THE COMMONWEALTH TECHNOLOGY RESEARCH FUND:

ADVANCING TECHNOLOGY AND ECONOMIC DEVELOPMENT IN VIRGINIA BY INVESTING IN HIGHER EDUCATION RESEARCH

ANNUAL REPORT
JULY 1, 2005 – JUNE 30, 2006

Submitted by the Fund Administrator:
Center for Innovative Technology
The Commonwealth of Virginia Innovative Technology Authority
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EXECUTIVE SUMMARY

In accordance with §2.2-2233.1.E of Title 22, Chapter 22, Article 3 of the Code of Virginia, this report regarding the Commonwealth Technology Research Fund (CTRF) is respectfully submitted. The CTRF was created to attract public and private research funding for institutions of higher education, in order to increase technological and economic development in Virginia. Awards from the Fund were made to Virginia public institutions of higher education or their associated intellectual property foundations.

A total of twelve grants were made: seven in July 2001, four in January 2002, and one in January 2003, for a total of $24,574,630. Implementation costs (including honoraria for peer reviews) amounted to $45,992, for a grand total of $24,620,622 in expenses under this program. All twelve projects have been completed; three were completed in FY 2004, two were completed in FY 2005 and the remaining seven were completed in FY 2006. All grantees were required to submit annual progress and final reports, and this report is based upon their input. A summary of each project appears in the next section.

The impact of the CTRF was broad in terms of financial leverage as well as technology and economic development. From Tidewater to Central and Southwest Virginia to Northern Virginia; from bioinformatics to information technology to defense and homeland security, the CTRF led to significant benefits at participating institutions, their communities, and the Commonwealth in general. CTRF outcomes include increased federal funding, development of curricula and degree programs, intellectual property creation, and company creation. Most CTRF-supported projects will continue activities catalyzed by the Fund. Since investments in basic research and infrastructure often generate mid- and long-term results, future benefits to the Commonwealth can be anticipated. Highlights of achievements and activities since the Fund's inception include:

Leveraged Funding – More than $167 million was leveraged by CTRF grant participants; this is more than a 6.7:1 return. CTRF recipients won nearly 200 federal, private, and foundation grants and received more than $6.8 million in donated equipment. Leveraging included a $5 million, 5-year commitment from the Air Force Office of Scientific Research for the Multidisciplinary University Research Initiative (MURI) at the University of Virginia (UVA), an $8.2 million award from the National Institute for Standards and Technology for the Commonwealth Information Security Center at James Madison University (JMU), a $10.3 million award from the National Institutes of Health – National Institute of Allergy and Infectious Disease to the Virginia Bioinformatics Institute, and a $14.7 million award from the Department of Defense, Research Development Engineering Command (RDECOM) for Pathport: A Common Asset for Biological Security.

Industry Inducement - Relocation of a leading bioinformatics company to Virginia – Incogen invested $2.4 million to relocate from South Carolina as a result of the College of William and Mary Industry Inducement Award. Incogen received a $2 million SBIR Phase II award for cancer diagnostics and currently owns and occupies a building in a new research and technology park in Williamsburg, VA.

New Companies –The creation of Adaptive Genomics Corp, in Blacksburg, was associated with the CTRF award to the Virginia Bioinformatics Institute. Adaptive Genomics currently employs five people.

Intellectual Property – CTRF award recipients reported 45 disclosures, patent applications, patents received, and licenses.

Economic Development and Outreach Outcomes – CTRF projects led to local and regional benefits. The CTRF-sponsored Battle Lab at Old Dominion University's Virginia Modeling, Analysis and Simulation Center (VMASC) increased the strength and recognition of the modeling and simulation cluster in Hampton Roads. A program to train K-12 teachers through an NSF-funded grant, leveraged from the CTRF, between CTRF-funded Virginia Bioinformatics Institute and Galileo Magnet High School in Danville, VA. In addition, the Center for High Performance Manufacturing delivered more than one hundred presentations in more than 70 cities and counties in the Commonwealth.

Recruitment of Strategic Personnel – Many post-doctoral fellows, promising junior faculty and senior faculty with strong reputations and the ability to secure major federally-funded research were recruited to the Commonwealth's institutions of higher learning. Expanded and upgraded research space, acquisition of powerful, cutting-edge equipment and other infrastructure improvements aided in the recruitment of top tier faculty.

