Governing Iowa's public universities and special schools

University of Iowa
Iowa State University
University of Northern Iowa
Iowa School for the Deaf
Iowa Braille and Sight Saving School
Lakeside Lab Regents Resource Center
Quad-Cities Graduate Center
Southwest Iowa Regents Resource Center
Tri-State Graduate Center

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January 10, 2008

Charles Krogmeier, Director
Department of Management
State Capitol

Dennis C. Prouty, Director
Legislative Services Agency
State Capitol

Re: FY 2008 Infrastructure Appropriations Annual Report

Dear Mr. Krogmeier and Mr. Prouty:

As required by 2006 Legislative Acts, Chapter 1179 (HF 2782) and amended by 2007 Legislative Acts, Chapter 219 (HF 911), attached is the report which lists the status of all capital projects completed or in progress at the Regent institutions (as of December 15, 2007) which received FY 2007 and FY 2008 appropriations from this legislation. The table on the next page lists each appropriation and identifies the corresponding attachment.

If you have any questions or need more information, please don't hesitate to contact this office.

Sincerely,

Andrew J. Baumert

H:\BF\Legislative\2007 Session\Responses\reynolds_HF2782report122206.doc
Attachment (8)
cc: Marcia Tannian, LSA
Dick Oshlo, DOM
Legislative Liaisons
Legislative Log

Appropriations for FY 2007 and FY 2008 - HF 2782
Summary

Rebuild Iowa Infrastructure Fund
(HF 2782, Sec. 33)

Tuition Replacement	$ 10,329,981	Debt service, not a capital project.
Economic Development	8,200,000	Separate attachment per university.
Batelle Funds	1,800,000	Separate attachment per university.
Batelle Funds - Endowments and Salaries	5,000,000	Separate attachment per university.
Iowa State University - Protein Processing Plant	1,000,000	Part of ISU spreadsheet.
University of Iowa - Hygienic Lab FY 2007	8,350,000	Part of SUI spreadsheet.
University of Iowa - Hygienic Lab FY 2008	15,650,000	Part of SUI spreadsheet.
Iowa State University - Vet Lab	2,000,000	Part of ISU spreadsheet.
Renovation and Repair - $6,200,000 total		
University of Iowa	2,557,500	Part of SUI spreadsheet.
Iowa State University	2,480,000	Part of ISU spreadsheet.
University of Northern Iowa	1,162,500	Part of UNI spreadsheet.
University of Northern Iowa - Playground Safety	500,000	Part of UNI spreadsheet.

Vertical Infrastructure Fund
(HF 2782, Sec. 35)

Batelle Funds - Economic Development	5,000,000	Separate attachment per university.

Endowment for Iowa Health Account Restricted Capitals
Fund of the Tobacco Settlement Trust Fund
(HF 2782, Sec. 19)

University of Iowa - College of Public Health	2,000,000	Part of SUI spreadsheet.
Iowa State University - Chemistry Building	5,000,000	Part of ISU spreadsheet.
University of Northern Iowa - Upgrades to Electrical Distribution System	3,000,000	Part of UNI spreadsheet.

LEGISLATIVE CROSS REFERENCES
Environment First Fund (HF 2782, Sec. 34)

Restricted Capitals Fund of the Tobacco Settlement Trust Fund
(HF 2782, Sec. 38)

Technology Reinvestment Fund
(HF 2782, Sec. 23)

Iowa State University - as of December 15, 2007

	FY 2007 Appropriation
Veterinary Lab	$ 2,000,000
Protein Processing Plant	$ 1,000,000
Renovation and Repair Needs (allocation to Iowa State University)	$ 2,480,000
Chemistry Building	$ 5,000,000

