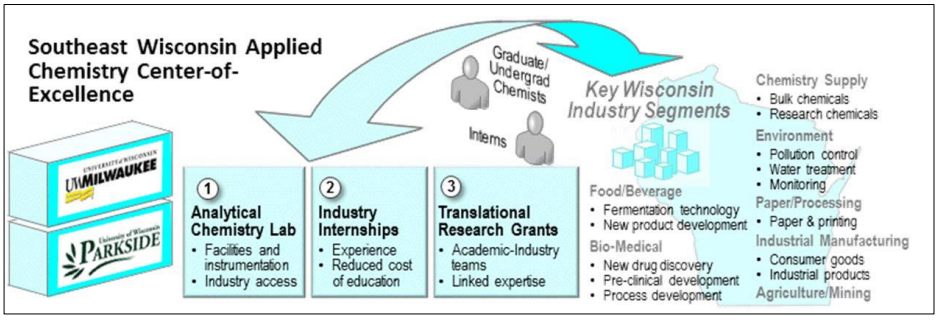
Economic Development Incentive Grant 2014-15 Annual Report

Directions

Please submit the annual report as a **Word document via email** to ttalukdar@uwsa.edu (no hard copies please). The annual report is due by **Friday, July 3, 2015 at noon**. The following information must be provided:

Institution Name(s):	**Project Title:**
Principal Investigator: Douglas Stafford, PhD, MS	**Person submitting Report:** Douglas Stafford
Email: dcstaff@uwm.edu	**Contact Phone #:** (414) 416-5594
Grant Award Amount: $2,998,800	**Report Date:** July 3, 2015
Grant Funding Spent (to date): $2,998,800	**Date project began:** January 1, 2014
	Date project ends (projected): June 30, 2015

I. Status Report



The Incentive Grant launched the SE WI Applied Chemistry Center of Excellence (the "Center"). Located in the heart of Wisconsin's industrial base, the Center is a partnership between UWM and UWP formed to stimulate economic vitality in industries dependent on chemistry and trained chemists. With over 96% of all manufactured goods involving technologies of chemistry, it is essential that WI's companies are supplied with world class chemistry resources and an exceptionally well-trained workforce. In WI, chemistry impacts priorities across the industrial spectrum, including healthcare, food and beverage, water technologies, consumer goods, industrial monitoring, and general manufacturing. Incentive Grant funding supported an integrated strategy to stimulate excellence in applied chemistry to: 1) Equip a state-of-the-art analytical chemistry laboratory in UWM's new Kenwood-Interdisciplinary Research Complex; 2) Provide office and lab spaces for faculty and industry partners to work side-by-side; 3) Award Translational Research Grants based on the scientific needs of industry, faculty expertise, and economic impact; 4) Facilitate industry access to expert faculty, and 5) Expand industrial chemistry internships to include student financial awards to reduce undergraduate costs. The Incentive Grant funds were used to support these initiatives to enhance chemistry-based industrial competitiveness in WI. The following commentary details each of these initiatives as they were carried out over the past 18 months and their impact.

Regional Analytical Chemistry Center

World class analytical chemistry laboratory as regional resource
Corporate partnership with Shimadzu Corporation ($1.13 million)
Grant funds already secured based on new capabilities (>$2.5 million); more pending
Sustainability from corporate support, grants, collaborations, fee-for-service

Instrumentation: A centerpiece of the SE WI Applied Chemistry Center of Excellence was the establishment of a regional analytical chemistry laboratory to support a wide range of academic and industry-collaborative research. As set forth in the proposal, several core pieces of instrumentation were considered essential for the scope of research contemplated for the Center. Accordingly, the following core instruments were purchased:

- Matrix-assisted Laser Desorption Ionization-Time of Flight Mass Spectrometer (MALDI-TOF MS)
- Liquid Chromatography-Triple Quadrupole Mass Spectrometer (with solid phase extraction module; LC-MS)
- Gas Chromatography-Mass Spectrometer
- Ion Trap-Time of Flight Mass Spectrometer (IT-TOF)
- Fourier Transform-Infrared Spectrometer (FT-IR)
- Ultraviolet/Visible Spectrometer (UV/Vis)


MALDI-TOF MS

Additional instruments were acquired according to plan that support the analytical instrument platform:

- Chemical Ink Jet Printer (CHIP; sample preparation for spatially resolved MALDI-TOF MS proteomics, metabolomics studies)
- AccuSpot (micro-volume sample preparation system for MALDI-TOF MS)
- Cell culture suite and general biochemistry lab bench instruments

In addition, several complementary instruments were purchased from other funds and placed into the lab:

- Inductively Coupled Plasma-Mass Spectrometer (ICP-MS)
- Single Quadrupole Mass Spectrometer (LC-MS)
- Preparative High Pressure Liquid Chromatography System (Prep-HPLC)


Assoc. Professor Alexander Arnold using LC-MS instrument on NIH funded drug discovery research

Facilities: As set forth in the Incentive Grant proposal, the analytical chemistry instrumentation (above) was housed temporarily in renovated spaces in UWM's Chemistry Building to facilitate rapid start-up of research studies. In spring 2015 the instrumentation was relocated to the newly constructed Kenwood-Interdisciplinary Research Complex (KIRC) on the UWM main campus. The KIRC laboratory comprises approximately 2,000 square feet of spaces specifically designed to accommodate instrument functionality, instruction, utility service, security, safety, and work flow. Office spaces are available for trainees and industrial collaborators. Facilities vacated in UWM's Chemistry Building will now house the new fermentation instructional laboratories developed separately from this grant funding (see Saffarini Translational Grant below). Funding also was provided to UWP to upgrade its ICP-MS for research and instructional purposes. All analytical instrumentation funded through this Incentive Grant are readily available for researchers at both campuses.

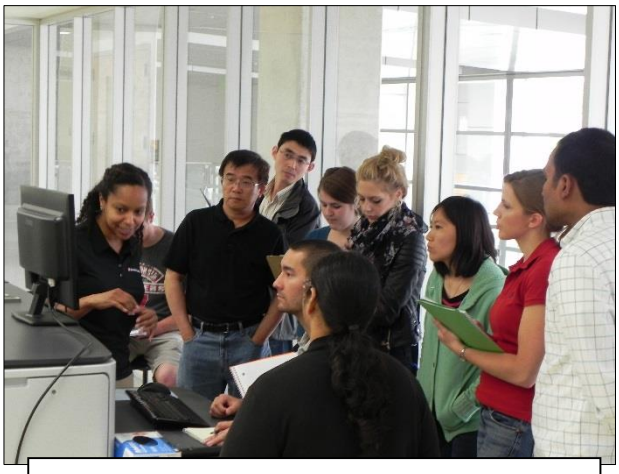
Funding: Start-up of the analytical chemistry laboratory was seeded by funds budgeted in the Incentive Grant. These funds were leveraged immediately by attracting matching support of $1.13 million from Shimadzu Scientific Instruments, Inc. In addition to support for instrument purchase, the Shimadzu relationship also includes 5 years of

comprehensive repair and maintenance support, on-site applications and training support, and a "flex account" for incidental items needed for time-to-time improvements in instrument functionality or consumables. In recognition of Shimadzu's support, UWM formally named the analytical laboratory the "Shimadzu Laboratory for Advanced Applied and Analytical Chemistry." Additional funding to acquire core instruments came from extramural grants and other UWM resources.