Strategic Partnerships – CTRF funds fostered national and international collaborations between Virginia universities and academic and industry colleagues. The establishment of strategic partnerships with businesses and other organizations, such as the partnership between VCU, GMU, and INOVA that is working on cancer genomics and related diagnostic tools and therapies, has advanced Virginia's leadership in technology research.

Upgraded Facilities – Renovation and upgrading of research facilities at UVA's Gilmer Hall and the Virginia Modeling, Analysis and Simulation Center at Old Dominion University has significantly enhanced their ability to obtain federal and private funding.

Capital Equipment – Acquisition of major scientific equipment and computer hardware and software, enabled grantees to enhance their research programs, to attract additional funding and new research staff, and to enhance education and training.

Publications and Presentations – An indicator of the success of the CTRF program is the significant number of publications and presentations that have resulted. CTRF award recipients reported more than 750 publications and presentations.

BACKGROUND

The Commonwealth Technology Research Fund (CTRF) was created in the 2000 Session of the General Assembly to leverage federal and private investment in research at Virginia's public universities. The ultimate goal of this investment was to increase technological and economic development in Virginia. Based on the original legislation and amended legislation of March 2003, the Fund had four components:

- **Strategic Academic Enhancement Program**: This component was based on the evidence that top-ranked departments are disproportionately successful in attracting external research funds. This program provided funds to help strong departments in Virginia's universities to become world-class research organizations. Funding under the strategic academic enhancement program was typically for recruitment packages for new faculty, purchase of specialized equipment, renovation of laboratories, funding for graduate research assistants, and similar activities.

- **Matching Funds Program**: Under this component, universities applied to the CTRF for matches to federal or private grant proposals that they were preparing to submit. These matching funds not only helped to qualify institutions for grant competitions, they also reflected the state's and institution's commitment to the project and influenced decision-makers regarding the feasibility and value of the proposed research.

- **Industry Inducement Program**: This component helped universities upgrade their research capacities in key departments in order to attract specific companies to locate or expand in Virginia.

- **Commercialization Program:** This component enhanced the capability of the universities to commercialize technologies developed through their research.

Awards were to be considered for work in the following disciplines:

- Information technology and communications
- Biotechnology and bioinformatics
- Advanced materials and nanotechnology
- Advanced manufacturing and biomanufacturing
- Aerospace
- Energy
- Environmental technologies
- Transportation

The program was initiated in FY 2002 with $26 million in funding; however, during the 2002 Session of the General Assembly (2002 amendments and 2002-2004 biennium), a decision was reached to discontinue funding the program as a part of statewide budget reductions. The Fund was reduced to cover expenditures and commitments made up to that point (~$24,620,600). A

total of 12 projects were ultimately awarded grants; a detailed listing can be found on page 14 of this report.

The Fund was initially administered by the Department of Planning and Budget (DPB) with policy guidance provided by the Virginia Research and Technology Advisory Commission (VRTAC). In March 2003, the enabling legislation (§2.2-2515 of the Code of Virginia, Chapter 22, Article 3) was reenacted and amended to add a fourth component to support the efforts of the universities in commercializing technologies resulting from their research. At that time, administrative responsibility was also amended, naming the Innovative Technology Authority (ITA) in lieu of DPB, and the transition to ITA's operating arm, the Center for Innovative Technology, occurred at the end of June 2003. No new funds were appropriated; therefore, this report covers activities related to the initial 12 grants.

PROJECT SUMMARIES AND HIGHLIGHTS

Advancing Virginia's Information Security Expertise (SE2002-01)

Researchers at James Madison University, George Mason University, Hampton University, and Virginia Tech established the Commonwealth Information Security Center (CISC), which addresses escalating attacks on computing systems and built a robust R&D program focused on infrastructure and information assurance. The universities partnered with numerous large and small corporations as they pursued research and sought commercial applications. CISC successfully solicited $26 million in federal funding to support its Critical Infrastructure Protection (CIP) Program of which $8.2 million was directed to JMU.