Description of Project	Progress of Work Completed	Total Estimated Cost of Project	Revenue Sources for Funding Project	Revenue Amounts	State Funds Obligated, but not expended as of 12/15/2007 (signed contracts or agreements)	State Funds Expended as of 12/15/2007	Estimated Completion Date of Project
Veterinary Lab							
1) Construction of a Biosafety Level 3 laboratory at the Vet Diagnostic Lab	Design	$1,861,900	FY 2007 State Appropriations (RIIF)	$1,000,000		$0	June-08
			Private Funds	$113,666			
			Iowa State Research Foundaton	$660,000			
2) Improvements/equipment		$1,000,000	IDED - Iowa Values Fund	$88,234			
These funds have been allocated to support the development of a biosecurity level 3 laboratory (BSL3) to be used for research and diagnostic purposes and to renovate VDL laboratory space and update equipment to provide comprehensive diagnostic services and expand disease surveillance programs.			FY 2007 State Appropriations (RIIF)	$1,000,000		$1,000,000	June-08
Protein Processing Plant	Design	$19,000,000	FY 2007 State Appropriations (RIIF)	$1,000,000	$278,302	$494,057	October-08
Planning underway to incorporate/modify the facility to be part of the biorenewables program			IDED - Iowa Values Fund	$3,314,000			
			Federal Small Business Administration	$3,671,525			
			Private Funds	$11,014,475			
Renovation and Repair Needs (allocation to Iowa State University**)**	Completed	$2,480,000	FY 2007 State Appropriations (RIIF)	$2,480,000		$2,480,000	June-07
Maintenance, system upgrades, or repairs including those that were deferred to a future budget cycle or postponed until funding became available.							
Chemistry Building	In Design	$74,500,000	FY 2007 State Appropriations (RCF)	$5,000,000	$2,892,519	$2,107,481	December-10
The project would provide additional, new space to meet the needs of the Department of Chemistry; the facilities would supplement space in Gilman Hall.			FY 2008 Academic Building Revenue Bonds. Authority granted HF920	$53,900,000			
			Private Funds $15,600,000	$15,600,000			

The University of Iowa

Information for the Legislative Services Agency
Battelle-funded projects as of 12/31/2007

The University of Iowa received a total of $8,410,000 to support three primary areas including the endowed chairs ($2,000,000), Infrastructure ($2,720,000) and the Platforms ($3,690,000). As of December 31, 2007, all of the Battelle funds have been obligated with a total of $6,099,984 being spent or encumbered. From July 1, 2007 to December 31, 2007, $1,247,329 was spent or encumbered.

Battelle Program Summary	Description of Program	Funding & Committed Amount	Allocation to Projects	Progress through December 31, 2007
Infrastructure	To create a joint venture partnership between The University of Iowa, regional economic development leaders and the private sector to expand and develop a new Technology Incubation Center and Research Park on the Oakdale Research Campus.	$2,720,000	New TIC $1,420,000	Design of a new BioVentures Center is complete. Construction began in the November 2007. Anticipated completion date of Fall 2008.
			Myriad Purchase $1,300,000	Building at Myriad Plaza on the Oakdale Research Park was purchased (2656 Crosspark). This building allowed the University to provide space for a California based start-up company.

Battelle Program	Description of Program	Funding & Committed Amount	Allocation to Projects	Progress through December 31, 2007
Endowment	Description: To create an endowed professor- and/or entrepreneur-in-residence program to attract world-class, entrepreneurial talent in the core platform areas.	$2,000,000	Long term Investment Pool $2,000,000	One endowed professor ($100K/year for three years) position was filled allowing us to retain one of our most prolific and entrepreneurial professors (July 1, 2007). Without this endowed professorship, we would have lost him to a University on the East coast. This professor recently obtained a $15M NIH grant and is affiliated with Optherion, which also recently closed on a $30M venture capital investment. VPR is currently negotiating to name an additional endowed chair in the College of Liberal Arts and Sciences. This endowed chair will help create an attractive recruitment package for the new DEO recruit for the

				Department of Biological Sciences. His research will focus on the study of cranial evolution and development, especially in the development of the sensory and neural elements of the inner ear. Funding was $50K from interest income and $50K match from academic department.

