Opportunities for Partnering in Rehabilitation and Imaging

Biomedical Technology Alliance. Southeastern Wisconsin has significant resources in the area of biomedical technology. The Biomedical Technology Alliance (BTA) was formed to enhance collaboration between the academic institutions in southeastern Wisconsin and with industry to ensure that the region receives the maximum benefit possible from these resources.

Collaborative Conference. This whitepaper examines two areas of strength for southeastern Wisconsin, rehabilitation engineering and biomedical imaging. It is based on a collaborative conference held in November 2004 that included researchers from multiple institutions and multiple disciplines. In addition to promoting a greater awareness among researchers the conference had several specific objectives: 1) identify areas of strength in southeastern Wisconsin, 2) identify possible areas for collaboration, 3) identify clinical, scientific and business challenges and opportunities and 4) develop strategies to address these challenges.

This whitepaper begins with an examination of the economic and collaborative environment that exists in southeastern Wisconsin. As the first major collaborative event organized by the BTA, the November event included comments by several academic and political leaders in southeastern Wisconsin. The whitepaper concludes with a discussion of the Functional Imaging Research Center, highlighting some of the aspects of this center that make it a model for a larger collaborative initiative.

Appendix A shows an agenda for the event and a list of speakers and panelists. The authors wish to thank all the participants for their insight as well as their commitment to this collaborative initiative.

Summary. The following highlights the key challenges, opportunities and strategies.

Economic/Collaborative Environment	
Challenges/ Opportunities:	• Milwaukee-area economy is shifting away from its traditional manufacturing base • Southeastern Wisconsin has significant resources in biomedical technology • Academic research in Metro Milwaukee lags other metro areas
Strategies:	• Organize industry and academic collaborations • Create a common front in southeastern Wisconsin to access State and Federal funds
Clinical/Scientific	
Challenges/ Opportunities:	• Rehab has well defined performance measures but clinical trials are difficult • Significant clinical opportunities exist in stroke, cardiac care and spinal cord injury • Trend toward evidence-based medicine drives need for quantitative measures
Strategies:	• Imaging data can complement rehabilitation performance measures • Focus care and collaborative efforts on key clinical needs
Technology/Commercialization	
Challenges/ Opportunities:	• Selection of the right technology is key to clinical adoption • Funding gap between basic research and commercialization impedes new technologies • Reimbursement key to successful products and services • Promising technologies include fMRI, robotics, multi-mode imaging, nanotechnology
Strategies:	• Patient and Physician outreach can ensure technology meets a clinical/market need • Apply imaging measures in rehabilitation can help in clinical trials and improve patient care • Bridge the funding gap with SBIR/STTR grants and other mechanisms

Economic/Collaborative Environment

Challenges/Opportunities:

- ***Economic Base:*** The importance of manufacturing to the Milwaukee area economy is decreasing, creating a challenge for business, community and academic leaders to find new sources for prosperity; however, the area's significant industrial base also offers significant collaborative opportunities for academic researchers.
- ***Biomedical Technology Resources:*** Southeastern Wisconsin has significant resources in biomedical technologies, both in the industry as well as local academic institutions; however, the academic resources are spread across multiple institutions, creating challenges for developing research collaborations.
- ***Academic Research:*** Academic research can be a significant economic driver; however, Milwaukee-area research institutions lag in R&D spending compared to other metro areas.

Strategies:

- ***Collaboration:*** Creating academic-industry collaborations will enhance the value of industry-sponsored R&D while increasing the amount of academic R&D. In addition, fostering academic collaborations will increase competitiveness of local researchers applying for basic research grants.
- ***Common Front:*** Creating a common organization to access state and federal funding will increase the region's competitiveness for these funds.
- ***Leverage Biomedical Technology Alliance:*** The BTA can provide a mechanism to identify and organize academic and industry collaborations. If the BTA can develop funding from private, state and federal sources, it may also be able to provide incentives for collaboration and fund collaborative infrastructure as similar alliances have done in other states.

