducement for resource-poor companies to work with it. • DoD customers and users would benefit from testing by a trusted third-party to help reduce acquisition risks. • CTC would also offer its expertise to support tests conducted by DoD customers and users themselves.
	<p>CTC would advise users and customers on relevant commercial and government product and security standards.</p>

D. DTLO: Inside Organization

DTLO would collaborate with CTC to promote the rapid insertion of innovative commercial technologies into DoD systems and operations. This section discusses how DTLO would be organized and how it would perform its functions.

A summary of the DTLO organization is sketched on Table 6. The key point is that DTLO must be designed to succeed. It would coordinate a new process that some would view as a challenge to traditional DoD approaches. To succeed, its leadership, resources, and hierarchical position must signal interest and support at the highest levels of the Defense Department.

Table 6. DTLO Organizational Highlights

Government Organization	DTLO would be a new organization established within DoD
Oversight	DTLO would be established at a high level and would require demonstrable support from the highest levels of DoD
	A Senior Technology Advisory Board would be established to centralize guidance and support from top DoD officials. An advisory board to represent DoD stakeholders would also be formed.
Success Criteria	DoD would evaluate DTLO based on the functional value of commercial innovations actually transitioned into DoD systems and operations. DTLO would be a key enabler for CTC and its own success would depend on CTC's success.
Personnel	DTLO would operate with a minimal core staff comprising 20-25 permanent billets and augmented with additional liaison staff from DoD stakeholders.
	The individual assigned as DTLO director would be highly competent, enthusiastic about the mission, and have an entrepreneurial bent.
Funding	DTLO would be funded by annual appropriations.

DTLO would be assigned three major functions that support the overall end-to-end process described above. Following is a more detailed description of how DTLO would perform those functions.

DTLO's functions and a concept for performing them are described on Table 7. In general, DTLO holds a pivotal position at the beginning and end of the process; it must ensure that CTC is aware of and understands DoD's problems and needs and that DoD customers and users consider the solutions that CTC finds. DTLO is the inward enabler that will allow DoD to take advantage of innovative commercial technologies.

Table 7. DTLO Functions: Concept of Operations

<p>Problem Definition</p>	<p>DTLO would orchestrate a process to define a broad problem set to provide strategic guidance to CTC.</p> <ul style="list-style-type: none"> • DTLO would periodically consult with DoD users, customers, and S&T providers to identify problems and needs. • DTLO would formulate problem sets in coordination with stakeholders and senior technology officials. • DTLO would continually update its awareness of problems and needs and interpret problem sets accordingly as requested by CTC.
<p>Process Coordination</p>	<p>DTLO would coordinate communications and facilitate collaboration between CTC and DoD users, customers, and other stakeholders.</p> <ul style="list-style-type: none"> • DTLO would help users and customers send specific requests to and work with CTC. • DTLO would help CTC identify and work with potential DoD users and customers. • DTLO would help build relationships between CTC and the DoD S&T community, especially to enable the commercialization of DoD technologies.
<p>Transition Support</p>	<p>DTLO would manage a transition support fund to aid the insertion of CTC technologies into DoD systems and operations.</p> <ul style="list-style-type: none"> • The fund would support the timely transition of ready or near-ready products as they are found and business cases warrant. • It could be used to acquire prototypes, defray related integration and infrastructure costs for DoD users and customers, and help bridge other budget-related funding gaps, e.g., critical technology deployments or partial deployments while waiting for traditional procurement methods to work. Use of the fund to support procurement would be discouraged. • DTLO would develop mechanisms to ensure that DoD customers would follow through and complete the transitions enabled by DTLO funds. • The fund would be replenished by annual appropriations; mechanisms should be explored to enable recipients to reimburse DTLO as funds became available under standard regulations.

E. Process Implementation

The new process would be implemented in phases. To ensure continuity with existing collaborations between DoD and venture capitalists, DTLO would be established quickly. CTC's initiation would require more preparation.

