May 2001

Hampton Roads Research Partnership
Technology Commercialization Assessment
Phase 1: Needs Assessment

Sponsored by
Hampton Roads Partnership
430 World Trade Center
Norfolk, Virginia 23510

Presented by
Research Triangle Institute
Center for Technology Applications
3040 Cornwallis Road
Research Triangle Park, North Carolina 27709

Contents

Attachments

Exhibits

Executive Summary

The Hampton Roads Research Partnership (HRRP) intends to leverage its local technology base to create regional economic development that will bring the types of jobs to the area that will increase the regional per capita income. Economic development has stagnated in the last 10 years while that of neighboring regions, such as Northern Virginia and Research Triangle Park, North Carolina, has grown. The HRRP recognizes that the increased job opportunities and per capita income realized by its neighbors are linked to technology-related business. Thus, the HRRP has an interest in leveraging its technology base in future development efforts to bring increased licensing and sponsored research and development (R&D) revenue to the area and to form new local businesses based on "home grown" technologies.

As a first step, Research Triangle Institute (RTI) was tasked with identifying the current capabilities and future opportunities of the HRRP to transfer technology. Nine institutions[1] were examined. RTI performed a benchmarking study, including a strengths, weaknesses, opportunities, and threats (SWOT) analysis of the individual HRRP members and an examination of the performance of the eight members, collectively.

The results of the benchmarking study indicate that no individual institution has the capability to drive economic development. Collectively, the technology transfer capability of the eight academic HRRP members is more effective, but the collective effort still lacks the strength to have an extraordinary economic impact. If the capabilities of the eight HRRP members are combined and enhanced, they could become a key ingredient in a regional economic development model.

The data that RTI collected point to an approach for technology-based regional economic development that includes the following:

- Increasing the technology transfer capabilities of the less active institutions, so that all HRRP members are operating at a shared level of awareness and capability.
- Forming a single point-of-business organization to serve the technology transfer needs of all HRRP members and to facilitate increased research and development (R&D) collaboration among the members.
- Incorporating the technology transfer function into a comprehensive strategy for increasing R&D expenditures and focusing technology transfer on hot technology areas and the existing strengths of the area technology base.

[1] The nine institutions examined were the Jefferson National Laboratory and the eight academic institutions that collectively make up the HRRP: Christopher Newport University (CNU), Eastern Virginia Medical School (EVMS), Hampton University (HU), Norfolk State University (NSU), Old Dominion University (ODU), Virginia Wesleyan College (VWC), and the College of William and Mary/Virginia Institute of Marine Sciences (W&M/VIMS).

1.0 Introduction

Research Triangle Institute (RTI) is providing technology commercialization services to the Hampton Roads Research Partnership (HRRP) as a phased project. This report documents the findings of Phase 1—the benchmarking of the technology transfer capabilities of the nine HRRP institutions.[2] Upon completion of this report, RTI will provide training, as agreed, based on recommendations. RTI has also discussed providing the following additional services to the HRRP:

- Technology assessments
- Program guidance and consulting

RTI team members who contributed to the report include the following:

Gary Hughes	Brenda Linton
Sam Leaman	Al Sharp
Peter Liao	Amy Witsil

The HRRP includes research universities and government laboratories in the Hampton Roads, Virginia, region. The HRRP's goal is to spur technology-based regional economic development. A large part of any strategy for meeting this goal will include capabilities for commercializing the technologies from the universities and national laboratories in the area.

The participating institutions commercialize their technologies with various levels of effectiveness. Although each institution has unique needs, all HRRP members would benefit from access to an array of technology commercialization services, including educational and awareness-raising activities, invention scouting, technology assessments, business development planning, licensing and negotiation assistance, and venture capital networking.

[2] The nine institutions examined were the Jefferson National Laboratory and the eight academic institutions that collectively make up the HRRP: Christopher Newport University (CNU), Eastern Virginia Medical School (EVMS), Hampton University (HU), Norfolk State University (NSU), Old Dominion University (ODU), Virginia Wesleyan College (VWC), and the College of William and Mary/Virginia Institute of Marine Sciences (W&M/VIMS).

The HRRP has initiated a technology assessment and commercialization effort designed to help the member institutions improve their capabilities to transfer technologies to regional industry. To facilitate program startup, RTI has completed the following tasks:

- Performed an initial benchmarking study to determine the current level of technology transfer at each institution and to identify each institution's potential for improvement
- Made recommendations for meeting the technology transfer needs of the institutions
- Provided recommendations for the universities to work together and with the community to more effectively energize technology-based, regional economic development both in the near term and in more strategic ways

The benchmarking study was intended to gauge short- and long-term demands for technology commercialization services. In order to assess those demands, RTI examined the following factors at each institution:

- Current objectives for a commercialization program
- Major assets for attracting industry interest (i.e., research specialties, patent portfolio, facilities, faculty)
- Established industry partnerships
- Current level of research funding by funding agency
- Annual rates of invention disclosures, patents, and licenses
- Current process for invention disclosure, patent review, filing, and commercialization
- Resources for patenting and commercialization
- Resources for developing industry collaborations
- In-reach methods to inform and motivate potential inventors

To assess the needs of the participating institutions, RTI completed the following tasks:

- Met with key commercialization contacts at each institution to discuss commercialization goals, research environment, experience, and institutional support
- Reviewed existing policies, handbooks, and resource materials describing each institution's program

The institution visits resulted in interviews with 23 individuals at the 8 member institutions. RTI met with a cross-section of university personnel, including administrators (i.e., vice presidents for finance and administration, provosts), technology transfer office staff, sponsored research staff, university attorneys, and intellectual property (IP) committee members.

RTI responded to requests at a project meeting held in March 2001, where it was found that examination of several regional economic development cases could be of value. RTI's project team called upon other RTI expertise in economic development to identify appropriate models. Those models were examined, and long-term strategic planning ideas were developed for inclusion in the recommendations to the HRRP.

This report covers the following required deliverables:

- Overview of the current situation for each institution and a composite for the region
- Description of the needs for each institution and a composite for the region
- Options for meeting the institutional and regional needs
- Recommended approach to meet the needs

2.0 Results

2.1 Summary of Findings

The members of the HRRP are a diverse group in terms of their technology facilities, capabilities, and expertise and their technology transfer capability. The members can be grouped into the following categories, according to the maturity of their technology transfer capabilities:

- Beginning
- Emerging
- Transitional
- Maturing
- Developed

Beginning: Beginning institutions have limited intellectual property, no process in place to address IP, and little support for technology transfer. Institutions with beginning-level technology transfer require extensive support and training to build infrastructure and an operational technology transfer capability. Virginia Wesleyan College (VWC) is in this category.

Emerging: Emerging institutions have the potential to generate IP and conduct technology transfer, but they either have not yet done so or have done so on an infrequent basis. Institutions in this category can become effective in technology transfer with some support through training and additional infrastructure, and their chances for success will be greatly increased under the guidance of experienced personnel. Christopher Newport University (CNU) and Hampton University (HU) are in this category.

Transitional: Transitional institutions have recognized the opportunity and the need to focus on technology transfer and have therefore established official technology transfer offices in the last few years. They are ahead of the emerging universities in their evolution toward becoming fully effective at technology transfer, but they still need similar types of support. With some formal training and additional infrastructure, the resources allocated for technology transfer can be used more effectively, and commercialization activity on these campuses will likely increase. Norfolk State University (NSU) and The College of William and Mary/Virginia Institute of Marine Sciences (W&M/VIMS) are in this category.

Maturing: Maturing institutions have been conducting technology transfer for 3 to 12 years and have integrated technology transfer into their general activities. Researchers are

aware of the technology transfer process and submit tens of invention disclosures per year. Licensing activities generate revenues for the institutions, although spinoff activity is rare. The opportunity exists for these institutions to increase their effectiveness by improving their infrastructure and incentives, and they could be instrumental in providing peer mentoring to the less mature member organizations. Eastern Virginia Medical School (EVMS), Jefferson National Laboratory (JLab), and Old Dominion University (ODU) are in this category.

Developed: Developed institutions have been conducting technology transfer for over 12 years, and they have fully integrated the technology transfer process into their general activities. Faculty are aware of the process and use it to submit hundreds of invention disclosures per year. Licensing and spinoff activities generate significant revenues for these institutions. No HRRP members have reached this level yet. Stanford and the Massachusetts Institute of Technology are examples of universities that have reached this level of technology transfer maturity.

Exhibit 2.1 lists the technology transfer statistics for each member institution. Exhibit 2.2 is a graphic representation of four key technology transfer parameters for each institution. All numbers in both exhibits are based on 1999 data. The data for the number of full-time equivalent (FTE) technology transfer personnel, invention disclosures, patent applications, patent case load, licenses, and royalties were obtained from interviews with technology transfer personnel at each institution. The data on 1999 sponsored research and development (R&D) were obtained from the National Science Foundation WebCASPAR database, except where noted.

Exhibit 2.1: Technology Transfer for HRRP Members

	Sponsored Research Funding ($million)	Formal IP Policy	Year Program Formed	Program Age (years)	TT Staff ***	Invention Disclosures/ Year	Patent Case Load/ Year	No. of Licenses/ Year	Royalty Income/ Year ($million)
CNU	1.99*	Y	2000	1	1	0.2	0	0	0
EVMS	24.10	Y	1993	8	1	12	14	4	3.7
HU	7.47	Y	1995	6	3	7	5	0	0
JLab	101.50	Y	1990	11	2.5	10	5	1	0
NSU	2.99	Y	1999	2	1	3	2	0	0
ODU	23.03	Y	1997	4	1	10	3	3	.04
VIMS		Y	2000	1	2		0	0	0
VWC	0.03	N	N/A		1	0	0	0	0
W&M	31.32	Y	2000	1	2	4	2	0	0
	90.93**			3	12	36	26	7	3.7004

*Source: Interview with sponsored research coordinator at CNU.
**Total does not include JLab.
***In the case of institutions with less than 1 FTE, the number of TT staff was rounded to 1.

Exhibit 2.2: Key Technology Transfer Parameters for HRRP Members

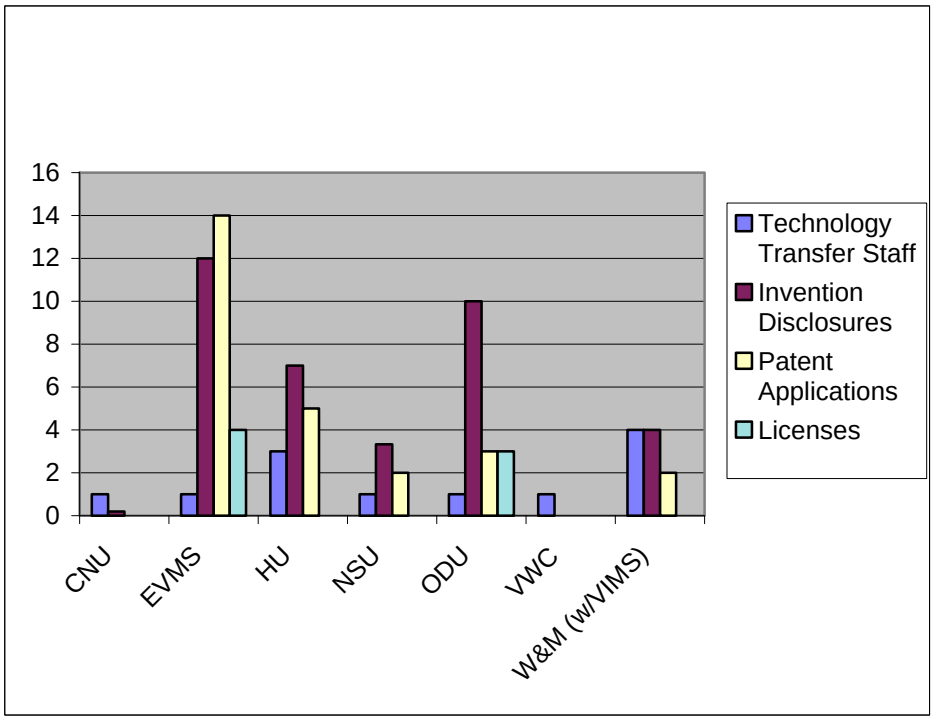
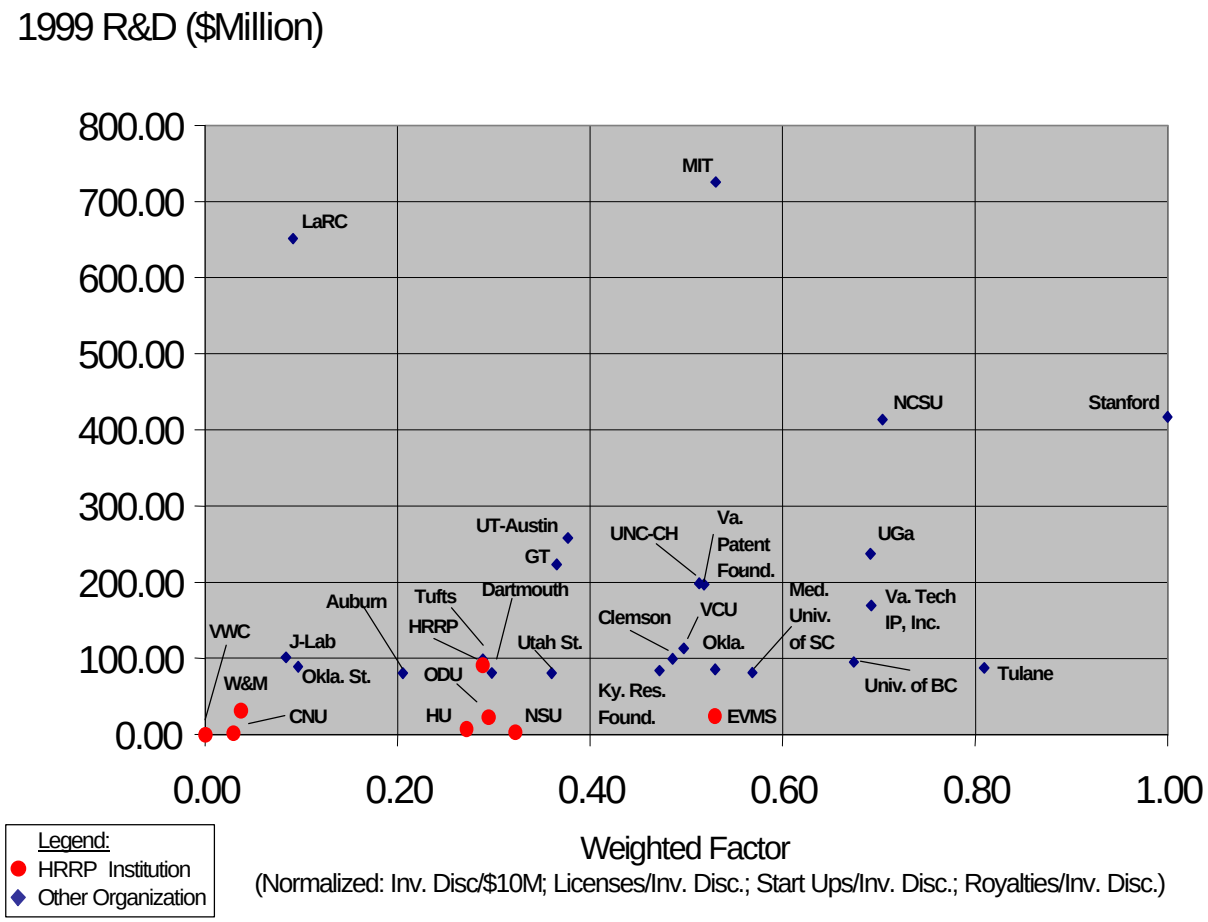


Exhibit 2.3 identifies the capabilities of each member institution relative to other members and relative to universities outside of the HRRP that are considered to be effective technology transfer organizations.[3] Universities with and without medical schools were chosen for comparative purposes. Exhibit 2.3 shows 1999 sponsored R&D, a measure of the active research at a university, against a normalized measure of technology transfer effectiveness that accounts for productivity, success, and contribution to new businesses. The productivity measurement was based on invention disclosures per $10 million R&D. The success measurement was based on licenses per invention disclosure and royalties per invention disclosure. The measurement for contribution to new businesses was based on startups per invention disclosure. Each individual HRRP member and the collective capability of the eight HRRP members (labeled HRRP) is denoted by a closed circle in Exhibit 2.3.