Platforms:

PI	Title of Battelle Proposal	Battelle Funds Awarded	Platform	Progress Update – December 31, 2007
Abdel-Malek Team	Commercialization of Santos, a Human Simulation Environment	$370,000	IT	• Refinement of existing modules - customized predictive motion, posture, and muscle activation • New functionality modules added – configuration management, source code control, and quality assurance procedures • New Hires: o Business Development - Individual will work on focusing commercialization objectives, including examination of markets, strategy, and development of a business plan. o Senior Software Engineer – extensive industry experience in game theory and design of intuitive human-machine interfaces o Software Engineer – applied virtual reality research OBJECTIVES • Module integration • Delivery of intermediate results to corporate sponsors • Aggressive outreach with potential sponsors and customers • Draft business plan Jan 2008 • Further hiring
Leno Team	Designing Transgenic Cells for Biomedical Applications	$400,000	Bio-genetics- transgenic cell lines	• Measurement of Leno TNFα-targeted reporter cell line more accurately reflects natural regulation of TNFα gene expression than non-targeted reporter cell lines – in process • Developed ELISA methodology to quantify TNFα protein in cell lines • Developed RT-PCR methodology to quantify TNFα and Luciferase mRNA levels in cell lines • Compared TNFα and Luciferase protein levels among

				targeted and non-targeted cell lines before and after induction of TNFα gene expression (in progress) • Compared TNFα and Luciferase mRNA levels among cell lines before and after TNFα induction (in progress) • Proof of Principle: Knock-out a disease gene in primary fetal fibroblasts using AAV targeting technology • Obtained cells from fetal pigs • Isolated *ApoE* gene fragment from pig cells OBJECTIVES: • Measurement of Leno TNFα-targeted reporter cell line • Compare to wild-type TNFα • Proof of Principle: • Construct AAV targeting vector • Generate *ApoE* targeting virus • Targeted AAV-mediated KO *ApoE* gene • PCR screening *ApoE* KO clones • Confirmation of targeting by Southern blotting • Focus on drug discovery platform • Construct targeted double reporter cell line • Develop business model • Continue discussions with potential partners • Prepare STTR grant application • Pursue further intellectual property
O'Dorisio Team	Development of Peptides for Diagnosis and Therapy of Cancer	$400,000	Bio-imaging & drug discovery	• Creation of novel peptides in cell culture and in animals • Design – completed • Synthesize – completed • Radiolabel – completed • Test – in process • Identification and discussion with potential partners • Submitted NCI grant application that is close to pay line OBJECTIVES: • Establish peptide laboratory equipped with cGMP compliant peptide synthesizer and HPLC purification system • Design, synthesize, and test imaging quality of novel peptides in vitro in cell culture and in vivo in animals • Partner with Northstar Nuclear Medicine to develop PEPTIDE PET imaging • Obtain Exploratory IND for at least one 68Ga-peptide • Conduct PEPTIDE PET imaging trial in humans

				• Career Development award to launch PEPTIDE PET, Inc.
Sharpe	Myriad Fit-Out	$ 1,019,060		• These funds covered the renovation costs of the Myriad Plaza project (2656 Crosspark) on the Oakdale Research Park. This building allowed the University to provide space for a California based start-up company
Shields	Iowa Neuro-Musculoskeletal Therapeutic Training System: Impact on Commercialization in Iowa	$130,000	Bio-therapeutic/ medical device	• Neurogenic Oesteoporosis: therapy demonstrated significant improvement in bone retention in low-functioning patient with spinal cord injury • Functional prototype developed • Device to Human interface improved • Computer control system simplified OBJECTIVES: • Finalize development of new frame through Stand Aid of Iowa • Develop "single module" software control system for commercial applications testing. • Complete first task in gaming software environment • Formalize the commercialization team of key Iowa tech businesses by submitting a phase I and II SBIR application to NIH • Place system in 4 key locations for feedback in Iowa Sports Medicine Centers • Formalize the operational model of the Intelli- ex company
Van Beek Team	Iowa Imaging-Based Multi-center Trials Organization	$400,000	IT; Bio- imaging	• Hired project managers • A strategic partnership has been announced between an Iowa-based multicenter trials company, CompleWare, and UIQI2 along with VIDA • UIQI2 has acquired dedicated office space at the Oakdale Technology Innovation Center right next to VIDA and less than 10 minutes from CompleWare • A first subcontract has been awarded by CompleWare to QI2 • PW+ 510(k) compliance will be submitted to a 3rd party reviewer mid-November allowing for use in a fee-for-service model as well as in commercially sponsored multi-center clinical trials • A system of electronically tracking, entering, and analyzing

