



**10 Case Studies of High-Value, High-Return
University-Industry Collaborations**

Since the 2006 publication of the University Industry Demonstration Partnership's *Living Studies in University Industry Negotiations*, academic and corporate institutions, as well as other research funders and performers, have raised the bar on finding innovative and mutually beneficial ways to collaborate. In order to raise awareness of such collaborations, building on the UIDP's Partnership Continuum work, as well as share lessons learned to inspire new high-value, high-return partnerships, the University-Industry Demonstration Partnership (UIDP) has collected 10 Case Studies of engagements that provided benefits and insights to the engaged parties.

The Case Studies are presented here in chronological order and at uidp.org. The University Industry Demonstration Partnership continues to highlight U-I collaborations through its Partnership Showcase project. To learn more email info@uidp.net.

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The Nonwovens Institute (NWI) at NC State University, a Sustainable Industry/University/Government Partnership Model

1991 – Present

The Nonwovens Institute (NWI) traces its history to 1991, when the Nonwovens Cooperative Research Center (NCRC) was established as a State-Industry-University Cooperative Research Center (State-I/UCRC). In 1998, upon the conclusion of NSF grant funding, NCRC continued to enhance its technology and research capabilities while growing its membership to become the most successful State-I/UCRC in the Nation. NWI was launched in 2007 as the world's first accredited academic inter-disciplinary program for engineered fabrics. NWI engages experts in building next-generation fiber-based applications while also providing training and guidance to the field's future leaders. NCRC now serves as NWI's fundamental research and discovery arm. The NWI is notable for its longevity and for transitioning from public funding to being supported almost entirely by private funds, with 98% of NWI's funding coming from private industry.

Keywords: open innovation, industry-university interface, public-private partnerships, innovation acceleration, corporate-sponsored research, pilot manufacturing facilities

Background: The Nonwovens Cooperative Research Center (NCRC) was established as an NSF State-Industry-University Cooperative Research Center (I/UCRC) in 1991 with the grant period lasting through 1998. After the grant period ended, the State of North Carolina and industry partners continued to support NCRC. Today, NCRC still operates in an open innovation model where all the members contribute to, and share in the research findings of the center. Following graduation from the National Science Foundation, the focus expanded beyond basic and enabling research. NCRC responded to the expressed needs of the industry and built the public sectors most comprehensive pilot and testing facilities, providing for access to lab-scale and pilot-scale manufacturing technologies. NCRC also started a program to help the development of new and innovative products using these facilities. NCRC responded to the industry needs by making significant investments in manufacturing technologies to support members and non-members by providing them fee-based access. The testing and technology investments were essential to enhancing fundamental research, accelerating innovation, and enabling the center to aid companies in product development. NCRC also focused on developed continuing education courses to support the growing industry.

After years of growth and expansion of the original mission of NCRC, The Nonwovens Institute (NWI) was formed in 2007 as the world's first accredited academic program for the interdisciplinary field of engineered fabrics. Interdisciplinary research and education form the basis of the NWI's mission. The NWI engages experts from industry and higher education in building next-generation nonwoven applications while also providing training and guidance to the field's future leaders. The NCRC now serves as the NWI's core fundamental research and discovery arm while the NWI engages industry through the use of its extensive testing and facilities, continuing education programs, research and product development programs and as an industry service organization.

Parties Involved: At NC State, the expertise is drawn primarily from the colleges of Textiles, Engineering and Natural Resources. In addition, NWI has had a tradition of supporting students and faculty at other partner universities. These include the University of Illinois at Chicago; Virginia Commonwealth; Akron; Georgia Tech; Clemson; Loughborough, UK; Albstadt, Germany and Mulhouse, France. NWI currently supports the work of over 35 Masters- and PhD-level students pursuing advanced studies in fiber and

polymer science, chemical and biomolecular engineering, materials science and engineering, paper science and engineering, textile engineering, biomedical engineering and other disciplines. NWI has over 70 industrial partners from around the world including 3M, Ahlstrom Nonwovens, Andritz Nonwoven, Bailksan Lintex, BASF, BSN Medical, Cardinal Health, Colbond bv, Cotton Incorporated, Cummins Filtration, Dow Chemical, Duke Energy, Eastman Chemical Company, E. I. Dupont, Elmarco, ExxonMobil, FiberVision, First Quality Enterprises, Flanders, Freudenberg, Groz Beckert, Hills Inc., Hollingsworth & Vose, innoPad Inc., Janesville Acoustics, Johnson & Johnson, Kimberly Clark, Kraton Polymers, MANN+HUMMEL, Millipore , NATICK, Pall Corp, Pentair Water Pool & Spa, PGI Nonwovens, Ply Gem Industries, Procter & Gamble, Prometic BioSciences, Reifenhauer REICOFIL, Schlumberger Technology Corporation, Techmer PM, Truetzshler Group, Veolia, VF Corporation, etc.

Level of Engagement: In the shared research environment of the NCRC, the level of engagement is collaborative and in the one-on-one relationships with companies, NWI's level of engagement is typically alliance.

Staffing: NWI has 18 core staff including faculty, research scientists, engineers/technicians and administration. Through NCRC, NWI also supports 35+ graduate students and 20+ professors from multiple degree programs at NC State and partner universities. NWI has over 70 industrial partners.

Role of Government: NCRC began with funding from NSF (grant period ended 1998) and the State of North Carolina and NCRC continues to receive approximately \$240,000 annually from the State of North Carolina.

Budget: NCRC began with equal support from NSF, Industry Partners and The State of North Carolina equaling \$900,000 dollars annually. Since the NSF grant period ended in 1998, NWI and NCRC have continue to grow primarily from industrial support. The NWI current annual budget ranges from \$5-6 million split between NCRC membership, use of pilot and testing facilities and sponsored research programs. NWI has invested significantly to create its world renowned pilot and testing facilities that are valued over \$30 million US dollars. NWI currently receives 98% of its funding from private industry.