1. Early Harvest Initiative

A notional implementation timeline is shown on Figure 3. If, for example, DoD decided by May 1, 2003 to proceed with the Defense Venturing Process and commit resources, it could stand up DTLO by August 1, 2003. CTC, however, would be an external organization and more time would be needed for garnering Congressional support for a strong charter, as well as detailed planning, soliciting proposals, and recruiting personnel. Figure 3 optimistically depicts CTC as operational within nine months.

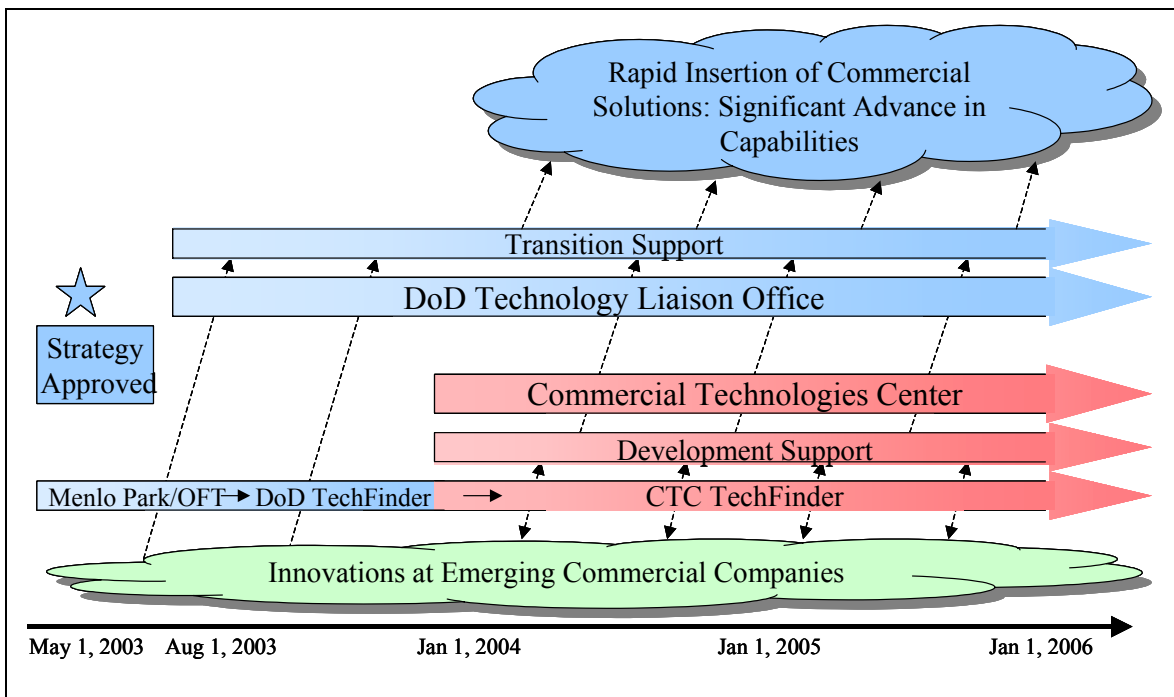


Figure 3. Implementation Phasing

DTLO's early start would enable DoD to expand its current cooperative engagements with VCs, including the meetings held in Menlo Park and the efforts of DoD's Office of Force Transformation (OFT). As the figure illustrates, DTLO would continue these efforts and perform an interim role as TechFinder. Eventually CTC would take on its full TechFinder role as described in previous sections.

The transition support fund at DTLO would be funded from the start, enabling that Office to lead what could be called an early harvest initiative. Its TechFinder would work with existing and new VC contacts and other sources to identify ready and near-ready commercial technologies that could quickly be inserted by DoD to improve capabilities in the near term. DTLO would identify DoD customers and users and help them seize these unplanned opportunities, offering seed funding from the transition support fund where appropriate. This initiative to harvest “low-hanging fruit” would provide immediate benefits for DoD, signal the Department’s continuing interest to the VC community, and establish DoD on a learning curve for implementing its ultimate process.