The strong connections built through the Commonwealth Information Security Center have allowed JMU to develop and implement the Institute for Infrastructure and Information Assurance, which now serves as the integrative force behind JMU's efforts within cyber and physical security.

Bringing the Future of Bioinformatics to Virginia (IN2002-03)

The four major objectives of this project were (1) attract INCOGEN to the Commonwealth, (2) enhance the infrastructure for biotechnology research at the College of William and Mary, (3) enhance biotechnology-related programs at the college, and (4) develop and implement bioinformatics and systems biology research partnerships with VBI, leveraging its high performance core facilities (computations and laboratory).

The Institute for Computational Genomics, Inc. (INCOGEN) moved its facilities to Williamsburg, VA from South Carolina in order to collaborate with the College of William & Mary and the Virginia Bioinformatics Institute at Virginia Tech (VBI) in the creation of a cooperative bioinformatics program. Infrastructure investments were estimated at $2.2 million. W&M was able to partner for the first time in multi-investigator collaborative proposals aimed at the National Institutes of Health with the Eastern Virginia Medical School in the area of cancer

proteomics. Furthermore, fourteen biotechnology related courses were created or expanded at W&M.

Additionally, INCOGEN collaborated with Eastern Virginia Medical School and the James Madison University Governor's School for Science and Technology. INCOGEN received a $2 million Phase II Small Business Innovation Research (SBIR) award from the National Institutes of Health – National Cancer Institute to continue its research program in cancer diagnostics. Moreover, INCOGEN is the owner of a building in New Town, a mixed-use development in which the research and technology-focused Discovery Business Park will anchor the development.

Cancer Genomics and Development of Diagnostic Tools and Therapies (SE2002-02)

Virginia Commonwealth University, George Mason University, and Inova Health Systems joined together to explore the role genes play in cancer. The research assisted in the development of more cost-effective means of diagnosing and treating cancer. Researchers applied emerging technology to the health care field and worked closely with technology companies in the Commonwealth.

Within the overall goal of creating infrastructure to productively support research, specific objectives included establishing a tissue bank (enabling researchers to access to human samples), database development, isolating RNA and performing gene expression microarray analysis on each specimen, data analysis, and development of diagnostic biochips. Considerable data was generated addressing crucial aspects of quality control of microarray data, which is critical if these techniques are to be useful for real-time testing of patients for diagnosis and monitoring of disease.

Center for In-vivo Hyperpolarized Gas MR Imaging (IN2002-01)

With the CTRF grant, researchers at the University of Virginia were able to continue their investigations into the possible uses of hyperpolarized Helium-3 and Xenon-129 in medical imaging. UVA remains the world leader in polarization and imaging technology for human applications of hyperpolarized helium-3 and xenon-129. These pharmaceuticals show great promise for improved imaging of lung diseases including asthma, emphysema, and cystic fibrosis. UVA forged a partnership with Nycomed Amersham, a world leader in in-vivo diagnostic imaging, to explore the possibilities these pharmaceuticals possess.

Achievements included the award of a $2.4M, four-year NIH grant to *Develop Improved Methods of Hyperpolarized-Gas MRI of the Lung*. Studies also were done to assess secondhand exposure to smoking as well as lung maturation in children.

In short, the increased sensitivity and specificity offered by hyperpolarized-gas magnetic resonance imaging (MRI) may enable pharmaceutical companies to reduce both the number of subjects enrolled in FDA clinical trials and the time required to establish an observable change in lung status. Currently, clinical trials for new respiratory therapy drugs can cost as much as $100M per drug. Both of these factors will contribute to significant cost-savings for Food and Drug Administration (FDA) clinical trials of respiratory-therapy drugs. This is a major reason for the growing interest of pharmaceutical companies in the new technology of hyperpolarized-gas MRI.

Collaborative Research in Bioinformatics (SE2002-04)

The Virginia Tech Department of Computer Science and the Virginia Bioinformatics Institute (VBI) forged a partnership to create the infrastructure for and implement world-class research, graduate education, and economic development in bioinformatics. More than $64 million in federal and other non-Commonwealth funding was achieved, and VBI received more than $2.8 million in donated equipment.