Major infrastructure support for the Shimadzu Laboratory is as follows:

UW System Incentive Grant	$1,692,817
Shimadzu matching funds	1,130,000
UWM/Chemistry Department	219,000
Total	$3,041,817

The laboratory is staffed by a full time PhD-level scientist previously employed under UWM's Chemistry & Biochemistry Department budget (thus, no increase in base budget occurred) and funds from the Milwaukee Institute for Drug Discovery. Numerous faculty members and graduate students work routinely in the laboratory with support from extramural grant funds. UWM provides all overhead cost support for the laboratory.



MALDI-TOF MS training session by Shimadzu applications scientist in the new KIRC facility

Training: Instrumentation in the Shimadzu Laboratory is highly sophisticated and requires substantial training to operate. The grant principals also believe that students should be trained on the instruments as part of their educational experience at both undergraduate and graduate levels. Accordingly, more than 50 UWM students/staff have been trained on various instruments in the laboratory and will include experimental results from the laboratory in their PhD dissertations. Training was provided by in-house personnel and Shimadzu technical applications staff.

Collaborations/Grant Engagements: Approximately 30 new grant proposals, research collaborations, educational partnerships, or service arrangements have been established since launch of the laboratory. These arrangements involve numerous faculty members and regional national funding agencies, foundations, industry partners, universities (e.g., MCW, Columbia University), and a charter school (e.g., Watertown WI Endeavor School). Taken together, these arrangements demonstrate the impact of UWM's chemistry excellence in research, education, and industrial vitality.

Already, several extramural research grants have been funded based on the analytical chemistry resources now at UWM. For example, two new drug development grants based on the new mass spectrometry capabilities have been received: a $2 million, 4-year R01 grant from the National Heart, Lung and Blood Institute (NIH) to UWM and a multi-year subcontract to UWM from Columbia University for $400,000. Other grants in excess of $100,000 have been awarded from foundation sources.

Sustainability: Long-term operational viability of the Shimadzu laboratory will result from a combination of financial support:

1) The Shimadzu relationship: Under current arrangements, Shimadzu will provide long-term (5 year) repair and maintenance support for the core analytical instruments in the laboratory. Support at this level is uncommon and a substantial asset for UWM's facility. The support timeline provides UWM the opportunity to secure follow-on funding for repair and maintenance in subsequent years.

2) Grant support: the advanced capabilities of the analytical instruments offers grant funding opportunities to multiple faculty members across several departments. As stated above, many grants have been submitted/awarded already or are in progress that would provide operational funding to the analytical laboratory. As evidence, the recently awarded NIH grants provides substantial funding for laboratory operation and staffing.
3) Collaborations – A fee for service model has been established to recover costs for work performed for external collaborators.

Translational Grant Program

Grants: $749,320 in research funds linked twelve WI companies with UWM/UWP faculty
Impacts: new products, patents, processes, translatable skills, trained students, follow on funding, visibility, internships, long-term relationships

Summary: A key objective of the Incentive Grant was to enhance the linkage of university faculty with industry partners based on chemistry research of importance to business. One of the most difficult challenges in developing discoveries into commercial products is funding for translational research, i.e., those studies occurring between uncovering the discovery and commercial proof-of-concept. In addition, many early stage companies do not have the resources (advanced instrumentation or specialized expertise) to carry out sophisticated research projects. To address this need, the Translational Grant program was launched to provide up to $100,000 each to UWM or UWP faculty researchers who were teamed with a commercial partner working on economically compelling translational or applied research. A call was announced for investigator originated Translational Grant research proposals, resulting in 24 submissions and 11 awards totaling $756,820.

With support of the UWM-Research Foundation, a formal process for receipt and processing of grant applications was established and an ad-hoc committee comprised of scientific and economic development experts was assembled (committee members volunteered their service) to review grant proposals for possible funding. The Translational Grant review and award criteria and process included the following:

1. The Principal Investigator (PI) for each proposal must be a full-time faculty member or academic or research staff member of a partnering UW institution (UWM or UWP). Proposals must also have a WI business collaborator. (A proposal may involve the formation of a new WI business or involve more than one business).

2. Funds could be requested up to $100,000. Matching funds were not required but contributions to projects may be included in the overall budget where applicable. Budgets may be adjusted based on programmatic balance and specific deliverables determined by the review committee and grant principals.

3. The project timeline must correspond to the research goals and outcome metrics set forth in the proposal. That said, project timelines could not extend beyond June 30, 2015 without approval of the grant principals. Projects with more rapid timelines and performance outcomes were encouraged.

4. Grants were awarded based on a combination of their scientific merit and economic development impact. Considerations included one or more of the following:

a) Projected WI job creation and/or job retention resulting from the collaborative research (most important)
b) Potential to gain follow-on funding (research grants, SBIR/STTR grants, partnerships, sponsored research, venture capital, patent licenses, etc.)
c) Creation of intellectual property (patents, new products, industrial processes, etc.) and its potential for licensing or other commercial outcome
d) Creation of student internship/advanced training opportunities
e) Academic publication and/or enhanced visibility of WI industry
f) Speed at which these outcomes would be achieved
g) Proposals were judged in part on the quality and commitment of business collaborators.

Intellectual property management, including protecting intellectual property through patents and copyrights, marketing technology and licensing technology, was governed by policies and procedures in place by the participating UW institution (UWM-Research Foundation or WiSys, as appropriate). Budget requirements for use of funds complied with procedures and policies in place at UWM and UWP for grants similarly awarded.

The funded Translational Grants comprise an impressive body of chemistry research across significant industrial sectors– consumer goods, bio-pharmaceuticals (drugs, vaccines), industrial chemicals, research chemicals, agriculture, analytical instrumentation, fermentation skills (food and drug), and water purification. These grants created an innovative opportunity to join academic and industrial scientific talents to solve industrial problems. Benefits of the research to the industrial partner (as summarized below) can be seen in new products and processes, proof of concept, patentable inventions, enhanced visibility, follow-on funding, and trade secrets. The academic partner gained a robust training platform that gave students real-life experience in industrial research and problem solving within businesses. More that 50 students were trained through their participation in the grants – some will go to the regional workforce following graduation and some, via their experience, will continue in pursuit of graduate training. While there are real, immediate payoffs from the grants, the long-term impact of a highly trained workforce and university-industry relationships will have significant sustained valuable. The awareness of industry that UWM and UWP faculty are approachable, highly talented, and willing to use their resources for problem solving is a sustainable benefit of this grant program.

Summary of awarded Translational Grants (The following includes summary information on each of the funded Translational Grants. Certain technical details are not disclosed herein to protect trade secret information or where public disclosure might jeopardize future patent protection. Further information may be obtained from the Principal Investigator. Names of students who received training are not provided to avoid any inappropriate disclosures under FERPA.).