After CTC became operational, it would assume the TechFinder role from DTLO and expand it to the full scope discussed in previous chapters. The early harvest initiative would continue indefinitely as part of the broader process. CTC would search for both early- and late-stage technologies, supporting the development of the former and seeking DoD customers for the latter. DTLO would help customers and users harvest the mature products and offer support through the transition support fund.

2. Implementation Planning

The overall process represents a strategic enhancement which adds both additional access to technology and a more commercial business-like model to augment DoD’s more traditional approach to finding and acquiring solutions. Careful preparation would be essential, especially for establishing a legal and regulatory framework to enable CTC to perform as required.

Responsibility for implementation would be assigned to a committed, enthusiastic, and highly competent executive. Leadership capabilities and team building skills would be paramount. This leader would be aided by transition teams that would demonstrate the support of high-level officials and articulate the needs of DoD stakeholders. The prompt availability of adequate funding would send a strong signal of support. A smooth and substantial start would be essential to maintain momentum and begin the early transitioning process as soon as possible. The leader would ensure that DTLO was established quickly and became operationally effective with minimal delay. The leader also would be responsible for implementing the overall process, including the establishment of CTC. Since initiating DTLO and preparing for CTC are both major tasks, the implementation leader would not necessarily also be the DTLO director.

A key planning task would be to design an enabling legal and regulatory framework for CTC, which must enable CTC to operate in a flexible, entrepreneurial, commercial style while also ensuring that DoD funds are used in an effective, accountable way. Locating CTC in an independent not-for-profit entity would aid in providing both commercial deal-making flexibility and full fiscal accountability. In addition, existing DoD regulations include provisions for flexibility in negotiating intellectual property rights and “other” transactions (OTRs) and in meeting requirements for competition. Serious planning would nevertheless be required to determine whether these provisions would be adequate for CTC, to ensure that they could be invoked when and as necessary, and to seek Congressional support and wording as required.

VI. CONCLUSIONS

To maintain technological superiority and achieve its force transformation goals, the Department of Defense needs to take advantage of all potential sources of innovation. One source that DoD does not draw on enough is the world of emerging companies developing innovative products for commercial markets. This paper sketches a new venturing process that could enable DoD to obtain critical emerging technologies from the commercial sector more effectively.

The process includes a number of features designed to ensure that DoD could find solutions, nurture them, and transition them into use.

- **VC Collaboration:** The process would build partnerships with a wide range of venture capitalists to find innovative companies and potential solutions.
- **Entrepreneurial Approach:** The process would include a not-for-profit organization, CTC, with the independence, flexibility, and resources to operate effectively in a business-like manner in the fast-paced, opportunistic space of emerging companies.
- **Commitment to Transition:** The overriding objective of the process would be to improve DoD capabilities through the transition of innovative commercial technologies into actual use. The process design reflects this commitment from beginning to end:
 - ❖ **Problem Definition:** A new government organization, DTLO, would ensure that the problems and needs of users and customers guided the process.
 - ❖ **Early Contacts:** Companies with potential solutions would be matched to users and customers from the start.
 - ❖ **Early Shaping:** Resources would be provided to accelerate the development of embryonic technologies, increase the number of solutions addressed, and enable the inclusion of critical defense-related capabilities at the earliest stages of product development.
 - ❖ **Experimentation:** The process would actively support experimentation by users in a partnership to discover the utility of commercial technologies.
 - ❖ **Test and Evaluation:** The process would include recurring test and evaluation of potential solutions to reduce acquisition risks.
 - ❖ **Transition Funding:** Seed funding would be available to help users and customers seize unplanned opportunities as they arose.