Milwaukee-Area Shift from Manufacturing-Based Economy. The Milwaukee economy is changing. In 1975, 34% of the workforce was employed in manufacturing. Ten years ago, 20% of the workforce was employed in manufacturing, and today only 13% of Milwaukee's workforce is employed in manufacturing. This shift represents an important challenge given the significance of Milwaukee to the State's economy. The Milwaukee area represents the greatest concentration of population in the state, has the greatest portion of the state's employment, and also the greatest portion of the state's high-tech employment, 44%. Community, academic and business leaders must work together to ensure that region remains a healthy part of the Wisconsin economy.

Milwaukee-Area Lags in Academic R&D. The per capita research spending of Metro Milwaukee is three times lower than other metro area research institutions. [TechStar whitepaper – "Metro Milwaukee's Academic R&D"]. Academic R&D spending and the researchers who lead it are key catalysts for starting new technology companies. Metro Milwaukee is the most significant determinant of the state's economy, yet it ranks especially low in new-economy strength.

Southeastern Wisconsin Resources Spread Across Multiple Institutions. Southeastern Wisconsin has many of the same resources found at the UW-Madison, including a world-class medical school and strong engineering programs. The total student population in Metro Milwaukee is comparable with UW-Madison. However, these resources are spread across multiple academic institutions, and these institutions may have differing emphases and missions, making collaboration between institutions difficult.

Significant Biomedical Resources Represent Opportunity for Southeaster Wisconsin. Despite the economic and structural challenges facing the institutions in southeastern Wisconsin, there are significant resources in the area, particularly in the area of biomedical technology – both in the academic institutions as well as in industry. These resources include strength in rehabilitation engineering and medicine, biomedical imaging, medical devices, medical informatics, bioinformatics, genomics and proteomics. Appendix A shows a partial listing of the resources in two key areas – rehabilitation and imaging.

Strong Industrial Base Creates Opportunity for Collaboration with Academic Institutions. Southeastern Wisconsin has a significant industry base – including important biomedical companies such as GE Healthcare and a variety of smaller companies. Milwaukee also has the state's greatest portion of high-tech employment, 44%. An estimated 74% of the research done in the state is done by industry, but just 0.1% of that research is done collaboratively with academic institutions. Industrial collaboration clearly represents a significant opportunity. For industry, this would enhance the value of their R&D investment. For the academic institutions, this would increase the standing of the local academic institutions.

A Southeastern Wisconsin Alliance Can Better Access State Funding. The State of Wisconsin has demonstrated an understanding of the importance of biomedical technology resource. Given the strength of research at UW-Madison, the State has, understandably, focused much of their attention on building infrastructure in Madison. However, given that there is already significant investment in Madison, the marginal value of additional investment in the Milwaukee area could be much higher than investing in larger, more established research portfolios. The Biomedical Technology Alliance will allow the local institutions to come together and form a consolidated front in approaching the State to ensure that the Milwaukee area gets the State resources necessary for this important element of the economy.

A Southeastern Wisconsin Alliance Can Better Access Federal Funding. By demonstrating the depth of resources in southeastern Wisconsin, the Biomedical Technology Alliance can be more competitive in approaching funding organizations, such as NIH, because they can show a complete spectrum of resources needed to carry out multi-disciplinary resources. Furthermore, a southeastern Wisconsin alliance will be better able to address the federal legislators to ensure that all possible federal help is provided toward building infrastructure and growing capabilities in this area.

Use Biomedical Technology Alliance to Organize Collaborative Efforts. The Biomedical Technology Alliance, which includes academic institutions of southeastern Wisconsin as its founders, can be a key organization around which to organize collaborative efforts. UWM Chancellor, Carlos Santiago, commented on the success of creating a similar collaboration at the State University of New York at Albany in the area of nanotechnology. Key ingredients for that alliance were the quality of the students and the graduates as well as creating private partnerships with industry. That alliance raised a billion dollars from public and private sources. As Mike Bolger, President and CEO of the Medical College of Wisconsin indicated, such partnerships rely on trust, and that trust will be key to suppressing the turf wars that go on in academia.