[3] The data for universities outside of the HRRP were obtained from the Association of University Technology Managers (AUTM) Licensing Survey: Fiscal Year 1999

Exhibit 2.3: Capabilities of HRRP Members



*Source: Association of University Technology Managers (AUTM)

As indicated by Exhibit 2.3, the state of technology transfer at the HRRP member institutions varies greatly, with VWC on the low end of the spectrum and EVMS at the higher end. No HRRP member is on par with the most effective organizations in neighboring regions (e.g., University of North Carolina at Chapel Hill, University of Georgia, or Virginia Tech). Nor is any HRRP member on par with those organizations that are associated with successful regional economic development (e.g., University of Texas at Austin, North Carolina State University).

2.2 Collective HRRP Members

If the HRRP pooled its technology resources and technology transfer capabilities, a higher level of technology transfer might be achieved. Exhibit 2.4 presents the technology transfer statistics of a combined HRRP capability.

Exhibit 2.4: Measure of Yearly Technology Transfer Performance Factors

	HRRP Partnership
Technology Transfer Staff	12
Invention Disclosures	37
Patent Applications	26
Licenses	7
Royalties	$3,740,000
Private R&D Funding	$13,020,000
Federal R&D Funding	$48,320,000
Total R&D Funding	$90,934,000

Exhibits 2.5 and 2.6 depict the level of sponsored R&D and the source of all of the sponsored R&D of a combined HRRP capability.

Exhibit 2.5: Funding Distribution by Institution

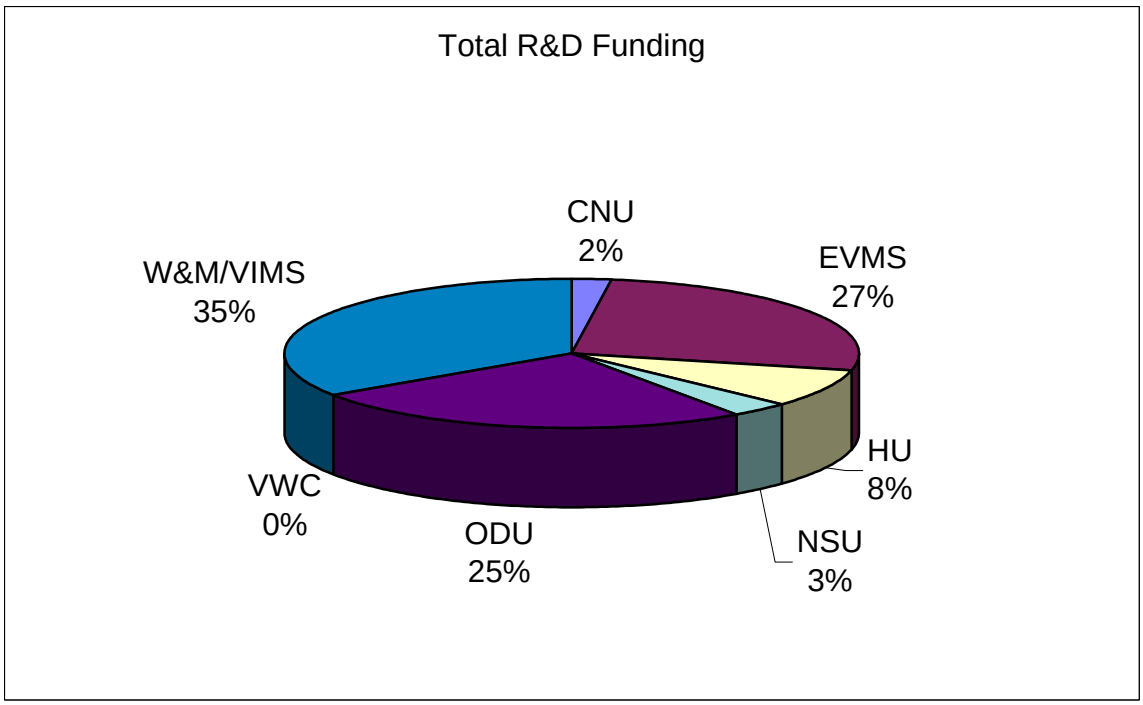
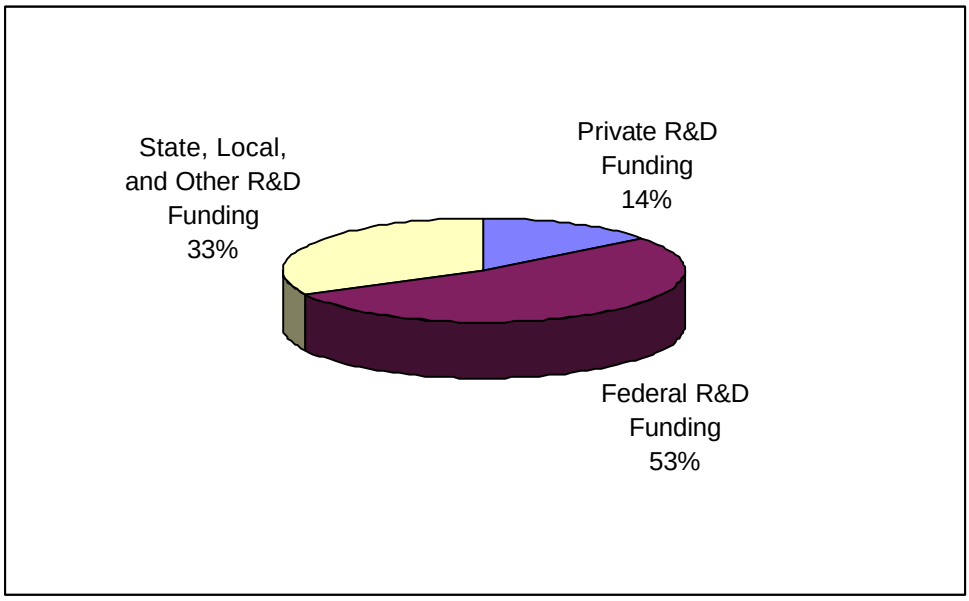


Exhibit 2.6: Funding Sources for Sponsored R&D



In order to examine the performance of the collective HRRP capability relative to that of similar organizations, several peer organizations were identified for comparative purposes.

The university peer group was chosen based on the size and source of its sponsored R&D. Collectively, the HRRP has about $90 million of sponsored research each year, about 50% of which is from federal sources. The university peer group has sponsored R&D budgets that are between $80 million and $100 million per year and federally sponsored research that accounts for 25% to 75% of their total research budget. The HRRP peer group chosen for this study includes the following institutions:

- Auburn University
- Clemson University
- Dartmouth College
- Medical University of South Carolina
- Oklahoma State University
- Tufts University
- Tulane University
- University of British Columbia
- University of Kentucky Research Foundation
- University of Oklahoma-All Campuses
- Utah State University

The following 12 factors were examined for the HRRP and its peers (all data are from 1999):

- Sponsored R&D
- Age of technology transfer program
- Full-time technology transfer staff
- Invention disclosures
- Patent applications
- Licenses
- Royalties
- Startups
- Invention disclosures per $10 million R&D funding
- Licenses per invention disclosure
- Startups per invention disclosure
- Royalties per invention disclosure

Exhibits 2.7 through 2.18 show how the collective HRRP capability compares to that of its peers. For reference, each exhibit shows data for two of the highest and lowest ranking performers in the category, represented by dashes.

Exhibit 2.7: HRRP Peer Group Rankings—1999 Total R&D Expenditures

Rank	*Institution*	*Medical School*	*1999 R&D Expenditures*
-	Univ. of California System	YES	$1,864,901,000
-	Johns Hopkins University	YES	$1,010,088,334
1	Clemson University	NO	$99,340,766
2	Tufts University	YES	$98,567,533
3	Univ. of British Columbia	YES	$95,341,717
4	HRRP Partnership	YES	$90,934,000
5	Oklahoma State University	NO	$88,900,000
6	Tulane University	YES	$87,324,000
7	Univ. of Oklahoma-All Campuses	YES	$85,584,836
8	Univ. of Kentucky Research Fndtn.	YES	$83,743,077
9	Medical Univ. of South Carolina	YES	$81,246,129
10	Dartmouth College	YES	$81,055,083
11	Auburn University	NO	$80,544,000
12	Utah State University	NO	$80,539,784
-	Ecole De Technologie Superieure	NO	$3,005,324
-	Lakehead University	NO	$2,779,608

Exhibit 2.8: HRRP Peer Group Rankings—Year Technology Transfer Capability Established

Rank	*Institution*	*Year Established*
-	W.A.R.F./Univ. of Wisconsin-Madison	1925
-	Iowa State University	1935
1	Tufts University	1978
2	Univ. of British Columbia	1984
3	Univ. of Oklahoma-All Campuses	1984
4	Univ. of Kentucky Research Fndtn.	1984
5	Tulane University	1985
6	Dartmouth College	1985
7	Clemson University	1987
8	Utah State University	1987
9	Auburn University	1988
10	Oklahoma State University	1995
11	HRRP Partnership	1998
12	Medical Univ. of South Carolina	N/A
-	Univ. of New Orleans	1999
-	California State Polytechnic University	1999

Exhibit 2.9: HRRP Peer Group Rankings—Technology Transfer Staff (1999)

Rank	*Institution*	*Full-time Licensing Staff*	*Other Full-time Staff*
-	Univ. of California System	35	57
-	Massachusetts Inst. of Technology (MIT)	14	15
1	Univ. of British Columbia	10	3
2	HRRP Partnership	2	10
3	Univ. of Oklahoma-All Campuses	2	2
4	Medical Univ. of South Carolina	2	2
5	Utah State University	2	1
6	Auburn University	2	1
7	Univ. of Kentucky Research Fndtn.	1	2
8	Tulane University	2	1
9	Tufts University	2	1
10	Oklahoma State University	1	1
11	Dartmouth College	1	1
12	Clemson University	1	1
-	Portland State University	0	0
-	Loyola University Medical Center	0	0

Exhibit 2.10: HRRP Peer Group Rankings—Invention Disclosures (1999)

Rank	*Institution*	*Invention Disclosures*
-	Univ. of California System	818
-	Massachusetts Inst. of Technology (MIT)	381
1	Univ. of British Columbia	126
2	Univ. of Kentucky Research Fndtn.	65
3	Tufts University	51
4	Medical Univ. of South Carolina	40
5	HRRP Partnership	37
6	Univ. of Oklahoma-All Campuses	30
7	Clemson University	29
8	Utah State University	27
9	Auburn University	25
10	Oklahoma State University	19
11	Dartmouth College	18
12	Tulane University	13
-	Lakehead University	0
-	Univ. of Northern Iowa	0

Exhibit 2.11: HRRP Peer Group Rankings—Patent Applications (1999)

Rank	*Institution*	*Patent Applications*
-	Univ. of California System	670
-	Massachusetts Inst. of Technology (MIT)	341
1	Univ. of British Columbia	95
2	Univ. of Oklahoma-All Campuses	45
3	Tufts University	32
4	Univ. of Kentucky Research Fndtn.	32
5	HRRP Partnership	26
6	Dartmouth College	26
7	Medical Univ. of South Carolina	24
8	Tulane University	17
9	Auburn University	13
10	Oklahoma State University	9
11	Clemson University	7
12	Utah State University	7
-	Woods Hole Oceanographic Inst.	0
-	Lakehead University	0

Exhibit 2.12: HRRP Peer Group Rankings—Licenses (1999)

Rank	*Institution*	*Licenses*
-	Univ. of California System	219
-	Iowa State University	163
1	Univ. of British Columbia	14
2	Tufts University	12
3	Tulane University	9
4	Univ. of Kentucky Research Fndtn.	9
5	Clemson University	7
6	HRRP Partnership	7
7	Dartmouth College	7
8	Univ. of Oklahoma-All Campuses	6
9	Medical Univ. of South Carolina	5
10	Auburn University	5
11	Utah State University	4
12	Oklahoma State University	1
-	Woods Hole Oceanographic Inst.	0
-	Lakehead University	0

Exhibit 2.13: HRRP Peer Group Rankings—Royalties (1999)