The process would operate through two new organizations, working cooperatively with the traditional acquisition structure. They would provide a service, finding and nurturing commercial innovations to the point that the traditional process could take over. The new venturing process would be designed to take prudent and necessary business

risks that the traditional process could not, to capitalize on potential breakthrough innovations.

The ultimate success of the new process would depend on the utility of the potential commercial solutions. They would compete with solutions found at other sources by the traditional acquisition structure. Some failures should be expected in this search for truly revolutionary innovations.

APPENDIX A: OTHER VENTURING MODELS

The problems discussed in Chapter I have not gone unnoticed within the federal government. The Central Intelligence Agency, the Navy, and the Army, among others, have already initiated efforts to resolve these issues. Additionally, private entities have sprung up, both for-profit and not, mainly in response to rising commercial interest in defense activity in the wake of September 11. These efforts contributed valuable lessons learned that were incorporated into the proposal discussed in this paper, a design for a new venturing activity that could serve the entire Department of Defense.

This Appendix describes a sampling of these other initiatives; it is not intended to be exhaustive. The examples given are taken only from organizations within the Department of Defense or the Intelligence Community, or private entities whose primary customers lie within those circles. They were chosen to be representative of the possible models for functionality and organization.

On the basis of primary activity, three categories distinguish themselves. The first contains federal programs that seek to disburse existing R&D funds either in a non-standard way or to non-traditional recipients. These include the Small Business Innovation Research Program (SBIR) and its variants, as well as the Dual Use Science and Technology Program (DUST). The second category includes initiatives that seek to bridge the gap between the R&D and acquisition communities within the DoD and broker deals, either internally or externally. Examples are Rosettex and the Navy's Commercial Technology Transition Office (CTTO). Finally, entities that make direct equity investments in emerging firms with technologies of interest to DoD comprise the last category. Among these are In-Q-Tel and the upcoming Army Venture Capital Investment Corporation.

A short description of each of the chosen examples' organizational and functional models, together with a summary of the strengths and weaknesses of each approach, appears below.

1. New Approaches for Non-Equity R&D Investment

The two programs discussed below are sizeable efforts initiated by Congress to improve the diversity and efficiency of R&D spending within DoD (as well as the rest of the federal government, in the case of SBIR). There are certain problems inherent in any

such Congressionally mandated program. Typically, the vast majority of the necessary funding for the programs comes out of DoD's existing R&D funds. This leads to a perception of those programs as an external "tax" on the Department. Also, these initiatives may come to be regarded as politically sensitive, because Congress often restricts flexibility and imposes strict regulations, for example, to guard against improper use of funds. A last concern is that both programs may fall short of bringing in innovation from all available sources, even within the legislated constraints.

a. Small Business Innovation Research

The U.S. Congress established SBIR in 1982 to stimulate technological innovation; to utilize small businesses to meet federal R&D needs; to foster and encourage participation in technological innovation by socially and economically disadvantaged small businesses; and to increase private sector commercialization of innovations derived from federal R&D. The program is funded through a directive that requires all federal organizations with R&D budgets exceeding \$100 million to allocate 2.5 percent of those funds to SBIR. DoD's contribution is about \$750 million, the largest of any federal department.

The Congressional legislation specifies the structure of the awards process and the character of the awards, as well as the primary criteria for selecting recipients. Twice a year, each participating agency releases solicitations listing desired topics of research. After a short period, individual proposals are evaluated within the participating agency primarily on the basis of scientific and technical merit and the potential for commercialization. The funding and selection process has three phases. Phase I awards of up to \$100,000, and six months are intended to fund feasibility studies. If Phase I is judged successful, companies may apply for Phase II awards of up to \$750,000 and two years, during which they are expected to develop their ideas into prototypes. Phase III involves completing product development and commercialization, but no funding is provided for it.