				the data and results is under development through a consortium between: UIQI2 / I-Clic; QI2; VIDA OBJECTIVES: • Obtain clinical research contracts for drug and device trials and help develop a pay-per-use model of operation for trials involving lung imaging • Expand beyond lung-only image analysis to take advantage of non-lung technology being developed at the University • Spin out company from UIQI2 to continue work once initiative has expired. This company has already been established and is called QI2, Inc. (Quantitative Imaging of Iowa)
Welsh	Porcine Models of Human Disease	$400,000	Bio-genetics- animal models	• Developed first knock-out of a human disease gene (cystic fibrosis) in pigs • Developed the first-ever knock-in pig – the most common cystic fibrosis mutation in humans • Validation of disease pig models in comparison to normal pigs begun • Continuing development of relationship with probable business partner • Approval to be a tenant in the UI Bioventure Center OBJECTIVES • Characterize first CF pigs (is the model working?) • Continuing validation of pig models • Begin moving to miniature pig breeds (commercialization species) • Provide a limited number of CF pigs to CF research community for further validation • Evaluate further disease models (cardiovascular, cancer, neurodegenerative, eye, muscular dystrophy, …) • Further develop business model • Working with Cystic Fibrosis Foundation for further funding
Griffith Team	Development of AD5-Trail as a Cancer Therapeutic	$400,000	Bio- genetics- cancer therapy	• Current phase I trial is nearly complete • Completed production and testing of new Ad5-TRAIL MVB • Completed preliminary optimization run for Ad5-TRAIL clinical lot • Established contact with 2 pharmaceutical/biotech companies regarding further development/licensing • Combination studies with HDACi to increase adenoviral infection

				• Increase Ad5-TRAIL transgene expression, and modulate tumor cell sensitivity to TRAIL-mediated apoptosis (Merck & Co) OBJECTIVES: • Phase I Clinical Trial Results: Spring/Summer 2008 • Develop plan for Phase II Clinical Trial (assuming Ph I positive) • Continue Ad5-TRAIL development and clinical testing to generate further corporate interest • Evaluate other cancer applications
Weiss Team	Design and Testing of Novel Toll-like Receptor 4-Directed Immunomodulators	$100,000 $70,9401/14/2008 Additional funding allocated to Dr. Weiss from remaining balance of the Myriad Fit-Out	Bio- drug delivery, genomics	• Production and purification of wild type and variant compounds • Publications: 1 in press; 1 in review; 1 meeting (baculovirus technology) • Demonstration that natural compound is a potent agonist for airway TLR4 • Demonstration that underacylated compound is a weaker airway agonist • Agreement with NIH/NIAID to test ability of compounds to prime airway host defense against highly virulent airway pathogens OBJECTIVES: • Test ability of additional compounds (or other underacylated compound (products of other grants) to act as TLR4 antagonists/airway • Further characterize ability of natural compound to prime airway host defenses (dosing/timing; range of pathogens, including respiratory viruses; effects on innate/adaptive host defenses) (continue mouse expts) • Test in larger animal models, including neonatal pigs • Characterize “activation surface” of natural compound (monoclonal antibody; structural comparison of natural and variant compound) (other grants) • Evaluate further compounds: small molecule mimetics (e.g., peptides –focus on search for TLR4 inhibitors) • Evaluate synthetic peptides • Begin business viability assessment