Outcomes:

Research and education

- Recognized as the global leader in nonwoven research and education
- \$22 million in total research expenditures 2002-2012
- Work with 30 internationally recognized faculty and scholars in multidisciplinary programs

Student engagement

- Over 120 Ph.D. alumni with 95% in leading industrial positions and 5% in academia
- Currently provide graduate assistantships to 35 PhD students in multidisciplinary programs
- 55 Graduate Certificates awarded
- 30 students currently enrolled in Graduate Certificate program
- Established annual exchange program with German students

Industry engagement

- Numerous products currently available commercially developed through partnerships,
- 30+ patents held
- 3 startup companies

- 200+ companies served annually
- 10+ industry professional development and training courses annually

Access to resources

- State-of-the-art testing and pilot facilities valued at over \$30 million dollars

Measuring Success: Sustainability is the best measure of success for a center or institute. To make an institute sustainable there must be many successes. The typical metrics recognized by both industry and university are financial like research funding, commercial licenses, Intellectual property, commercial products and start-up companies. In additional metrics are the number of students trained, number of students hired by industry partners, publications, jobs created, and industry/university interactions. Our metrics are simple and measured in the following terms:

1. Training of future leaders – NWI has been instrumental in training over 120 PhDs who serve in industry. A great example is Freudenberg Nonwovens (largest producer of nonwoven fabrics globally) whose US headquarters is located in Durham, NC. In Durham, 5 out of the 6 members of the development leadership team received their PhDs from NWI at NC State.
2. Economic Development – The impact of our activities has resulted in significant gains for the State, the region, and the Nation. Many companies have relocated to North Carolina because of the presence of NWI, its people and its facilities. The initial investment alone for those companies is over \$700M, with manufacturing facilities located in economically distressed counties.
3. Growth with little or no State support is a great testimony to the relevance of the mission of NWI.

Keys to Your Success:

- Ability to adapt to the changing industry and anticipate future directions
- Strong leadership with a clear vision
- Listening to the industry/customer and engaging them in the decision-making process
- Having a win-win approach to all collaborations
- Support of university administration (Research, Innovation and Economic Development Office, Sponsored Programs and Regulatory Compliance, Office of Technology Transfer, etc.)
- An interdisciplinary team that includes both industry and academic expertise
- Focusing on the mission of the organization instead of the individuals

Lessons Learned: The development of a forum where industry and academia can play together is quite appealing but almost always impossible without a clear understanding of the value that the Center/Institute can bring to the table. Establishing the ground rules early in the process is critical so as everyone is clear what the expectations are and what the guiding principles that govern this partnership. Teamwork is also another element that is essential to the success of the endeavor. In academia, it is often the case that faculty work alone and not as part of inter-disciplinary teams. This requires a culture change. To engage industry requires that we understand the “industry”, its products and needs, and lead the change. This requires participation in forums that are often less appealing to academia – for

example, exhibitions, shows, etc., are forums in which not many faculty participate. Yet, it is critical to be present at these events to recognize/understand the current trends and potential needs. Finally, the leadership has to be recognized by the community (both industry and academia) and be a facilitator who can bring these communities together and build the teams that are effective.

For additional information: www.thenonwovensinstitute.com

Caltech Boeing Strategic Agreement

2004 – Present

Caltech is a world-renowned educational institution with a long history of fulfilling the needs of industries, governments and academia. Boeing is the world's leading aerospace company, providing products and services to over 150 countries. In order to focus basic scientific research, Boeing has signed overarching, long-term research agreements with nine of the world's top research universities in specific critical technology areas. For Caltech, this is "systems integration" technology. Caltech provides world-class leading edge research, technology and graduates, enabling the basis for advanced innovation leadership and allowing Boeing to benefit from a long-term relationship, access to the university research, as well as top students.

Keywords: strategic, research, rankings, intellectual property, collaboration, industry, university

Background: Boeing and Caltech have a long-standing relationship as one of the universities in the Boeing corporate university portfolio. Boeing Research & Technology began discussing the benefits of pooling research dollars with several key schools and establishing long-term partnerships. Boeing had piloted these long-term relationships with several universities after an industry benchmarking study. In order to engage in the partnership, Boeing required that the university sign a five-year agreement that provided upfront agreement of intellectual property and other key factors. The five-year agreement allows for long-term investments in key faculty and students. Boeing had a single point of contact for all key university relationships.

Based on those conversations, a Caltech/Boeing workshop was held in the Fall 2003 in which a number of Caltech faculty doing relevant research visited a Boeing facility in Seal Beach, CA. The faculty briefed their research interests during that day-long meeting.

Caltech began discussion with Boeing about setting up a strategic agreement addressing key issues of importance to both organizations, including IP issues. Once the agreement was set up, Caltech submitted three proposals to Boeing based on the faculty who had visited Boeing and Boeing's technology interests. Boeing assigned a single technical staff member to manage the portfolio. In addition, Boeing uses a Principle Investigator to manage each specific research project with corresponding work at Boeing in the same area.

Although the initial area of research focus for Caltech was Systems Integration Technologies, Boeing and Caltech have expressed an interest in expanding the collaboration to other aerospace technologies. For Boeing it was important that the university's capabilities matched Boeing's long-term strategic technology needs.

Parties Involved: Boeing and Caltech

Level of Engagement: Collaborative

Staffing: Boeing and Caltech researchers and "PI.s"; students. In order to expedite transition of the technology, Boeing is striving to hire talented students. Students are encouraged to participate in internships with the company earlier in their research careers.

Role of Government: None

Budget: Boeing has provided a significant multi-year investment in technology at Caltech.

Outcomes: As a result of this agreement, the relationship continues to expand. Potential opportunities include, leveraging the relationship to pursue other sources of funding, including, NSF, other federal funded agencies (DOE, DOD, DARPA), and other corporate research centers. Additionally, the current Caltech/Boeing partnership will examine state and local government economic development agencies as another source of funding. The collaboration continuum continues to develop new ways of working together to enhance the value for both Caltech and Boeing.

For current projects, Boeing and Caltech evaluate the projects based on previously identified criteria and then determine which ones will continue to be funded. Promising projects received continued funding as sponsored research projects.

- Senior executives at Boeing have access to key faculty and administration at Caltech.
- Patent applications have been filed.
- Students are encouraged to participate in internships with the company earlier in their research careers.
- Boeing has hired researchers in key areas.
- Company and academic scientists regularly interact throughout their respective collaborations. Symposiums may be held at the company or at Caltech, corporate scientists come to campus to visit and/or work in the lab of their Caltech collaborator, and Caltech faculty may give talks at the company.
- Caltech faculty members provide regular reporting and updates to their scientific partners and Boeing and Caltech hold an annual “Research Review” on campus to discuss the projects and key findings.
- As a result of the achievements and technology transition, Boeing has increased the funding of Caltech scholarships.
- Caltech faculty played a key role in the certification of Boeing’s new 787 “Dreamliner”

Scintillator Development for Medical Imaging

October 2005 – Present

This academic-industrial partnership seeks to develop new scintillators at the University of Tennessee (UT) that will enhance the performance of medical imaging devices that are manufactured by Siemens Medical Solutions. Scintillators are crystalline materials that are used to detect radiation such as X-rays and gamma rays used in nuclear medical imaging. A multidisciplinary team of faculty and students in the UT College of Engineering works together with scientists at Siemens to discover and develop new materials technology aimed at providing a competitive business advantage for Siemens while simultaneously providing research topics for students.

Keywords: scintillators, medical imaging

Background: Dr. Chuck Melcher previously worked for Siemens. He conceived the idea of an academic research center that would carry out basic research in an area that is critical to Siemens' medical imaging technology. With the help of senior administration at Siemens and in the College of Engineering, the research center concept was further developed and implemented.