Other achievements include: 1) the expansion of the graduate curriculum with specialized courses in bioinformatics and computation biology; 2) the establishment of an operational interdisciplinary doctoral degree program; 3) the creation of a high performance / high capacity computational infrastructure, and 4) the hiring of new faculty who produced significant research publications and attracted external research funding. VBI has worked with federal labs as well as U.S. and international companies and research institutes.

The Development of an Environmentally Compliant, Multi-functional Coating for Aerospace Applications Using Molecular and Non-Engineering Methods (MF2002-01)

The University of Virginia, joined by researchers at Ohio State University, the University of Cincinnati, the University of New Mexico, Arizona State University, and the US Naval Academy, received a $5 million, five-year grant from NSF for a Multidisciplinary University Research Initiative (MURI). The $728,000 CTRF Matching Funds grant was instrumental in obtaining this award. The purposed of the project was to develop a new multi-functional coating for military vehicles by implementing advances in molecular- and nano-engineering.

Researchers made technical progress in developing and demonstrating numerous important capabilities of this coating. Attributes include the ability to sense corrosion and mechanical damage and initiate mitigating responses, the ability to change color on demand, the ability to provide corrosion protection and adhesion using environmentally compliant materials, and the ability to improve the fatigue resistance and mechanical integrity of the fuselage.

The coating concepts have significant commercialization potential, evidenced in part by the awarding of two Small Business Technology Transfer (STTR) awards aimed at commercialization. The technology was introduced to several small businesses as well as large companies, including Airbus.

Development of the VMASC Battle Lab Facility (SE2002-05)

The CTRF-supported Battle Lab, an innovative computer simulation laboratory providing advanced modeling and simulation (M&S) infrastructure, augmented the research capability at Old Dominion University's Virginia Modeling, Analysis and Simulation Center (VMASC). This improved and more modern infrastructure allowed the conduct of world-class research, graduate education and economic development in this field, the results of which have both military and commercial applications. VMASC's expanded capabilities allow it to address such problems as larger and more complex simulations, reducing cost and development time, modeling human behavior, and homeland security. Other highlights include expanded interactions with the U.S. Joint Forces Command that led to three task order contracts with a contract ceiling totaling $65 million and an enhanced modeling and simulation community in the region. Lockheed Martin,

for instance, announced plans to construct a $35 million visualization center, and General Dynamics and SAIC committed to establishing offices. VMASC identified non-military applications for modeling and simulation that the Battle Lab's expertise supports. Areas include medical training, transportation, enterprise decision lab, port operations, entertainment and computer gaming, and emergency management. For instance, VMASC researchers are ushering in new technology for medical simulation training. Working with surgeons and other medical personnel at Eastern Virginia Medical School, the Naval Medical School and the Uniform Services University of the Health Sciences, members of VMASC have advanced medical training and curricula through a number of projects. Among these were modeling the Hampton Roads regional medical response to a mass casualty event, and the development of an augmented garment that can be worn by simulated patients to train medical students. This augmented garment would produce the physiological sounds that correspond to various underlying conditions when the patient is examined with a stethoscope. In addition, VMASC partnered with 16 local companies to form the Emergency Management Training, Analysis and Simulation Center, a nonprofit in Suffolk that provides cutting-edge training and support for homeland security and emergency management command and management operations.

Recent active membership of the Virginia Modeling, Analysis, and Simulation Center totaled 105 organizations, including 72 industrial members, 13 government members, and 10 academic members.

Dr. Mielke, PI for the project, attributes CTRF monies as key to VMASC's research expansion and its contributions to the region's stature in modeling and simulation.

Enhancing Virginia's Research Infrastructure for High Performance Manufacturing (SE2002-03)

Researchers at Virginia Tech, James Madison University, and the College of William and Mary partnered with manufacturing firms to establish the Center for High Performance Manufacturing (CHPM). This project assisted Commonwealth manufacturing firms in becoming high performance producers by providing a "one-stop source" of manufacturing research in strategy design and analysis for new products and facilities or re-engineering existing manufacturing systems. It also enhanced the manufacturing research competitiveness of Virginia universities. The universities partnered with dozens of manufacturing firms and organizations across the nation for this project. Nine semi-annual meetings, more than 100 presentations, more than 50 Center-designated and company-designated projects were successfully carried out, and more than 15 disclosures were made. In addition, 24 graduate students were supported; the Center indicated that most of these students proceeded to employment in industry or further graduate study. Furthermore, CHPM was an active participant in the planning and execution of the first three Governor's Summits on Advanced Manufacturing in Virginia.