The members of the Biomedical Technology Alliance should use a variety of methods to foster collaboration among the academic institutions and with industry. Specifically, the BTA should focus on creating an awareness of research efforts by continuing to sponsor collaborative conferences. These events also give researchers the opportunity to interact that can lead to collaborations. The BTA could follow the model of other states such as Michigan or Minnesota where the Alliance could provide incentives to researchers who reach out to other institutions to collaborate. Ultimately, the BTA may also provide infrastructure, such as wet lab spaces and other shared infrastructure for collaborative research. Funding for incentives and collaborative infrastructure will require a concerted effort by alliance members to gain state, federal and private industry support for the alliance.

Clinical/Scientific

Challenges/Opportunities:

- ***Unique Aspects of Rehabilitation Engineering:*** Rehabilitation engineering has a well defined set of performance measures; however, the challenges in performing clinical trials may create an opportunity for imaging-based measurements.
- ***Clinical Challenges:*** There are several clinical challenges that southeastern Wisconsin is particularly well poised to address given the imaging and rehabilitation strengths – including stroke diagnosis and management, cardiac care, spinal cord injury and paralysis.
- ***Evidence-based Medicine:*** The drive toward evidence-based medicine creates an opportunity to combine rehabilitation therapies with imaging techniques that help determine the appropriate type, duration and intensity of treatment.
- ***Rehabilitation and Imaging Resources:*** The combination of resources in southeastern Wisconsin, including a strong research and industry base in imaging as well as a strong research and clinical base in rehabilitation offers a significant resource for the development and commercialization of new technologies.

Strategies:

- ***Imaging Data to Complement Rehabilitation Measures:*** Imaging techniques can provide an anatomical correlate to the typical performance-based rehabilitation measurements.
- ***Focus Care and Collaboration on Clinical Needs:*** Collaborative efforts should focus on key clinical areas for which there are existing resources, include stroke, cardiac care, spinal injury and paralysis.

Unique Aspects of Rehabilitation Engineering Present Unique Challenges. As Dr. Tim Dillingham pointed out, there are several unique aspects of rehabilitation that make it challenging as well as a potentially fertile ground for collaboration. Rehabilitation is the only field with its own outcome measures that include series of performance-based measures. However, rehabilitation does not have a single organ system and, instead, must treat the patient as a whole-body system. Given the nature of care, it is particularly difficult to perform randomized clinical trials in rehabilitation, making it difficult to get quantitative results comparing different treatment options, duration of treatment or intensity of treatment. Furthermore, the rehabilitation process is a process of change, and tends to be focused on care rather than cure.

Clinical Challenge in Stroke Diagnosis and Management. The diagnosis and treatment of stroke represent an important clinical problem that can benefit from the rehabilitation and imaging resources in southeastern Wisconsin. Dr. David Klemer described a key challenge facing clinicians in the immediate treatment of stroke. Emergency room physicians are faced with the challenge of quickly determining whether or not a patient's stroke has been caused by a hemorrhage in the brain. This knowledge is key to determining whether or not blood thinning medication will be given. Imaging technologies in this area are advancing faster than the standard of care. The accepted practice indicates that a non-contrast CT must be completed and interpreted with 45 minutes; however, recent data shows that MRI may be better at detecting hemorrhagic stroke.

The diagnosis and management of stroke is an area that leverages the biomedical resources found in southeastern Wisconsin. Imaging clearly plays an important role in acute stroke management. Rehabilitation plays an important role in the long term care of stroke patients. Imaging may also play a role in long term care of stroke patients, by providing anatomic measures inside the body to complement the performance measures currently available in rehabilitation.