Parties Involved: University of Tennessee and Scintillation Materials Research Center, Siemens Medical Solutions.

Level of Engagement: Collaborative

Staffing: Currently two research faculty (80% support), four graduate students, one research associate (40% support), one post-doctoral researcher (50% support); two Siemens scientists have frequent interaction with the academic team.

Role of Government: None

Budget: \$500,000/year operating funds from Siemens plus donation of ~\$1,000,000 equipment; the University supplies ~2,000 square feet of laboratory and office facilities.

Outcomes: This partnership has provided research topics and financial support for several graduate students and their advisors. Two Ph.D. and three M.S. degrees have been awarded so far. Over 40 journal articles have been published, numerous conference presentations have been made, and several patent applications have been filed.

Keys to Your Success: An understanding between the partners that universities need to publish research and companies need to protect intellectual property. Maintaining frequent communication is crucial. In this case, the partners have face-to-face weekly and monthly meetings with corresponding written reports.

Lessons Learned: Working out the contractual legal details requires patience and flexibility by both partners. Following the initial five-year contract, a second five-year contract was successfully executed. The second contract followed the terms of the first contract rather closely and therefore was easier to execute.

The Energy Biosciences Institute: A University-Industry-Government Triple Helix

November 2007 – 2017 (unless renewed)

The Energy Biosciences Institute (EBI) at the University of California, Berkeley (UC Berkeley) was established with a \$500M funding commitment from BP Technology Ventures, Inc. (BP) to support alternative energy research over 10 years. Berkeley's research partners in this multi-disciplinary industry/university/government initiative are the Lawrence Berkeley National Laboratory (LBNL) and the University of Illinois at Urbana-Champaign (UIUC). The funding, through a grants-making process, has enabled >350 researchers across several departments to produce scores of research publications, is training talent for high-tech sector jobs, enhances university research facilities, has produced dozens of patents and IP agreements, is accelerating innovation and catalyzing commercial investment, and has engendered additional funding and collaborations.

Keywords: alternative energy research, triple helix, strategic alliance, industry-university interface, public-private partnerships, innovation acceleration, use-inspired research, open innovation, corporate sponsored research, university and national laboratory cooperation

Background: BP envisioned a global competition for long-term and stable funding to harness biology to create alternative energy solutions, with a near-term emphasis on biofuels. UC Berkeley and BP had a prior, one-on-one traditional sponsored research agreement that had produced a number of interesting inventions. That agreement, which also featured a 10 year term, provided \$10M in research in pre-defined laboratories in the College of Chemistry according to pre-defined "scopes of work". That contract featured certain pre-defined IP license terms and payment caps that, having worked well in terms of streamlining commercial uptake, were included in the current \$500M agreement. The prior agreement was designed to create the expected; the current agreement allows, encourages, and enables the unexpected to arise.

Several of the funded projects and principal investigators would not have been identified by BP according to the standard sponsored research models. This is one of the serendipitous outcomes of the relationship, and a validation of the benefits of open innovation. The long time frame and funding stability have enabled academics to explore basic research areas that federal funding agencies are not funding. Research funding creates enough preliminary results and publications to generate subsequent interest in follow-on funding and additional collaborations.

Parties Involved: BP, UC Berkeley, UIUC, and LBNL. The master agreement is between UC Berkeley and BP, and both funds and contractual terms and conditions flow down to UIUC and LBNL through sub-awards.

Level of Engagement: Collaborative

Staffing: Administrative staffing for EBI is centralized in the Institute. The EBI Director and Deputy Directors are academics. Researchers perform work in laboratories in several departments. Research is multi-disciplinary. Researchers are funded in the hard sciences and engineering, and in fields that are relevant to the broad field of alternative energy, such as sociology, agricultural economics, public policy, and law. Scores of students are being trained. BP is renting office space on campus and locates an Associate Director and several of its own analysts there.

Role of Government: LBNL leadership had prioritized research on alternative energy in the years leading up to BP's announcement of a global competition for the grant. LBNL is owned and funded by the U.S. Department of Energy but is managed by the University of California under an operating agreement. The partnership between UC Berkeley and LBNL combines the best of two worlds to create a research dynamo. Hundreds of scientists have joint appointments. The research infrastructure of LBNL, including, for example, the Joint Genome Institute, the Advanced Light Source, the Molecular Foundry and other facilities constitute a tremendous resource for the Berkeley campus (and others). The synergies between LBNL and UC Berkeley are tremendous and the partnership provides a model for bridging translational research gaps that should be scaled beyond the field of alternative energy. The Department of Energy streamlined commercial uptake of the research results by agreeing to waive the "U.S. manufacturing requirement" that is a standard feature of its IP licenses.

Budget: A minimum of \$350M for open, academic research and up to \$150M for BP's proprietary research over 10 years. Funding is allocated according to a governance structure (i.e., approvals of submitted budgets on a rolling basis).

Outcomes: The establishment of research institutes at universities to tackle the grand challenges of science helps us to address concerns that have been articulated in a report of the National Academies of Science, "Rising Above the Gathering Storm." The industry-university interface is changing, and for the better. Open innovation and permeable interfaces are features that can be replicated as long as there are visionary and courageous individuals driving the business, legal, policy, public-private partnership, and scientific aspects of new relationships, and strong cooperation among multiple participants. Dozens of people were involved in the conception, contracting and implementation of the institute. The continued robustness of collaboration and collegiality perhaps validates the original idea, which involves alignment of goals, but preservation of individual identities and missions of public and private participants. Several approaches to creation of clean fuels are being scaled in commercial settings and advances in biomass creation, harvesting and conversion are being piloted. The IP arrangements follow a "yours, mine, and ours" roadmap with respect to rights management. The academic institutions own their IP rights arising from open, academic, published research, and BP licenses IP rights from each owner. BP may own what it creates in its own space with its own employees. Patent applications naming at least one inventor from BP and one from an academic institution are jointly owned.

License fees were capped at predefined maxima; however, if a given licensed product becomes a tremendous commercial success then the license fee caps are removed and the financial terms are renegotiated.

Background IP rights were addressed and are being managed accordingly.

Scores of patent applications have been filed between the partners (>40 at Berkeley alone), at least one has advanced to the commercial license stage, and the rest are subject to option agreements.

Symposia are provided for the benefit of all, and there are also elements of K-12 educational outreach. All academic research is published.

Measuring Success: IP rights, commercial licenses and products are merely one measure of success for an industry/university/government research partnership. Other factors include: students trained, publications, grants, public outreach, new faculty positions, demonstration of collaboration models,

innovation acceleration, raising awareness of the modes of academic-industry engagement and outcomes of cooperation, jobs created, the relevance of academic research to manufacturing, improved infrastructure, leveraging of resources, recruitment and retention, economic development, methods of financing translational R&D, and impacts on academic culture and norms.