Project Title: **"Optical Sensors for Real-Time Effluent Monitoring of Wastewater-Treatment Systems"**
Principal Investigator: Peter Geissinger, PhD, Professor, Department of Chemistry & Biochemistry, UWM
Partnering Company: Advanced Chemical Systems, Inc., Milwaukee, WI
Grant Amount: $84,823

Background: The real-time detection of Zn^{2+} is of interest to our corporate partner, Advanced Chemical Systems, Inc. (ACS), whose customers require real-time measurements of pollutant concentrations in wastewater discharged into the environment to verify regulatory compliance, but also to provide feedback for the control of the wastewater treatment process (before discharge). Current methods employ sampling and submission to an analytical laboratory, which typically requires about one week, i.e. far from real time. This project investigated a substantial modification of our patented optical-fiber-sensor technology (which is already licensed to the company). While hitherto luminescent sensor molecules were required (with changes of the luminescence properties indicating a sensing event), the new layout allows for employing the changes in the absorbance of an indicator molecule upon binding of a metal ion. Technical Objective 1 thus focused on providing the proof-of-principle with a known Zn-sensitive dye. Technical Objective 2 focused on the synthesis of a metal-sensor dye with improved sensing characteristics for use with the new sensing platform.

Results/Impacts: A sensor dye (termed AWSO) was synthesized that can be covalently attached to the optical fiber (either directly to the fiber core or the fiber-cladding polymer). The properties and spectral characteristics of this dye were investigated exhaustively and the binding affinities for various metals ions were determined. Proof of concept for the modified sensor technology was demonstrated and significant progress made towards the fabrication of a prototype sensor system, in particular on the miniaturization of the electronic circuitry required to control the measurement and to process the data. This is highly significant, as the developed electronics circuits obviate the need for a large laser light source and a large-bandwidth oscilloscope. Consequently, the footprint of the control electronics is greatly reduced to a handheld device with substantial reduction in cost, which is a key metric in the business plan developed by ACS. An invention disclosure was filed with UWM Research Foundation ("Optical Fiber Sensors for Metals with Enhanced Stability"). ACS is currently evaluating a US patent application on this invention. Two graduate students received

advanced training from this project. The corporate partner continues to license IP from the UWM Research Foundation and is engaged in ongoing commercialization activities from this research.

Project Title: **"Development of a fast, sensitive, and versatile micro-spectroscope for probing protein association stoichiometry and quaternary structure in living cells: Towards structure-informed drug design"**
Principal Investigator: Valerica Raicu, PhD, Professor, Department of Physics, UWM
Partnering Company: Aurora Spectral Technologies, Inc., Shorewood, WI
Grant Amount: $98,599

Background: Spectrally-resolved two-photon absorption microscopy offers excellent potential in rapidly probing, in vivo, the stoichiometry and quaternary structure of protein complexes, which are potential drug targets. A two-photon microscope which delivers fluorescence images with superb spectral resolution (200 wavelength channels at 1 nm resolution) has been developed in the Raicu research lab at UWM. In this microscope, fluorescence emission is projected through a transmission grating onto an electron-multiplying CCD (EM-CCD) camera with single-photon sensitivity. After passing through the transmission grating, the fluorescent signal is separated into its spectral components along a line, allowing the rows of the EMCCD to serve as different spectral channels. This technology, patented by UWM, has been licensed by Aurora Spectral Technologies and constitutes the building block of their Optical Micro-Spectroscopy System (OptiMiS). The goal of this proposal was to design, construct, and test a commercial prototype that dramatically extends the capability of this technology by introducing a detection protocol based on active descanning of the fluorescence signal prior to striking the EMCCD.

Results/Impacts: The most significant benefit of this research to AST was the launch of a new product, OptiMiS d-Lux, which is already being advertised on its website (http://www.auroraspectral.com/main-products/optimis%20de/). OptiMiS d-Lux expands the customer base of AST because it opens up the possibility of using less expensive continuous wave lasers with the OptiMiS brand of spectrally resolved fluorescence detection. The research has also resulted in upgrades to the OptiMiS Control Software package currently offered by AST. The quality of the data obtained from an OptiMiS system has been vastly improved because of improvements to the data collection process spurred on by the research performed in this grant. Additional patent claims and extramural research funding is expected as a result of this research.

Project Title: **"Commercialization of a Universal Kinase GTPase Assay"**
Principal Investigator: Alexander Arnold, PhD, Assoc. Professor, Department of Chemistry & Biochemistry, UWM
Partnering Company: AviMed Pharmaceuticals LLC, New Berlin, WI
Grant Amount: $84,346

Background: Over one third of all drugs targeting proteins are either interacting with kinases (22% of drugs) or a GTPases (15% of drugs). These families of proteins are actively pursued as drug targets by all major pharmaceutical companies, as well as many academic drug discovery laboratories. This proposal presents novel and patented assays for these two families of protein drug targets. The assays that will be prepared and optimized in the proposed studies can be sold as kits – either directly by AviMed, or through a strategic industrial partner in this business sector. The project goal is to optimize and validate commercializable assays and prepare prototype kits for sale.

Results/Impacts: New products: The synthesis of sulfur and selenium GTP and GDP were developed and optimized and all compounds were shown to be of high purity. Mass spectrometry instrumentation in the new chemistry center provided essential analytical tools for this study. Furthermore, the new-found collaboration with AviMed now enables the team to commercialize other products, for instance a new assay for the vitamin D receptor is now being planned. During the last year a new research assistant position was created. We also had support from a SMART student team at the Concordia University that provided student research experience on commercialization GTPase assays and securing future patent claims. The grant mechanism created internships at Concordia University that focused on providing the background information for the commercialization of the proposed GTPase assay. Results were presented at the UWM

Chemistry Research Symposium in April 2015 and were included in a graduate thesis. Follow on funding for this line of research will be sought through a RGI grant to the Graduate School at UWM in October 2015.

Project Title: **"Industrial Fermentation and Biotechnology Option for the B.S Degree in Microbiology and the B.S. Degree in Biochemistry including laboratory experiences and internships to serve regional biotechnology and pharmaceutical industries"**

Principal Investigator: Daad Saffarini, PhD, Professor, Department of Biological Sciences, UWM

Partnering Company: Biotechnical Resources, Inc., Manitowoc, WI

Grant Amount: $46,540

Background: Fermentation is the oldest biotechnological process. Its use to preserve food as wine, beer, bread, cheese, yogurt, sausages, pickled vegetables, and vinegar, began more than 10,000 years ago. Over the centuries, fermentation processes evolved to use pure cultures of microorganisms (yeasts, bacteria, and molds) and resulted in more controlled and precise end products. Today, fermentation is a crucial core process in pharmaceutical and bio-manufacturing companies for production of many products. For example, antibiotics are obtained from both bacterial and mold fermentation. Fermentation by various transgenic microorganisms is used to obtain enzymes, which in turn are used as catalysts for medical and industrial processes. Fermentation in microbes or mammalian cell cultures yields biopharmaceuticals such as antibodies, nucleic acids, vaccines, and blood proteins. While the use of fermentation in the food and beverage industry is widely known and appreciated, the biotechnological and pharmaceutical applications are equally important; the latter drive the need for highly trained and skill personnel for the development of new processes and products. Together, the industries using fermentation processes serve the entire population in many different ways. One-half of new therapeutics approved in the US are biologics (in contrast to small molecules) produced via fermentation of production strains. Accordingly, there is a real and growing need for trained scientists to work in the proprietary biologic therapeutic and biosimilar industry. This project developed courses in the Departments of Biological Sciences and Chemistry & Biochemistry for an Industrial Fermentation and Biotechnology Option for the B.S degree in Microbiology and the B.S. degree in Biochemistry. It will complement existing programs in microbiology or biochemistry by incorporating the science and practice of fermentation to develop professionals prepared for careers that utilize fermentation not only in the food and beverage industries, but also in the pharmaceutical and biotechnology industries. Thus, this proposal addresses the needs of industry broadly.