Clinical Challenge in Cardiac Care. Cardiac care is another area that can potentially benefit from collaborative efforts of area researchers. Dr. Ming Zhao highlighted an example where cardiac MRI was showing significant promise in animal models. Cardiac MRI can play an increasing role in the diagnosis of cardiac diseases and the care of patients. However, bringing this technology to clinical practice will require the involvement of clinicians.

Clinical Challenge in Spinal Cord Injury and Paralysis. Spinal cord injury can have devastating effects for patients. The treatment of spinal cord injury and searching for a cure for paralysis is an important clinical challenge that leverages the rehabilitation and imaging strengths found in southeastern Wisconsin. Imaging techniques such as diffusion tensor imaging are giving researchers new ways to isolate injuries to the spinal cord. This and other imaging techniques may offer imaging correlates to the functional outcomes typically measured in rehabilitation. Southeastern Wisconsin also has the clinical populations that are critical to investigating potential techniques, including a center of excellence in spinal cord injury at Froedert Hospital and a regional center in spinal cord injury at the VA hospital.

Wide Array of Research in Rehabilitation, Imaging and Related Fields. The academic institutions in southeastern Wisconsin are the home to a wide array of research in imaging, rehabilitation and related fields. Some examples of that research include:

- Diffusion tensor imaging research that uses advanced imaging techniques to isolate the location and extent of spinal cord injury
- Visual field mapping that correlates the site of a brain tumor with visual field defects
- Imaging tools that predict the extent of language decline from epilepsy surgery
- Cardiac imaging techniques that use MR to identify cardiac infarctions
- Robotic tools to measure range of motion for stroke patients undergoing rehabilitation
- Telemedicine applications that allow occupational therapists to remotely monitor patient progress
- Sensory substations that explores plasticity of the nervous system
- Research in multiple sclerosis and muscle fatigue that combines MR, fMRI and EMG to obtain a more complete picture of what occurs during exercise

Trend Toward Evidence-based Medicine Creates Opportunity in Imaging/Rehab. Several panelists commented on the important trend toward evidence-based medicine. Reimbursement is key to the adoption of a new technology, and Medicare and Medicaid are increasingly demanding quantitative evidence to support the use of a given treatment. Imaging techniques may offer the potential for specific quantitative measures to help in the development of rehabilitation therapy. Given the difficulty in performing randomized clinical trials in rehabilitation, this represents an important opportunity for imaging researchers to work with researchers in rehabilitation to monitor the type, duration and intensity of rehabilitative therapies and to complement the existing performance measures with quantitative anatomical data.

Imaging Offers Anatomical Correlate to Rehab Performance Measures. The field of rehabilitation has a well-established set of performance measures (such as functional independence measures) which are clinically based. Imaging offers a potential window on the inside world of what is happening in the patient's body, giving researchers and clinicians an anatomical correlate of the existing functional measures. Imaging techniques can help researchers better understand the healing process that takes place during rehabilitation. In spinal cord injury, it is easy to measure the effects of the injury from a functional standpoint; however, it is not well known how that correlates to the morphology of the injury to the spinal cord. The combination of imaging techniques and functional measures could be an important tool in measuring the effectiveness of treatments for spinal cord injury, including stem cell treatments.

Imaging Offers Way to Personalize Rehabilitation Treatments. In addition to helping researchers better understand the healing process in general, imaging techniques have the potential to help clinicians and occupational therapists better personalize treatments. Imaging techniques may provide highly specific, quantitative data for individual patients that will allow their doctors and occupational therapists to individually determine the type of treatment that would be most effective, determine what intensity of treatment will yield the optimal results and determine the duration of treatment that is appropriate for that patient.

BTA Efforts Should Bring Together Groups Around Specific Clinical Challenges. Collaborative efforts are most likely to succeed where there are clearly identified clinical needs and existing resources to address these needs. Several clinical areas identified at this conference, including stroke diagnosis and

treatment, cardiac care, spinal cord injury, treatment paralysis and treatment of traumatic brain injury represent important clinical needs that southeastern Wisconsin is well positioned to address. Important research is already being carried out in these areas, and the BTA should leverage these efforts to increase the regions contributions in these areas.