Keys to Your Success: Use of UIDP principles

Lessons Learned: Try the audacious, think creatively, build and nurture alliances, test new partnership models, shake hands not heads, collaborate while retaining your respective identities and missions, promote and reward risk-taking, and don't forget to recognize and celebrate success!

For additional information: <http://www.energybiosciencesinstitute.org>

Improving Research and Education By Bringing the World of Practice On To Campus

2007 – Present

A new model for creating a relational, rather than transactional, University-Industry relationship is reviewed. The model focuses on having the University build a long-term strategic relationship with the industry collaborator across the inter-related areas of research, curriculum, internships and community engagement. This model has enabled a greater benefit to both the University and the Industry collaborator – such as new academic programs, joint research efforts, and a significant number of internship opportunities.

Background: In 2007, JPMorgan Chase (JPMC) and Syracuse University (SU) set out to transform the way students are educated, with a focus on better preparing students for technology careers in global organizations. Prior to this time the two organizations had not worked together. However, from the start there was a shared vision to create a long-term relationship (10+ years, JPMC funding of \$30M) that focused on a range of activities, including research, curriculum and internships. This vision, established by the Chancellor of SU and the Chief Operating Officer of JPMC, had initial objectives to:

- Transform the way technologists are trained in the classroom and on the job
- Drive innovation in university education and financial services technology
- Deliver long-term value to JPMorgan Chase, Syracuse University and the broader community
- Create a sustainable model for world-class university-industry collaboration

Parties Involved: Syracuse University and JPMorgan Chase

Level of Engagement: Collaborative

Staffing: The collaboration occurs at all levels of both organizations. Involvement and support by senior executives has been crucial to the success of this effort, as has been the involvement of faculty and technologists within JPMC. In fact, the collaboration has engaged hundreds of JPMC employees, hundreds of students (often working as interns) and faculty across all schools within the university.

Role of Government: None

Outcomes:

Project Results - Joint Applied Research

We have launched over one dozen joint research projects, many in the domain of IT Risk and cyber security. These research efforts were influenced by:

1. The Center of Excellence in Information Security at the JPMC Tech Center at SU, which opened in 2009
2. The launch of an SU Center for Information and Systems Assurance and Trust (CISAT), which brought together faculty across six SU colleges to engage practitioners and address cyber security challenges.

These research efforts have reached into SU classrooms, impacting undergraduate curriculum content and engaged faculty and graduate students in real-world applied research. The research has resulted in a positive ROI, improved JPMC knowledge, and enabled papers to be published

in domains ranging from social network analysis to credential interoperability requirements within wholesale banking.

Project Results - Curriculum

The domain of Global Enterprise Technology (GET) was developed. This domain focuses on large complex information systems that are typically not covered via traditional university courses.

The following programs have been created:

- GET minor – an undergraduate minor with courses from three schools within SU (Information Studies, Engineering, and Management). More than 200 students are enrolled in the minor.
- GET Immersion Experience (IE) Extended Internships: an eight-month paid internship for undergraduate students. IE interns remain full-time students through residencies combined with distance coursework. GET IE courses leverage learning opportunities that one can only appreciate while working full time within an organization. The program includes other companies (such as CISCO, Ernst & Young, nationwide) as well as students from other universities (including University of Delaware, Rutgers, and The Ohio State University).
- GET Certificate of Advanced Study: a graduate level five-course program. Courses taken can be applied towards a master's degree in Business, Information Systems, or Computer Science.

Project Results – Internships

All internships provide value to the student (work experience), to the company (GET curriculum enables more productive students), and to the university (enhanced student learning).

JPMorgan Chase has filled a substantial portion of its recruiting pipeline from these programs.

The opportunities include:

Academic year internships: 70+ students, doing real work, part-time, in the tech center.

GET IE: Paid 8-month internship, while also taking courses that leverage the work context.

Summer internships: traditional 10-week summer internships at various JPMC locations.

Project Results - Community Engagement

Our joint efforts on community engagement have included:

Supporting at risk youth: Both organizations have invested both time and employee volunteer hours to help support at-risk high school students (e.g., mentoring programs).

Veterans Technology Program: an online Veterans Technology Program, called GET Vet, for veterans who are pursuing a career in technology. The tuition-free program began in the summer of 2011.

The Institute for Veterans and Military Families (IVMF): The Institute, launched jointly by SU and JPMC in June of 2011, serves as a national center in higher education focused on the social, economic, education, and policy issues impacting veterans and their families post-service.

Keys to Your Success: The three Guiding Principles outlined in the 2006 Living Studies have all been leveraged:

1. The university-industry collaboration should support the mission of each collaborator:
 - a. SU: Research funding, improved curriculum, and experiential learning for students
 - b. JPMC: Pipeline of talent (via internships) and knowledge via research projects

2. Focus on fostering appropriate long-term collaborations between universities and industry:
 - a. The long-range commitment enables both organizations to better understand the objectives of the other party, and hence, identify efforts that provide that elusive “win-win” opportunity.
3. Streamline negotiations to ensure timely conduct of the research:
 - a. A master collaboration contract was executed and a research project template was created which facilitates research efforts.

Lessons Learned:

Due to the long-term relationship, there has been a cross pollination of ideas across the work-streams (curriculum, research, internships).

Within our model, employees have enjoyed volunteering their time at the university – without this model, it had been difficult for employees to find the appropriate avenue to share their expertise.

Procter & Gamble / University of Cincinnati Simulation Center

2008 – Present

The Procter & Gamble Company (P&G) is the world's largest consumer goods company, serving approximately 4.6 billion people and spending over \$2 billion per year in Research and Development. Headquartered in Cincinnati, Ohio, P&G has chosen to work with the University of Cincinnati (UC) as a strategic academic partner to develop Modeling and Simulation capabilities for advancing product and process development. UC is classified as a Research University (Very High Research Activity) by the Carnegie Commission, and is ranked as one of America's top 25 public research universities by the National Science Foundation. With specific expertise in structural mechanics and dynamics, computational fluid dynamics, and other modeling disciplines, P&G finds great value in working with UC's faculty and students to deploy modeling and simulation capabilities across projects in R&D and Product Supply. This partnership is part of P&G's Connect+Develop open innovation work, aimed at linking the most innovative minds in the world to the Company's most challenging opportunities to accelerate innovation for consumers.

Keywords: strategic, research, collaboration, industry, university, Modeling and Simulation

Background: P&G and UC have had tactical relationships through the years, where individual project teams within P&G would engage with a faculty member to do research on a specific project. P&G personnel also sat on industrial advisory boards across the campus. This project idea was a direct re-application of what Caterpillar had setup with the University of Illinois at Urbana-Champaign, called the Champaign Simulation Center (CSC). However, UC and P&G decided that UC should “own” the simulation center, whereas Caterpillar “owned” the CSC. Having the University “own” the center, and with progressive leadership, resulted in more collaborative engagements with UC's faculty across departments and colleges. To date the UC Simulation Center is fully funded by P&G, with no additional support from local, state, or Federal funding agencies. P&G and UC are open to expansion to other entities.

