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**Stage 1 – Initial Needs Assessment
Final Report for the University of North Carolina
Technology Development Initiative**

Presented to

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Executive Summary

The University of North Carolina System comprises 16 universities that engage in various levels of technology transfer activities. These universities consist of established technology transfer players (e.g., NCSU, UNC-CH), rising technology transfer players (e.g., ECU, NCA&T, UNC-C), and universities that do not have active technology transfer programs. Although each group has unique needs, all groups would benefit from access to an array of technology case management services.

The UNC System created the Technology Development Initiative (TDI) to provide technology case management services to the 16-campus system in order to promote technology-based economic development. To facilitate program startup, the UNC General Administration selected Research Triangle Institute (RTI) to provide selected technology case management services to the UNC System. This report provides a summary of observations and recommendations developed during TDI Stage 1 – Initial Needs Assessment.

During this stage of the TDI, RTI conducted initial phone interviews with 24 individuals from the 16 universities. The initial phone interviews were used to prepare for site visits and interviews. The site visits included interviews with 127 individuals at 15 universities.

Through the initial phone interviews and site visits, RTI identified many infrastructure and training needs. RTI also identified many opportunities for technology transfer across the UNC System. These needs and opportunities are summarized in the following observations:

- ▶ Opportunities for technology transfer exist at every university in the UNC System.
- ▶ The technology transfer process needs the support of university administration to be successful.
- ▶ Additional infrastructure is needed to support technology transfer efforts on a larger scale.
 - Additional personnel are needed at each university.
 - A support network of internal resources and external consultants is needed to provide assistance for universities and their technology transfer efforts.
- ▶ There is a widespread need for more training on technology transfer and intellectual property (IP).
 - Personnel closely involved with technology transfer, as well as university administrators and faculty, need formalized training.
- ▶ Faculty incentives are needed to increase the number of invention disclosures submitted.

- ▶ Technology transfer processes need to be revised to focus more on faculty needs in order to make technology transfer more effective.

Based on the observations listed above, RTI recommends that, in order to increase the effectiveness of technology transfer across the UNC System, the UNC General Administration should pursue the following tasks:

1. Work closely with each university to increase the focus on technology transfer.
 - ▶ Build support among university administration where needed.
 - ▶ Provide mentoring to core groups charged with developing technology transfer policies and processes. Help revise current or new processes to become more accommodating for faculty.
 - ▶ Provide mentoring to Intellectual Property Committees (IPCs) in order to gain necessary relevant experience. Place experienced personnel on these committees to help other committee members develop experience and expertise.
 - ▶ Encourage use of university Web sites to communicate technology transfer policies and procedures (see Appendices A, B, and C for samples of existing university technology transfer Web sites).
2. Continue investigating best infrastructure models that support technology transfer activities.
 - ▶ Identify a network of internal and external resources to assist with technology assessment, market research, technology marketing and valuation, legal assistance, and IP prosecution.
 - ▶ Determine the advantages of various infrastructure models: regional offices, a centralized office, individual offices, or some combination.
 - ▶ Help each university understand its current abilities and needs. Assist with identifying support services for each university and where additional full-time staff are needed.
3. Create incentives at each university that reward and encourage technology transfer and IP-related activities.
 - ▶ Integrate the creation of patented and copyrightable materials into the reward and tenure systems. (Patents and copyrights should be considered another form of publishing.)
 - ▶ Provide seed funding to support continued research and development (R&D) of embryonic technologies.
 - ▶ Provide financial assistance to support release time and/or lighter teaching loads so that any faculty can pursue or continue innovative research.
 - ▶ Provide financial assistance to support prosecution of more, and perhaps riskier, patents.
 - ▶ Encourage faculty recognition for IP and technology transfer successes.

- ▶ Promote successes through local and university media and patent recognition ceremonies.
4. Provide technology transfer and IP training for personnel from each university.
- ▶ Provide overview and detailed training as appropriate on IP and technology transfer to a core group from each university.
 - ▶ Provide additional training to university administrators at the beginning and emerging universities to help communicate the benefits of the technology transfer process.
 - ▶ Train faculty on IP and how it affects the work that they do. Faculty should be trained also on the technology transfer process, the benefits of participating in the technology transfer process, and the importance of having a technology transfer process.