Gilmer Hall Laboratory Renovations: Cell and Molecular Biology Labs (MF2003-01)
The University of Virginia secured a federal grant ($2 million) for renovation of a portion of Gilmer Hall to provide laboratories for research in cell and molecular biology. Improvements such as renovations to primary lab space, research support space, equipment rooms and interactive spaces such as a conference room were central to building UVA's expertise in

morphogenesis and developmental biology. As with the MURI, this federal grant would not have happened without the CTRF Matching Funds Award.

The CTRF grant was instrumental in recruiting and hiring six new faculty (including two prominent senior faculty), and in providing research space for two promising young tenure-track faculty. All these hires contributed to the expansion and reputation of research in the Biology Department at UVA. The design of the renovated space changed to accommodate the research needs of these individuals, with the University providing additional funding for those modifications. As of June 30, 2006, two of the five modules in the original plans for Gilmer Hall were complete and occupied by faculty performing grant-funded research; a third module will be occupied in Fall 2006 to accommodate two new senior faculty hires. The final two modules have been condensed into a revised and expanded single module that will meet current research needs and allow for future growth. That expanded module should be completed by late 2007.

Governor's Blue Ribbon Commission for a Review of Virginia's Research and Graduate Programs (SE2003-01)

Virginia Tech coordinated the commissioning of a panel of nationally recognized experts to examine the strengths and weaknesses of Virginia's nationally ranked research and graduate programs. This effort involved all the research universities in a significant effort to catalogue and evaluate programs, creating a basis for future investments.

The Commission completed the majority of its work in the fall of 2003. Following the October 2003 Governor's Research Review, seed funding of $10,473,337 was invested in 2004-06 to strengthen higher education. The funding supported research programs that participated in the peer review process and reflected an increased investment in graduate student financial aid.

Mucosal Therapy of Infectious & Autoimmune Diseases (SE2002-06)

Researchers at the University of Virginia, Virginia Commonwealth University and Virginia Tech partnered with biotechnology companies to develop mucosal therapeutics through biotechnology. Their work was influenced by September 11, 2001 events, and the investigation of several pathogens relevant to biodefense have expanded the scope of this project.

VCU's key role was to apply genomics and informatics technology to discover potential targets for immunotherapy or chemotherapy. UVA's primary role was to study the mechanisms of regulation of mucosal immune responses, while Virginia Tech's focus was to develop edible plant vaccines and mucosal delivery systems. By bringing their unique strengths to the project, the three universities established a world-class resource for the development of pharmaceuticals.

Virginia Bioinformatics Consortium (IN2002-02)

Researchers at George Mason University, the University of Virginia, Virginia Commonwealth University and Virginia Tech engaged in groundbreaking developments in the field of bioinformatics, increasing the quality and quantity of bioinformatics research in the Commonwealth. This project included negotiating standards for data management, developing shared data analysis resources, scaling up laboratory facilities at each university, and conducting

collaborative research projects. The Virginia Bioinformatics Consortium (VBC) created a venue for Virginia universities to work together on state-of-the-art research and allowed individual members of the group to maximize research capabilities at their respective institutions.

Key accomplishments include the following: 1) VCU established one of the most comprehensive training programs in the country, 2) for GMU, UVA, and VCU, CTRF support led directly to more than $40 million in new R&D funding, and 3) new software programs that UVA developed for computation biology / biological sequence companies and the GEOFF gene expression database are now standard tools for bioinformation research across the country.

ACTIVITIES TO DATE

Leveraged Funding – More than $167 million was leveraged by CTRF grant participants; this is more than a 6.7:1 return. CTRF recipients won nearly 200 federal, private, and foundation grants and received more than $4.07 million in donated equipment. Leveraging included a $5 million, 5-year commitment from the Air Force Office of Scientific Research for the Multidisciplinary University Research Initiative (MURI) at the University of Virginia (UVA), an $8.2 million award from the National Institute for Standards and Technology for the Commonwealth Information Security Center at James Madison University (JMU), a $10.3 million award from the National Institutes of Health – National Institute of Allergy and Infectious Disease to the Virginia Bioinformatics Institute, and a $14.7 million award from the Department of Defense, Research Development Engineering Command (RDECOM) for Pathport: A Common Asset for Biological Security.

