Executive Summary

Some trends have been emerging over the last several years that significantly effect the way the Department of Defense (DoD) conducts R&D. One trend is the fact that budgets for R&D (in real dollars) will continue to decrease. Also, the development of commercial high tech industries will continue to be a source of innovation for military procurements in some industrial sectors. With the shrinking of the Federal R&D budget and the proliferation of technology, federal laboratories need to find alternative ways to leverage their R&D through alliances with industry.[1] Industry also prefers to leverage their own R&D efforts by exchanging ideas, accessing unique facilities, and building on the work the labs have done.[2]

The purpose of technology transfer is to make federally generated scientific and technological developments accessible to private industry and the state and local governments. Legislation has focused on the transfer of technology from the Federal laboratories to the private sector, however, value also has been realized by the federal partners. The Cooperative Research and Development Agreement (CRADA) is one mechanism by which technology transfer can occur. The CRADA is a mechanism which allows flexibility in R&D and protects the intellectual property of both parties. The objective of this study was to evaluate a sampling of DoD CRADAs to assess the benefits that the DoD is reaping from participating in these agreements.

The intent of Congress has remained essentially the same for many years: leveraging federal R&D dollars for the greater good of the economy. The expectation has been that more partnerships between industry and Federal labs would improve U.S. competitiveness, help small businesses, and create new jobs and products for the nation's economy (The Stevenson-Wydler Technology Innovation Act of 1980 and the Technology Transfer Act (TTA) of 1986). In accordance with these laws, the FY93 Defense Authorization Act established the Office of Technology Transition within the Office of the Secretary of Defense to ensure "that technology developed for national security purposes is integrated into the private sector of the United States in order to enhance the national technology and industrial base, reinvestment, and conversion activities...."[3] As illustrated in a Secretary of Defense memorandum, the OSD is clearly encouraging technology transition activities to promote cost sharing of DoD R&D through dual-use initiatives; integration of commercial technology through "spin-on" mechanisms, as well as making existing technology more affordable and accessible through spin-offs.[4]

As of the time of this study, June 1998, there were a total of 2456 DoD CRADAs initiated since the inception of the TTA of 1986. Of the 2456 CRADAs, 1256 were completed or closed-out. Initially the study was to focus exclusively on closed CRADAs, however, difficulties were encountered in finding federal POCs who had either retired, left the Government, or whose positions were eliminated as a result of base closures and also in finding non-federal POCs whose companies no longer existed. Therefore, it was determined that the most practical approach was to focus on CRADAs that were closed as well as some that were still open and already showing progress. CRADAs were selected from those that were available and recommended by the Offices of Research and Technology Applications (ORTAs) as well as from those that were gathered from various published sources. This study was not meant to be comprehensive. Since it was not practical to evaluate all CRADAs, a sampling of 30 CRADAs were chosen (10 from each Service) for evaluation from a total of 131 CRADAs that were identified for possible use in this study.

DoD has developed five management principles to guide in the development of the S&T programs of the Military Departments and Defense Agencies. These management principles, or elements, are designed to place the best mix of capabilities possible into the hands of the operational forces by leveraging the best resources in the DoD and the nation.[5]

Guiding Management Principles of the DoD S&T Program

- Transition Technology to Address Warfighting Needs
- Reduce Cost
- Strengthen the Industrial Base
- Promote Basic Research
- Assure Quality

Army CRADAs

		Address Warfighting Needs	Reduce Cost	Strengthen the Industrial Base	Promote Basic Research	Assure Quality
A1	Advanced Technology for High Resolution Physics Based Interactive Simulations	●	●		●	●
A2	Blanket CRADA Between Ford, General Motors, Chrysler and the U.S. Army Tank-Automotive Research, Development and Engineering Group				●	
A3	Construction Equipment Performance Optimization			●	●	●
A4	CORE-LOC Concrete Armor Unit			●	●	
A5	Development of Biodegradable Polymers			●	●	
A6	Development of Novel Imaging System for Medical, Non-Destructive Testing & Investigation of Micro-electronic Circuits			●	●	
A7	Evaluation of Electron Cyclotron Resonance Plasma Technology	●		●	●	●
A8	Formulation of a Liposomal Transdermal Vaccine System and Other Novel Pharmaceuticals	●		●	●	●
A9	Full Scale Fabrication & Optimization of Composite Cylinder Processing		●	●	●	
A10	Vaccines for Infectious Desease	●		●		●