One of the main concerns with SBIR in DoD is that it fails to resolve one of the key problems with typical R&D funding: it assumes that successful completion of Phase II will result in further development by the private sector or contracts from the acquisition community. Some commercialization studies of the SBIR projects indicate that as many as 40 percent of the projects receive some form of follow-on funding, either sales or further funding for development. In many cases, however, companies are left with a working prototype but no funds to pursue commercialization. This is the potential

discontinuity discussed in Chapter I of this paper. Another concern is that new innovations outside the specific topics requested are not considered.

The Defense Department has instituted several additions to the SBIR program to address this transitional gap. The Fast Track Program is intended to leverage outside funding and incentivize SBIR companies to seek private investment as soon as possible. It provides for interim funding of \$30,000 between Phases I and II to enable the recipient to pursue private funds, along with expedited evaluation for Phase II awards and a higher chance of selection. Similarly, the Phase II Plus Program provides up to \$250,000 and a one-year extension to Phase II projects that attract investment from the acquisition community.

The Commercialization Assistance Program pursues a more active approach. Phase II companies that opt in to the program are mentored and assisted with introductions to facilitate private investment or acquisition contracts. In the Navy's version of this program, a "virtual showcase" is held to exhibit participating companies to potential customers in DoD.

The federal SBIR program has gained a reputation, deserved or undeserved, for being more a means of reaching out to constituencies than of improving federal R&D spending. The Congress has expressed its desire that disadvantaged businesses receive a share of the program's funds, and individual legislators may show a special concern that awards be made in their respective districts. Also, the legislation that established SBIR is very detailed and imposes a certain rigidity in implementation that prevents individual departments from tailoring the program to their needs, and the Small Business Administration is tasked with ensuring that the participating organizations do not deviate from the strict regulations. This inflexibility encourages the growth of businesses that "survive" on repeated SBIR awards without ever commercializing their research.

b. Dual Use Science and Technology

In 1998, the Congress established DUST to encourage private industry and the military Services to co-fund the development of dual-use technologies and, in so doing, to encourage the Services to adopt this approach as a normal way of doing business. Each year, the Services issue solicitations for proposals, which are then evaluated on the basis of quantity and quality of industry cost share, military and commercial viability, and technical and business approach. At least 50 percent of the project cost must be paid by non-federal participants. Presumably, this investment on the part of outside firms ensures that commercialization of the resulting products will be pursued. Awards must be made

under non-procurement agreements, either “cooperative agreements” or “other transactions,” and thus are exempt from the Federal Acquisition Regulations (FARs), giving them considerable flexibility in intellectual property negotiations.

The Congressional legislation established goals for the Services as a percentage of their applied research (6.2) funds, scaling from 5 percent in fiscal year 1998 to 15 percent in 2001. There is some concern that the latter, higher goals may only be achieved by cutting spending on military-specific research. A further concern is that the funding for the program itself has steadily decreased since its inception. If Congress does not maintain an adequate level of funding, the dual-use philosophy may quickly fall out of favor with the Services. Even if the dual-use emphasis remains, awarded projects may still fall disproportionately among traditional prime contractors, for the reasons elaborated in Chapter I.

2. Bridging Development Gaps

Many of the initiatives considered during our research focused on improving information exchange between interested customers in DoD and potential sellers, as well as coordinating the development process so that discontinuity could be avoided. The examples included here are interesting because they attempt to close the transition gap from different directions. The CTTO starts with a customer that has a specific problem and searches for technology solutions; Rosettex starts with its own assessment of problems and needs (within broadly defined problem areas), finds technologies, and orchestrates the process of developing them and transitioning them into use.

a. Navy Commercial Technology Transfer Office

The CTTO, established in 1999, seeks to promote the rapid insertion of technology from any source into Navy systems. It accomplishes this by identifying specific needs at existing program offices together with time, money, and risk constraints. Then a search is conducted among private and government sources, mainly through informal networking. If a commercial solution exists or is nearing completion, the CTTO assesses its potential for meeting the program office’s constraints, and then brokers development and acquisition deals. The CTTO mitigates the transition gap by staying involved from assessment of needs through to acquisition contracts. Addressing problems directly identified by program offices eliminates the problem of finding customers, but it also restricts the subsequent technology search to companies and technologies that are relatively mature.