Rank	*Institution*	*Royalties*
-	Columbia University	$95,799,615
-	Univ. of California System	$80,888,000
1	Tulane University	$7,652,483
2	Clemson University	$4,648,141
3	HRRP Partnership	$3,740,000
4	Univ. of Kentucky Research Fndtn.	$2,496,786
5	Univ. of British Columbia	$839,571
6	Tufts University	$664,060
7	Dartmouth College	$500,329
8	Utah State University	$227,929
9	Auburn University	$186,738
10	Oklahoma State University	$154,946
11	Medical Univ. of South Carolina	$121,627
12	Univ. of Oklahoma-All Campuses	$110,265
-	Portland State University	$0
-	Lakehead University	$0

Exhibit 2.14: HRRP Peer Group Rankings—Startups (1999)

Rank	*Institution*	*Startups*
-	Stanford University	19
-	Massachusetts Inst. of Technology (MIT)	17
1	Univ. of British Columbia	6
2	Medical Univ. of South Carolina	3
3	Univ. of Oklahoma-All Campuses	2
4	Univ. of Kentucky Research Fndtn.	2
5	Clemson University	1
6	Utah State University	1
7	Tufts University	0
8	HRRP Partnership	0
9	Oklahoma State University	0
10	Tulane University	0
11	Dartmouth College	0
12	Auburn University	0
-	Portland State University	0
-	Lakehead University	0

Exhibit 2.15: HRRP Peer Group Rankings—Invention Disclosures per $10 Million R&D Expenditures (1999)

Rank	*Institution*	*Invention Disclosures Per $10 Million*
-	Brigham Young University	41.21
-	Univ. of Akron	28.45
1	Univ. of British Columbia	13.22
2	Univ. of Kentucky Research Fndtn.	7.76
3	Tufts University	5.17
4	Medical Univ. of South Carolina	4.92
5	HRRP Partnership	4.07
6	Univ. of Oklahoma-All Campuses	3.51
7	Utah State University	3.35
8	Auburn University	3.10
9	Clemson University	2.92
10	Dartmouth College	2.22
11	Oklahoma State University	2.14
12	Tulane University	1.49
-	Univ. of Northern Iowa	0.00
-	Lakehead University	0.00

Exhibit 2.16: HRRP Peer Group Rankings—Licenses per Invention Disclosure (1999)

Rank	*Institution*	*Licenses Per Invention Disclosure*
-	Torrey Pines Inst. for Molecular Studies	4.000
-	Loyola University Medical Center	2.500
1	Tulane University	0.692
2	Dartmouth College	0.389
3	Clemson University	0.241
4	Tufts University	0.235
5	Univ. of Oklahoma-All Campuses	0.200
6	Auburn University	0.200
7	HRRP Partnership	0.189
8	Utah State University	0.148
9	Univ. of Kentucky Research Fndtn.	0.138
10	Medical Univ. of South Carolina	0.125
11	Univ. of British Columbia	0.111
12	Oklahoma State University	0.053
-	Univ. of North Dakota	0.000
-	Woods Hole Oceanographic Inst.	0.000

Exhibit 2.17: HRRP Peer Group Rankings—Startups per Invention Disclosure (1999)

Rank	*Institution*	*Startups Per Invention Disclosure*
-	Ecole De Technologie Superieure	0.333
-	Concordia University	0.333
1	Medical Univ. of South Carolina	0.075
2	Univ. of Oklahoma-All Campuses	0.067
3	Univ. of British Columbia	0.048
4	Utah State University	0.037
5	Clemson University	0.034
6	Univ. of Kentucky Research Fndtn.	0.031
7	Tufts University	0.000
8	HRRP Partnership	0.000
9	Oklahoma State University	0.000
10	Tulane University	0.000
11	Dartmouth College	0.000
12	Auburn University	0.000
-	Univ. of North Dakota	0.000
-	Woods Hole Oceanographic Inst.	0.000

Exhibit 2.18: HRRP Peer Group Rankings—Royalties per Invention Disclosure (1999)

Rank	*Institution*	*Royalties Per Invention Disclosure*
-	New York Blood Center	3,888,889
-	Florida State University	2,491,870
1	Tulane University	588,653
2	Clemson University	160,281
3	HRRP Partnership	101,081
4	Univ. of Kentucky Research Fndtn.	38,412
5	Dartmouth College	27,796
6	Tufts University	13,021
7	Utah State University	8,442
8	Oklahoma State University	8,155
9	Auburn University	7,470
10	Univ. of British Columbia	6,663
11	Univ. of Oklahoma-All Campuses	3,676
12	Medical Univ. of South Carolina	3,041
-	Portland State University	0
-	Univ. of North Dakota	0

Exhibit 2.19 provides a summary of HRRP peer group data rankings.

Exhibit 2.19: Summary of HRRP Peer Group Data Rankings

Institution	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*I*	*J*	*K*	*L*
Auburn University	11	9	6	9	9	10	9	12	8	6	12	9
Clemson University	1	7	12	7	11	5	2	5	9	3	5	2
Dartmouth College	10	6	11	11	6	7	7	11	10	2	11	5
HRRP Partnership	4	11	2	5	5	6	3	8	5	7	8	3
Medical Univ. of South Carolina	9	12	4	4	7	9	11	2	4	10	1	12
Oklahoma State University	5	10	10	10	10	12	10	9	11	12	9	8
Tufts University	2	1	9	3	3	2	6	7	3	4	7	6
Tulane University	6	5	8	12	8	3	1	10	12	1	10	1
Univ. of British Columbia	3	2	1	1	1	1	5	1	1	11	3	10
Univ. of Kentucky Research Fndtn.	8	4	7	2	4	4	4	4	2	9	6	4
Univ. of Oklahoma-All Campuses	7	3	3	6	2	8	12	3	6	5	2	11
Utah State University	12	8	5	8	12	11	8	6	7	8	4	7

A=1999 R&D funding
B=Year established
C=Full-time employees
D=Invention disclosures
E=Patent applications
F=Licenses
G=Royalties
H=Startups
I=Invention disclosures per $10 million R&D
J=Licenses per invention disclosure
K=Startups per invention disclosure
L=Royalties per invention disclosure

Based on the data presented in these exhibits, one can see that the collective HRRP capability functions adequately relative to its peer group, ranking in the middle on most performance factors. Collectively, the HRRP attains approximately the same results as its peers with similar budgets but requires more full-time equivalent personnel to do it, which would normally indicate an efficiency problem. In the HRRP situation, however, several institutions with relatively small technology transfer loads have dedicated technology transfer staffs. If the HRRP pooled its resources, certain technology transfer functions could be centralized to increase efficiency. The average age of technology transfer organizations in the HRRP is 2.8 years, which is younger than most organizations in the peer group. According to the AUTM data, age closely correlates to licensing revenue. The HRRP ranks on the lower end of its peer group in the number of university startup companies per year—an indicator of technology-based regional economic development.

Based on information obtained in the interviews, RTI noted that the level of collaboration among the HRRP member universities is low. Although many institutions are working in similar or complementary areas of research, few collaborative projects exist across the HRRP region. Opportunities exist for collaboration in several areas since several universities share technology strengths. Listed below are the most fertile areas for

potential collaboration. The number of HRRP institutions that share the designated area of expertise is listed in parentheses.

Areas of Common Expertise

- Computational Modeling and Simulation (6)
- Technology in Education (6)
- Software and Hardware (6)
- Environmental and Marine Sciences (5)
- Sensors (5)
- Materials (5)
- Electrical Engineering & Circuitry (4)
- Photonics, Lasers, and Fiber Optics (4)
- Instrumentation (4)
- Atmospheric Science and Atmospheric Modeling (3)
- Biotechnology (3)
- Physics (3)
- Aerospace Engineering (2)
- Maritime Industry (2)
- Mechanical Engineering (2)
- Oceanography (2)
- Public Policy (2)
- Internet Tools and Commerce (2)

There is a generic need for increased training and infrastructure across all four categories described in Section 2.1 (beginning, emerging, transitional, and maturing). However, the specific types of training and infrastructure vary according to category.

Exhibit 2.20 lists the generic needs for building a successful technology transfer program. More detailed information on the performance and needs of each individual technology transfer organization is included in the following individual institution reports.

Exhibit 2.20: Needs Assessment Summary

Establish infrastructure: Needs for developing programs
Develop support for TT at university administration
Establish TT presence/POC on campus
Involve faculty in creating TT policies
Establish clear communication methods for TT policies and procedures
Raise awareness/Educate
TT opportunities, process (faculty/ students)
TT basics (staff /IP committee)
IP issues (staff/IP committee)
IP issues (faculty/students)
Create incentives: Needs for starting the flow
Integrate IP and TT successes into faculty reward system
Lighten teaching loads to allow more time for research
Provide seed funding to foster development of innovative ideas
Provide faculty release time to pursue high-potential technologies
Provide funds to support patent/copyright prosecution
Identify resources: Needs for keeping the flow
Provide mentoring to university staff /IP committee
Provide mentoring to develop /revise TT process on campus
Provide mentoring to assess technologies
Provide mentoring to conduct preliminary market research
Provide legal assistance on IP
Develop marketing/licensing strategies
Market technologies
Scout industries for research opportunities
Develop networking between universities to collaborate on joint research and leverage TT capabilities
Provide business advice for startup companies
Create incubator for university innovations
Create POC, specifically for copyright issues
Integrate TT process with local economic development activities

*TT=technology transfer; POC=point of contact; IP=intellectual property

2.3 Individual Institutions

For each institution, a strengths, weaknesses, opportunities, and threats (SWOT) analysis is provided, along with text addressing the following issues:

- Current objectives for a commercialization program
- Major assets for attracting industry interest (i.e., research specialties, patent portfolio, facilities, faculty)

- Established industry partnerships
- Current level of research funding by funding agency
- Annual rates of invention disclosures, patents, and licenses
- Current process for invention disclosure, patent review, filing, and commercialization
- Resources for patenting and commercialization
- Resources for developing industry collaborations
- In-reach methods to inform and motivate potential inventors

The information presented in the following individual institution report sections is based on (1) interviews with key personnel and (2) a review of published policies and procedures.

2.3.1 Christopher Newport University

SWOT Analysis

As part of this assessment, RTI used information gathered during this study to construct a strengths, weaknesses, opportunities, and threats chart for CNU (see Exhibit 2.21).

Exhibit 2.21: Christopher Newport University—SWOT Analysis

Strengths	• Faculty dedicated to developing sponsored research • Clear, established IP policies and practices with provisions for inventor incentives • Proximity to two national laboratories and the Newport News Shipyard • Applications of computer science and environmental science to the following: – Instrumentation – High-speed data/image processing – Integrated circuitry – Environmental monitoring – Remote sensing – Internet technology innovations – Artificial intelligence – Catalyst development • Nuclear physics
Weaknesses	• Lack of administrative support; benefits of commercialization activities not recognized • Low/no volume of IP • Faculty carry a full instructional load; little time for research • No dedicated technology transfer office
Opportunities	• Ties to local high-tech businesses • Faculty partially dedicated to developing commercial partnerships • Supportive graduate faculty • Recruitment of new graduate faculty with sponsored research potential • Web design and e-business capabilities • High growth rate (students and facilities); opportunity to encourage high growth in hot technology areas
Threats	• Lack of administrative support for sponsored research • Lack of awareness about sponsored research enhancing quality of instruction • Lack of institutional focus on sponsored research

*IP=intellectual property

Summary

CNU provides a liberal arts education that emphasizes excellence in undergraduate teaching. At CNU, the facilities, capabilities, and expertise for technology-related intellectual property are found in the College of Science & Technology. For commercialization efforts, the technical facilities, capabilities, and expertise are complemented by the skills in the School of Business. Historically, developing and commercializing IP has not been a focus at CNU. Most of CNU's research is performed under grants and contracts. Also, CNU administration does not consider sponsored research and commercialization as supporting its primary goal of providing quality instruction to students.

However, CNU is experiencing significant growth that includes an increased number of undergraduate students, new facilities, a maturing graduate program, recruitment of talented faculty and researchers, and increased opportunities for sponsored research. If CNU's graduate program continues to strengthen, it is reasonable to expect that increased IP and commercialization activities are forthcoming. In preparation, CNU has taken steps to lay the foundation for a commercialization program.

The present objective for a commercialization program at CNU is to offer incentives to faculty to bring in new commercially applied research that will involve both undergraduate and graduate students and, therefore, ultimately increase the quality of the instruction and overall education at CNU.

CNU's most distinctive asset for attracting industry interest is its geographic proximity to the Newport News Shipyard and to two national laboratories: NASA Langley Research Center and JLab. The university has access to the laboratory facilities at JLab's Applied Research Center, which can broaden the work that faculty can do with commercial clients. CNU also has faculty partially dedicated to identifying new opportunities for commercially applied research.

CNU's best resources for developing industry collaborations are its contacts with the local business community, which leads to commercial collaborations, and its proactive effort to seek out work at the Newport News Shipyard, JLab, and other facilities. The expertise of Lee Beach, CNU's ARC director, in the technical needs of area businesses and the technical capabilities of CNU serves the university well. CNU also is well connected to the network of technology startup companies through the involvement of Stephanie Honeycutt, an attorney and instructor in the School of Business who is active in local business incubator and high-tech startup groups.

CNU has established partnerships with the following organizations:

- Center for Innovative Technology
- Department of Criminal Justice, State
- U.S. Environmental Protection Agency
- Fish & Wildlife Services (Federal)

- U.S. Department of Energy, Thomas Jefferson National Accelerator Laboratory
- NASA
- NATO
- Newport News, City of
- National Science Foundation
- Office of Naval Research
- Science Application Integration Corporation
- State Council of Higher Education in Virginia
- Virginia Center for Economic Education

The partnerships account for $2 million in sponsored research per year. The sources for sponsored research at CNU are estimated in Exhibit 2.22.

Exhibit 2.22: Christopher Newport University—Sponsored Research Sources

Source	*Share*
Federal	62%
State and Local	13%
Private	25%

CNU has had one invention disclosure in the past 5 years. It has no patents or licenses. Several faculty members anticipate submitting invention disclosures resulting from new sponsored research within the next few years.

CNU has IP policies and procedures in place for filing invention disclosures. The process, described in the IP policy handbook, includes review by an ad hoc committee to determine the university's interest. At this point, no resources for technology assessment, patenting, and marketing have been identified because no cases have met CNU's criteria for pursuing patenting and commercialization.

The faculty and staff of CNU's College of Science & Technology are very supportive of commercialization. They see that commercial collaboration can benefit CNU in many ways and are taking steps forward. The University administration, however, believes that commercialization and R&D might compromise CNU's primary focus on providing top-notch undergraduate education. Since commercialization has not been part of CNU's past, most faculty do not think of commercialization as a priority and could benefit from some training.