Parties Involved: The Procter & Gamble Company and the University of Cincinnati

Level of Engagement: Collaborative

Staffing: P&G provides a “Site Leader” as the single point of contact for P&G project teams to engage with the UC Simulation Center. The Site Leader works with P&G project teams to assess the project needs and determine if it is a good fit for the Simulation Center. The Site Leader also works with UC faculty and staff to recruit the right talent into the Simulation Center. UC provides an “Operations Manager” to handle daily operations, onboarding and oversight of the students. The Operations Manager also consults on specific projects within their field of technical expertise. The UC Simulation Center also hires UC post-doctoral candidates where there is a critical mass of projects within a specific modeling discipline. The majority of projects are supported by M.S. and Ph.D. students, with some of the projects being thesis-based, and others not. Undergraduate Co-ops and part-time students also support P&G Modeling and Simulation experts. There are currently 3 post-docs, 27 graduate students, and 11 undergraduates at the Center, each working with separate project teams within P&G. A total of 7 of those projects are thesis-based, with the P&G “mentors” also serving on the thesis committee and coauthoring publications with the faculty and students.

Role of Government: No government support has been provided to this center.

Budget: The P&G Site Leader manages project funding on a per-project basis, with infrastructure and base funding factored into the P&G internal funding mechanisms. Over time, P&G has provided a significant multi-year investment in UC and the Simulation Center. In late 2012, P&G and UC agreed to a 5-year, \$5 million base funding level (\$1 million per year). Additionally, P&G has agreed to work with UC to seek additional funding through state and federal opportunities. Multiple National Science Foundation and multi-agency proposals have been co-authored.

Intellectual Property: The agreement between P&G and UC states that each individual project will be classified according to the publication and IP rights agreed to by the P&G project team and the UC faculty involved in the project. In general, all IP developed through the Simulation Center belongs to P&G, while UC is allowed to apply for patents in areas where P&G does not operate.

Obstacles Encountered: Obstacles are minimized by having a P&G Site Leader and UC Operations Manager co-located at the Center. The P&G Site Leader is a single point of contact for P&G related issues, which minimizes confusion. UC has been very progressive in accommodating P&G requests, which has led to continued growth of the center and engagements between P&G and UC since the Center's inception.

Outcomes: As a result of the UC Simulation Center, the relationship between UC and P&G continues to grow. Many P&G modeling and simulation experts were not aware of the capabilities that exist so close to their offices. P&G has hired 10 students out of the UC Simulation Center as full time employees, as of early 2013. P&G sees this as a strategic relationship to train talented researchers who “hit the ground running on day one” at P&G. The UC Simulation center has received positive feedback from project teams across the company. Many project teams are now “repeat customers” for the Simulation Center. P&G has continually increased funding to the Simulation Center, as a result of successful projects. Students are supporting new-to-the-world modeling capability developments, inspired by P&G's industrial challenges. Models developed at the Simulation Center are being applied to disruptive innovations across the company to support market introduction of transformational and sustaining technological innovations. Numerous publications, conference presentations, and patents have resulted from work at the Simulation Center.

Growth Opportunities: Yes, P&G and UC are currently exploring new opportunities and ways the project may be scaled out.

Measuring Success: Internal P&G metrics are not shared here, but continued growth and repeat business are great indicators of success. The University benefits in various ways. The students are better prepared for the workforce, having direct industrial experience. The faculty get more funding for research and their students, and insight/collaborations on industrial challenges that will likely lead to even more funding/ support. P&G gets talent to develop and apply modeling and simulation capabilities across the company.

Keys to Your Success: P&G and UC followed the UIDP Guiding Principles for university-industry collaboration, enabled by progressive UC Faculty, willing to “do things differently” from the traditional industry-academia engagements. From P&G, having project teams willing to fund students, train them, and mentor them over a period of time made this a success. Locality is also a key for this being successful. P&G personnel can spend part or all of a work day at the Center (a leased office space 10

minutes from UC's College of Engineering and Applied Science) without impact to their work and work/life balance.

Lessons Learned: Providing clear guidelines for IP ownership and on-site relationship owners from both P&G and UC allows students, faculty and researchers to focus on individual projects and areas of expertise. The co-location encouraged by the Simulation Center enables all participants to learn from each other and gain insights they would not have achieved working separately. Partnering with universities is one example of P&G's Connect+Develop strategy, which leverages external resources to drive discontinuous, sustainable innovation and productivity. The success of the P&G – UC partnership demonstrates how C+D can build global innovation partnerships that create a win:win:win for both partners and the consumer.

For additional information: <http://www.min.uc.edu/ucsc/>

Forming a Strategic Alliance: Kansas State University and Abaxis, Inc.

January 2011 – Present

This case study presents the events leading to the formation of a strategic alliance and a successful collaboration between a Land Grant University and a major corporation in the animal health arena, and represents a model that exemplifies an Industry-University relationship that respects the mission, goals and culture of each entity. Three components make this strategic alliance unique: (1) Different from most university/industry linkages, this does not involve the transfer of intellectual property [IP] or the establishment of a research relationship [with IP issues contractually resolved]. Rather, it involves the merging of Kansas State University (K-State) capabilities with industry growth needs. (2) The entrepreneurial enterprise at K-State involves not only the university, but a K-State controlled organization [K-State Institute for Commercialization – KSU-IC] which could negotiate the final package. (3) The strategic alliance was made possible by a three-way discussion between KSU-IC, several entrepreneurial investors in the animal health arena, and a company having the need to diversify.

In January 2011, Abaxis, Inc. and K-State created a unique Industry-University alliance to form a new laboratory division called Abaxis Veterinary Reference Laboratory (AVRL). Previously, Abaxis had been a products oriented company, and was developing a strategic plan to expand its business to include diagnostic services, thus providing a broader offering to its clients. Abaxis needed a partner with expertise and credibility in veterinary diagnostic services. K-State had been exploring options for growing the companion animal portion of its animal disease diagnostic capabilities. K-State needed a partner to leverage its capabilities outside of the Midwest.

Keywords: Abaxis, AVRL, K-State, veterinary, diagnostic, strategic, alliance, entrepreneur, growth

Background: Nearly two years before the formation of the strategic alliance with Abaxis, Inc., four entrepreneurs from Kansas City approached the K-State Veterinary Diagnostic Laboratory (KSVDL) to explore the creation of a for-profit veterinary reference laboratory. The entrepreneurs, with KSVDL, engaged the KSU-IC and K-State to assist with the strategic planning and business formation. A startup company was initially envisioned, but the capital needed to create both the lab and the sales force was a major hurdle. The decision was to seek a strategic partner having a national veterinary sales force and available capital to help create the lab.