Education Strategies for Practitioners. Among the key resources that exist in southeastern Wisconsin is a strong educational system in rehabilitation and engineering. Efforts to bring new technologies into clinical practice should include a concerted effort to work with the educational programs for entry-level practitioners to educate them about the new technologies.

Technology/Commercialization

Challenges/Opportunities:

- ***Technology Selection:*** Selecting the right technology and gaining clinical acceptance is a key challenge in developing and quickly commercializing new technologies.
- ***Funding Gap:*** The funding gap between basic research and venture funding makes it difficult to bring new technologies to market
- ***Reimbursement:*** Reimbursement is key to the success of a new biomedical product or service.
- ***Promising Technologies:*** Expertise in southeastern Wisconsin creates an opportunity to apply several promising technologies to clinical challenges already identified; these promising technologies include: fMRI, robotics, multi-modality imaging and nanotechnology.

Strategies:

- ***Patient & Physician Outreach:*** Outreach to patient and physicians can help create seamless conduit between the laboratory and the clinic to ensure that the right technologies are developed and quickly adopted.
- ***Inexpensive and Easy to Use:*** New products must be cheap and easy to use.
- ***Imaging Measures for Rehabilitation:*** Imaging can provide quantitative measures of rehabilitation progress to demonstrate efficacy and help reimbursement issues.
- ***Bridge the Funding Gap:*** SBIR/STTR funding mechanisms can help bridge the funding gap between basic research and commercialization. Institutions and the BTA may also be able to address this issue by providing other sources of funds to help in the commercialization process.

Selection of Right Technology Key to Gaining Clinical Acceptance. Dr. John Ulmer pointed out that only 5% to 10% of techniques published in the clinical literature make it into clinical practice. In some cases, technology developers try and push a new technique into clinical practice. Instead researchers should first determine a specific clinical target and develop requirements for the technology based on that target. As Dr. Ulmer described, what is needed is a seamless conduit between the researchers and the clinic. This should extend beyond the development of the technology into clinical trials. Balancing the clinical pull and the technology push requires great insight and collaborative efforts of many groups.

Outreach to Patient Groups Can Help Identify Right Technologies. Involvement of patient groups is important developing the right technologies. Dr. Dillingham pointed out an example in the development of new prostheses that underscores the importance of patient involvement. Surgeons thought patients wanted better cosmetics. Researchers thought patients wanted a limb that would allow them to vary friction with cadence. But, when patients were asked, what they really wanted was a limb that was cheaper and more comfortable. The development of prosthetic devices also illustrates the importance of understanding the patients broader systemic problems. Many of the systemic problems experience by diabetics prevent them from taking advantage of high-tech limbs.

Outreach to Physician Groups Can Help Identify Right Technologies and Speed Adoption. Involvement of physician groups can also help ensure that the right technologies are developed. MD's

need to be invited into the process early enough so that they have a chance to learn about the technology and can gain a depth of understanding. This may also help speed adoption of the technologies if MD's can help identify and eliminate problems early and if they become advocates for the technology as it enters clinical practice.

Involvement of clinicians, including MD's and occupational therapists, can also help in the development of intuitive user interfaces. A good user interface is key to adoption and success of a product. In the laboratory, where the experts are available to operate the system, the user interface is not critical to proving the feasibility of the technology. But in the commercial market, a good user interface can mean the difference between success and failure of a product.

Involvement of MD's also presents challenges. MD's are very creative at using the tools that they have to best serve their patients. Furthermore, their busy clinical schedules may make it difficult to get meaningful involvement.

Training of Biomedical Engineers Should Address Patient and Clinical Requirements. The biomedical engineering departments at Marquette University and MSOE are a key resource in training the next generation of biomedical engineers. Given the importance of reaching out to both patient groups and physician groups, training programs must address the need to properly solicit requirements.