Results/Impacts: To meet the growing need for a highly trained workforce, the new Industrial Fermentation and Biotechnology option has been designed around a core of five courses in addition to the Microbiology or Biochemistry degree requirements. Instrumentation that provides instruction at a scale relevant to industrial processes has been acquired. Course instruction also includes experience with international and FDA requirements for process validation, good manufacturing practices, and analytical method development and validation. Course content includes the following:

1. Applied Microbiology and Biotechnology (Bio Sci 536). This is a 3-credit lecture course that describes microbial physiology and fermentation pathways that lead to production of important biological molecules (syllabus attached). This course has been approved and is currently listed in the Fall 2015 schedule of classes.
2. Industrial Microbiology and Biochemistry laboratory (Bio Sci 537/Chem 537). This is a 2-credit laboratory course that is jointly offered by Chemistry and Biochemistry and Biological Sciences departments (syllabus attached). This course has been approved and is currently listed in the Fall 2015 schedule of classes.
3. Bioprocess Chemical Engineering (Chem 541). This course has been approved and will be offered in Spring 2016
4. Bioproduct Regulatory Protocols (Chem 542). This course has been approved and will be offered in Spring 2016
5. Seminar: Science Career Transitions (Chem 690). This is a capstone course that will be offered in Spring 2016.

In summary, the aims of the funded proposal to develop and approve new lecture and laboratory courses, design a curriculum based on combination of needs assessment and requisite knowledge, and to implement the new track in Fall 2015 have all been met during the funding period. In addition, we have solicited interest of regional biotech companies to provide work experience internships for students enrolled in the Industrial Fermentation and Biotechnology option to complement their classroom and laboratory instruction.

Project Title: **"Manipulating the immune response: enhanced prediction of cathepsin cleavage sites"**
Principal Investigator: Nicholas Silvaggi, PhD, Asst. Professor, Department of Chemistry & Biochemistry, UWM
Partnering Company: EigenBio LLC, Madison, WI
Grant Amount: $56,670

Background: The goal of this proposal is to improve the ability to predict the cleavage of proteins of interest (e.g. biologics) in antigen-presenting cells of the human immune system. These cells use enzymes called cathepsins to break proteins into smaller pieces that can be recognized by the immune system and initiate a response. Accurate predictions of exactly what fragments a protein will be broken into may allow manipulation of the immune system to, for example, target cancer cells for destruction by the immune system or prevent a biologic therapy from triggering an immune response. The problem is that our current knowledge of cathepsin processing in antigen-presenting cells is too fragmentary to accurately predict all of the potential cleavage sites in a protein. To alleviate this problem, we are using the world-class mass spectrometry infrastructure available through the Shimadzu Laboratory for Advanced Applied and Analytical Chemistry at UWM to identify all possible cleavage sites for the immunologically relevant cathepsins B, L, and S. Successful completion of this work will improve our understanding of the diverse roles cathepsins play in cells, and their functions in the immune system in particular, by providing the data necessary to bioinformatically identify potential substrates. More importantly, this work will provide the volume of data required to train EigenBio's predictive immunoinformatics package, uTOPE™. The resulting improvement in predicting cathepsin cleavage events will make the already powerful uTOPE™ analysis even more marketable. We envision the improved uTOPE™ analysis being a valuable resource for biotech and pharma companies, and an important asset for EigenBio.

Results/Impacts: Since the last progress report, we have focused on the development of new methods for the analysis of cathepsin cleavage sites, because in our hands, the published protocols did not give data of sufficient quality to justify examining the complex, cell-derived peptide libraries we proposed to study. These methods involved multiple rounds of chemical protection and purification, followed by LC-MS/MS analysis. The world class MADLI instrument, coupled with the AccuSpot nano-spotting apparatus, both located in the Shimadzu Laboratory, may make it possible to analyze complex protease digest mixtures directly without the need for chemical protection and purification. We are now generating data using this technique, but the proprietary commercial interests of EigenBio preclude us from providing those data here. This research has trained the PI in the collection and interpretation of LC-MS data, as well as two undergraduate students and two graduate students. The analytical chemistry experience these students have received through their work on this project will make them more marketable to employers in this field. Future studies will be supported in partnership with UWM's Milwaukee Institute for Drug Discovery and it is expected that future extramural grant funding will be sought for this project in collaboration with our corporate partner.

Project Title: **"Prototyping Platform for Accelerated Chemical Analysis and Drug Discovery at the Single Molecule Level"**
Principal Investigator: Jörg C. Woehl, PhD, Assoc. Professor, Department of Chemistry and Biochemistry, UWM
Partnering Company: Isopoint Technologies, Inc., Milwaukee, WI
Grant Amount: $100,000

Background: The main objective of this project is the prototyping, testing, and ultimately commercializing the E-Trap, a novel hardware platform for trapping a variety of charged micro- and nanoscale particles as well as single molecules in aqueous solution using electrostatic fields. The underlying trapping method is based on patented technology developed by the PI. The work will be carried out in close collaboration with Isopoint Technologies LLC, a new startup company founded by a UWM graduate student (winner of UWM's 2013-14 Student Startup Challenge competition and the Grand-Prize winner of the 2013-14 New Venture Business Plan Competition sponsored by UWM's School of Business). The E-Trap device takes fundamental research on molecular, nanoscale, and microscale objects and applications in fields such as drug discovery, disease control, and biomedical diagnosis/analysis to the next level by not only allowing for the observation but also the direct interaction with the system under investigation. The novel trapping technique has been shown to allow the manipulation of individual, charged microspheres (diameter: 2

μm), spherical nanoparticles (diameter: 21 nm), and single-stranded, 800-nucleotide DNA molecules. Funding was used for the development, prototyping, and optimization of a complete trapping platform that can easily be integrated into existing microscopy setups and potentially serve as the basis for a portable setup for fieldwork