RTI will assist with this recommendation by preparing overview and detailed training modules on IP and technology transfer and conducting training sessions for core groups from each university.

RTI found that each university in the UNC System was excited and enthusiastic toward technology transfer. With the proper infrastructure and training, as described in this report, each university will have the opportunity to become effective at technology transfer.

1. Introduction

1.1 Background

The University of North Carolina System comprises 16 universities that engage in various levels of technology transfer activities. These universities consist of established technology transfer players (e.g., NCSU, UNC-CH), rising technology transfer players (e.g., ECU, NCA&T, UNC-C, UNC-G), and universities that do not have active technology transfer programs. Although each university has unique needs, all would benefit from access to an array of technology case management services. These services might include educational and awareness-raising activities, invention scouting, technology and market assessments, business development planning, licensing and negotiations assistance, and venture capital networking.

The UNC System created the Technology Development Initiative (TDI) with the charter to provide technology case management services to the 16-campus system to promote technology-based economic development. The charter of the TDI also supports specific objectives of the Academy Fund, which was established in 1999 to provide seed capital for entrepreneurial businesses seeking to commercialize technologies developed in the Charlotte and Triad regions. The Academy Fund has been expanded to include a commitment to identify opportunities based on technologies from UNC System universities across the state.

To facilitate program startup, the UNC General Administration selected Research Triangle Institute (RTI) to provide selected technology case management services to the UNC System.

1.2 Objective

RTI's objective is to provide the UNC General Administration with the capability to spark technology-based economic development within the UNC System. RTI will provide the UNC General Administration with the following services:

- ▶ Initial Needs Assessment
- ▶ Commercialization Training

RTI also has discussed providing the following additional services for TDI:

- ▶ Technology Assessment
- ▶ Program Guidance

This report provides a summary of observations and recommendations developed during TDI Stage 1 – Initial Needs Assessment.

2. Methodology

RTI used the following methodology for each university. First, RTI conducted an initial phone interview with the contact(s) provided by Russ Lea, vice president of Research for the UNC System. This call was used (1) to quickly assess the stage of development of technology transfer at the university and (2) to identify the appropriate individuals who should participate in site interviews. A site visit then was scheduled, and RTI arranged interviews with a variety of university staff, administrators, and faculty members involved in highly innovative activities.

The following are highlights of the tasks conducted by RTI:

- ▶ RTI contacted all 16 universities.
 - ▶ Initial phone interviews were conducted with 24 individuals from the 16 universities.
 - ▶ Site visits included interviews with 127 individuals at 15 universities:
 - 1. Appalachian State University (ASU)
 - 2. East Carolina University (ECU)
 - 3. Fayetteville State University (FSU)
 - 4. North Carolina Agriculture & Technical State University (NCA&T)
 - 5. North Carolina Central University (NCCU)
 - 6. North Carolina School of the Arts (NCSA)
 - 7. North Carolina State University (NCSU)
 - 8. University of North Carolina–Asheville (UNC-A)
 - 9. University of North Carolina–Chapel Hill (UNC-CH)
 - 10. University of North Carolina–Charlotte (UNC-C)
 - 11. University of North Carolina–Greensboro (UNC-G)
 - 12. University of North Carolina–Pembroke (UNC-P)
 - 13. University of North Carolina–Wilmington (UNC-W)
 - 14. Western Carolina University (WCU)
 - 15. Winston-Salem State University (WSSU)
- *Interviews with Elizabeth City State University (ECSU) were conducted by telephone due to scheduling difficulties.

Detailed summaries of each site interview are provided in Chapters 5 – 20 of this report.

3. Observations

Through the initial phone interviews and site visits, RTI identified many infrastructure and training needs for universities in the UNC System. RTI also identified many areas of expertise that will create future opportunities for technology transfer across the UNC System. Details of RTI's observations are shared below.