Looking Forward

CNU has the potential to contribute to the technology base of the region in several areas due to its technology strengths (e.g., Internet technologies, software, and data processing), capabilities to attract high-tech talent and sponsored research, and high growth rate. In order to realize its potential, technology transfer must first be supported by the university administration. Then CNU can begin to establish a technology transfer infrastructure, raise awareness of its benefits to the students and faculty and educate, and create incentives for technology transfer (see Exhibit 2.20).

2.3.2 Eastern Virginia Medical School

SWOT Analysis

As part of this analysis, RTI used information gathered during this study to construct a strengths, weaknesses, opportunities, and threats chart for EVMS (see Exhibit 2.23).

Exhibit 2.23: Eastern Virginia Medical School—SWOT Analysis

Strengths	• Strong technology transfer: 50 patents, 20 active licenses, 3 spinoff companies, 1 product and others developing under active research and licensing agreements • Licensing and royalty income • Periodic review and assessment of existing technology inventory • Faculty members dedicated to technology transfer • Biomedical and pharmaceutical technologies • Externally contracted IP management including integrated review with R&D program • Formal invention disclosures and assessment process • Research infrastructure
Weaknesses	• Limited internal capability for technology assessment and marketing • No separate technology transfer department—function operating out of Office of Administration and Finance
Opportunities	• Collaboration with HRRP partners for grants and sponsored research projects • Share experiences with less mature programs in HRRP • Regional capability once other HRRP members are up the learning curve
Threats	• Inability to see benefits of exclusive participation in regional capability at this point • Use of external sources for IP management might prevent integration of EVMS into collective HRRP capability

Summary

Established in 1973, EVMS is a private, community-based medical school that does not own a teaching hospital. Instead, EVMS works in partnership with hospitals, physicians, and education, research, and health institutions throughout the region. EVMS has an operational technology transfer process that features both in-house and contracted intellectual property management sources. Within the HRRP, EVMS emerges as the most mature of the technology transfer operations. However, relative to the technology transfer operations of other medical schools, there is room for improvement, particularly in the size of its sponsored research and development program.

EVMS's objectives for a commercialization program include the following:

- Protecting EVMS's interests in its IP while allowing for scholarly distributions of knowledge

- Directing income generated from EVMS technologies back to EVMS
- Investing in technology protection and assessment fees prior to licensing/selling rights
- Getting biomedical discoveries on the shelf
- Encouraging researchers to produce inventions and to submit invention disclosures (one-third of license fees and royalties returned to the inventors)

EVMS has several major institution assets for attracting industry, including 50 patents and expertise in the following areas:

- Geriatrics
- Diabetes
- Women's Health
- Contraception and Infertility
- Prostate Cancer and other Cancer
- Pediatrics
- Basic Sciences— Anatomy, Biochemistry, Microbiology/Immunology, Pathology, Physiology, Pharmacology
- Opthalmology/Pharmacology

EVMS has partnerships with several organizations that account for $33 million in sponsored research per year. The vice president of the Office of Administration and Finance at EVMS actively markets the school to develop industry collaborations. The sources for sponsored research at EVMS are estimated in Exhibit 2.24.

Exhibit 2.24: Eastern Virginia Medical School—Sponsored Research Sources

Source	*Share*
Federal	36%
State and Local	3%
Private	61%

Compared to other academic institutions in the area, EVMS has more privately sponsored research, in part because its primary technology is in the biomedical sciences, which has seen more technology transfer success than its physical science counterparts.

In 1999, EVMS received 12 invention disclosures, filed 14 patent applications, and signed 4 licensing agreements. Currently, EVMS has

- Three spinoff companies
- One product on the market (pharmaceutical) and 2-3 expected in the near future

- 50 active patents
- 20 active license agreements
- $18 million in technology transfer and license payments since 1992
- $17 million in technology transfer and license payments due by 2004
- An undisclosed amount of future royalty payments and equity interests

EVMS periodically reviews (quarterly) its patent portfolio for commercialization opportunities. The patent portfolio has been reviewed in spring of 2001. Prior to 1990, EVMS inventors did not routinely disclose their technology, and publication occurred prior to protection of discoveries. Most researchers now see the benefit of disclosing inventions to EVMS's IP office and participating in the established technology transfer program.

The technology transfer process at EVMS includes the following steps:

1. The researcher assigns and discloses an invention to EVMS through the vice president of Administration and Finance.
2. The vice president works with the inventor, retained patent counsel, and retained assessment firm to make an initial determination of the novelty patentability and potential market of the technology. The technology is given a rating that identifies what commercialization track is appropriate. For example, an "A" technology might be immediately patented and actively marketed, while a "B" technology might be protected with a provisional patent application and given an additional evaluation period.
3. EVMS decides whether to file for patent protection (provisional or full) or to return the rights to the inventor. If future improvements are made by the inventor, EVMS has reassignment rights.
4. EVMS's contract marketing firm markets the technology. In some instances, the faculty or scientist/inventor might identify potential funding companies. In most cases, the funding company is likely to license the technology, which might include future research and development funding. If the technology is entering the first phase of drug development, indicating an adequate commercialization potential, EVMS considers foreign filing.

EVMS retains technical assessment capabilities, as well as full capability for patenting and commercialization. These services are provided by two firms—one marketing firm and one law firm—that are kept on retainer by EVMS. EVMS entered these agreements well before it was aware of HRRP efforts to establish a shared capability for these services. EVMS plans to continue the retainer arrangement for assessment and to continue using its own patent attorneys but notes that the availability of nonexclusive regional services for commercialization might be advantageous for EVMS because it provides another option and encourages free market competition. Working closely with the IP office, patent and commercialization resource, EVMS researchers are involved in all phases of the commercialization process.

Inventors are required to work with EVMS throughout the commercialization process in good faith. However, the potential exists for conflict of interest because the inventor could be granted rights to the technology if EVMS decides not to pursue commercialization. EVMS uses the success of the faculty who are active in commercialization to motivate researchers. The vice president of Administration and Finance hand-delivers royalty checks and the peers of the inventors can clearly see the rewards of commercialization. Also, EVMS has held three symposia over the past 2 to 3 years to inform its scientists about the value of technology transfer, IP policies, and IP practices.

Commercialization is a priority at EVMS, but EVMS would be hesitant to enter any regional initiative that included exclusive commercialization assessment rights given by EVMS. EVMS would be interested in collaboration on technology transfer activities. Specifically, EVMS recognizes the value of a regional partnership for the following scenarios:

- Matching members as partners for grants: Collaborations would increase the school's ability to obtain grants.
- Bringing more grants to the region: Two HRRP institutions could be competing for the same grant. A collaboration would increase the strength of the applications and ensure that money would come to the area.
- Sharing resources and equipment: For example, if EVMS developed a material and used equipment available locally to test the material, a matchmaking service between regional testing, research needs, and regional providers would be useful.
- Collaborating on technology transfer with individual HRRP members or through a regional initiative that added mutually beneficial value to specific technologies or bundles of technologies.

EVMS is considering establishing a nonprofit foundation for the purpose of technology transfer to and from EVMS. Since EVMS is private, the state does not play a part in its commercialization process. However, EVMS does have to answer to a 17-member board.

Looking Forward

EVMS can be a key contributing member to a unified technology base in the region. It has an established program that serves the current R&D needs well. Participation in a regional-based technology transfer alliance could help EVMS leverage its current success to compete with other medical institutions of similar size. Also, integrating the technology transfer process into the medical school could strengthen EVMS's commercialization capability.

2.3.3 Hampton University

SWOT Analysis

As part of this assessment, RTI used information gathered during this study to construct a strengths, weaknesses, opportunities, and threats chart for HU (see Exhibit 2.25).

Exhibit 2.25: Hampton University—SWOT Analysis

Strengths	• Strong relationships with alumni and NASA Langley • Business Assistance Center • Infrastructure (72nd most wired campus) • Technical fields of expertise – Atmospheric science – Physics – Sensors
Weaknesses	• Low volume/flow of IP • Low licenses • Minimal IP management infrastructure/visibility • No dedicated technology transfer office
Opportunities	• Internal IP stimulation • Access to federal programs for HBCUs: – The Department of Energy – Office of Naval Research – Federal Aviation Administration – NASA
Threats	• Lack of IP generation, resulting in stagnant, small IP portfolio

*IP=intellectual property; HBCUs=historically black colleges and universities

Summary

HU is a private university offering a broad range of technical, liberal arts, pre-professional, professional, and graduate degree programs. The university offers a variety of resources to facilitate technology transfer and targeted economic development.

The Hampton University Business Assistance Center (HU-BAC) and Rural Business Assistance Center are designed to assist new and existing small and minority-owned businesses to bridge the technical gaps that exist in small businesses. Their mission includes providing economic, business, and technical assistance; providing economic development to the Peninsula area through job creation and stimulation of capital investment; and developing a program of small business assistance and thereby improving the performance of Peninsula business. HU-BAC is funded by the Economic Development Program under the U.S. Department of Commerce. Technology is not an apparent focus for HU's business assistance groups.

HU's leading research areas include atmospheric science, physics, and sensors. The university also was named the 72nd most wired university in the United States by Yahoo! Internet Life in 2000.[4]

The top funding agencies of HU research are NASA, the National Science Foundation, the U.S. Department of Defense, the National Institutes of Health, and the U.S. Department of Energy. HU has worked with NASA Langley Research Center for over 30 years. Alumni support is strong and provides financial benefit through contributions and strategic assistance with obtaining grants and contracts. The relationships with NASA and alumni are potential resources for developing industry collaborations.

HU also offers an expertise guide to share its resources. Typically, this guide is used to identify faculty for media interviews or free-of-charge public speaking.

HU has about 5 patents and 12 disclosures per year. A commercialization process (including invention disclosure, patent review, and filing) has been established, and intellectual property is reviewed regularly. The awareness of the need for IP management is growing at the university.

The sources for sponsored research at HU are estimated in Exhibit 2.26.

Exhibit 2.26: Hampton University—Sponsored Research Sources

Source	***Share***
Federal	96%
State and Local	4%
Private	0

Looking Forward

HU presents a case of some untapped potential. Technical research is there, as is association with cutting edge technology (i.e., NASA interaction). The flow of IP appears to be relatively low, with some potential to increase. HU will likely need to continue to strengthen its capabilities by boosting the output of its researchers in order to contribute to the HRRP.

The effort to create an IP generation and management program at HU that can contribute to an agglomerated capability among the HRRP members includes most of the needs listed in Exhibit 2.20. It is assumed that the agglomerated technology base would be one of several key drivers of regional economic development.

[4] Available online at www.zdnet.com/yil/content/college/college2000/rank_university_72.html

2.3.4 Jefferson National Laboratory

SWOT Analysis

As part of this assessment, RTI used information gathered during this study to construct a strengths, weaknesses, opportunities, and threats chart for JLab (see Exhibit 2.27).

Exhibit 2.27: Jefferson National Laboratory—SWOT Analysis

Strengths	• Age of program (11 years) • 2.5 full-time equivalents for technology transfer • Technology transfer Web site—clearly communicated policies and commercialization opportunities • Technology Review Committee • ARC • Stature as a world-class facility • Technical expertise
Weaknesses	• Little to no corporate research and development
Opportunities	• Experience and maturity of program: mentor to less mature organizations • Through ARC, facilitation of HRRP collaboration • With advanced materials and photonics capabilities, complement to other HRRP member strengths for collaborative efforts
Threats	• Rigid research agenda—not as flexible in response to industry needs

*ARC=Applied Research Center

Summary

The U.S. Department of Energy Thomas Jefferson National Accelerator Facility, or JLab, is a basic research laboratory built to probe the nucleus of the atom in order to learn more about the quark structure of matter. JLab employs 550 people, and over 1,500 scientists around the world use the facility to conduct experiments. JLab's tools for probing nuclei include the continuous beams of high-energy electrons from Jefferson Lab's unique Continuous Electron Beam Accelerator Facility (CEBAF) and the advanced particle-detection and ultra-high-speed data acquisition equipment in CEBAF's three experimental halls.

JLab is managed by a consortium of 53 universities called the Southeastern Universities Research Association (SURA) under contract to DOE. SURA's goals are to foster excellence in scientific research, strengthen the scientific and technical capabilities of the nation and of the Southeast, and provide outstanding training opportunities for the next generation of scientists and engineers.

JLab represents a $600 million investment of the Federal Government, the State of Virginia, the City of Newport News, foreign contributors, and the U.S. nuclear physics research community. JLab has an annual operating budget of approximately $70 million.

JLab's objective for a commercialization program is to fulfill its mission as a national laboratory—to transfer the technology, or intellectual property, developed at the laboratory to the private sector. In pursuit of its basic nuclear physics mission, several new technologies have been, and continue to be, developed with the potential for industrial development, including the following:

- Superconducting accelerating cavities
- Accelerator-related technologies
- Accelerator-driven light sources
- Real-time control system software
- Cryogenic systems
- Magnet technology
- Radio frequency power systems
- Accelerator diagnostics
- Particle detectors and data acquisition systems
- Advanced accelerator research and development

To facilitate successful technology transfer, JLab has established the Technology Review Committee.[5] The committee is charged with establishing Memoranda of Understanding (MOUs) and Cooperative Research and Development Agreements (CRADAs) to recommend licensing of JLab patents and manage the patent process for the laboratory. The committee assesses technologies, reviews and authorizes patentability searches, authorizes patent applications, and assists in the marketing and commercialization efforts.

In 1999, JLab had 10 invention disclosures, resulting in 5 patent applications and 1 license. JLab estimates that the Technology Review Committee work totals 2.5 full-time equivalents. JLab uses outside patent counsel for filing, and local and regional groups for marketing (e.g., the Center for Innovative Technology [CIT], Virginia Economic Development Partnership [VEDP], HRRP, Peninsula Association for Economic Development [PAED], Mentech).

JLab could use more resources for marketing its technologies. The technologies that are available for licensing are currently listed on the laboratory Web site, and JLab is pleased with the Web listing and the response to it. JLab has significant joint R&D partnerships with local universities. The universities, including ODU and W&M, use JLab facilities to patent technologies resulting from joint efforts with the laboratory.

JLab reports sponsored R&D of approximately $100 million.[6] The sources for sponsored research at JLab are shown in Exhibit 2.28.

[5] Description available online at http://www.jlab.org/exp_prog/techtransfer/review.html
[6] 2000 data from interview with Fred Dylla. This differs significantly from the $70 million budget for 1999 noted in NSF data.