b. Rosettex

The private sector also has entered into the business of coordinating technology development with future consumers in DoD. Rosettex is a for-profit organization that manages a consortium of seventy independent entities, including innovative technology firms, traditional defense contractors, research universities, and private R&D laboratories. The members of the consortium were chosen so that Rosettex could address the entire timeline of technology development up to acquisition, and they are divided into groups organized around stages on that timeline to eliminate conflicts of interest. First, members reach out to users within DoD and independently analyze needs. Next, other members assess the availability of the required technologies. A third group performs R&D and prototyping, and still another group completes development and commercializes the products. The last group inserts the technology into integrated systems.

Rosettex itself maintains only a small staff to administrate membership in the consortium and to form integrated product teams from the various member groups. Rosettex's coordinated approach bridges potential discontinuities in the development process, even bringing in prime contractors to ensure that products can be inserted into major DoD platforms. Nevertheless, Rosettex has no guarantee that DoD will acquire its products. Program managers may be uninterested or may delay acquisition for two years or more while they attempt to get the requisite funds.

3. External Equity Investments

The last category of models involves a more active approach than the others. The advantages of purchasing equity in a company of interest are well known to private investors, and considerable research has been done on the characteristics of such activities. The exemplar within the federal government is In-Q-Tel, the Central Intelligence Agency's private, non-profit, venture capital firm. In-Q-Tel has undergone repeated scrutiny by the CIA itself, the Congress, and officials in DoD interested in pursuing a similar approach. The new firm has fared well in these assessments, leading the Congress to earmark \$25 million of Army funds for a Venture Capital Investment Corporation to be modeled along the lines of In-Q-Tel. The legislation did not indicate that the allocation would be continued for more than one year, so the Army has decided to implement a model designed around the need to become self-sustaining, swiftly. In

many respects, however, the planned organization is similar to In-Q-Tel; thus, only In-Q-Tel is discussed in further detail.⁹

After considerable internal research and debate, the CIA decided that its extant research mechanisms were too large and slow to stay ahead of the IT revolution, or to even keep pace with it. To address those issues, In-Q-Tel, a 501(c)3 corporation, was formed in 1999 with a five-year CIA charter. Its objectives were to raise the Agency's IT competence to the levels enjoyed in the private sector, and to stimulate research that would place it on the leading edge of that technology.

One of the key components to the CIA's model is the In-Q-Tel Interface Center (QIC), an office within the CIA that liaises between In-Q-Tel and the Agency. The QIC prepares annual statements of Agency-wide IT needs to guide In-Q-Tel's investments, identifies end users in the Agency for In-Q-Tel's technologies, coordinates the negotiation of contracts between companies and the CIA, and facilitates direct communication between end users and developers selected by In-Q-Tel in order to assure that final products match user requirements. It also has substantial funding and staffing to support the insertion of In-Q-Tel's sponsored products into the Agency, thereby bridging the transitional gap between development and acquisition.

The corporation itself operates along the lines of a small venture capital firm, with additional staff in place to support piloting and insertion into the Agency, as well as marketing to potential users. In-Q-Tel maintains a network of contacts with other venture capital firms, both to track technology advances at small firms and to encourage co-investment. In-Q-Tel also surveys the open market for developments, and tracks advances at universities, defense contractors, DARPA, and similar research organizations.

Like any venture capital firm, In-Q-Tel conducts rigorous assessments of the technological and business potential of a potential portfolio company. In-Q-Tel seeks investments that both produce solutions to CIA needs identified by the QIC and have the potential for significant returns. Investment decisions are vetted by internal review boards, with the CIA represented through the QIC in a non-voting capacity. For each investment, In-Q-Tel provides unified management through to marketing within, and potential acquisition by, the Agency, as well as CIA-specific technological expertise and testing capabilities.