Navy CRADAs

		Address Warfighting Needs	Reduce Cost	Strengthen the Industrial Base	Promote Basic Research	Assure Quality
N1	CRADA between The Naval Training System Center and Computer Group of Motorola, Inc.	●	●		●	
N2	Deep-Towed Acoustic/Geophysical System	●			●	
N3	Demonstration of CL-20 Based Explosive Formulations	●		●		
N4	Detection of Contraband and Narcotics by Nuclear Quadrupole Resonance (NQR)/Fast Recovery Time Nuclear Quadrupole Resonance Detection			●	●	
N5	Electric Vehicle/Hybrid Electric Vehicle Battery Chemistry Research & Evaluation				●	
N6	Exploring the Effects of Lipid-Lowering Agents on Complex Cognitive and Performance Tests	●				
N7	New Paint Formulations for Fluorinated Polyurethane Resins		●	●		
N8	Ocean Bottom Profiler (OBP) Joint Project	●		●	●	
N9	Technical Assistance to CIT			●	●	
N10	Use of Spinning Microfilters to Separate Oil from Water for Abatement of Marine Spills				●	

Air Force CRADAs

		Address Warfighting Needs	Reduce Cost	Strengthen the Industrial Base	Promote Basic Research	Assure Quality
AF1	Automated Software for Composite Material Analysis			●	●	
AF2	Covert Adjustable Laser Illumination CRADA	●		●		●
AF3	Hazardous Materials Management System		●	●		
AF4	Helmet Mounted Display Fitness of Use	●			●	
AF5	Ogden Air Logistics Center X-Ray/Computed Topography Sections			●	●	
AF6	Strategic Avionics Battle Management Evaluation and Research (SABER)	●	●			
AF7	Test and Evaluation of Imaging System	●		●		
AF8	USAF CRDA Between Weber State University and the Science and Engineering Laboratory				●	
AF9	Warhead Arena Test				●	
AF10	Whole Spacecraft Isolation System for Taurus/GEOSAT	●	●		●	

Given that there is no common definition of "value" (i.e. metrics) as it relates to a CRADA, the DoD S&T guiding management principles were used as a means of showing value back to DoD. CRADAs must support specific R&D efforts that are related to and consistent with the DoD laboratory's mission, therefore, it is reasonable to assume that if the CRADAs evaluated in this study reflect the DoD S&T management principles, then they add value to the DoD S&T program as a whole. In fact, many of the CRADAs evaluated in this study met more than one of these management principles.

Many interesting findings were deduced from the information gathered from the interviews with the federal and non-federal CRADA partners on their particular collaborations. There is a belief that CRADAs should lead to commercial products in order to be considered "successful." However, in actuality this appears to be the exception rather than the rule. CRADAs typically entail knowledge-share opportunities that facilitate advances in research leading to product or process improvements, advancing research to points that would have taken longer to achieve independently, or allowing an opportunity to perform research that would not have otherwise occurred due to restricted funding resources. The following findings were recurring themes described by participants in the collaborations.