Exhibit 2.28: Jefferson National Laboratory—Sponsored Research Sources

Source	*Share*
Federal	98.5%
State and Local	1%
Private	0.5%

JLab hosts the Applied Research Center, a facility that houses laboratory space for shared R&D and training activities for three local universities (i.e., CNU, ODU, and W&M) and industry. The ARC was established as part of JLab's Free Electron Laser (FEL) Program. FEL is a manufacturing tool using laser light that has potential applications in products involving fiber films metals, ceramics, and electronic materials.

Looking Forward

JLab has policies and procedures in place to handle its technology transfer load, and it has successfully transferred technologies. Enhancing JLab's technology transfer program would include measures to provide more sources for technology assessment and marketing (see Exhibit 2.20). JLab could contribute to the HRRP by providing mentoring services to the less mature organizations.

2.3.5 Norfolk State University

SWOT Analysis

As part of this assessment, RTI used information gathered during this study to construct a strengths, weaknesses, opportunities, and threats chart for NSU (see Exhibit 2.29).

Exhibit 2.29: Norfolk State University—SWOT Analysis

Strengths	• Support from the administration • Established and well-published IP policies • Strong relationships with alumni and NASA Langley • Link to community via bringing university technology themes to secondary education • Technical strengths – NSF Center for Photonic Material Research (e.g., crystals as ultra-high density data storage medium) – Center for Materials Research – Internet security technologies – Modeling and simulation—virtual reality training tools – Candidate for licensed DNA center
Weaknesses	• Low rate of disclosures, licenses, and royalties • Lack of resources for patenting and marketing • Minimal IP management infrastructure/visibility • New program/IP practices in need of maturation – Undefined royalty-splitting scheme until close to sale – Lack of success in capturing revenue from commercialization activities – Slow process due to involvement of state • Technology transfer handled from Dept. of Finance & Business; no separate office
Opportunities	• Untapped potential; inventory • Collaborative research opportunities at the Center for Photonic Materials Research to partner with ARC members (i.e., CNU, W&M, NSU, ODU, and J-Lab) • Openness to adopting a universal best practices approach from HRRP partners • Access to federal programs for HBCUs: U.S. Department of Energy, Office of Naval Research, Federal Aviation, NASA • Capability to train a high-tech workforce using the Cisco Networking Academy
Threats	• Lost IP revenues due to need for documents that split IP ownership and/or royalties • More effective processes at other universities with a nonprofit foundation • No facilities or support for spinoff companies • Mandatory state involvement; slow process, inventor dislike of state having first right of refusal

*NSF=National Science Foundation; IP=intellectual property; ARC=Applied Research Center; HBCUs=historically black colleges and universities

Summary

NSU is a public university that is made up of 5 undergraduate schools (i.e., Business, Education, Liberal Arts, Social Work, and Science and Technology) and 15 graduate study programs including Materials Science. NSU has the facilities, capabilities, and expertise to become a key contributing partner to a regional technology base. NSU's technology strength is materials science research—a strength it shares with fellow HRRP members NASA Langley Research Center and fellow HRRP members (ODU, HU, and W&M/VIMS). NSU falls under the category of historically black colleges and universities (HBCUs). Its intellectual property management policies are in place and have been in practice for about 18 months. Through partnerships with federal organizations and private companies, NSU is likely to increase its IP generation in the next few years. Also, the university is establishing a Center for Materials Research that is likely to attract technical talent and sponsored research to the area.

In the near term, NSU's objective for a commercialization program is to develop or adopt an IP process that ultimately brings revenues to the university in the form of royalties and commercial contracts. NSU sees the benefits of having a uniform IP process across the HRRP member universities. NSU's commercialization program needs to motivate researchers to participate in the program and to think in terms of commercializing NSU technology for use in products, ultimately garnering value for the university to reinvest in programs and infrastructure. NSU also wants to increase its IP portfolio.

NSU has capabilities in materials research, including photonics R&D centered on optical storage of data on crystals. NSU has a Center for Materials Research and an emerging center for entrepreneurship that offers various technical and administrative support for potential new businesses. NSU also plans to become a licensed DNA analysis center. Other assets for commercialization include an established partnership with IBM for crystal growth and data storage R&D and a partnership with Cisco Systems in which the company hosts a Cisco certification program at NSU.

NSU has partnerships predominantly with federal organizations including NASA, the National Science Foundation, the U.S. Department of Energy, and the National Institutes of Health that account for $3.8 million in sponsored research per year. The sources for sponsored research at NSU are shown in Exhibit 2.30.

Exhibit 2.30: Norfolk State University—Sponsored Research Sources

Source	*Share*
Federal	97%
State and Local	2%
Private	1%

The vice president of Finance and Business works part time with technology transfer activities. Since the IP policy was introduced in 1999, five invention disclosures have been

submitted (over an 18-month policy). NSU has submitted two patent applications and awaits action from the U.S. Patent and Trademark Office. NSU has no licenses, royalty income, or recent commercialization activity.

NSU representatives say that NSU likely is 10 years behind other local institutions in establishing and maturing its IP policy and practices. NSU would like to have an IP policy that is uniform with others in the state and is willing to adopt an established IP policy.

The current technology transfer process includes the following steps:

1. The researcher submits invention disclosure to the vice president for Finance and Business.
2. The vice president for Finance and Business reviews the technology with the researcher and gathers the researcher's opinions on the commercial potential of the invention.
3. An assessment of the technology is made based on the researcher's input, and a decision is made to file or not to file for patent protection.
4. Rights are automatically assigned to the state. The vice president for Finance and Business prepares a memo to the attorney general to justify assigning rights to NSU and filing for patent protection on the technology. Rights are generally transferred to NSU, and the patent is assigned to an attorney general–approved patent practice for filing. NSU pays the patenting costs, which have been agreed upon ahead of time.

Once the patent is issued, and if the technology remains commercially promising, NSU negotiates patent license terms and/or patent ownership. NSU might negotiate a license or assignment of ownership to the inventor and/or a company in return for a portion of the royalty stream. This is done on a case-by-case basis, and terms are not established (even with the inventor) until the licensing phase is reached.

University resources are limited for patenting and commercialization, and no formal technology assessment process is in place. The professors at NSU are typically responsible for seeking out company partners for research and for marketing their technology. The university has limited funds to pay for patenting.

NSU is working on including the submission of invention disclosures as part of the employment contract for researchers. Also, an NSU IP representative visits labs and encourages the researchers to submit an invention disclosure as soon as they think they have something that might be patentable.

Faculty are generally interested in commercialization activities. However, most researchers could benefit from seeing the rewards of commercialization. The administration is supportive of commercialization as evidenced in the establishment of the Center for Entrepreneurship. There is no support mechanism for technology assessment or marketing.

Looking Forward

NSU has the potential to contribute to a regional technology capability through its materials research skills and experience and programs that are being set up with NSF funding. To realize its potential, NSU needs to mature its technology transfer practices. It has policies in place but is willing to adopt a regional uniform model. NSU's IP management is new and needs training and other resources.

The effort to mature an IP generation and management program at NSU that can contribute to an agglomerated capability among the HRRP members includes most of the needs listed in Exhibit 2.20. It is assumed that the agglomerated technology base would be one of several key drivers of regional economic development.

2.3.6 Old Dominion University

SWOT Analysis

As part of this analysis, RTI used information gathered during this study to construct a strengths, weaknesses, opportunities, and threats chart for the ODU (see Exhibit 2.31).

Exhibit 2.31: Old Dominion University—SWOT Analysis

Strengths	• Invention disclosure process in place • Royalty stream • High percentage of applied research • ODU Research Foundation – Represents a single point of business for companies – Provides administrative and passive marketing resources • Diversity of sponsored research projects • Broad base of technical acumen – Aerospace, electrical, computer, and mechanical engineering – Oceanography, biotechnology, and environmental sciences – Maritime industry – Computational modeling and simulations – Alliance with Virginia Commercial Space Flight Authority – Virtual reality facilities
Weaknesses	• Low sponsored research funding • Inability to process an increased load of patent disclosures
Opportunities	• Experience and maturity of program: mentor to less mature organizations • Untapped potential: inventory • Connections to wide base of sponsors • Access to ARC
Threats	• Lack of capability to work the invention disclosures

*ARC=Applied Research Center

Summary

Established in 1997, ODU's technology transfer office complements the services of the ODU Research Foundation—a nonprofit corporation under contract with the university that assists in certain sponsored research and technology transfer functions.

ODU's technology transfer office commercializes intellectual property as a service to the faculty and as a public service, to generate income from ODU's technology investment and to motivate ODU's researchers. Faculty incentives include recognition and royalties; the public benefits from the technologies that are made available and through the royalties that are reinvested in the public's school.

ODU has several major institution assets for attracting industry interest, including a diverse patent portfolio based primarily on the physical sciences (materials, electronics, instrumentation, and environmental science). Like its patent portfolio, ODU's technical strengths are diverse. Since the university was developed around local industry needs, its technical strengths complement those of the major local industries—shipbuilding and repair, aerospace, materials, electronics, and environmental and biotechnology sciences. As a result, the percentage of research that is applied is significant, meaning that these technologies should be more readily transferable to industry.

ODU has partnerships that account for $26.6 million in sponsored research per year. The sources for sponsored research at ODU are estimated in Exhibit 2.32.

Exhibit 2.32: Old Dominion University—Sponsored Research Sources

Source	*Share*
Federal	61%
State and Local	24%
Private	15%

ODU lists 12 federal organizations, 11 state and local organizations, and the following private organizations as its research sponsors

- A.L. Philpott Manufacturing
- Argonne National Laboratory
- Casram
- Lawrence Livermore Laboratory
- Lifenet Transplant Services
- Princeton University
- Siemens
- Virginia Modeling Analysis and Simulation Center (VMASC)
- Virginia Commercial Space Flight Authority
- Virginia Microelectronics Consortium

ODU researchers have submitted 5 to 10 invention disclosures per year over the past 3 years, resulting in a yearly average of 3 patents and 2 to 3 new licenses. ODU averages royalties of $40,000 per year. Sources note that the royalty income is not a steady stream, but rather a series of lump payments including up-front licensing fees or maturing equity. Historically, ODU has not been staffed to address more than 10 invention disclosures per year in a timely manner. ODU sources say that the current disclosure rate could likely be doubled if inventors were actively encouraged to submit. However, ODU recognizes that being unable to handle the disclosure load in a timely manner could be permanently damaging to the system if inventors stop submitting their inventions due to the

unresponsiveness of the technology transfer office. Therefore, ODU has not maximized its efforts to encourage invention disclosures.

Under ODU's current process for invention disclosure, patent review, filing, and commercialization, ODU inventors typically assign ownership of inventions to the university. ODU then assigns ownership to the Research Foundation. Technology transfer occurs when the Foundation, by a license agreement, grants a third party commercial rights to the invention.

The Research Foundation gives most research sponsors an exclusive option to negotiate a license of inventions arising from the sponsored research. Faculty inventors receive up to 50% of the net royalties paid to the Research Foundation.

The Research Foundation serves as the fiscal and administrative agent for sponsored research and other projects conducted by ODU. The foundation has the authority to enter into agreements with external funding agencies on behalf of the university. While the recruiting of sponsored research and the technical direction of a sponsored project remain the sole responsibility of the principal investigator or project director, the Foundation provides a broad range of administrative and fiscal services.

Technology assessment is not part of ODU's commercialization process. The Research Foundation makes patenting decisions with the input of the inventor and any relevant administration. ODU pays the Foundation for patenting costs, and the Foundation markets the technologies by placing descriptions of technologies that are available for licensing on its Web pages.

Current in-reach methods to inform and motivate potential inventors include having the IP manager talk to incoming faculty about technology transfer policies and practices. Faculty and management are interested in, and supportive of, commercialization activities.

Looking Forward

In order to reach a level of commercialization that is in line with more mature technology transfer organizations, ODU should first leverage its existing technology base by encouraging inventors to submit invention disclosures. However, ODU must have the infrastructure in place to handle an increased disclosure case load in a timely manner.

In addition to developing or identifying a resource for technology transfer services, ODU could benefit from some awareness training for its researchers. ODU sources assert that the technology is being created and that it is just a matter of getting the technology into the pipeline.

RTI recommends that ODU obtain or improve certain infrastructure and support functions. Exhibit 2.20 depicts these needs. Since ODU has a relatively strong potential to produce commercially valuable IP and has a working technology transfer program, most of the needs are focused on improving the existing program.

2.3.7 Virginia Wesleyan College

SWOT Analysis

As part of this assessment, RTI used information gathered during this study to construct a strengths, weaknesses, opportunities, and threats chart for VWC (see Exhibit 2.33).

Exhibit 2.33: Virginia Wesleyan College—SWOT Analysis

Strengths	• Strong relationship with alumni • Secondary education expertise • Familiarity with Virginia funding groups (e.g., Commission on the Humanities, Foundation for Independent Colleges) • Faculty active in publication and local community-oriented work
Weaknesses	• No IP management system • Minimal IP outside of copyright material • Focus almost completely on teaching, not IP creation or commercialization
Opportunities	• Joint research with other HRRP members • Possible copyrights on books, literature, creative art, course materials
Threats	• Potential lack of support in administration and faculty • Potential to be overlooked due to small size and narrow capabilities

*IP=intellectual property

Summary

VWC is a private liberal arts college that primarily executes technology transfer through publication by the faculty. However, the college typically does not pursue this form of technology transfer under the protection of intellectual property or with the intent to generate revenue. VWC is active in the state, obtaining funding from organizations such as the Virginia Commission on the Humanities and the Virginia Foundation for Independent Colleges.

VWC does not have a commercialization program because its institutional focus is on teaching, not research. As such, VWC does not have any in-reach methods to motivate potential creators of IP or development of invention disclosures and systems for generating IP, patents, or licenses. The college does not offer any institutional resources for patenting, commercialization, or developing industry collaborations. Commercialization and patenting are voluntary, individual efforts by faculty. The faculty does publish and pursue local, community-oriented work, however.

VWC has several assets for attracting industry interest: the PORTfolio program (offers internships and other career-related learning experiences), the Tek.Xam program (nationally standardized exam, administered and paid for by the college, allowing students to earn certification of their technology and problem-solving skills), and the adult studies program. Both the PORTfolio and Tek.Xam programs involve interaction with local industry. Additionally, VWC has an infrequent yet strong relationship with alumni.