Results/Impacts: This was a multi-disciplinary collaboration between UWM Chemistry and Engineering departments; involving three faculty and five graduate students as well as undergraduate students participating together in scientific research, product development, and market analysis. The work of the graduate students will lead toward continued research onto dissertation level publications. In addition to the continued work of graduate students, the technological progression of the project has occurred in parallel with translational developments focused bringing the technology to market. These efforts have given opportunities for more students to become involved in the project. Specifically, undergraduate students interviewed for the first internship position at Isopoint Technologies. Research findings and vital student involvement drives continued success for the project outside the scope of the Translational Grant, including recognition of research merit at a professional conference and additional grant funding. At the IEEE Great Lakes Biomedical Conference, an overview of the work that has gone into the project was presented in the form of a research poster. This presentation was awarded 3rd Place in the Larry Hause Student Poster Competition. The additional grant funding was awarded as a part of the Ideadvance Seed Fund from the UW-Extension. The Ideadvance program provided a useful opportunity for students involved in the project to conduct real market research and talk to potential customers. Based on approximately 40 customer interviews during and directly after the Ideadvance program, we've seen a need for a method of manipulating and sorting micro-scale droplets. Our conclusion is that current technologies do not offer the speed or selectivity that the user's desire. In particular, customers have expressed interest for an improved sorting method with speed and selectivity; that is a speed above 1 kHz to 2 kHz single-droplet (10 – 20 μm) sorting and less expensive than using fluorescence-activated cell sorting (FACS) flow cytometry ($200K - $300K). This is data that were not previously quantified by our team and are being taken to account in the development of the MVP. After reflecting on what we learned through these interactions, we have begun creating a market position diagram to understand where we fit and what value we bring to the industry of isolating and manipulation of micro- and nanoscale objects according to quantifiable metrics. Each competing technology is ranked for price and versatility based on usefulness in categories such as 1D, 2D, or 3D manipulation, abilities to manipulate micro-, nanoscale particles or both. With the electrostatic trapping technology simplified into a marketable module, Isopoint Technologies can use this prototype to solicit early adopters of the product. This step is very important to get feedback from customers towards the next stages of development. The key research findings and student market analysis conducted in part of the Translational Grant program has most importantly lead to the growth of a company.

Project Title: **"The use of zeolite-based ceramics for water filtration"**
Principal Investigator: Shapnging Xu, PhD, Professor, Department of Geosciences, UWM
Partnering Company: Kohler Co., Kohler, WI
Grant Amount: $95,918

Background: More than 2 billion people across the globe do not have the access to safe drinking water. The development of effective, low-cost, low-maintenance and environmentally friendly water filtration techniques (e.g., clay pot filters) can have tremendous public health, social and economic benefits. The primary goal of this proposed research is the development of ceramic water filtration materials that can be used for both point-of-use (POU) systems (e.g., similar to the design of Brita filters) and large scale (e.g., municipal water treatment) applications. The industrial collaborator for this research was Kohler Co. During this research, we have been working with Kohler on the commercialization of related ceramic filters. Natural aluminosilicate/silicate clays carry negative charges and have high cation exchange capacities (CEC) (> 1 eq/kg). Compared to existing filtration materials, ceramic materials can have the advantage of being able to remove cationic contaminants such as a variety of heavy metals (e.g., lead) thanks to their high CEC values. The negatively-charged natural clays, however, are generally ineffective in removing anionic contaminants such as arsenic (i.e., arsenate or arsenite). To introduce positive charges to the ceramic materials, we added Fe_2O_3 nanoparticles into the zeolite clay. The ceramics made from zeolite with impregnated Fe2O3 nanoparticles are capable of removing both cationic and anionic contaminants from water.

Results/Impacts: One major goal of this research was to develop a water filtration material that can be used for POU systems such as Brita filters. For comparison purpose, the diatomaceous earth based filtration material was crushed, and

the 30-35 mesh size fraction was added to an emptied Brita pitcher filter to 5 cm depth (the original Brita filter has a depth of ~10 cm). Water filtration experiments using the original Brita filter showed that ~ 74% of copper was removed when 1 L of water was filtered through the filter driven by gravity. As we showed in laboratory testing, removal rate is usually independent on initial copper concentration. At about half depth, our diatomaceous earth based material achieved a removal rate that is constantly above 70%. Therefore, the Cu removal efficiency using the diatomaceous earth based materials will range from 91% to 99% under comparable conditions to the Brita filters, which was significantly higher than the 74% removal efficiency that was measured for the original Brita filter. Future work on the NanoFe_2O_3 impregnated ceramic material development will focus on the selection of NanoFe_2O_3 materials, the examination of alternative adsorbents, and improved production protocols that can maximize the adsorption capacity for Cr(VI). This work will set the stage for further materials optimization leading to product development. Additionally, it is expected that inventions from this research will lead to patent applications.

Project Title: **"Method Development and Analysis of a New Ecofriendly Herbicide"**
Principal Investigator: Gary Wood, PhD, Assoc. Professor, Department of Chemistry, UWP
Partnering Company: Pacific Sands, Inc., Kenosha, WI
Grant Amount: $32,348

Background: Pacific Sands, Inc. is a small company based in Kenosha, WI that specializes in low toxicity and environmentally friendly cleaning products and pool and spa chemicals. This company has in development a biodegradable, environmentally friendly weed killer that is a potential substitute for other broad spectrum weed killers. Commercialization of this product depends on having it registered with the federal Environmental Protection Agency (EPA). Pacific Sands does not have the laboratory facilities or the personnel to carry out the testing required by the EPA, and the cost associated with hiring an independent testing firm to do the work is prohibitive for a small company. In their words, the project simply would not move forward with external support. The goal of this project is to form a partnership between Pacific Sands and UW-Parkside and use the university's facilities, equipment and expertise to carry out the analytical work required for EPA registration. If successfully registered and commercialized, the company would expand its workforce and blend and package this new product at their Kenosha site.

Results/Impacts: Pacific Sands sells environmentally healthy products under the brand names EcoOne (pool and spa products) and Natural Choices (laundry and cleaning products). The commercialization of an herbicide product as proposed herein would introduce Pacific Sands into a new market area, driving product diversification and growth for the company. If the venture is successful, Pacific Sands will consider additional product development in this field. Results generated in this project include the following:

1. Developed a method to quantify the product's active ingredient.
2. Successfully applied the method and submitted all of the required physical and chemical data to the Environmental Protection Agency (EPA) for registration of the product.
3. Conducted animal toxicity testing required by the EPA.
4. Began development of a website to market the product.

Although he does not work exclusively on this project, one UWP student is employed at Pacific Sands. A local chemical testing company was supported in conducting the EPA required chemical analyses.

Project Title: **"Assessment of repurposed drug pharmacokinetics"**
Principal Investigator: Douglas Stafford, PhD, Director, Milwaukee Inst. for Drug Discovery, UWM
Partnering Company: PhysioGenix, Inc., Waukesha, WI
Grant Amount: $17,191

Background: Discoveries about the molecular basis of disease provide unprecedented opportunities to translate research findings into new medicines. However, developing a brand-new drug takes an enormous amount of time, money and effort, mainly due to bottlenecks in the therapeutic development process. Delays and barriers mean that translation of a promising molecule into an approved drug often takes more than 14 years. It is crucial to advance strategies to

reduce this time frame, decrease costs and improve success rates. Drug repurposing is one such strategy. Many agents approved for other uses already have been tested in humans, so detailed information is available on their pharmacology, formulation and potential toxicity. Because repurposing builds upon previous research and development efforts, new candidate therapies could be ready for clinical trials quickly, speeding their review by the Food and Drug Administration and, if approved, their integration into health care (NCATS). This project seeks to uncover fundamental information on an existing FDA approved drug for new (proprietary) uses identified by Physiogenix. Drug discovery resources at UWM, including expertise in pharmacokinetics, drug metabolism, toxicology, and analytical chemistry will be employed in collaboration with partner resources in animal modeling. It is expected that data generated in this project will be used to secure further funding for formal pre-clinical testing leading to human clinical trials.