⁹ Note that Rosettex too is building a small venture capital fund.

In-Q-Tel's charter provides for substantial flexibility in negotiating contracts with portfolio companies, especially in the area of intellectual property rights. As a private corporation, Federal Acquisition Regulations do not apply. Oversight is provided by the QIC, which is subject to review by Agency boards. Since In-Q-Tel is relatively new, it also relies upon the CIA for funding its operating costs.

It is important to note that In-Q-Tel has no guarantee that the CIA will procure its sponsored products; In-Q-Tel must compete with traditional sources. Thus, to foster its own survival, the firm actively markets its solutions inside the Agency. This competition incentivizes In-Q-Tel to ensure that its sponsored products are well matched to user needs.

GLOSSARY

COTS	Commercial Off-the-Shelf (products)
CTC	Commercial Technologies Center
CTTO	Commercial Technology Transition Office (Navy)
DARPA	Defense Advanced Research Projects Agency
DTLO	(Department of Defense) Technology Liaison Office
DUST	Dual-use S&T (Program)
FAR	Federal Acquisition Regulation
IT	Information Technology
QDR	Quadrennial Defense Review
ODUSD(S&T)	Office of the Deputy Under Secretary of Defense for Science and Technology
OFT	Office of Force Transformation
QIC	In-Q-Tel Interface Center
OSD	Office of the Secretary of Defense
OTR	“Other” Transactions
PPBS	Planning, Programming, and Budgeting System
R&D	Research and Development
SBIC	Small Business Investment Companies (Program)
SBIR	Small Business Innovation Research (Program)
S&T	Science and Technology
VC	Venture Capitalist

REPORT DOCUMENTATION PAGE			<i>Form Approved OMB No. 0704-0188</i>		
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1. REPORT DATE (DD-MM-YY) March 2003		2. REPORT TYPE Final		3. DATES COVERED (From - To)	
4. TITLE AND SUBTITLE Defense Venturing Process: A Model for Engaging Venture Capitalists and Innovative Emerging Companies			5a. CONTRACT NO. DASW01-98-C-0067		
			5b. GRANT NO.		
			5c. PROGRAM ELEMENT NO(S).		
6. AUTHOR(S) David R. Graham, James P. Bell, Andrew J. Coe with Gregory N. Larson, Michael S. Nash, Stephen M. Olechnowicz			5d. PROJECT NO.		
			5e. TASK NO. AK-6-2229		
			5f. WORK UNIT NO.		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Institute for Defense Analyses 4850 Mark Center Drive Alexandria, VA 22311-1882			8. PERFORMING ORGANIZATION REPORT NO. IDA Document D-2847		
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Office of the Deputy Under Secretary of Defense (Science and Technology) 1777 N. Kent Street, suite 9030 Rosslyn, VA 22209			10. SPONSOR'S / MONITOR'S ACRONYM(S) ODUSD(S&T)		
			11. SPONSOR'S / MONITOR'S REPORT NO(S).		
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution unlimited.					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT To maintain technological superiority, DoD needs to access and insert innovative technologies from all available sources. Recently, several DoD organizations have explored the use of venture capitalists (VC) and VC methods to gain access to innovations at emerging companies. This paper examines the rationale for defense venturing, identifies some alternative approaches, and outlines a plausible, end-to-end venturing process.					
15. SUBJECT TERMS Venture capital(ist), VC, innovation, start-up companies, defense R&D, technology transfer					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT UU	18. NO. OF PAGES 35	19a. NAME OF RESPONSIBLE PERSON Dr. Steven E. King
a. REPORT U	b. ABSTRACT U	c. THIS PAGE U			19b. TELEPHONE NUMBER (Include Area Code) (703) 588-7560