General Findings

- CRADAs are seen by many Labs as mission extenders
- CRADAs can provide a means for industry to talk openly with Government
- CRADAs are a means of advancing research to points that would otherwise have taken longer to achieve independently
- CRADAs can provide access to Government/Military facilities that are not otherwise commercially available
- CRADAs can result in new, improved, or more cost effective products/processes
- CRADAs can eliminate interpersonal barriers that can arise in a contractual relationship
- CRADAs are successful when objectives are clearly laid out
- CRADAs can advance research for both partners sometimes leading to new programs/contracts
- CRADAs that result in follow-on CRADAs between organizations is an indicator of progress

In supporting the belief that successful CRADAs should lead to commercial products, many of the CRADAs selected for evaluation in this study resulted in products or product improvements. Some of the products are either still in development or pending commercialization, however, they are at stages where they are considered to be viable products. In some cases, the use of DoD facilities or test sites provided a means for products to be further refined as a result of the data gathered by the industry partner.

The values for both the work-in-kind and cash-in (cash-in was $31,046,098.00 in FY98) illustrate the importance industry is associating with the CRADA mechanism as well as the significant contribution partnering is making to the DoD mission. The actual dollars that are coming into the laboratories cover such costs as overhead, materials, third party contracts, and travel expenses.

In addition to the above findings, during the course of the study some interesting insights were discovered. In most cases, the ORTA is not the first point of entry for an industrial partner wishing to do business with the DoD. CRADAs are typically initiated through working relationships that have evolved between scientists over the years through research conferences, consortia, contracts, etc. In some cases the industrial partner or government scientist initiates a literature search to find those people working in a specific area of interest. This finding underscores the need for S&Es to know how to use this mechanism.

It was interesting to note that the scientists and engineers are not as aware as they should be of the technology transfer process that exists at their laboratories. Additional training in technology transfer processes and what the mechanisms can do for the S&E could exploit the use of these mechanisms making technology transfer more effective.

In reviewing the sample of CRADAs selected, it became apparent that these collaborations do not take a simple linear route to commercialization and may only serve as one step in a series of steps along the route. Each partnership is unique in its process to meet its objectives. Some CRADA partnerships are a continuation of an earlier contractual partnership for the purposes of bringing a technology into the commercial sector. Some CRADAs lead to a patentable product or process bringing dollars back to the laboratory. Some CRADAs leverage R&D dollars and make small advances in a specific technological area which over time (and maybe many CRADAs later), may lead to a product or process which the DoD can access.

Three exemplary CRADAs, one from each Service, are showcased in detail to illustrate their value to the DoD mission and to the private sector.

Three Exemplary CRADAs

- Evaluation of Electron Cyclotron Resonance Plasma Technology
  - Partners: CECOM/NVESD and Texas Instruments
  - Accomplishment: Manufacturing improvements for higher density focal plane arrays. Used new etching process to produce an array 128 pixels X 128 pixels.
  - Impact: One of DoD's long-term investment initiatives in technology maturation
- CRADA Between Naval Training Systems Center and the Computer Group of Motorola, Inc.
  - Partners: NAWC and Motorola
  - Accomplishment: Gained experience in working with new interoperability standard. Co-developed three DIS software tools (Middleman, Aladdin and Daemon)
  - Impact: Tools are used to connect simulators of complex battlefield scenarios
- Hazardous Materials Management System
  - Partners: Air Force Research Laboratory and Modern Technologies Corporation
  - Accomplishment: Beta tested the LINDEN™ Environmental Management System for hazardous materials management.
  - Impact: Streamlined hazardous waste management operations. Winner of the 1995 Ohio Governor's Award for Outstanding Achievement in Pollution Prevention

In summary, in times of constrained R&D budgets, whether it be a small business, a large business or a DoD laboratory, the public and the private sector can benefit from leveraging expertise that lies outside of their own labs in areas of mutual interest. It is evident from this study, that the CRADA mechanism is the mechanism of choice for accomplishing these partnerships. Drawing upon external expertise can provide the means to overcome obstacles that arise along the path to new discoveries or even determine that the path being pursued is leading to a dead-end and another needs to be followed. New knowledge can lead to advancing the research to the next level in the development cycle or can spawn new ideas leading to new R&D programs altogether.

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