3.1 General Observations

During TDI Stage 1 – Initial Needs Assessment, RTI made several general observations across the UNC System:

1. The state of technology transfer at the 16 universities in the UNC System can be grouped into four categories: beginning, emerging, transitional, and mature. The generic needs for infrastructure and training are the same across the four categories for each university; however, the specific needs for infrastructure and training at each university vary.
 - ▶ **Beginning** — These universities have the potential to generate IP and conduct technology transfer with that IP but have not done so yet. Each university in this category can become effective at technology transfer with support through additional infrastructure and training because they have bright faculty who are interested in conducting research and solving problems, even if research is not the focus of their particular institution. These universities can become effective also because many of the staff are interested in pursuing technology transfer activities. Their chances for success will increase greatly under the guidance of experienced personnel. Beginning universities in the UNC System are the following:
 - FSU
 - NCSA
 - UNC-A
 - UNC-P
 - UNC-W
 - WCU
 - WSSU
 - ▶ **Emerging** — These universities have generated potential IP and, in some cases, have conducted technology transfer with that IP but on an infrequent basis. Similar to the beginning universities, each university in this category can become effective at technology transfer with additional infrastructure and training because of bright faculty who are interested in conducting research and solving problems, even if research is not the focus of their particular university. These universities can become effective also because many of the

staff are interested in pursuing technology transfer activities. Their chances for success will increase greatly under the guidance of experienced personnel. Emerging universities are the following:

- ASU
- ECSU
- NCCU
- UNC-G

- ▶ **Transitional**— These universities have recognized the opportunity and the need to focus on technology transfer and have established official technology transfer offices in the last few years. These universities are ahead of the emerging universities in their advances toward becoming fully effective at technology transfer, but they still need similar types of support. With additional infrastructure and formal training, the resources allocated for technology transfer can be used more effectively, and technology transfer activity likely will increase. Transitional universities in the UNC System are the following:

- ECU
- NCA&T
- UNC-C

- ▶ **Mature**— These universities have been conducting technology transfer for some time and have integrated technology transfer processes into general university activities. Faculty are aware of the process and use it to submit hundreds of invention disclosures. Licensing and spin-off activities generate significant revenues for these universities. However, these universities have the opportunity to become more effective. The needs of mature universities differ from the emerging and transitional universities but still fall under infrastructure and training. Mature universities in the UNC System are the following:

- NCSU
- UNC-CH

2. Opportunities for technology transfer exist at every university in the UNC System. From biological designer materials developed at the Center for Marine Sciences at UNC-W to renewable energy technologies at ASU, each university has the potential to provide innovative ideas that can lead to products or services that can be commercialized (see Exhibit 3.1). The UNC System benefits from having faculty at each institution who are capable of, and in many cases interested in, bringing their ideas to market and solving problems. With proper support and incentives, faculty can bring forward a significant number of innovative ideas.

Exhibit 3.1: Sample Areas of Opportunity at Universities in UNC System

	ASU	ECU	ECSU	FSU	NCA&T	NCCU	NCSA	NCSU	UNC-A	UNC-CH	UNC-C	UNC-G	UNC-P	UNC-W	WCU	WSSU
Areas of Opportunity																
Aerospace sciences					x											
Assistive device technologies		x														
Biochemistry				x												
Biological designer materials														x		
Biotechnology			x	x		x			x		x	x	x		x	
Building and construction management	x															
Business processes												x				
Computer science														x		x
Computer software	x										x	x				
Educational & training materials	x		x	x		x			x		x	x	x	x	x	x
Engineering mechatronics									x							
Engineering technology															x	
Environmental sciences			x		x											
Health sciences																x
Heart cell growth and manufacturing		x														
High-technology music creation							x		x							
High-technology tools for oceanography														x		
Human-machine systems					x											
Industrial design	x															
Information technology											x	x				
Materials					x											
Medical data record technology		x														
Organic medicinal chemistry						x										
Photonics and optoelectronics											x					
Precision metrology											x					
Rapid prototyping			x													
Renewable energy technologies	x				x											
Robotic surgery		x														
Satellite imaging			x													
Speech and hearing therapies												x				
Student film licensing							x									
Telemedicine and telehearing		x														
Undergraduate research ideas			x						x							
Urban studies											x					
Use of handheld devices in education		x												x		x

3. The technology transfer process needs the support of university administrators to be successful. University administrators should support the technology transfer process by allocating resources toward the effort as well as directly promoting the process and rewarding its participants. Also, administrators should promote the

integration of IP creation into the faculty reward system. To achieve these goals, administrators need to be educated on the benefits of the technology transfer process as well as the need to encourage and motivate faculty to participate in the process.