Results/Impacts: Test article has been dosed to experimental animals and tissue samples provided to UWM for analytical testing. The first stage of the research is development and validation of a suitable liquid chromatography mass spectrometer assay for quantification of the drug or its metabolites in situ. Instrumentation in the Shimadzu Laboratory (single quad, triple quad and IT-TOF mass spectrometers) are used extensively for this project. Two internships engaging UWM students have been established to support the research activities. In light of delays in obtaining test samples, this work is ongoing and will not be completed until later summer 2015. Data will be key preliminary data to allow Physiogenix to advance drug development, partnering, patenting, and fund-raising. UWM expects to be a continuing partner is supporting studies leading to clinical trials.

Project Title: **"Mathematical Modeling of Pigment/Filler Settling in Coating Formulations*"**
Principal Investigator: Bruce A. Wade, PhD, Professor, Department of Mathematics, UWM
Partnering Company: Rust-Oleum, Inc., Pleasant Prairie, WI
Grant Amount: $79,278

Background: Pigments and fillers are commonly used in water and solvent based coating formulations (paints and stains) for color, appearance, and performance. Pigments and fillers tend to settle in liquid coating formulations during storage and transportation, forming a tightly packed solid layer at the bottom of the container. 'Soft' settling of pigments and fillers leads to the ability to be stirred to homogeneity, while 'hard' settling involves a tightly packed layer that renders the coating unusable. Both soft and hard settling present serious quality issues that require either extra efforts from end users or economic losses to either the manufacturer or end-user. Novel approaches to understanding, mitigating and eliminating pigment and filler settling in liquid coatings are highly desirable, and the goal of this project. Rust-Oleum of Wisconsin loses many hundreds of thousands of dollars per year from unrecoverable hard settling upon shipping paint and stain products overseas. We have developed novel mathematical models and analysis with computer simulation to learn how to mitigate or prevent product loss from ocean shipping.

Results/Impacts: This project represents a highly successful innovative approach to use mathematical modeling to solve a problem in a chemistry-based product. Substantial trade secret information (not disclosed herein) was developed that provides a computer simulation tool for experimentation on the settling process, deeper understanding of the issues of shipping the product on ocean-going container ships, and deeper understanding of the role of polymer additives with regard to the settling problem. One internship was incorporated into this project, two graduate students received training (one student will receive a PhD in mathematics based in part on this research), and one undergraduate student participated in the project through the SURF program (undergraduate research). It is expected that the relationship established herein will result in long-term collaborations.

Project Title: **"The Development of Drug/Herbicide Targets as Commercial Products in Partnership with Sigma-Aldrich"**
Principal Investigator: Graham Moran, PhD, Professor, Department of Chemistry & Biochemistry, UWM
Partnering Company: Sigma-Aldrich, Milwaukee, WI
Grant Amount: $50,492

Background: The project was a translational effort whereby the results of basic science research were used to place three known drug/herbicide targets within commercial reach of the research community. Inter-molecular interactions are the

basis of all life. Molecules in living organisms are designed to associate in order to induce specific outcomes required for life. Complexation is also a common means by which mankind seeks to control nature for specific outcomes. Each therapeutic, herbicide and pesticide has a specific biomolecular target, commonly a protein, whose biological function is altered by association with a chemical effector molecule. The de novo development and/or refinement of such molecules requires access to stable, active target molecules in order to validate and improve interactions. The preparation of high quality target molecules however, often involves a skill set that differs from that of the synthetic/medicinal chemists and physiologists who collaborate to develop bioactive ligands. The discovery of new bioactive molecules can be severely undermined by a lack of viable targets. Enzymology is the study of biological catalysis and a discipline that is utterly reliant on high quality preparations of enzymes for biophysical characterization. The laboratory of the principal investigator routinely prepares three enzymes that are established or emerging drug/herbicide targets. These enzymes are 4-hydroxyphenylpyruvate dioxygenase (HPPD), kynurenine monooxygenase (KMO), and renalase (REN). As such we proposed to develop these proteins as commercially available products in partnership with the Wisconsin based company Sigma-Aldrich Corp.

Results/Impacts: The initial objective was to produce each of the target proteins in relative large quantity. HPPD, KMO and REN were each heterologously expressed in an Escherichia coli host, purified, quantified in terms of yield and amount and activity. A student was trained and employed on an hourly basis to accomplish these objectives. Joseph mastered the skills required to produce and characterize batches of each protein and has continued to develop new expression, purification and quantification for other proteins that will ultimately also be offered for commercial sale through Sigma/Adrich. Specifically, these additional targets were a bacterial renalase from Pseudomonas phaseolicola (PpREN) and a tRNA methyltransferase (TrmFO). The first two phases of the original proposal are complete. The third stage, actual commercialization, is ongoing. In consultation with Sigma product management and we have completed detailed "new product" descriptions and defined a range of sale parameters such as quantity (per unit), concentration and shipping conditions and vessels. Sigma/Adrich is currently preparing packaging materials for each of the first three protein targets. The principal investigator intends for this to be an initial phase of a long-term relationship with Sigma/Aldrich. In such a relationship the enzymes produced routinely the laboratory of the principal investigator would be made available commercially. We expect robust demand for each of these validated herbicide/drug targets. It is too soon to accurately gauge the commercial impact of these items as they are expect to be sold for the first time in the coming months. Delays associated with the Merck/Sigma/Adrich merger have displaced full realization of the goals of this project. However, all critical laboratory objectives have been accomplished and so each of the objectives will be realized at no additional cost outside the initial funding period. The sale of these items will, to some small extent, increase the viability of a Wisconsin-based chemistry industry leader. The employment experience of the student has prompted him to join the UWM Chemistry and Biochemistry Graduate program in pursuit of his doctorate degree; the completion of which will place a highly qualified biochemistry professional in the Wisconsin workforce. The reaction catalyzed by this enzyme is highly intricate and fundamental to all life. As such will also be the basis for a grant proposal (~$600K) submitted to the National Science Foundation in October of 2015.

Project Title: **"Green And Sustainable Microreactor Process Development Of Trans-2-Hexenal As A Replacement Of Formaldehyde In Conventional Animal Feed Mold And Bacteria Inhibitors And For Use In Flavor And Fragrance Formulation"**

Principal Investigator: Gary Wood, PhD, Assoc. Professor, Department of Chemistry, UWP

Partnering Company: Wholechem, LLC, Racine, WI

Grant Amount: $10,615

Background: In 2011, the National Toxicology Program's Report on Carcinogens, 12th Edition, declared that formaldehyde is known to be a human carcinogen. For decades, the primary method for preparing contamination-resistant animal feedstuffs has been treatment of the animal feed with aqueous formaldehyde. This process makes the feed resistant to recontamination by pathogenic bacteria such as *Salmonella, Streptococcus, Staphylococcus, E. coli, Clostridia* and *Bacillus,* and inhibits mold growth. Trans-2-hexenal has the classification Generally Recognized as Safe from the Food Extract Manufacturers Association, and has recently been proven to be a very effective replacement for formaldehyde in animal feed mold inhibitors. It is not yet economically feasible, however, to completely replace

formaldehyde with trans-2-hexenal. Liquid-phase chemical microreactor technology may reduce the manufacturing cost of trans-2-hexenal enough that it could be competitive with formaldehyde. Trans-2-hexenal is currently manufactured using conventional batch processing technology, and has been marketed for flavor and fragrance (F&F) formulation for many years. Successfully reducing the cost of the manufacture of trans-2-hexenal is the primary industry motivation for both animal feed and F&F applications. The university would benefit by acquiring the chemical microreactor technology, said to be the 21st century chemist's round bottom flask. In this project, we propose to 1) demonstrate the successful synthesis of trans-2-hexenal in a small batch process using standard methods, and 2) develop the microreactor technology for large scale production and compare the cost of this process to batch production. Currently, trans-2-hexenal is being commercially manufactured only by one company in Japan and one company in Romania. If successful, this project will create long-term chemical manufacturing jobs in Wisconsin.