After evaluating several options, Abaxis, Inc. in California was approached in the Fall of 2009. The team flew to California for a high level meeting with Abaxis's executive management. The parties agreed that if the opportunity passed the diligence parameters, two main issues would be addressed quickly. **First**, the K-State administration, including the President, needed to understand the opportunity and determine if they would leverage K-State's credibility and infrastructure. **Second**, a business structure was needed that accounted for the respective contributions of the entrepreneurs, K-State and Abaxis.

First, the KSU-IC arranged a visit to K-State by Abaxis, both to tour KSVDL and to meet with President Schulz. Understanding the importance of university-industry collaborations leading to educational and economic growth, Dr. Schulz confirmed his support for an alliance with Abaxis if it made financial and legal sense for the University. **Second**, two business structures were explored: 1) a stand-alone company and 2) a new division of Abaxis. Estimates were that \$5 million might be required to make the project breakeven. Model #1 would provide the most upside for the entrepreneurs and K-State if the venture

was successful, but required the need for them to raise the larger share of the \$5M. Raising capital for a service company in the 2010/2011 economic environment argued against Model #1. Model #2 would be the quickest time to market since the lab creation and operations would be funded by Abaxis, but Abaxis would also completely own the business.

After discussion, the partnership pursued Model #2 by creating Abaxis Veterinary Reference Laboratory (AVRL). The entrepreneurs would manage AVRL as Abaxis employees. The lab would be created in Olathe, Kansas, with proximity to K-State providing expeditious diagnostic turnaround time as a strategic advantage benefiting the diagnostic community. AVRL would leverage KSVDL's expertise and infrastructure to manage cost, lab setup time, and time to lab opening.

The alliance was formalized by written agreements and announced in Abaxis's quarterly earnings announcement in January 2011. Operations were launched in October, well ahead of schedule.

Parties Involved: Kansas State University and Abaxis, Inc.

Level of Engagement: Alliance. The parties in the collaboration shared aspirations and long-term goals.

Staffing: Kansas City entrepreneurs, Abaxis employees

Role of Government: None

Budget: Funding provided by Abaxis.

Outcomes:

- KC entrepreneurs became managers of AVRL.
- K-State was granted stock warrants in Abaxis (held by KSU-IC), a royalty on AVRL net sales, and a diagnostic service contract.
- The AVRL alliance made it possible for students to enhance their educational experience at K-State: About 15 students and residents have participated in the program thus far by using the increased case load for teaching material, work study programs and creating new technician jobs for students.
- Over 20 professors at K-State have participated in the alliance to provide veterinary interpretation, and over 50 new industry jobs have been created in Kansas.
- For its expertise and infrastructure investments, K-State receives reimbursement, which is used to fund research and development focused on advanced, efficient and cost-effective diagnostic tools and on the development of a well-trained diagnostic professional pool from which industry could recruit.
- Abaxis received credibility and a decreased cost to market by leveraging K-State's veterinary expertise and infrastructure. Complicated equity sharing issues were resolved in a collegial manner.

Keys to Your Success: The three Guiding Principles outlined in the 2006 Living Studies guided our success: (1) Supporting the mission of Abaxis by creating a new division potentially will allow significant revenue growth over the next 10 years. K-State receives additional case-loads for educational opportunities, a source of revenue from the stock warrants, royalty and diagnostic service agreement. These can be reinvested to foster the mission of the university to grow the economy of Kansas. (2) An

alliance will benefit both parties for at least the next decade. (3) Focusing on the overall benefits of the alliance overcame obstacles presented during negotiations

Lessons Learned:

- Start with buy-in from top management, which will help overcome snags in negotiations and other obstacles.
- Match opportunities with companies/institutions having similar cultures.
- Bet on a winning team.

Scalability Factor (0-4): 3 - The model is scalable to other universities that have a unique capability that industry can leverage. The university and industry partner need to have complementary cultures.

University-Industrial Collaboration to Develop a Real-World Test-bed for Airport Video Security Technology at a Major Airport

June 2011 – December 2012

The Transportation Security Administration (TSA), in Cleveland, has initiated a multi-university project to test the potential of video analytics to improve the monitoring and control of passenger movements within an airport. A key programmatic innovation of the project is the development of a video test-bed within a major US airport, which will tap into live camera feeds through a digital video overlay network. This test-bed enables the TSA experts to provide frequent onsite feedback to the university research teams, shaping the research to meet their vision for next-generation security operations. Industrial partners are supporting the technology transition process and test-bed design.

Keywords: technology transition; video analytics; airport security; test-bed

Background: The project is led by ALERT, a multi-university Center of Excellence sponsored by the Department of Homeland Security. The Ohio Senior Federal Security Director for the Transportation Security Administration (TSA), in a collaborative partnership with senior leadership at the Cleveland Hopkins International Airport (CLE), are the primary drivers of the project, defining the operational problems of interest, and are providing access to a joint TSA/CLE lab for the testbed. TSA partnered with ALERT to develop the project concept and team. ALERT sought the assistance of SC CT to guide the technology transition in general, and to lead the design and development of the testbed at CLE. The long-term benefit to Siemens is in the exposure to the advanced research of the universities for potential licensing, and the short-term benefit is the access to the testing data. SC CT has been an Industrial Partner of ALERT since its inception, and before that, a partner of a "sister" NSF Engineering Research Center called CENSSIS. SC CT has worked with CENSSIS/ALERT in several high-impact projects in the Homeland Security domain.

Parties Involved: Three university members of the Department of Homeland Security's ALERT Center of Excellence: Northeastern University (NEU, leader of ALERT), Boston University (BU), Rensselaer Polytechnic Institute (RPI); Siemens Corporation, Corporate Technology (SC CT, industrial partner of ALERT); Ohio Senior Federal Security Director Transportation Security Administration (TSA), Cleveland Hopkins International Airport (CLE). The following numbers of individuals are directly involved: University (~15); Industry (~7); Government (~4); Airport (~4).

Level of Engagement: Alliance

Staffing: TSA & CLE personnel at the airport support the video system, data collection process, and provide feedback on performance. University students from NEU, BU, and RPI are heavily involved in the development and testing of the algorithms under the supervision of professors from each partner institution. SC CT provides: (1) video system design guidance; (2) the software that enables the university researchers to access live video; (3) record the video and the video analytics event metadata.

Role of Government: The TSA establishes the technology transition goals and DHS provides funding.

Budget: The budget (~\$500K) is provided through ALERT and its sources of government funding, which cover the expenses of the university and industry researchers involved. Siemens business units are

supporting the effort indirectly both technically and through providing licenses to software for the test-bed at no cost. TSA and CLE are providing facilities, hardware and personnel to the research and test-bed enterprise at no cost.