Leveraged Funds

Project	Leveraged Funds Received	Value of Donated Equipment
Advancing Virginia's Security Expertise	$8,516,060	$86,675
Bringing the Future of Bioinformatics to Virginia*	$10,453,091	
Cancer Genomics and Development of Diagnostic Tools and Therapies	$14,535,446	
Center for In-vivo Hyper-polarized Nobel Gas MR Imaging	$4,913,994	$200,000
Collaborative Research in Bioinformatics*	$64,093,156	$2,805,706
Development of an	$4,339,687	$93,000

Environmentally Compliant Coating for Aerospace		
Development of the VMASC Battle Lab Facility	$24,139,566	
Enhancing Virginia's Research Infrastructure for High Performance Manufacturing	$ 943,834	$768,150
Gilmer Hall Laboratory Renovations	$1,906,652	
Governor's Blue Ribbon Commission	Note: Direct pursuit of leveraged funding was not an objective	
Mucosal Therapy of Infections & Autoimmune Diseases	17,966,275	
Virginia Bioinformatics Consortium*	$55,634,813	$2,805,706
Total Federal, Private, and Foundation Leverage*	$167,020,740	$4,076840

** Although $40,421,833 in leveraged funds and $2,805,706 in donated equipment were reflected in the reports of both projects, in order to avoid double counting, these amounts were not included in the final totals.*

Industry Inducement - Relocation of a leading bioinformatics company to Virginia – Incogen invested $2.4 million to relocate from South Carolina as a result of the College of William and Mary Industry Inducement Award. Incogen received a $2 million SBIR Phase II award for cancer diagnostics and currently owns and occupies a building in a new research and technology park in Williamsburg, VA.

New Companies –The creation of Adaptive Genomics Corp, in Blacksburg, was associated with the CTRF award to the Virginia Bioinformatics Institute. Adaptive Genomics develops adaptive computing technology-based systems that are expected to lead to new developments in pharmaceutical and infectious disease research in plants, animals and humans. Its bioinformatics applications enabled researchers to develop new approaches to complex biological problems, including research into existing drug efficacy such as AZT. Adaptive Genomics currently employs five people.

Intellectual Property – CTRF award recipients reported 45 disclosures, patent applications, patents received, and licenses. A few examples of intellectual property follow. "Pathport: A Common Asset for Biological Security," generated from the "Virginia Bioinformatics Consortium," combines information about pathogens from around the world with powerful analysis and visualization tools to aid in the rapid detection, identification and forensic

attribution of high priority pathogens (whether these cause infectious diseases or could be used as potential biological weapons). Since its release in 2003, PathPort has become a national resource.

Other applications include energy and defense and homeland security. The "Collaborative Research in Bioinformatics" project team filed a provisional application for "Fungal Biotechnology Platform," which may be used for the production of new industrial enzymes for the biofuels and cellulose ethanol industry. A disclosure was filed for a surgical simulator to support wound debridement – removing foreign material and/or dead, damaged, or infected tissue from a wound or burn. through the "Development of the VMASC Battle Lab Facility" endeavor.

Translational Research (Commercialization) - Commonwealth universities are committed to moving new technologies, products and processes from the laboratory to the marketplace and have collaborated with, among others, private industry to further this effort. An example of this is the interaction between UVA's project team for "The Development of Environmentally Compliant Multi-Functional Coatings" and Virginia Technologies, Inc., which led to the development and commercialization of the ECI-1, an embeddable corrosion monitoring device intended for aerospace and military vehicles.

Economic Development and Outreach Outcomes

Virginia's economy was impacted positively by these twelve programs. A case in point is the contribution of the CTRF-sponsored Battle Lab at Old Dominion University's Virginia Modeling, Analysis and Simulation Center (VMASC) to the strength and recognition of the modeling and simulation cluster in Hampton Roads. In a report by the Hampton Roads Planning District Commission, VMASC was recognized as important to the growth of that area of the state.