4. Technology transfer can lead to increased opportunities for collaboration among universities in the UNC System. RTI found that many institutions are working in similar or complementary areas of research (see Exhibit 3.1). RTI also found that UNC System universities are engaged actively in collaborative projects with universities outside of North Carolina but do not appear to be engaged actively in collaboration projects inside the UNC System. A greater focus on technology transfer might lead to increased communication within the UNC System, which can lead to greater collaboration on research and technology transfer activities.
5. Faculty and staff recognized that technology transfer could benefit universities in the UNC System in many ways. At every university that RTI visited, faculty and staff quickly recognized the benefits that technology transfer can bring to a university. Unsolicited comments on the benefits of technology transfer included the following:
 - ▶ Is consistent with the university's goal to generate new ideas and share them with the world.
 - ▶ Increases financial resources for the university to use for scholarly activity
 - ▶ Helps attract and retain talented faculty and students
 - ▶ Creates regional economic development
 - ▶ Benefits the citizens of North Carolina
 - ▶ Improves the visibility and stature of the university
 - ▶ Educates students about technology transfer
 - ▶ Helps attract grant funds
 - ▶ Provides a creative outlet for faculty
 - ▶ Creates an "intellectually alive" environment
 - ▶ Provides an important measure of the performance of a research university
 - ▶ Provides a means to increase university/industry relationships
 - ▶ Gives evidence of productivity among faculty
 - ▶ Protects the IP of the university
 - ▶ Moves the university's innovations to the market
 - ▶ Provides a means to increase collaboration across the university and to involve students in new ways
 - ▶ Keeps the university on the cutting edge of technologies and prevents isolation from industry and market trends

3.2 Observations of Infrastructure Needs

During TDI Stage 1 – Initial Needs Assessment, RTI made several observations about the infrastructure needs across the UNC System.

1. Additional infrastructure is needed to support technology transfer efforts on a larger scale. The existing technology transfer personnel at the transitional and mature universities in the UNC System need support in a number of areas, including technology assessments, market research, legal counsel, technology marketing and valuation, and technology transfer strategies. In addition, many of the emerging and beginning universities either have not established a technology transfer focus or are currently formalizing their processes. These universities will need mentoring and support to conduct those initiatives. Infrastructure will be able to provide these support services.
 - ▶ Additional personnel are needed to make a marked impact on technology transfer activities at any university. Even at the mature universities, opportunities to pursue the best technology transfer paths are not realized fully because of limited personnel. Most of the licensing activity that occurs at these universities is limited to the companies involved with the original sponsored research. Technology transfer staff simply do not have time to look for opportunities beyond the research partners.

Transitioning universities that have technology transfer offices also are in need of additional personnel to perform various support functions such as helping to raise awareness around campus, performing market research, developing industry relationships, and handling copyright questions.

Beginning and emerging universities are eager to participate in technology transfer activities but require additional personnel to focus on establishing a technology transfer presence.

- ▶ A support network is needed to provide assistance for universities and their technology transfer efforts. Each university needs support in a number of areas, including technology assessments, market research, legal counsel, technology marketing and valuation, and technology transfer strategies. Beginning and emerging universities in particular also need experienced personnel to provide mentoring and assistance in forming technology transfer processes and achieving technology transfer successes. One solution to provide this broad range of expertise in a timely manner is to develop a network of shared internal expertise and external consultants that have experience in these areas; otherwise, the time and expense needed to identify, recruit, and integrate experienced personnel into each university will be detrimental to the overall success of technology transfer across the UNC System.

In addition to relevant expertise, external consultants can provide an objective, unbiased viewpoint, which can be especially important in the initial assessment of a technology. Often, emotions or politics can influence patenting decisions when the decision makers are too close to the technology. This can be avoided

by using external consultants who are not closely tied to the technology's success, which allows them to review a technology objectively for potential and to conduct realistic market research. The results of using external consultants include more realistic expectations for technologies, more effective use of the limited funds available for IP prosecution, and fewer lost opportunities.