Research funding at VWC is currently less than $30,000. However, VWC is the lead institution in the HRRP's search for funding of a school-related assessment and instructional support initiative. Potential sources of IP generally are limited to books, literature, creative art, and course materials created by VWC faculty and students.

Looking Forward

VWC will likely gain from the HRRP in the near future. Collaboration with other institutions in the HRRP will help open new possibilities for VWC. For example, the large school-related project for which VWC is the lead institution could generate various grants and a great increase in research funding. As a learning institution, VWC has not had the need or opportunity for technology transfer. However, in the ever-changing world of academics, the college wants to stay open to possibilities for growing or adding capability.

To effectively contribute in the future to an agglomerated capability among the HRRP members, VWC should review its needs for creating an IP generation and management program in light of Exhibit 2.20.

2.3.8 The College of William and Mary/Virginia Institute of Marine Sciences

SWOT Analysis

As part of this assessment, RTI used information gathered during this study to construct a strengths, weaknesses, opportunities, and threats chart for W&M/VIMS (see Exhibit 2.34).

Exhibit 2.34: College of William and Mary/Virginia Institute of Marine Sciences—SWOT Analysis

Strengths	• Established and growing invention disclosure process • Large number of funding agencies • Technical strengths – Environmental and marine sciences (VIMS) – Surface processes and characterization – Surface modification by photophysics and photochemistry – Medical imaging – Nondestructive evaluation – Biotechnology and plasma and laser processing – Computational modeling and simulations • High status among marine science institutes in the U.S. • Broad scope of technology expertise
Weaknesses	• No licenses or royalties • Low disclosure rates • No formal technology assessment process • Minimal staff dedicated to technology transfer • Relatively newly established
Opportunities	• Increasing disclosure rates • Strong commercial possibilities with biotechnology assets (VIMS) • Access to Applied Research Center
Threats	• Need for expanded support from administrative levels

Summary

W&M is notable as a small public college that receives high rankings for its quality instruction. W&M has a graduate program with degrees offered in biology, business administration, chemistry, computer science, environmental science, law, marine science, mathematics, and physics. Historically, W&M has had almost no focus on intellectual property management and commercialization, as it has seemed contrary to the college's primary emphasis on pure research and quality instruction.

Recently, W&M has taken measures to set up an IP management program and has added staff dedicated to technology transfer. The IP management system will process the IP of

both W&M and VIMS. Technology transfer at both W&M and VIMS has been pursued predominantly through the dissemination of information in technical panels, at conferences, and in papers.

Active technical areas at VIMS include aquaculture, contaminants, sensors and instrumentation, genetic sequencing of fish, disease (vaccines), policy, physics, robotics, fisheries, resource management, and computing. These areas of research are in contrast to W&M's more traditional curriculum.

W&M's goals regarding management of IP include the following:

- Developing a source of funds from industry
- Using industry collaboration to keep the school abreast of industry priorities so that W&M's teaching is responsive to industry trends and the college is able to attract entrepreneurial people
- Faculty recognition; for example an R&D 100 award was given recently for a technology that W&M worked on with NASA

W&M/VIMS has several industry partnerships in place including those with the following:

- Newport News Shipyard
- Lockheed Martin
- French Marine Institute
- Applied Research Center
- DiagXotics
- Smartclic.com
- Airak, Inc.
- Applied Sciences
- DuPont
- Truview Imaging (Science & Technology)
- Retinex
- Various consulting groups

W&M/VIMS's partnerships with organizations generate $23 million in sponsored research per year. The sources for sponsored research at W&M/VIMS are estimated in Exhibit 2.35.

Exhibit 2.35: College of William and Mary/Virginia Institute of Marine Sciences—Sponsored Research Sources

Source	*Share*
Federal	72%
State and Local	17%
Private	11%

The most common form of IP generated at W&M is copyright, which could be applicable to some W&M distance-learning materials currently in development. W&M has a low invention disclosure rate of four per year and has filed two patent applications. One patent was issued in 2000. To facilitate management of its IP, W&M has a database that tracks all disclosures and other IP generated since 1990.

The invention disclosure process at W&M is relatively new and is evolving. A new IP policy has been submitted for consideration. Until the revised policy is in place, the current process includes the following steps:

1. The inventor submits an invention disclosure to Joy Bryant, a registered patent agent.
2. Ms. Bryant meets with the inventor and files a provisional patent application.
3. The inventor and Ms. Bryant follow up leads during the provisional period and make a decision on full filing based on the response from the leads in the provisional period.

The policy in place prior to the current process, which was adopted in 1980, allows the creator all ownership rights; thus, the new policy might require a shift in the culture of W&M's faculty. W&M plans to post some forms on its technology transfer Web site. Staff cited the Web sites of the University of Texas and Texas A&M as having complete IP forms (e.g., nondisclosure agreements, contracts) available on the Internet. W&M has ad hoc Patent and Copyright Committee meetings.

VIMS currently has an invention disclosure form that initiates the process that leads to patent review, filing, and, ideally, commercialization. The form is available on VIMS's Web site. While recent years have seen minimal creation of IP, VIMS has received 5 invention disclosures since the beginning of 2001 and expects to receive 10 to 20 for the full year. The initial 5 disclosures are being reviewed, and VIMS expects to file for 3 or 4 patents from that group and possibly for 15 to 20 patents by the end of 2001. VIMS has only one patent from the past 7 or 8 years. This patent currently is assigned to Center for Innovative Technology (CIT). VIMS has no licenses but does have several research agreements underway that might result in licenses.

CIT granted W&M $2,000 to establish a technology transfer infrastructure. While W&M is still working to build that infrastructure, it does have both a top-20 law school program and a patent agent on staff. However, because it is a state institution, the Virginia attorney

general has to approve an attorney for patent prosecution and litigation. W&M uses its own resources to pay for the patenting services provided through the attorney general. Additional funding for patenting would be welcome.

W&M administrators see a potentially easier solution for commercializing its IP through partnering with the University of Virginia (UVA) Patent Foundation. W&M also envisions that the HRRP could help fund or provide technology marketing services such as market research capability to target companies for commercialization. Also, W&M would like to support its researchers by identifying technical market trends to guide their research.

W&M has a variety of institutional resources for developing industry collaborations. It has researchers in a variety of fields that could be useful in collaborations to do research in industry agreements. W&M uses the Hampton Roads Technology Incubator.

One institutional asset for attracting industry interest to VIMS is that it works with several government agencies across a variety of fields. The top-five funding sources, responsible for the majority of about $10 million to the school, are the National Oceanic & Atmospheric Administration, Virginia government agencies, the National Science Foundation, the U.S. Department of the Interior, and the U.S. Environmental Protection Agency. VIMS is very active in soliciting research dollars; it submitted 250 proposals in 2000. The school also has state-of-the-art facilities.

W&M is starting an in-reach initiative, and the first task is to survey the staff's capabilities and expertise. The goal is to create a forum for researchers to work collaboratively. W&M is interested in learning about the in-reach programs at other schools through Web sites and other media. An indirect method for motivating potential inventors at W&M would be the proposed shared royalty streams made possible by commercializing new inventions.

The deans of W&M's law and business schools have formed a committee to develop an entrepreneurship center. W&M also is exploring a Technology and Business Center to support commercialization in a new facility in a development called New Town. Several members of the board of visitors and newer faculty members recognize the importance of commercialization. New emphasis on commercialization will require a paradigm shift among the faculty and staff.

Looking Forward

W&M's technology transfer capability is relatively new and currently handles a low volume of IP. W&M is currently transitioning to a higher level of operation with the addition of staff and an expected increase in IP from VIMS in the near future. This is a critical time for W&M technology transfer. Improved infrastructure and training are key to the success of the program. Specifically, W&M needs resources to help perform technology transfer services, including technology assessment, marketing, valuation and licensing assistance. Also, training could help raise the awareness of the value of technology transfer since W&M researchers have historically focused on pure research.

VIMS continues to grow as a source for IP and technology transfer. The institution, one of the top such institutions nationwide, can draw upon its biotechnology assets since that area is currently a hot topic in today's market. The technology transfer process is growing rapidly. The technology pipeline, virtually dry in recent years, should be flowing more freely in 2001, with up to 20 invention disclosures expected.

The effort to create an IP generation and management program at W&M that can contribute to an agglomerated capability among the HRRP members includes most of the needs listed in Exhibit 2.20.

3.0 Recommendations

The results of this study indicate that the potential exists to improve the infusion of university-developed technology into the regional economy. However, compared to successful university-driven efforts in other regions, there is a long road to travel.

Universities contribute to regional economic development when they provide a link between the research and development efforts and the interests of academic institutions and businesses and when they enhance the environment for innovation and entrepreneurship. Universities increase the attractiveness of a region to new technology-based companies by having strong science departments that can provide intellectual property, consultation, and additional training for company employees. Universities can become the pivotal factor in regional economic development when they develop, own, or sponsor a research park that is the focal point for attracting new technology-based companies to a region.

The most important common denominator of top performing university, industry, and government collaborations is the strong commitment of the partners to work together to achieve regional economic development. Companies have many options for locating new facilities, and they can quickly assess whether the academic, business, and government leaders of a region are working together or whether they have separate agendas. Universities that successfully lead the development of research parks create ongoing partnerships that incorporate key government and business leaders in a region. Other common denominators are listed in Attachment 1.

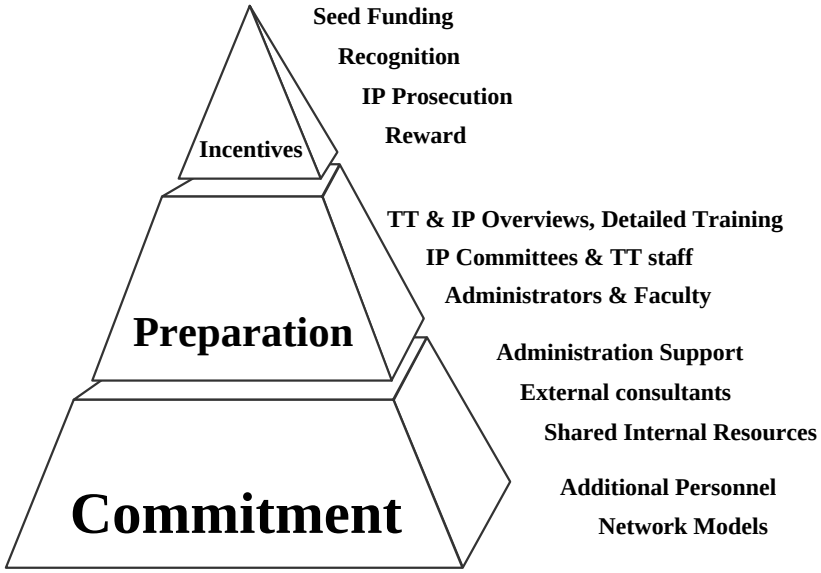
For the Hampton Roads region, many actions can be taken, from the straightforward and relatively quick to the complex and long term. The recommendations are divided into subsections that describe essential near-term actions, opportunity enhancements, and long-term strategies.

Before laying out the detailed recommendations, it might be helpful to frame the overall technology transfer challenge faced to some degree by each of the member institutions. Options for maximizing the level of technology transfer at a university will vary according to the maturity of its technology transfer program.

As shown in Exhibit 3.1, a successful technology transfer program can be thought of as a pyramid, with commitment to the program as the foundation upon which the technology transfer program is built. The most important commitment is made by the university administration because, without it, the base is exceedingly weak, and the program has little chance to reach its potential. A strong base also includes dedicated staff and an infrastructure to support the research staff and to serve as a liaison to government and

industry entities. Commitment is also embodied in the resources allocated to the staff, including access to external expertise that cannot be cost-effectively developed in-house.

Exhibit 3.1: Elements for a Successful Technology Transfer Program



A solid program builds on the foundation of commitment by preparing the research and support staff to effectively create, manage, and commercialize the university's IP. Such preparation includes developing appropriate procedures and incentives, and training research staff and technology transfer people. A prepared organization, including administration and staff, learns and applies best practices; creates lean, agile oversight committees; and assumes a forceful positive posture that sends a message to the community. The message must clearly state that the university is a willing, eager partner that will work with local government and industry.

Successful organizations implement their programs with conviction. New funding sources are found for both research and commercialization. Incentive programs are implemented. The IP is identified, assessed, marketed, and deployed. Finally, the process repeats itself and begins to build on its successes and reputation.

The following recommendations are designed to address the specific needs identified by this study. They identify immediate action items, suggest some potential enhancement opportunities, and set the stage for thoughtful strategic planning.

3.1 Near-Term Actions

Each university, possibly with the HRRP's help, needs to strengthen its technology asset base and improve its effectiveness in transferring technologies to industry. Specific recommendations for each need follow.

Need 1: Strengthen the technology asset base

- Develop support from the administration
- Provide incentives for research staff to do appropriate research
- Determine relevant research thrust areas and create targeted research projects
- Recruit new talent in the research thrust areas
- Partner with one another (and share facilities) to win more grants and contracts
- Take better advantage of government funding

Need 2: Improve the effectiveness of transferring the technologies (connecting with industry)

- Create dedicated organizations and processes (Uniform processes will facilitate collaboration and the possible combining of functions. See Enhancement Opportunities below.)
- Train researchers and staff, raise awareness
- Provide informal mentoring among member institutions
- Provide access to external resources that might be required to assess, protect, market, value, and license IP
- Reward technology transfer efforts and successes

To address the recommendations, the following near-term actions can be taken:

1. Improve technology transfer capabilities of member institutions

Start to improve commercialization programs at each member institution now. Provide training, mentoring, and process models. Identify, assess, and capture relevant IP. Emphasize regional transfers of technology.

2. Find the intersection of hot technologies and HRRP technologies

Identify the growth or hot technologies that will become economic powerhouses in the next 10 to 20 years. Cross these technologies with the HRRP constituent university strengths to determine where near-term opportunities lie. Perform further analysis to determine where the hot technologies intersect the strengths of the existing regional technology-based companies. These hot technologies will become the most important technology thrust areas for Hampton Roads regional economic development. The same exercise will provide a gap analysis that highlights areas where economic opportunities might be lost because some hot technologies will not currently be in the strength inventory for either the universities or local companies.

3. Attract research talent in the technology thrust areas

Contact experts in the field, compile lists, begin the courting process, and study what other successful recruiting organizations have done.