Funding Gap Between Basic Research and Venture Funding Makes Commercialization Difficult. One of the key systemic problems in the technology development continuum is the funding gap between basic research and commercialization. There are well established funding sources, such as the NIH and foundations, to address basic research. However, there is a lack of funding available to move technologies from this basic research stage to a point where it is appropriate to receive venture capital funding or be licensed to industry. Particularly in the biomedical area, industry has become more risk averse and less willing to invest until the technology has reached a later stage (as late as human trials). Venture capitalists have also become more risk averse and moved later in the process, often waiting to invest until there is significant animal data. This has exacerbated the problem of funding technologies past the point of basic research.

BTA and Other Organizations Should Further Exploit SBIR/STTR Mechanism to Address Funding Gap. SBIR and STTR grants can help address the funding gap between basic research and commercialization. These programs are specifically designed to fund technology transfer. They are designed to provide funds to small businesses to demonstrate commercial feasibility of a product after basic research has been completed. The programs are structured to give funds to small business, and they require a certain ownership structure as well as intellectual property rights. Organizations such as TechStar and the Regional Economic Partnership are increasingly trying to use this mechanism to move technologies past the funding gap. The BTA should continue to develop programs to address this funding mechanism and should work with the licensing groups at the academic institutions to help ensure researchers can gain access to this funding source.

University Based System to Fund Basic Prototyping. Another potential strategy to address the funding gap is to develop a institutionally based system to fund prototyping. Dr. Bill Gregory described the efforts of NovaScan to develop a working prototype that would help the company to obtain venture capital funding. Funding the development of a prototype for a proven researcher may be a small expense compared to money spent setting up a laboratory for a new researcher. In the long term, the BTA might also provide a funding source for prototyping activities that help move technologies from basic research to commercialization.

Reimbursement is Critical To Successful Business Models. The development of CPT codes that allow for reimbursement of new technologies is a lengthy process. As already suggested, imaging may help in the reimbursement of rehabilitation-based products and services by providing quantitative data to support their effectiveness. Furthermore, the clinical resources in southeastern Wisconsin can also support the

success of early stage business by providing access to patient populations that are necessary for clinical trials.

Opportunity to Exploit New Technologies – fMRI, Robotics, Multi-modality Imaging, Nanotechnology. It is clear that there must be a clinical pull and close involvement of the end users to develop successful new technologies. There are several promising technology areas with the potential to link to the clinical challenges noted above and others. Functional Magnetic Resonance Imaging (fMRI), robotics and multi-modality imaging are technology areas with significant research strength in southeastern Wisconsin. In addition, nanotechnology offers the potential to address many of the clinical challenges already identified.

Technical Challenge – Make it Cheap and Easy to Use. Biomedical engineers who have worked in the development of technology emphasized two requirements for the success of a new technology – make it cheap and easy to use.

Standards Can Contribute to Success of Niche Products. One of the challenges in creating commercial successes for products in rehabilitation is that some products target only a small market. Mark Gehring of Emageon suggested that standards can help with that problem. Standards that allow niche products to integrate with existing systems can contribute to their success. This can allow manufacturers of other products to integrate them and offer them as part of a larger suite of products where the product alone many have difficulty achieving commercial success.

Functional Imaging Research Center – A Case Study in Collaboration

As Dr. Steve Rao highlighted in his address, The Functional Imaging Research Center (FIRC) at the Medical College of Wisconsin illustrates many of the aspects that will also allow the Biomedical Technology Alliance to be successful, including:

- ***Multi-institutional, Multidisciplinary Collaboration***
- ***Shared Infrastructure***
- ***Targeted Clinical Applications***
- ***Training Programs***
- ***End-to-end Involvement Including Researchers and Clinicians***
- ***Industry Partnerships***
- ***Commercialization of Basic Research***

Collaboration. The FIRC represents a significant collaborative effort including multiple faculty, post doctoral fellows and graduate students from the Medical College of Wisconsin, Marquette and UWM. The center also brings together multiple disciplines including: neuropsycologists, anesthesiologists, biophysicists, neurobiologists, radiologists and others.