A network of shared internal resources and external consultants is one element of an overall infrastructure that is needed to support technology transfer activities. In keeping with a UNC System-wide focus, four models should be considered for this overall structure:

- Centralized office under UNC General Administration
- Regional offices that share resources among multiple universities
- Dedicated point of contact or technology transfer office at each university
- Any combination of the above

Each model has advantages and disadvantages. Generally, the more centralized approach increases resource efficiency but does not provide a high level of interaction with each university. A dedicated point of contact or office at each university can increase technology transfer activities rapidly but is cumbersome and expensive to implement. Regional offices allow sharing of resources among multiple universities and might provide the best balance of effectiveness and cost. However, more investigation is required to understand fully which model, or combination of models, is best for the UNC System.

2. Faculty incentives are needed to help increase the number of invention disclosures submitted. Possible faculty incentives include the following:
 - ▶ Seed funding to support additional research of promising innovations
 - ▶ Release time for faculty to focus on research
 - ▶ Lighter teaching loads for researchers at teaching institutions
 - ▶ Patents and technology transfer activities integrated into reward and tenure systems that traditionally have rewarded publishing
 - ▶ Additional funding to support more patent prosecution

In addition, faculty who participate in the process should be recognized for their efforts. Both publication of technology transfer successes in campus and local media and patent recognition ceremonies are effective ways to celebrate technology transfer success, build interest among faculty, and increase the number of invention disclosures.

3. The technology transfer process needs to be revised to focus more on faculty needs in order to increase its effectiveness. In many cases, a heavy burden is placed on UNC faculty that inhibits a fully effective technology transfer process. Many faculty carry heavy teaching loads, leaving little or no time for research. Faculty members who do submit invention disclosures then are expected to do many additional tasks: prove the technical feasibility of the invention, conduct the market research to prove patenting is worthwhile, and give presentations to the Intellectual Property Committee (IPC), for example. Most faculty do not have experience conducting market research, yet they are expected to build cases for their innovations. The burden of the additional responsibilities might prevent faculty from pursuing technology transfer for their innovations. The current process should be reviewed in detail to determine ways to shift unnecessary burden away from faculty and into the hands of more experienced personnel.

3.3 Observations of Training Needs

During TDI Stage 1 – Initial Needs Assessment, RTI made several observations of needs for training across the UNC System.

1. There is a widespread need for training on technology transfer and IP. The technology transfer process includes different groups of people, and all would benefit from additional education and training.
 - ▮ Personnel closely involved with technology transfer need formalized training. This includes technology transfer staff, IPC members, and university administrators and staff charged with creating a technology transfer process. Although involved in the technology transfer process, many personnel have not received formalized training in technology transfer. In addition, many IPC members have no technology transfer experience and are unclear about their roles and the entire technology transfer process. Technology transfer and IP training can help clarify the confusion and build excitement.
 - ▮ Faculty generally need to be made aware of IP issues and the technology transfer process. Raising awareness among faculty is a continuous challenge. In particular, faculty need to understand the technology transfer process and the benefits of participating in it. Faculty also need to understand the types of IP that they might be creating and how and why they should protect it. By training the core groups at each university, more people will be able to communicate the benefits of technology transfer, and a more consistent message will be delivered at each university. It will be important to stress to faculty through the educational process that technology transfer and the creation of IP are services provided to support faculty and their innovations, not just to create wealth for the university.

Many faculty have questions about ownership of IP. In particular, faculty need clarification about ownership of the newer media products such as Web-based curricula, distance-education materials, and video-based instruction, as well as software. These issues need to be addressed not only in technology transfer policies and procedures but also as a segment of faculty training and raising awareness.

A summary of the infrastructure and training needs suggested by University personnel across the UNC System is provided in Exhibit 3.2 below.