4. Capitalize on existing strengths

Emphasize the pursuit of funding for research in the thrust areas. Explore the funding programs of hitherto under-used sources, such as Small Business Technology Transfer (STTR) Program, Small Business Innovation Research (SBIR) Program, Advanced Technology Program (ATP), and the National Institutes of Health (NIH). Make maximum use of funding programs at NASA, the U.S. Department of Defense, and historically black colleges and universities, contacting not only local organizations but also remote entities such as the Kennedy Space Center. Develop unsolicited research grant proposals based on industry road maps. Send these to both government and industry funding organizations.

5. Organize a true collaboration

The universities need to overcome the Virginia culture of independence (some would say isolationism) and take the next step of defining how they can truly collaborate. One suggestion is described in the Enhancement Opportunities. There is no need to take bigger steps if the group is unable to create an effective collaboration. The level of consolidated R&D is so low that nothing less than forming a strong team is required to achieve the desired result.

6. Plan for the long term now

Organize a strategic planning committee to develop concrete plans for science-driven regional economic development that includes some of the success elements of the university-based research parks. The optimum solution will require big plans from big thinkers. Establish a credible basis for obtaining support and investment from stakeholders. As mentioned before, RTI has experts on staff in this field who could be useful.

3.2 Enhancement Opportunities

This section discusses the enhancement opportunities that, along with the near-term actions, address the specific needs identified by this study and set the stage for thoughtful strategic planning. The near-term actions will certainly improve the chances for more and better technology transfer activities between the individual universities and technology-based companies. However, if the universities develop a collaborative approach, the regional impact and the university successes could be improved to a greater degree.

RTI recommends that the HRRP use a shared, subordinate organization designed to manage the IP of its constituent universities. Clearly, some of the participating institutions cannot afford to staff a full-function office for commercialization; therefore, collaboration will have definite advantages for them. Organizations that currently have functional

offices for technology transfer could benefit as well. For purposes of this discussion, this organization is called a technology access foundation (TAF). The TAF function could be provided by an existing organization, such as the Virginia Patent Foundation, or by a newly created, regionally focused organization.

The TAF could serve the participating universities by offering technologies to regional companies and the community by providing a single source for seeking technology or solutions to technical problems encountered in growing their businesses. The breadth of coverage for either direction of this technology path can be tailored to the preferences of the participants. The TAF could also give cooperating participants a chance to team on proposals for funding for research programs.

In the broadest sense, the TAF would embody the following elements (through on-site staff or external resources). In a narrower implementation, the TAF could be organized around a selection of these features, depending on the consensus of the participants.

- Process development (for processes to be used by the universities and by the TAF)
- Training, in-reach, outreach (Training would provide guidance on how to use the procedure for protecting IP and for disclosing innovations. It also can establish the need for a commercialization mindset among the university researchers.)
- Identification of promising new technologies
- Assessment of new technologies for commercial potential
- Legal services, including patent filing and prosecution
- Marketing (planning and implementation)
- Valuation
- Selection, negotiation, deal-making
- Provision of forums for access to venture capital
- Business incubation

The TAF could be set up as a nonprofit organization. This approach eliminates the need to obtain approvals from the state attorney general for every patent, patent assignment, and patent license. It also could be structured to retain some earnings from patent licensing for operations and growth, or it could be totally funded by the participating organizations combined with funding that might be won through grant requests or state and local sources. Corporate funding is also possible. Royalty income would be shared with individual inventors and their research laboratories. When sufficient cash flows are developed, funds could also be provided back to the universities to support basic research.

The TAF could also offer guidance to regional companies on licensing procedures and could negotiate with them to finalize license agreements. As noted previously, the TAF could also be set up to provide a service to companies seeking to access or co-develop

new technologies within the university R&D base. These technologies would typically be early-stage developments. IP provisions in the contracting documents would define IP rights for any patentable discoveries. If the universities choose to offer a problem-solving service, the TAF could be used as the point of contact for company inquiries. Careful consideration should be applied in the case of providing problem solving, as there are some significant impacts, not the least of which is the additional workload for technical staff.

The following potential advantages are available to the universities if this enhanced approach is taken:.

- Powerful leverage for available resources—avoids some duplication of function and increases capability
- Additional recognition for university researchers
- Economic benefits to local technology adopters
- Increased political standing within state and federal funding circles
- Increased funding for university research
- Basis for expanding into a larger, higher impact organization

3.3 Long-Term Strategies

This section discusses the long-term strategic planning that, along with the near-term actions and enhancement opportunities, addresses the needs identified in this study. The goal of the HRRP is to spur the growth of the regional technology-based economy. The HRRP has examined other regions of the country that have successfully leveraged local technology sources to create the desired growth. RTI, through this study, has also looked at other successful efforts and examined the existing situation in the Hampton Roads area.

Strategically, the HRRP supposed that the regional universities had a sufficient technology base to spur economic growth similar to successful efforts in other regions. The RTI study was designed to characterize the university technology base and the effectiveness of each university in transferring or otherwise commercializing the technologies emerging from their laboratories. As part of this study, RTI was asked to make recommendations for the HRRP that would provide some guidance for them to devise a long-term plan that would take maximum advantage of the region's technology base.

As noted earlier, a broad range of technology development and technology transfer effectiveness is represented in the member universities. Also noted was the fact that no one or two universities embody sufficient technology assets to make a remarkable difference in the growth of the regional economy. In contrast, in every successful case examined by RTI where universities partnered with the community to drive extraordinary economic development, the R&D base was much larger than the individual programs within the HRRP member universities (see Exhibit 2.1). In fact, it would take the

aggregate university research base to approach some of the levels found at other successful research institutions that are considered drivers of their local economies. It is therefore recognized that a significant, meaningful collaboration among the member universities is necessary to form a basis (critical mass) for an economic growth engine.

Creating the TAF could represent a first step of a long-term strategy. The HRRP and the Hampton Roads Partnership need to address other issues that affect regional economic development, many of which are interdependent with the specific plans for increasing and using university-based technology assets.

The recently published *Metropolitan New Economy Index*[7] provides an analysis of the most successful metropolitan areas of the country with respect to the "New Economy." As defined in the report, the New Economy refers to new industries and jobs, a higher degree of globalization, and a revolution in information technology. Regions that are highly adaptable and rich in technology sources will have an advantage. The report states, "In short, a New Economy has emerged: it is a global knowledge and idea-based economy where the keys to wealth and job creation are the extent to which ideas, innovation, and technology are embedded in all sectors of the economy—services, manufacturing, and agriculture." [8]

The Norfolk, Virginia, area is ranked 44th out of the top 50 metropolitan areas in this benchmarking analysis. The rankings were based on 16 indicators in the following categories: knowledge jobs, globalization, economic dynamism and competition, the transformation to a digital economy, and technological innovation capacity.

The report provides a good analysis of the current situation in the subject areas, and it also describes some steps communities can take to improve their position in the New Economy. The seven "pillars" given by the authors that are important to competing in the New Economy are the following:

- Knowing your region's economic function in the global economy
- Creating a skilled workforce
- Investing in an infrastructure for innovation
- Creating a great quality of life
- Fostering an innovative business climate
- Reinventing—and digitizing government
- Taking regional governance seriously

[7] Atkinson, Robert, D. (Progressive Policy Institute) and Gottleieb, Paul D. (Case Western Reserve University), *The Metropolitan New Economy Index: Benchmarking Economic Transformation in the Nation's Metropolitan Areas.* April 2001. Available online at http://neweconomyindex.org/metro.

[8] Available online at http://neweconomyindex.org/metro/introduction.html.

RTI recommended performing analyses of the university technology base and the local technology companies. This opportunity/gap analysis is consistent with the recommendations in the Metropolitan New Economy Index. The report states, "Crafting a metropolitan-wide economic strategy for the New Economy requires an acute understanding of the regional economy and , in particular, how its key industrial sectors compete in a global economy. It behooves all metro areas to do a careful analysis of their economies to identify and assess the competitive position of their key industry clusters."

The observation made by the Metropolitan New Economy Index that is most relevant to the RTI assessment is the connection between university research and the New Economy. Many examples exist of regional economic growth being driven by university research. Some notable examples are mentioned at the end of this section. The Metropolitan New Economy Index states, "It is not enough to perform research; that research needs to be commercialized to have the full economic effect. Metro areas have instituted a number of programs to encourage innovation, including technology incubators, early-stage seed funds, research parks, technology-transfer programs, and technology sector networks."

Many examples of successful high-tech economic development are associated with research universities. Of the sources of information on this topic, RTI identified three articles in Technology Access Report[9] as one of the best overviews. The three articles cover the history of university technology transfer, the evolution of university-industry relations, and the important role played by the Massachusetts Institute of Technology over the years. RTI does not have permission to reproduce these reports; however, some of the more relevant points are summarized below.

- Two basic models exist: the New York Model (technology pull) and the Boston/Northern California Model (technology push, or science-based economic development).
- The New York Model is based on using technology to solve industry problems.
- The Boston/Northern California Model is based on combining technology with venture capital to create new businesses.
- University growth is stimulated as a by-product of partnering with industry.
- Recruitment of top researchers in targeted fields is common.
- Analysis of strengths and weaknesses before developing a plan is essential to success.
- The development of the university's role as economic driver evolves through the following three stages:
    1. Transition from publishing research to establishment of a link to industry through a liaison office
    2. Proactive transfer of technology through identification, patenting, marketing, and licensing—through a formal technology transfer office

[9] Etzkowitz, Henry. *Technology Access Report*. McGraw-Hill, January-March 2001.

3. Creation of businesses to embody the new technologies, spinning them out as commercial entities rather than offering only the technologies—incubation

- Another model, the Albany model, is a way to develop a critical mass when university research funding is insufficient to drive growth. It creates university-housed incubators that cater to local startups, R&D departments of companies, state and local government labs, as well as university research groups.
- Collaborations with industry and government laboratories open up new opportunities for joint funding.
- The future university will be an effective generator of science-based companies and jobs, becoming the "'third mission' of economic development" of the university.
- "Commercial motives have not displaced pursuit of academic honors; rather, each incentive overlays the other."
- The Bayh-Dole Act eliminated many of the barriers hindering the patenting and marketing of federally funded innovations. While some universities were successful prior to the Act, the door is wide open for future expansion of this important role of the universities: knowledge-based economic development.

RTI explored some representative university and community partnerships to assist the HRRP as it considered many options for long-term strategies. RTI contacted the Association of University Related Research Parks[10] to get its recommendation on the most innovative cases. The association recommended the following partnerships:

1. Rensselaer Technology Park, Troy, New York
2. University Research Park, Madison, Wisconsin
3. Cummings Research Park, Huntsville, Alabama [11]
4. University of Arizona Research Park, Tucson, Arizona [12]
5. University City Science Center, Philadelphia

The association also recommended the following partnerships for early stage developments:

1. University of California at San Diego Research Park, San Diego
2. University of California at Santa Cruz (on old Fort Ord Military Base), Monterey Bay Education and Science Technology Center (UC MBEST) [12]
3. Baton Rouge Research Park (Louisiana State University)
4. University of New Orleans Research Park [12]

[10] Available online at www.aurrp.org.
[11] These research park cases are described in detail in Attachment 2.

In particular, the University of Alabama case (i.e., Cummings Research Park) has several factors in common with the HRRP situation, except that it is not a startup operation. Common elements include the following:

- Nearby federal R&D facilities, including NASA Marshall Space Flight Center
- Several participating universities
- Combined university research funding of less than $100 million

The University of New Orleans case is interesting because it includes some of the same technology strengths that are evidenced in the HRRP members (marine and materials). The UC MBEST case also has a strong marine content.

All of these cases demonstrate elements of the common denominators of success listed in Attachment 1. Detailed analysis of the many university-related research parks and development of a strawman strategy for regional economic development is beyond the scope of this phase of the project. RTI's economic development staff should be consulted for ideas and possible assistance to the HRRP as it moves forward. See Attachment 3 for information about this RTI group.

As stated in the beginning of this section, the road is long—but it is well-traveled. Other regions have enjoyed success after good planning, dedication, hard work, some luck, and time. The Hampton Roads area has no reason to believe it should expect any less.

Attachment 1: University-Supported Economic Development—Common Denominators of Success

In a preliminary review of the economic development materials and in our search for appropriate case studies, certain patterns have emerged. Success seems to somewhat depend on a number of the following factors:

1. A well-developed site with full capital infrastructure is common to all. Furthermore, when the site adjoins a university campus, the location is identified as a significant marketing incentive.
2. A well-developed strategic plan with the bankable business plan is developed before the technology expands beyond its first major tenant. Increasingly the development plan demonstrates strong university, local government and broad community commitment and support.
3. There is continuity of institutional leadership in recognition of the longer development time frames and an assuaging of expectations.
4. There is strong institutional commitment as each major university puts its name and prestige on the line.
5. Identification of an individual champion is critical in the earlier stages of development.
6. In a number of cases the investment initiative had come from a particular firm, before the particular university was willing or was able to capitalize the ideas of partnership and propinquity.
7. The universities market intangibles such as image, respectability, etc. as part of the real estate (park development) activities, and compete with commercial research/industrial park ventures for private sector investment.
8. The critical shortages of technical labor are incentives for dependent industries to locate in or near university sponsored park developments. Firms want access to students, cooperative programs, graduate students, and faculty for specific labor pools when available in larger numbers.
9. University-supported developments assist firms in meeting their initial investments and/or start up costs through a variety of mechanisms. These recruitment incentives are reinforced by the easier access to venture capital, academic endowments, tax considerations, charitable donations or investment of public funds.
10. Sometimes success may be gratuitous. There are examples where success has more to do with spinning off one highly successful venture than the result of well-laid plans and careful execution.
11. There is the element of chance/luck/timing, which is rationalized after success has been recognized.

12. There is significant private sector investment, leadership, participation and benefit in each major development.

13. Finally, the institutional involvement of universities reduces the perception of risk and may clarify the legal framework for investment.

Attachment 2: Research Parks

Cummings Research Park

The Cummings Research Park is located in Huntsville, Alabama. It was started in 1962 and has combined government, university and federal support. The Association of University Related Research Parks picked it for the 1997 Outstanding Research Park Achievement Award and *Site Selection* magazine picked it as one of the top 10 research parks in the US.

The Park began as a private investment when Brown Engineering purchased 150 acres for a new facility. The Park grew to 1,000 acres in the 1960s. Other properties in the immediate area were made available for research activities through a university foundation now known as the University of Alabama Huntsville Foundation. Wernher von Braun lobbied for a branch of the University of Alabama to be located near the Marshall Space Flight Center at Cummings resulting in the University of Alabama at Huntsville.