"It is also interesting to note that several organizations, including VMASC and key DoD contractors, perform at different levels within the cluster. These organizations perform a facilitating role, including potential technology transfer and networking across different vertical applications and industries. The impact of this activity is important to the cluster and helps enable it to achieve its full potential and realize emerging growth opportunities.[1]"

Significant outreach efforts were undertaken by CTRF recipients. Among these was a program established for the training of K-12 teachers through an NSF-funded grant, leveraged from the CTRF. In the final report of the Collaborative Research in Bioinformatics, Dennis Kafura and Bruno Sobral commented, "A notable example of this training program is a collaboration between VBI and Galileo Magnet High School in Danville, VA, an economically depressed area. This program uses a problem-based, cross-disciplinary approach, as opposed to an isolated discipline-based approach…Students learn by addressing real life problems, such as the creation

[1] Hampton Roads Planning District Commission and the Virginia Modeling, Analysis and Simulation Center and ANGLE Technology Hampton Roads, "Virginia Economic Impact/Cluster Analysis: Modeling, Simulation & Visualization," March 2005, 8

of a biodefense alert project, which asks students to complete the task of identifying and analyzing an invading pathogen.[2]"

In addition, The Center for High Performance Manufacturing delivered more than one hundred presentations in more than 70 cities and counties across the Commonwealth.

Recruitment of Strategic Personnel; Recruiting and hiring of top candidates in various technology fields - Many post-doctoral fellows, promising junior faculty and senior faculty who bring strong reputations and the ability to secure major federally-funded research were recruited to the Commonwealth's institutions of higher learning. Expanded and upgraded research space, acquisition of powerful, cutting-edge equipment and other infrastructure improvements aided in the recruitment of top tier faculty. In some cases, these new hires considered and accepted positions only because of equipment acquired by CTRF funds. William and Mary, for example, was unsuccessful in attempts to hire two faculty members until acquiring a multiphoton confocal microscope and an automated sequencer through the CTRF program. In another instance, though not directly funded by the CTRF, but because of the improvements in infrastructure it financed, Virginia Tech was successful in attracting five faculty members from Los Alamos National Laboratories. These faculty members were hired together to form a "simulation science" group.

Grant recipients reported that more than 230 students were supported by the Fund; these include undergraduate and graduate students, as well as M.S. candidates, Ph.D. candidates and post-doctoral research associates.

Strategic Partnerships – CTRF funds fostered national and international collaborations between Virginia universities and academic and industry colleagues. The establishment of strategic partnerships with businesses and other organizations, such as the partnership between VCU, GMU, and INOVA that is working on cancer genomics and related diagnostic tools and therapies, advanced Virginia's leadership in technology research,. The partnership between VCU, GMU and INOVA led to the establishment of a human tissue repository. This achievement is significant because "with diseases being increasingly being defined at the genomic and gene expression levels, successful extrapolation of work with model systems increasingly requires well characterized human specimens against which the model systems data can be compared and hypotheses validated.[3]"

Many partnerships developed between universities, such as the collaboration between Dr. Pearson (UVA) and Dr. Buck (VCU), which resulted in the publication of the results of their research into the genome *Cryptosporidium hominis* in *Science* magazine. Dr. Houpt from the University of Virginia worked on validating a test at Kilimanjaro Christian Medical Centre (KCMC), Tanzania, a collaborative site, which developed under CTRF funding. His initial KCMC study, which suggested there may be important differences in the natural history of Cryptosporidium infection in HIV-infected persons depending on parasite species, was published in the American Journal of Tropical Medicine and Hygiene. This collaboration represents one of many between the academic and private sectors that the fund initiated. There were also many

[2] Kafura, D. and Sobral, B. "Collaborative Research in Bioinformatics: Final Report," August 2006, 4, 5.
[3] Garrett, C. and Torr, M. "Cancer Genomics and Development of Diagnostic Therapies Virginia Commonwealth University: Final Report" 2005, 17.

intra-university collaborations initiated by this fund. For instance, the University of Virginia identified additional investigators for the Mucosal Therapies of Infectious and Autoimmune Diseases project at the university. UVA investigators competed for CTRF funds and those investigators who received awards worked together to advance the understanding of infectious and autoimmune diseases of the digestive tract.