Shared Infrastructure. The MR scanners at the Center represent a significant investment that may not be justified for many of the local institutions. But at a collaborative center, researchers from even the smaller institutions can access state-of-the-art scanners, including a new 3T MR scanner and a new 9.4T animal scanner as well as existing 1.5T scanners.

Targeted Clinical Applications. The Center has specific clinical targets that include: brain tumors, stroke, epilepsy, drug abuse, Alzheimer's disease, Parkinson's disease, Huntington's disease, attention deficit disorder, multiple sclerosis, head injury, visual disorders, gastrointestinal disorders and schizophrenia.

Training Programs. In addition to providing a resource to local researchers, the FIRC also provides training programs in functional imaging that help researchers at other institutions in other parts of the country to develop their own programs and use tools that have been developed at the FIRC.

End-to-end Involvement. The FIRC brings together a complete spectrum of resources from basic researchers to clinicians.

Industry Partnerships. The FIRC leverages industry collaborations. GE is helping to provide new scanners to the FIRC. The center is also developing a collaboration with a commercial partner to explore PET-CT scaning.

Commercialization. MCW and the FIRC have over a decade of expertise in functional imaging. That fundamental research is now making the transition to commercial application through Neurognostics, a company formed to apply functional imaging techniques to the diagnosis and treatment of central nervous system disorders. This illustrates a key mechanism through which basic research, initially funded by public sources can ultimately reach the public domain through commercialization of the technology.

Appendix A. Conference Program

Opportunities for Partnering in Rehabilitation and Imaging

Thursday, November 18, 2004, 8:00 a.m. until 1:15 p.m.
Marquette University Union, Room 163, 1442 W. Wisconsin Avenue, Milwaukee

Agenda:

8:00 – 8:30	Mixer/Refreshments	
8:30 – 8:35	Welcome	**Stan Jaskolski**, Ph.D., Dean, College of Engineering , Marquette University
8:35 – 8:45	Introduction	**Tom Barrett**, Mayor, City of Milwaukee
8:45 – 9:10	Keynote Speaker	**Carlos E. Santiago**, Ph.D., Chancellor, University of Wisconsin-Milwaukee
9:10 – 9:20	Follow-up Comments	**T. Michael Bolger**, J.D., President and CEO, Medical College of Wisconsin
9:20 – 9:30	Follow-up Comments	**Madeline Wake**, Ph.D., R.N., FAAN, Provost, Marquette University
9:30 – 9:50	Keynote Speaker Imaging	**Stephen M. Rao**, Ph.D., Medical College of Wisconsin
9:50 – 10:30	Imaging Panel Discussion *Moderator:* **Kristina M. Ropella**, Ph.D., Marquette University	*Panel Members:* **Jeff Binder**, M.D., Medical College of Wisconsin **Edgar DeYoe**, Ph.D., Medical College of Wisconsin **Mark Gehring**, Emageon **William D. Gregory**, Ph.D., University of Wisconsin-Milwaukee **David P. Klemer**, M.D., Ph.D., University of Wisconsin-Milwaukee **Ming Zhao**, Ph.D., Medical College of Wisconsin
10:30 – 10:40	Break	
10:40 – 11:00	Keynote Speaker Rehabilitation	**Timothy R. Dillingham**, M.D., Medical College of Wisconsin
11:00 – 11:45	Panel Discussion on Rehabilitation *Moderator:* **Michelle Johnson**, Ph.D., Medical College of Wisconsin	*Panel Members:* **Thomas A. Current**, CPO, ACTRA Rehabilitation Associates, Inc. **John Gassert**, Ph.D., Milwaukee School of Engineering **Kathi L. Kamm**, Ph.D., University of Wisconsin-Milwaukee **Roger O. Smith**, Ph.D., O.T., University of Wisconsin-Milwaukee **Tina M. Stoeckmann**, P.T., M.A. Marquette University **Jacqueline J. Wertsch**, M.D.,VA Medical Center **Jack M. Winters**, Ph.D., Marquette University
11:45 – 12:30	Panel Discussion on Imaging/Rehabilitation *Moderator:* **William R. Hendee**, Ph.D., Medical College of Wisconsin	*Panel Members:* **Cherik Bulkes**, GE Healthcare **John R. McGuire**, M.D., Medical College of Wisconsin **Alexander V. Ng**, Ph.D., FACSM, Marquette University **Robert A. Scheidt**, Ph.D., Marquette University **Brian D. Schmit**, Ph.D., Marquette University **John L. Ulmer**, M.D., Medical College of Wisconsin
12:30 – 12:35	Concluding Comments	**William R. Hendee**, Ph.D., Medical College of Wisconsin
12:35 – 1:15	Lunch/Mixer	