In the early 1980s, the City of Huntsville purchased 818 acres west of the existing Park. Acting as a developer for the Park, the City sold about 400 acres of this property within the following five years. The Chamber of Commerce of Huntsville/Madison County works with the City to market, manage, and develop the Park. Today the Park has 3,800 acres; about 200 acres are available with infrastructure ranging from $45,000 to $55,000 per acre. More than 26,000 people work in Cummings Research Park's approximately eight million square feet of research and developments facilities.

Cummings has both university and federal support—the University of Alabama in Huntsville adjoins the Park. The Chamber of Commerce of Huntsville/Madison County set up an Alliance for Technology Transfer in 1992 that includes the Alabama A&M University, The Calhoun Community College and the Northeast Alabama State Community College. This alliance formed active committees dedicated to technology transfer and commercialization issues.

Both NASA and the Department of Defense have facilities in the area including the Marshall Space Flight Center, the U.S. Army Space and Strategic Defense Command, the U.S. Army Missile Command, the Defense Intelligence Agency, and the Missile Space Intelligence Center. Together, the four major government centers employ more than 10,000 people locally. NASA's Marshall Space Flight Center has been active in technology transfer.

The University of Arizona Science and Technology Park

This park is owned and operated by the University of Arizona at Tucson, Arizona. It is the 6th largest university-related research park in the US in terms of occupancy and jobs with approximately 6,000 employees on-site. 345 of the Park's 1,345 acres are developed. IBM originally developed the site in 1978, and the University of Arizona purchased the site from IBM in 1994. Through a creative self-financing mechanism, the cost to the University was only $645,000. The goal is to develop the remaining 1,000 acres over the next 15 years and have about 25,000 employees on site.

The Park is an integral part of the University of Arizona and a key vehicle for the University to fulfill its research mission. A willingness to establish working relationships with the University is one of the criteria for selection of Park tenants. The Park provides easy access to university resources—students, graduates and research partnerships with faculty. Nearly 90% of the Park tenant companies employ University of Arizona students as interns or in co-op work. Over half of the Park's high tech companies are involved in research partnerships with University of Arizona faculty. The University has almost 35,000 students and over 12,000 staff making it the largest employer in Pima County.

Within the University, responsibility for the Park rests with the Office of Economic Development, and the Associate Director of this Office serves as the Park Director and is responsible for the operation of the Park office. IBM serves as the managing operator of the Park. The Arizona Research Park Authority is a nonprofit entity under the auspices of the Arizona Board of Regents, and it provides a unique method for financing Arizona's university-related research parks.

The Tucson metropolitan area had a population of 861,000 in 2000. Services have 31% of employment, trade 24%, government 16%, and manufacturing 10%. The Greater Tucson Strategic Partnership for Economic Development (GTSPED) has identified and the University of Arizona provides support for industry clusters in aerospace, biotechnology industry, environmental technology, optics, plastics and teleservices. Major employers in southern Arizona include the Fort Huachuca Army Base, Raytheon Missile Systems, Davis Monthan Air Force Base and the Phelps Dodge Mining Company.

The Spring 2000 issue of Economic Development Commentary, published by the Council for Urban Economic Development, featured a case study of the University of Arizona Science and Technology Park. (RTI has ordered a copy.)

University of California Monterey Bay Education, Science and Technology Center (UC MBEST)

The University of California, Santa Cruz (UCSC) is developing the UC MBEST Center as a cornerstone of the Fort Ord defense conversion plan. This is a new regional research park that holds promise for development. Approximately 1,100 acres of the former Fort Ord military reservation were conveyed to the University in 1994 and about 484 acres are slated for the research and technology center. A new roadway and utilities infrastructure were completed in 2000, opening up 67 acres of real estate for development. New buildings, including the UC MBEST Center Headquarters and the City of Marina Business incubator, will be completed in the spring of 2001. Linked to Silicon Valley via the Highway 101 corridor and adjacent to the Marina Municipal Airport, the UC MBEST Center provides an opportunity for corporate and public organizations seeking growth through strategic partnerships with the education and research institutions of the Monterey Bay region.

In 1991, the U.S. Department of Defense announced plans to close Fort Ord. To mitigate regional economic impacts, members of Congress from California established an advisory task force to plan with the Army for the closure and reuse of the base. By the summer of 1992, an initial reuse vision was developed focusing on the region's strengths in education and research to stimulate job creation and the local economy. At the request of affected communities, the University of California and California State University played key roles in the base reuse planning effort. As a result of the commitment of these two universities with the local communities, the Fort Ord reuse effort was designated a national model for military base conversions by the Secretary of Defense in 1993.

The UC MBEST Center, with a goal of attracting technology businesses, has been identified as the largest potential job generator of the Fort Ord redevelopment effort. Over $15 million in funds have been raised to support these efforts. A key factor in potential success is that the Monterey Bay Crescent is home to approximately 30 public and private education and research institutions. Together, they employ several thousand scientists, engineers and specialized staff and have a combined annual operating budget of over $500 million. Areas of expertise include marine and biological sciences, environmental technologies, computer science and engineering, and advanced oceanographic and atmospheric studies. These research and education facilities include:

- University of California Santa Cruz
- California State University, Monterey Bay
- U.S. Geological Survey
- Long Marine Laboratory, UCSC
- NOAA National Marine Fish Service and Weather Service
- Naval Research Laboratory
- Marine Pollution Studies Laboratory, California Department of Fish and Game

The University of New Orleans Research and Technology Park

This park is located on a 56-acre development on the shores of Lake Pontchartrain adjacent to the University of New Orleans (UNO). UNO is the Park owner. The site is approximately six miles north of downtown New Orleans and is linked to Interstates 10 and 610. The site was the location of the Pontchartrain Beach amusement park from the 1940s through the 1980s.

The University of New Orleans broke ground for the Advanced Technology Center in the Park on November 3,1999. This is the first building built in New Orleans in the 1990s to solely house a variety of science and technology firms. The 80,000 square foot facility is the result of collaboration between the faculty and staff of the UNO, the UNO Research and Technology Foundation, and the Louisiana Public Facilities Authority. These organizations provided the startup capital of $1.5 million in tax-free development loans and the Whitney National Bank provided a $10.1 million loan for the balance of the project financing. Seven companies signed leases to occupy more than half of the available space before the groundbreaking.

Axonn Corporation, which leased the largest amount of space in the Advanced Technology Center, has maintained a cooperative relationship with UNO for several years, hiring 10 percent of the Engineering College's electrical engineering students. CLT, another tenant, indicates that the Research and Technology Park is the spearhead of a grass roots effort to change the face of the New Orleans economy by developing the community's scientific and technological research and development sector.

In addition to the Advanced Technology Center, UNO broke ground for the 104,000 square foot Center for Energy Management on September 8, 2000. Most of the university's applied research centers will be located in this facility. The Center will also house a high technology business incubator and a state-of-the-art conference center. It will be the primary link between UNO's applied research and the other activities in the Research and Technology Park. The Center will be connected directly to the planned Research and Technology Park hotel and is adjacent to the Advanced Technology Center. One of the primary roles of the Center is to develop methods for increasing the synergy among academia, government and industry.

Targeted research and technology transfer sectors include: aquatic sciences, chemical synthesis, computer software and systems, digital video computer technology, electric power utilization and energy conversion, environmental assessment, magnetic materials, naval architecture and marine technology, telecommunications, remote sensing and GIS. The Naval Information Technology Center was the first center to open in the Research and Technology Park.

New Orleans is one of the poorest cities in the U.S. Government agencies, including the U.S. Department of Commerce, the U.S. Department of Energy, the Louisiana Department of Economic Development, and the Mayor's Office of economic Development, support the concept of the Research and Technology Park as a step to

remedy the local economic situation. Local corporations such as Freeport McMoran, Entergy, Chevron, and Texaco have also voiced support for the new park. The goal of UNO is to partner with government and industry to use its multi-disciplinary programs to solve problems, create new products and increase the quality of life in the New Orleans region. It sees the Park as the physical interface for academia and industry

Attachment 3: Research Triangle Institute Experience in Economic Development

Research Triangle Institute (RTI) was one of the first companies in the Research Triangle Park and has been part of the growth of the research and development park since the 1960s. RTI is an independent contract research organization that currently has over 1800 employees. RTI was founded with close ties to the University of North Carolina at Chapel Hill, Duke University and North Carolina State University. Representatives from these universities still make up half of our Board of Directors and professors at these universities frequently serve as consultants on RTI projects.

RTI has had extensive involvement in economic development including capacity building, university involvement, strategic planning, community focusing, redevelopment and revitalization of underused areas, funding packages, targeted industry analysis and feasibility studies. Much of this work is directly relevant to the concerns of the Hampton Roads Partnership. RTI has conducted numerous economic development studies for federal, state, regional and local governments. Because of our location in the Research Triangle Park, RTI has a special expertise in analyzing the potential for university-related research parks and has conducted these studies in foreign countries as well as in the United States. The economic development staff is knowledgeable about the Hampton Roads area and has worked on projects with regional economic development agencies similar in size and scope to the Hampton Roads Partnership.

RTI has experience with science and technology park development. RTI has researched how technology parks can be the central focus of economic development for an entire region. However, they are challenging to develop and can require many years of lead-time for the construction of infrastructure and marketing to target industries. It is critically important to assess the overall feasibility of a research park concept and, if it is judged to be feasible, to structure the development and marketing to maximize the potential for success.

For example:
How can we determine whether we should try to develop a research park in our region?

What is the pattern of research park size, cost, development time and company locations for similar regions?

Located at and integrated into one of the most successful research/technology parks in the world, the Research Triangle Institute (RTI) has detailed knowledge about the development and success of the Park. RTI's location and history give it a unique capability to assess the feasibility of technology parks and recommend the appropriate steps for

initiating and marketing a technology park. RTI's approach to research park assessment is based on helping clients solve problems.

RTI has put into practice our unique perspective on successful technology- and research-led development efforts when assisting clients in their own technology and research planning, as reflected in the following examples:

- Development of a Science and Technology Park in Krakow. For this USAID-funded project in Poland, RTI assisted Jagiellonian University and the Krakow City Government in the initial planning of a science and technology park in Krakow.
- Advisory Assistance to Thailand Institute for Scientific and Technological Research. RTI conducted a series of workshops in Bangkok which were co-sponsored by the U.S. National Academy of Sciences and Thailand Ministry of Science, Technology and Energy (MoSTE) for public officials on the role of technology parks in regional development in the United States, sources of funding for technology park development, and governance structures for science parks.
- Development of a Science and Technology Park in Portugal. This project, financed by the Luso-American Foundation, provided advisory assistance to the Government of Portugal on the feasibility of establishing a science and technology research park, site location within the country, organization and management of the park, and public and private sector support roles.
- Research for the Development of an Eco-Industrial Park. RTI and its subcontractors, Indigo Development and Triangle J Council of Governments, worked under a cooperative agreement with the U.S. Environmental Protection Agency (EPA) to conduct research to support the development of communities of companies modeled after industrial ecosystems. The objective of this research was to examine issues that affected the ability of organizations to plan and create eco-industrial parks, and to aid the development of eco-industrial parks in Brownsville, Texas and Matamoros, Mexico.

Other examples of relevant economic development projects RTI has completed include the following:

- Targeted Industry Action Plan for the Research Triangle Region. RTI collaborated with the Research Triangle Regional Partnership, the economic development marketing organization for the 13 counties in the Research Triangle Region. We conducted research on several industry sectors, benchmarked the region against other regions that compete for these industries, held meetings with economic developers and other leaders in each county, facilitated a regional strategy session to decide steps for product development and promotion to targeted industries and prepared a final report.
- Economic Development Forum for the City of Durham - RTI prepared and conducted a public forum for the City of Durham's new Office of Economic and Employment Division. We identified key stakeholders and conducted informal interviews with community and business leaders about economic development issues and strategies. We prepared and delivered a presentation of data on Durham's recent economic situation and on results from preparatory interviews. In addition, we arranged a speaker panel, facilitated a forum of over 100

participants to generate development priorities for the city, and prepared a summary report.

- Cherokee County Economic Adjustment Strategy - RTI analyzed Cherokee County's assets and liabilities, its institutional capacity to support new and expanded industry, and its technology infrastructure. The technology assessment portion of the project identified the needs of technology-dependent businesses and the steps Cherokee County should take to meet those needs. RTI prepared an economic adjustment plan identifying growth industries that the county has the greatest potential to attract. In addition, we recommended a marketing strategy to achieve the county's economic development goals and objectives.

- Global TransPark Authority - RTI prepared a virtual reality model of the planned Global TransPark in eastern North Carolina. This model enables viewers to move through the planned park along the transportation corridors and inside the buildings planned for development. The model serves as a useful marketing tool for the Global TransPark Authority.

- Supporting Research for the Development of an Eco-Industrial Park (EIP) - RTI developed a conceptual framework for supporting the creation of EIPs, communities of companies that collaborate to enhance their economic performance through improved environmental performance. Their design includes features such as conversion of wastes into valuable inputs, co-generation of energy, and shared environmental infrastructure. RTI staff developed tools for analyzing the economic and environmental impact of EIP development, and wrote a "fieldbook" for planning, development, and management of EIPs. With the help of local economic development officials, RTI applied these concepts to specific companies in the areas of Brownsville, Texas and Matamoros, Mexico. Project recommendations were presented at an EIP conference attended by both U.S. and Mexican officials and formed the basis for additional projects funded by the Economic Development Administration and the Environmental Defense Fund.

- USAID-funded Local Government Assistance Project in Romania - In February 2000, RTI conducted a needs assessment in selected cities to develop an economic development plan for dissemination to a broad range of municipalities. Upon completion of the assessment, RTI conducted a national economic development forum to facilitate lateral exchange of development success stories among Romanian local governments and NGOs. RTI staff also designed and implemented the U.S. Local Economic Development Study Tour for Romanian officials and conducted a follow-up workshop in Romania to assist participants to complete action plans drafted during the tour. As a result of RTI technical assistance, pilot cities are creating city-level economic development departments, county-level economic development agencies, and public-private development partnerships. One such partnership targets economic development strategies for the pilot city of Pitesti. Comprised of representatives from the public, private, and NGO sectors, the Strand Park Public Private Partnership seeks to create local economic opportunities from the revitalization of a degraded municipal park.