Results/Impacts: This project was carried out to support the development of a synthetic method for trans-2-hexenal by Wholechem, LLC, with the ultimate goal of scaled up production and marketing of this product. During review of the proposal, the budget was modified to remove the microreactor portion of the project. The modified project included development and testing of a synthetic method for trans-2-hexenal and development of a gas chromatographic method for analysis of the product. Major accomplishments and outcomes of the research included:

1. A small batch synthetic method for synthesis and purification of trans-2-hexenal was tested, refined, and shown to be successful for preparing this product from readily available starting materials.
2. A gas chromatographic method was developed for evaluating the purity of the product.

The large scale production of this compound by Wholechem does not, unfortunately, appear likely. Given the new use for trans-2-hexenal as an animal feed preservative there was a rather rapid increase in global demand for this compound and a corresponding increase in interest among larger and more established producers. A Chinese company now manufactures this compound, which will preclude Wholechem's market entry. It is fair to say, however, that a very modest investment paid off in terms of developing a relationship between Wholechem and UWP that will continue into the future. We have already committed to assisting with other organic synthesis projects as the need arises. The project also developed a valuable employee for the company. One UW-Parkside student was employed part-time on this project. That student now works part-time at Wholechem and it is likely he will be converted to full-time in the near future.

Internships

48 students participated in internships
Diverse WI employers were engaged in the program
$114,000 in internship awards granted directly to students

Background: WI's employment is projected to grow by 8% from 2006-2016, creating nearly a quarter-million new jobs. In addition, there will be over 680,000 job openings due to replacement needs during this ten-year period. One-in-ten jobs in WI are in science, technology, engineering or math (STEM fields) and will account for over **one-in-five** of the new jobs created between 2006 and 2016.[1] And, at the national level, data from the Milken Institute revealed the overwhelming trend of technology and science leading the nationwide economic recovery, and competition among the states for technology talent is getting more intense.[2] They state, "[t]he recession made clear the importance of continuing to invest in innovation and education." Yet, in a recent career development survey[3], 31% of employers nationally indicated that recent graduates are "unprepared" or "very unprepared" for their job search. Over half of the employers indicated difficulty in finding qualified candidates for job openings. This survey also showed that science and technology are among the fields where **experience** is more valued than in other industries. Results show that a college major is the most important academic credential to employers; however, internships and employment during college are the top traits employers consider in evaluating recent graduates for a position and "[an] **internship is the single most important credential for recent college graduates** to have on their resume in their job search among all industry segments" [emphasis added].[3] In a separate study, a substantial majority (69-78%) of employers surveyed replied that hands-on experience, collaborative

[1] National Alliance for Partnerships in Equity Education Foundation STEM Equity Pipeline. http://www.stemequitypipeline.org/_documents/WI/WI.fact.sheet.9.9.09.pdf. 2009.
[2] The 2012 State Technology and Science Index. The Milken Institute. Santa Monica, CA. April 10, 2013.
[3] The Role of Higher Education in Career Development: Employer Perceptions. *The Chronicle of Higher Education*. December, 2012.

skills, and internships or community-based field experiences to connect classroom learning with real-world experiences lead to student success.[4]

Thus, practical skills are among the most important qualifications sought after by employers. "The skills most lacking in job prospects were reported to be written and oral communication skills, adaptability and managing multiple priorities, and making decisions and problem solving."[3] "More than three in four employers say they want colleges to place more emphasis on helping students develop five key learning outcomes, including: critical thinking, complex problem-solving, written and oral communication, and applied knowledge in real-world settings."[4] Employer survey results further indicate that colleges need to work harder to produce these traits in their graduates.[3]

Every organization has its unique set of new employee success determinants, but all generally focus on developing proper attitudes, knowledge, skills, and behaviors and integration into the company's culture.[5] Employers know that the faster new hires feel welcome and prepared for their jobs, the faster they will be able to successfully contribute to the firm's mission. In addition to general work-place skills, businesses engaged in regulated operations (such as drug development or manufacturing under FDA rules) have considerable investments in onboarding and skills qualification programs to meet mandated training requirements.

"Research and conventional wisdom both suggest that employees get about 90 days to prove themselves in a new job."[6] Thus, it is imperative that new hires arrive at their new job with a combination of strong technical skills (notably in the natural science disciplines) and the "soft" skills to ensure rapid integration to the work environment. While onboarding has traditionally been the responsibility of individual businesses, universities can improve their students' success by playing a **pro-active** role in preparing, or "pre-boarding," students via experiential learning. Indeed, job previewing via on-the-job experiences such as internships has been shown to help new hires adjust to the new employment environment.[7] The payoff to businesses is obvious – more effective new hires, lower training costs, lower turnover, and higher workforce satisfaction, which in-turn would boost productivity and accelerate innovation. The payoff to the university would be higher retention, better classroom performance, improved recruiting, improved time-to-degree, enhanced value of degrees, and enhanced reputation.

The impact of placement success in developing the university's reputation has been highlighted in recent research.[3] "Colleges and universities should view the working lives of their students not as a challenge, but as an opportunity, given the weight employers of all kinds place on experiential elements of a recent graduate's resume." This is particularly relevant to UWM in its desire to improve its quality brand, "[f]or colleges and universities an "employment brand", a pillar of a larger "outcomes brand" matters. If an institution is not known to employers, graduates will suffer the consequences when seeking jobs." An effective internship program would be a meaningful contributor to the notion of "proven results" that is now at the center of UWM branding efforts.

In summary, diverse stakeholders exist that have mutual interests in developing a scientific workforce with high-level technical skills and job efficacy skills, which together promote long-term individual career success and business organizational success. Accordingly, linking these stakeholders (academia, government, businesses, and community entities) via innovative experiential learning programming can serve a vital role in addressing compelling workforce development and industrial competitiveness needs.

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[4] It takes more than a major: Employer priorities for college learning and student success. Hart Associates. Washington, D.C. April 10, 2013. (accessed at http://www.aacu.org/leap/documents/2013_EmployerSurvey.pdf)

[5] Leading in the Human Age, Why an era of certain uncertainty requires new approaches to the world of work, Manpower Group, 2013.

[6] Talya N. Bauer. Onboarding New Employees: Maximizing Success. *Practice Guidelines Series*. Right Management. Alexandria, VA. 2010 (accessed from manpower.com).