Upgraded Facilities – Renovation and upgrading of research facilities at UVA's Gilmer Hall and the Virginia Modeling, Analysis and Simulation Center at Old Dominion University has significantly enhanced their ability to obtain federal and private funding.

Capital Equipment – Acquisition of major scientific equipment and computer hardware and software, enabled grantees to enhance their research programs, to attract additional funding and new research staff, and to enhance education and training. **I**nstrumentation included new genomic and analytical research equipment, an ABI 3100 *Avant* automated DNA sequencer, a phophorimager, a real-time PCR, a confocal microscope system upgrade, the development of the Bioinformatics Computational Core Labs, and sequencing, gene expression, and proteomic equipment.

Publications and Presentations – An indicator of the success of the CTRF program is the significant number of publications and presentations that have resulted. CTRF award recipients have recorded more than 750 publications and presentations.

ADMINISTRATION

Administratively, activities in FY 2006 focused on managing the Fund. This included rolling over unused funds from FY 2005 to FY 2006, processing no-cost extensions in those instances where the work could not be completed in the originally proposed period of time, and following up with the Principal Investigators with respect to final reports.

Copies of recent progress and final reports for each project are on file with the Fund administrator (CIT) and are available upon request.

TABLE OF GRANTS

Award No.	Period of Performance	Principal Investi-gator	Lead Institution	Title	Total CTRF Award	University Match	Federal Funds	Other Match	Total Proposed Match
Strategic Enhancement Program									
SE2002-01	7/1/2001 - 6/30/2005	Noftsinger	JMU	*Advancing Virginia's Information Security Expertise*	$4,092,769	$2,770,554	N/A	$2,554,961	$5,325,515
SE2002-02	7/1/2001 - 12/31/2004	Torr	VCU	*Cancer Genomics and Development of Diagnostic Tools*	$3,000,000	$3,000,000	N/A		$3,000,000
SE2002-03	7/1/2001 - 3/31/2006	Chen	VT	*Enhancing Virginia's Research Infrastructre for High Performance Manufacturing*	$4,339,577	$4,614,107	N/A	$500,000	$5,114,107
SE2002-04	7/1/2001 - 6/30/2006	Kafura	VT	*Collaborative Research in Bioinformatics*	$2,500,201	$2,814,229	N/A	$1,262,486	$4,076,715
SE2002-05	1/1/2002 - 10/31/2003	Mielke	ODU	*Development of the VMASC Battle Lab Facility*	$452,199	$452,199	N/A		$452,199
SE2002-06	11/1/2001 - 6/30/06	Petri	UVA	*Mucosal Therapy of Infectious and Autoimmune Diseases*	$1,800,000	$1,800,000	N/A		$1,800,000
SE2003-01	7/1/2002 - 6/30/2006	Steger	VT	*Governor's Blue Ribbon Commission*	$100,000		N/A		$0
Matching Funds Program									
MF2002-01	7/1/2002 - 5-15-2006	Scully	UVA	*The Development of an Environmentally Compliant, Multi-functional Coating for Aerospace Appication Using Moledcular- and Nano-Engineering Methods*	$728,000	$728,000	$5,500,000		$6,228,000
MF2003-01	1/1/2002 - 12/31/2003	Hornberger	UVA	*Gilmer Hall laboratory renovations: cell and molecular biology laboratories*	$1,000,000	$1,000,000	$2,000,000		$3,000,000
Industry Inducement Program									
IN2002-01	7/1/2001 - 6/30/2006	Brookeman	UVA	*Center for In-Vivo Hyperpolarized Gas MR Imaging*	$1,809,983	$1,945,670	N/A		$1,945,670
IN2002-02	7/1/2002 - 6/30/2004	Plank	UVA	*Virginia Bioinformatics Consortium*	$1,500,000	$1,580,404	N/A		$1,580,404
IN2002-03	11/1/2001 - 6/30/2006	Manos	W&M	*Bringing the Future of Bioinformatics to Virginia*	$1,087,196	$1,038,171	N/A	$2,663,730	$3,701,901