Exhibit 3.2: Suggested Infrastructure and Training Needs Across the UNC System

	ASU	ECU	ECSU	FSU	NCA&T	NCCU	NCSA	NCSU	UNCA	UNC-CH	UNC-C	UNC-G	UNC-P	UNC-W	WCU	WSSU
Infrastructure																
Establish TT presence/POC on campus	x		x	x			x		x			x	x	x	x	x
Provide mentoring to university staff / IPC	x	x	x	x		x							x	x	x	x
Provide mentoring to develop / revise TT process on campus		x	x	x			x					x	x	x	x	x
Provide mentoring to develop / revise TT policies and procedures on campus		x	x	x		x	x		x			x				x
Incentives																
Integrate IP and TT successes into faculty reward system	x	x	x	x	x	x			x				x	x	x	x
Provide seed funding to foster development of innovative ideas	x	x					x		x	x			x	x	x	x
Provide faculty release time to pursue high-potential technologies	x	x					x		x				x	x		
Provide funds to support patent prosecution					x	x				x						
Lighten teaching loads to allow more time for research				x												x
Network of resources																
Assess technologies	x	x	x		x	x	x							x		x
Conduct preliminary market research	x	x	x		x	x			x		x	x				x
Provide legal assistance on IP	x		x		x	x			x							
Develop marketing / licensing strategies	x	x	x		x	x	x				x	x		x		
Market technologies	x	x	x		x	x					x	x				
Scout industries for research topics					x											
Other needs																
Establish clear communication methods for TT policies and procedures				x		x								x		x
Develop networking between universities to collaborate on joint research and leverage TT capabilities					x	x					x	x				
Develop support for TT at university administration			x			x					x					
Create incubator for university innovations					x					x						
Integrate TT process with local economic development activities															x	
Involve faculty in creating TT policies																x
Create POC specifically for copyright issues		x														
Add resources to manage IP-related documents								x								
Add resources to allow expansion of marketing efforts								x								
Industrial research manager to focus on sponsored research								x								
Establish a venture capital fund to support university technologies										x						

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Training																	
IP issues (staff/IP committee)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
TT basics (staff / IP committee)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
IP issues (faculty / students)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
TT opportunities, process (faculty / students)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

TT=technology transfer; POC=point of contact; IPC=Intellectual Property Committee; IP=intellectual property

4. Recommendations

Based on the observations listed in Chapter 3, RTI recommends that the UNC General Administration pursue the following tasks in order to create effective technology transfer opportunities for every university in the UNC System.

1. Work closely with each university to increase the focus on technology transfer.
 - ▶ Build support among university administration where needed.
 - ▶ Provide mentoring to core groups charged with developing technology transfer policies and processes. Help revise current or new processes to become more focused on faculty needs.
 - ▶ Provide mentoring to IPCs in order to gain necessary relevant experience. Place experienced personnel on these committees to help other committee members develop experience and expertise.
 - ▶ Encourage use of university Web sites to communicate technology transfer policies and procedures (see Appendices A, B, and C for samples of existing university technology transfer Web sites).
2. Continue investigating the best infrastructure models that support technology transfer activities.
 - ▶ Identify a network of internal and external resources to assist with technology assessment, market research, technology marketing and valuation, legal assistance, and IP prosecution.
 - ▶ Determine the advantages of various infrastructure models: regional offices, centralized office, individual offices, or some combination.
 - ▶ Help each university understand its current abilities and needs. Help identify support services that can assist each university and where additional full-time staff are needed.
3. Create incentives at each university that reward and encourage technology transfer and IP-related activities.
 - ▶ Integrate the creation of patented and copyrightable materials into the reward and tenure systems. (Patents and copyrights should be considered another form of publishing.)
 - ▶ Provide seed funding to support continued research and development (R&D) of embryonic technologies.
 - ▶ Provide financial assistance to support release time and/or lighter teaching loads so that any faculty can pursue/continue innovative research.

- ▶ Provide financial assistance to support prosecution of more, and perhaps riskier, patents.
 - ▶ Encourage faculty recognition for IP and technology transfer successes. Promote successes through local and university media and patent recognition ceremonies.
4. Provide technology transfer and IP training for personnel from each university.
- ▶ Provide overview and detailed training as appropriate on IP and technology transfer to a core group from each university.
 - ▶ Provide additional training to university administrators at the beginning and emerging universities to help communicate the benefits of the technology transfer process.
 - ▶ Train faculty on IP and how it affects the work that they do. Faculty should be trained also on the technology transfer process, the benefits of participating in the technology transfer process, and the importance of having a technology transfer process.

RTI will assist with this recommendation by preparing overview and detailed training modules on IP and technology transfer and conducting training sessions for core groups from each university.

Arranged alphabetically, Chapters 5 – 20 contain summary information for each university. Summaries include information from the initial phone interviews and site visits conducted by RTI, the types of technology opportunities that exist, and the specific recommendations for needs at that university, which are grouped into two categories: infrastructure needs and training needs.