Outcomes: The project is ongoing and is in Phase 2 of a three-phase program. In Phase 1, video captured at the airport was used for proof-of-concept evaluation of university-developed video analytic software in the university laboratories. In Phase 2, we have designed and implemented the live test-bed at the airport, and have begun evaluation of the university-developed video analytic software at the airport, with testing protocols defined and implemented with the assistance of the TSA personnel.

If the testing at the airport goes well, there may be a Phase 3 in which additional challenges are defined by the TSA, and more robust video analytic solutions are developed and tested. By the end of 2012 the project will have demonstrated to the DHS/TSA the potential of advanced, university-developed video analytics to solve outstanding real-world technical challenges in airport security.

The university/industrial/TSA interactions during the project will also have: (1) facilitated the transition of real-world issues into algorithms and into commercial products; (2) provided the university researchers with new insight into the real-world domain of airport security, (3) provided industry with access to hard-to-come-by security data for testing, and (4) provided TSA with improved traveler understanding essential to national security.

Measuring Success: For the universities, the project will be a success if: (1) the test-bed enables them to test and advance the capabilities of their video analytic algorithms and software; (2) the results demonstrate that their algorithms are ready to transition into security operations at the major airports. For Siemens, the project will be a success if: (1) the test data acquired is suitable for using within its own development projects; (2) the test-bed enables the evaluation of its own advanced video software prototypes.

Keys to Your Success: Based on the information above, it is apparent that all three of the following guiding principles (from the UIDP 2006 Living Studies) were followed:

- A successful university-industry-government collaboration should support the mission of each partner. Any effort in conflict with the mission of either partner will ultimately fail.
- Institutional practices and national resources should focus on fostering appropriate long-term partnerships between universities, industry and government.
- Universities, industry and government partners should focus on the benefits to each party that will result from collaborations by streamlining negotiations to ensure timely conduct of the research and the development of the research findings.

In addition, a key has been the existing relationships established through the ALERT and CENSSIS centers of excellence.

Lessons Learned: In this kind of multi-institutional, multi-agenda project, we learned early on the key value of frequent, clear, and documented communications to ensure we were all “on the same page”.

Scalability Factor (0-4): 4, very scalable to other industry/university partnerships

A Multi-Disciplinary, Collaborative, Design-Build-Test Capstone Course

August 2011 – April 2012

Suppose there existed a cyber-enabled design environment that enabled geographically dispersed engineering students and incumbent engineers to collaborate within in a common cloud-based Computer Aided Design (CAD) environment, and suppose further that these students have multidisciplinary domain expertise in various engineering and technical disciplines, working within competitive design teams to solve real-life “industry identified” problems. This scenario would provide an experiential opportunity for students to learn from subject matter experts and for industry to crowd-source its research challenges, while fostering relationships with the very students they seek to hire upon graduation. This capstone design class describes an emergent design environment and a radical new partnership model to “emergent engineering design” via cloud-based synchronous and asynchronous multi-user CAx tools, advanced design and manufacturing methods, and mentoring by practicing aerospace engineers.

Keywords: Cyber Learning, Collaborative Design, Multi-disciplinary, Aerospace, Capstone, Design, Engineering, Advanced Manufacturing, Engineering Education

Background: Undergraduate students with backgrounds in varying engineering disciplines will work in a project-based learning environment to develop solutions for industry products based on market requirements. The students will develop and refine a NASA Common Research Model including a detailed design of the wing-fuselage interface, wingbox and winglet. Students will work in a revolutionary collaborative networked setting that will enable them to apply Product Lifecycle Engineering practices in ways unimaginable before. Students will be able to see innovative designs “emergent design” as multiple engineers leverage their domain knowledge base to advance the design simultaneously. This approach will utilize a rapid innovation cycle and lead to early integration of advanced manufacturing methods with the design, resulting in a compressed concurrent product development cycle. In addition to the technical training, the students will also receive introductions to entrepreneurship, organizational management, and cross-cultural collaboration, all attributes required by successful practicing engineers. The Attributes of a Global Engineer represent the knowledge, skills, abilities, and characteristics needed by engineering professionals living and working in an increasingly global context. (ASEE, Attributes of a Global Engineer).

The Boeing Company has long-term relationships with many universities for the purpose of research collaboration as well higher educational programs for its employees. Brigham Young University in Provo Utah is one of those schools where the School of Mechanical Engineering, a NSF I/UCRC center, has developed a software architecture that enables multiple people to work in a common CAD part across space and time. The server architecture is based on Massive Multi-player Online Role-playing Game (MMORPG) server architecture. Simultaneously, Boeing has worked with the Integrated Product Lifecycle Engineering (IPLE) Laboratory in the School of Aerospace Engineering at the Georgia Institute of Technology to develop and hold classes for Boeing employees on the topics of Integrated Product and Process Design (IPPD) and Systems Engineering.

During the winter of 2011 and the spring of 2012 a group of nine undergraduate students was introduced to both the CAD tool and the IPPD process. They were able to utilize their shared knowledge to develop a new wing design for the F-86 Sabre jet, as presented at the ASEE Conference 2012 and International Forum. Based on the preliminary success of the pilot, the program was expanded in fall

2012 to include a two semester, multi-disciplinary design – build capstone project. The new capstone will provide research data on cyber learning, distributed expertise and leadership models, design innovation cycles including the impact of social networking and engineering education research.

Parties Involved: The Boeing Company, Georgia Institute of Technology (Aerospace Engineering), Brigham Young University (Mechanical Engineering), Purdue University (Aeronautical and Astronautical Engineering), University of Washington (Aeronautical and Astronautical Engineering), and University of Southern California

Level of Engagement: Collaborative

Staffing: This project involves 16 undergraduates and six graduate students as well as six professors from multiple schools and varying disciplines working in collaboration with a team of Program Managers, Engineers, Technicians and Managers from The Boeing Company.

Role of Government: None

Outcomes: This project aims to provide a scalable model for modern project-based capstone courses carried out in collaboration between industry and academia. Key research objectives include: Connect collaborative, multidisciplinary, distributed university teams in such a way to ensure that students were exposed to the industry principles of collaborative digital manufacturing, targeting cyber-mechanical systems of moderate complexity.

View learning as a social process whereby knowledge is co-constructed within a social – technical cyber network, mentored by peers, industry workplace experts and professors through face-to-face relationships and leveraging the cyber infrastructure.

Theory to Practice: Competencies and learning strategies are directly linked to performance in the workplace.

Measuring Success: This study will measure the value of this model against student learning outcomes through a formal engineering education research plan. In the following year the complexity is set to increase dramatically by increasing the number of participating schools. This would allow for dispersed Integrated Product Development Teams, working accelerated concurrent product large scale system integration, including conceptual, detailed design and advance manufacturing of systems of systems, creating the type of large scale knowledge transfer required for successful long-term collaboration between industry and academia.