[7] J. H., Klein, *et al*. The effects of early socialization experiences on content mastery and outcomes: A mediational approach. J. Voc. Behav. 68:96-115. 2006.

The importance of UWM as a source for Wisconsin talent is further highlighted by the fact that 88% of UWM students come from Wisconsin and 55% from Milwaukee and surrounding counties.[8] Milwaukee County, at close to one million in population, and more than twice the size of Dane County, the next most populous county, is the engine of WI's industrial economy and is the heart of the state's population base. A significant demographic trend is the aging of Milwaukee's population, and in turn, the aging of its work force, that will influence future economic development and underscores the need for a newly educated expanding workforce. Serving the need for the next generation workforce are UWM's natural science programs that link to WI's strategic industries, such as biotechnology and healthcare, food and agriculture, water, and energy, reinforce the need for a workforce with well-developed expertise in a wide range of natural science disciplines. Yet it was noted that one factor working against new graduates is the lack of a professional network.[9] It has been further noted that, "the industry and work environment has changed dramatically during the past two decades and the skill set needed in industry today is very different than the skill sets needed in academia."[10]

Furthermore, science education at UWM directly addresses evolving funding paradigms whereby state allocations to public academic institutions may, in part, be determined by the effectiveness in student achievement and contributions to the workforce. Indeed, UWM's Provost also noted (in his campus update of Nov. 19, 2012) that land-grant universities must face "the challenge to become even 'more' economically relevant - for example universities' roles in job creation and preparing a 'relevant' workforce."

Transitional skills/internship course: To address the practical skills deficit highlighted above, an upper level undergraduate chemistry course entitled "Scientist Career Transitions" was developed and offered at UWM in each of the past three semesters (Chem 489; D. Stafford was the instructor). The course was designed to enhance students' understanding of common aspects of industrial science employment. Examples of course topics include: business organizations, professionalism, conflict resolution, regulation and research ethics, cross-functional teams, intellectual property, contracts, project management, research and development decision making, and entrepreneurship. While the course was organized around predetermined topics, there was a requirement that students survey weekly trade publications and present articles relevant to the classroom discussion topics. The cumulative impact from a semester analyzing current topics relating to industrial science (clinical trials, court decisions, licenses, new regulations, patent issuance, public perceptions, etc.) in the context of the formal topics resulted in students with a much more mature, nuanced appreciation of the practice of science in the workplace.

Internship placement: Forty-eight students were engaged in paid internships during the grant period, engaging numerous WI employers in the process (such as Rust-Oleum, Hydrite Chemical, and full time employment at Cambridge Major Laboratories). The Incentive Grant provided $114,000 in financial support directly to students for these internships. The job creation output from this cohort of students can be seen in the near term (at least 6 students offered or hired into positions; several more are expected to receive employment offers in the near term) and long term (some students have additional coursework to complete their degrees and are not available currently for full time employment; some available students decided not to enter the workforce at this time but instead to gain more research experience in pursuit of graduate degrees – these students would enter the workforce at a later date but with more advanced training and skills). While developing the internship placement plan, it was decided to expand the scope of skills developed through the work experiences. For example, the practice of chemistry and related STEM translational science in the industrial sector requires skills in project management, enterprise systems, communications, and business process analysis. Several students gained experience in these areas.

[8] http://www4.uwm.edu/acad_aff/assessment/intranet/newstd/nfbyhs/nfhs2012_passthrough.cfm

[9] S.L. Rovner, Chemical & Engineering News, November 5, 2012.

[10] L. Hamer, University-Industry Alliances: A Foundation for Innovative Business and Science Education in Emerging Professional Graduate Programs. NC State Univ. Journal of the Academy of Business Education. Spring 2007.

Internship logistics: To increase the effectiveness and efficiency of the internship process, a web-portal was designed and will launch in Sept. 2015. The portal will allow students to upload information on their internship interests, academic qualifications, availability, and employment objectives. The site will also provide information from employers wishing to hire an intern. Together, organized data from students and employers now offers a more streamlined, systematic process to effect job placements. We also have worked to introduce students to potential employers via on-campus meetings. Hydrite Chemical Co., for instance, hosted two informational luncheon sessions to describe industrial chemistry careers in general and specific opportunities and career development pathways at their company.

Sustainability: To maintain the momentum created through the Incentive Grant funding, we will seek ongoing funding from federal grants to support paid internship experiences (e.g., the US Chamber of Commerce Foundation is engaging employers and their partners across the country in developing a new demand-driven approach—talent pipeline management—to close the skills gap; also Department of Commerce and NSF). We would also like to partner with the WI Department of Workforce Development for ongoing financial support for STEM internships. We will also work with regional employers, bolstered by the successes reported herein, to gain their sponsorship of interns in their facilities. Sustainability is also supported by the ongoing offering and improvement of the Scientist Career Transitions Course in subsequent semesters and the web portal will improve ongoing program logistics.

II. Updated Goals/Performance Metrics and Assessment Plans

No significant changes in project activities, outcomes or evaluation have resulted from actual grant activities. As mentioned above, based on initial placements the scope of supported internship experiences was expanded to include business skills complementary to chemistry (or STEM fields). Data collection will occur beyond the end of the Incentive Grant period to determine the actual number of students whose employment is connected to their experiences in the Internship Program, the Translational Grant Program, or their training on instrumentation in the Shimadzu Laboratory. Based on past experience, it is expected that a significantly greater number of participating students will gain full time employment in the early months following graduation.

II. Project/Program Budget and Expenditures

The following budgetary information shows the expense items planned in the original Incentive Grant budget and expenses actually incurred during the grant period 1/1/2014-6/30/2015. Values for actual expenses are based on WISDM journal entries at 7/1/2105 and are pending any final postings to FY2015. Posting would be expected to be completed by 7/8/2015.

Expense Item	Planned	Actual	Deviation
Management and Operations:			
Center Director	183,391	213,892	Increase work on internship program
Student hourly	-	300	Ad hoc project work
Admin. expenses	10,000	4,630	Planned travel was unneeded
Facilities and Instrumentation:			
UWM Chemistry Bldg. lab upgrade	65,000	52,351	Economized on fixed improvements
General laboratory apparatus	50,000	41,494	Discount negotiated with vendors
Core Instruments	2,818,809	2,822,817	Additional freight charges
Less Shimadzu corporate grant	(1,130,000)	(1,130,000)	Per plan
Net Core Instruments	1,688,809	1,692,817	

Grants:

Translational Grant Program	750,000	749,320	Per plan
Internship Awards	150,000	114,000	Lower average award per participant
Laboratory Operations:			
UWP instrument upgrade/service	71,600	71,600	Per plan
Supplies/start up	30,000	60,793	Increased start-up/training expenses
TOTAL	2,998,800	3,001,197	
Net Under (Over) Budget		(2,397)	

The net over budget amount the will be covered by Departmental funds.

IV. Changes

All programmatic outcomes were achieved during the grant period. No substantive changes in staffing or program direction were made during the grant period. However, In light of the considerable administrative effort to launch several programs *de novo*, additional time commitment and salary support for the Director were needed. All components of the operating plan were carried out and funded substantially as anticipated in the Incentive Grant proposal. Some adjustments in budgeted categories were made as work was carried out to meet operational objectives and refine programmatic needs (see Section III above).