Appendix B. Southeastern Wisconsin Resources in Rehabilitation and Imaging

Resources in Rehabilitation Engineering and Medicine. The engineering and medical aspects of patient rehabilitation after illnesses and injuries are an especially strong intellectual resource in Southeastern Wisconsin. This resource is distributed among several institutions, and its strength as a collective effort is not readily apparent. However, TechStar is assimilating these components into a cooperative effort to leverage this intellectual capital into a productive force that is more than a simple sum of the components. Contributors to the region's strength in rehabilitation engineering and medicine include:

- Rehabilitation engineering, perhaps the strongest area of research within the Department of Biomedical Engineering at Marquette University.
- Rehabilitation engineering and medicine at the Zablocki Veterans Administration Medical Center, a research and clinical effort that services many veterans receiving care at that institution.
- The Departments of Physical Medicine and Rehabilitation, Neurosurgery, and Orthopedic Surgery at the Medical College of Wisconsin, all of which have programs in rehabilitation medicine for victims of stroke, spinal cord injuries, other forms of trauma, and debilitating diseases of the aged.
- The Orthopedic Research Engineering Center, a joint effort between Marquette University and the Medical College of Wisconsin focused principally on individuals with walking challenges, especially children.
- Research in biomechanics, biomaterials, speech therapy, and other areas important to rehabilitation engineering at the University of Wisconsin – Milwaukee.
- The Rapid Prototyping Facility at the Milwaukee School of Engineering, a regional resource important to rehabilitation engineering and used by manufacturers throughout Southeastern Wisconsin.
- A number of small companies producing products and services related to rehabilitation engineering and health care in the greater Milwaukee area. TechStar is compiling a directory of these companies.

Resources in Biomedical Imaging. Biomedical imaging is an especially strong resource of intellectual capital in Southeastern Wisconsin, with major strengths emanating from:

- General Electric Healthcare, traditionally focused on equipment for medical imaging, now focused additionally on information systems and healthcare services, and soon, through the merger with Amersham Pharmaceuticals, on molecular imaging.
- Companies such as Camtronics, IGC-Medical Advances, Merge Technologies, Wisconsin Cyclotron, Neurognostics, etc. with product lines and services targeted to imaging and image display and dissemination.
- Biomedical imaging at the Medical College of Wisconsin, with research in areas such as cone-beam computed tomography, functional magnetic resonance imaging, and cellular and molecular imaging.
- Biomedical imaging at Marquette University sited particularly in the Department of Biomedical Imaging and including image reconstruction and analysis related to functional imaging and rehabilitation engineering.
- A PhD program in functional imaging, currently providing education and research opportunities to 2 dozen PhD-seeking graduate students, has been in place for several years as a joint effort of Marquette University and the Medical College of Wisconsin.
- Biomedical imaging at the University of Wisconsin – Milwaukee, which is destined to grow through recruitment of faculty in areas such as optical imaging and imaging with coherent light sources.
- Functional Imaging Research Center at the Medical College of Wisconsin