Keys to Success: Collaboration should be brought into the framework of a long term partnership that continues to support the missions of all partners and encourages knowledge sharing across the industry-university boundary, and across geographically dispersed universities. As industry and academic partners, we are committed to support not only the intersection of the learning sciences and engineering education research, but also to the scientific process of exploration, discovery, confirmation, and dissemination.

Lessons Learned: While working on the pilot study it was determined that while it is very important to identify the common goals for industry and participating universities. We believe university and industry partnerships can profoundly impact educational ecosystems by:

- Integrating situated learning within a university – industry community of practice.
Dewey: Education and structured experience.

- Linking research and rigorous university teaching standards with real-world practice.
Piaget: Students construct knowledge based on their experiences.
- Addressing complex problems in real, authentic contexts in collaboration with practitioners.
Vygotsky: All learning occurs in a social – cultural context thru social interaction.

The International Food Safety Training Laboratory: A Partnership that Improves the Safety of Food Globally

September 2011 – Present

The International Food Safety Training Laboratory (IFSTL) is a partnership between the University of Maryland and the Waters Corporation. Signed in 2010, this alliance led to the creation of a training facility dedicated to analytical methods for food safety in microbiology and chemistry where subject-matter experts from the U.S. FDA, USDA, EPA and academics from the University collaboratively deliver hands-on training. This resource has benefited food laboratory professionals from many countries in its 18 months of operation and contributed significantly to the FDA's international capacity building plan aiming at strengthening laboratory capacity domestically and internationally to improve food safety globally. U.S. consumers have benefited since much of the food consumed in the U.S. is now imported and improving food safety in other countries benefits U.S. market.

Keywords: Food safety, laboratory capacity, international cooperation, laboratory training

Background: When the FDA decided to locate its principal food regulatory and science headquarters near the University of Maryland in the UM Research Park in the early 1990s, JIFSAN was created in 1996. JIFSAN's mission is to provide services of research, education and outreach in the fields of food safety and applied nutrition in support of the U.S. FDA's mission to ensure the safety of the food supply in the United-States. JIFSAN was heavily involved in education and outreach in the fields of food production and transformation. Waters is a developer and manufacturer of separations and detection laboratory equipment with an extended line of products addressing the measurement of chemical contaminants in food. In their business, Waters was often facing customers whom they could train on how to use instrumentation, but found no resources to train them on the performance of the methods recommended by governments and international organizations. Similarly, the FDA was receiving countless requests for assistance in training for laboratory analysts from foreign governments, but did not have sufficient resources to help them all. With financial and technical assistance from Waters, JIFSAN opened the IFSTL, a laboratory dedicated to teaching fit-for-purpose methods to ensure the safety of food. The relationship between JIFSAN and FDA, as well as USDA and EPA, provides an opportunity for subject matter experts from these organizations to be instructors in the IFSTL courses and thereby add a unique networking opportunity to the learning experience.

Parties Involved: University of Maryland's Joint Institute for Food Safety and Applied Nutrition (JIFSAN) and the Waters Corporation (Waters). JIFSAN is an Institute created through a Collaborative Agreement between the University of Maryland and the U.S. Food and Drug Administration (FDA).

Level of Engagement: Alliance

Staffing: Students of the University are trained and hired as teaching assistants for the courses at the IFSTL. In addition, a recent graduate from the University's chemistry PhD program was hired as a full-time instructor. The IFSTL employs three non-tenure track faculty members in the College of Agriculture and Natural Resources and a program coordinator. Instructors for the courses include technical specialists from Waters, subject matter experts from relevant government agencies, the IFSTL faculty and faculty from other disciplines in the University.

Role of Government: The IFSTL benefits from non-monetary government involvement in the form of advisory roles to determine priorities for training, upper management advice for the identification of subject-matter experts and very importantly, participation as instructors in the courses.

Budget: Waters made a monetary donation to the university to support the building renovations required to house a training laboratory and supplied instrumentation for the laboratory. The University contributes the rent for three years and access to the JIFSAN support resources. The IFSTL must generate revenue from its training activities and is expected to become self-supporting after three years.

Obstacles Encountered: The need was so evident and the desire to create this facility shared among the partners so there were no significant obstacles encountered during the creation of the IFSTL.

Outcomes: Almost two years following opening, the IFSTL has made great achievements directly aligned to its mission. We have trained professionals from Guatemala, Peru, Mexico, the Dominican Republic, Honduras, Chile, Pakistan, China, Philippines, Indonesia, Malaysia and the United-States. Students from the University have been hired as teaching assistants, and a graduate student was hired as a full-time instructor. Feedback from the trainees indicates that the Laboratory contributes to improving laboratory capacity in food safety and also a better understanding of the regulatory framework in the United-States, which helps develop food safety systems abroad.

Growth Opportunities: Shortly after the opening of the IFSTL at the University of Maryland, it became clear that a single laboratory could not meet the worldwide demand for methods training in food safety. Other partners were sought out to create a network of IFSTLs; the second IFSTL was opened 16 months later at the Food and Environment Research Agency in the UK. Additional network laboratories are expected to open in the coming years in China, India and Australia.

An important opportunity for the Laboratory is to leverage the facility and access to instrumentation to pursue research grants that will support students from the University of Maryland, but also will contribute to train students and stakeholders from developing countries through joint projects. Such research activities will give unique opportunities to simultaneously develop knowledge in the field of food safety and train future academics for developing countries that will continue the research and consequently create a sustainable pool of skilled individuals in their region by leveraging resources obtained through this public-private partnership.

Measuring Success: The return on investment from the financial as well as in-kind partners (FDA) is measured in the short term through compiling the number of trainees and scores obtained in immediate knowledge transfer tests. In the longer term, a survey instrument is applied to measure impact on the multiplicative effect of the training as well as reduction of import alerts issued for the regions of the trainees. Waters has enjoyed better exposure as a leading source of analytical equipment to international food safety markets and U.S. consumers will benefit from a better trained international food safety work force.

Keys to Your Success: The University of Maryland's JIFSAN had a longstanding relationship with the U.S. government to collaborate in areas that improve food safety and the common interest with our industrial partner is the key to the success of the partnership. Joining forces to benefits from the strengths of each organization, it was possible to build a unique training and collaborative opportunity

that can benefit a broad range of stakeholders, from foreign government to domestic industry, which could not have been possible for any of the partners alone.

Lessons Learned: One of the most valuable lessons learned through this project is that we must keep a strategic view throughout partnerships, look beyond the immediate tactical activities to foster long term engagements with the current but also with future partners to continue to build upon the success of the initiative. Physical proximity of university lab space to the U.S. government food regulatory space was also a key factor in making the training lab a success.

For additional information: www.ifstl.org