IOWA STATE UNIVERSITY
BATTELLE UPDATE: July 01, 2007 – December 31, 2007

EXECUTIVE SUMMARY

Platform	Expenditures	Total Allocation	Project Allocation	Project Obligated	Infrastructure Allocation	Infrastructure Obligation
Advanced Food & Feed	$ 10,037	$ 857,572	$ 507,572	$ 350,000	$ -	$ -
Advanced Manufacturing		$ 100,000	$100,000	$ -	$ -	$ -
Animal Systems	$ 302,699	$ 626,000	$ 579,000	$ -	$ 47,000	$ -
Bioeconomy	$ 1,058,662	$ 2,164,666	$ 1,054,666	$ -	$ 1,008,000	$ 102,000
Biosecurity	$ 376,826	$ 944,200	$ 450,000	$ -	$ 271,000	$ 223,200
Information Technology	$ 663,546	$ 1,718,800	$ 650,000	$ -	$ 1,068,800	$ -
Total	**$ 2,411,740**	**$6,411,238**	**$ 3,341,238**	**$ 350,000**	**$ 2,394,800**	**$ 325,200**

Endowed Chairs
ISU $2 million in funding to be used for matching dollars for endowed chairs. April 2007, the ISU Foundation received $1M in private funds from Dr. Eugene and Linda Lloyd to create the W. Eugene Lloyd Chair in Toxicology in the College of Veterinary Medicine. This endowment was matched with $500,000 from Battelle funds. A national search was done for this position and an offer is pending.

Advanced Food & Feed
The Nutrition and Wellness Research Center renovation was completed in April 2007. Several human studies are ongoing/completed in theNWRC. The completed studies were sponsored by industry partners. In September 2007, Dr. Diane Birt was named Interim Director of the NWRC and Administrative Specialist was hired. The search for a Director will begin in spring 2008. A fee structure for clinical research has been developed, a steering committee for research activities has organized, and financial goals and plans have been established. A clinical project manager is being hired to oversee and manage human subject research projects.

Advanced Manufacturing
We continue to partner with John Deere to provide lean training to some of their suppliers. We have been funded by EDA to investigate biobased product supply chains. We are looking at a simplified approach to analyzing clusters/supply chains to rank Iowa. We are nearing completion of the ag equipment supply chain proposal. We created a Supply Chain Advisory Committee from members of the CIRAS Advisory Council.

Animal Systems
Project and Infrastructures funds are being used to support two research projects.

The first project supports research using the pig as an animal model to predict bone disorders in pigs and humans. In this period, a total of 432 single nucleotide polymorphisms (SNPs) were identified in 174 porcine genes affecting skeletal development and mineral metabolism. A bone marrow culture system is being developed to conduct *in vitro* functional studies. This research helps to establish the pig as a model for human bone research. Platform leader has met with groups concerning commercial activities in Iowa. One new company, Gold Dragon Research has located in the ISU Research Park.

The second project supports research in large animal based on neurologic and ophthalmologic diseases. Engineered proteins have been evaluated *in vitro* and in mice. Studies to test protection of mice from disease have begun. Female beagle stock have been acquired and this model will be brought into the research colony by insemination. A feline congenital glaucoma model is being maintained. Work has begun on developing a whole genome scan mapping technique.

Infrastructure funds have allowed for the improvement of facilities in the Kildee Hall Animal Facilities to allow expanded housing of canine and feline models. Specifically a biosecurity airlock foyer has been constructed, unsealed concrete floors have been epoxy sealed, and walls repainted. Caging for dog housing in the facility have been installed, and dogs have been on sight in the new facilities since August of 2007.

Biosecurity
Project and Infrastructures funds are being used to support two research projects. Additional infrastructure funds are being utilized by the College of Vet Med and College of Agriculture for platform related needs.

The focus of the first project was to expand our knowledge and applications of methanobactin, an ISU discovery, and evaluate the antimicrobials in grape seed extract. Working with the ISU organic grape extension farm in Gilbert, IA we now have six different wine varieties and dried pomace (skin and seed). The antimicrobial properties will be evaluated on the Bioscreen using five strain cocktails. We expect to demonstrate superior health benefits and antimicrobial properties for Iowa grapes. Dr. Kalidas Shetty, Professor at University of Massachusetts, was an IFSS visiting professor this summer. His students worked to evaluate the antimicrobial properties of his enhanced plant extracts.

The Biosafety Level II research laboratory construction began September 2007. Most of the electrical and plumbing is close to completion. We reported last time that all the requested equipment has been purchased. The solvent hood and bioguard hoods installations are still in progress. Research lab benches will be fitted with working surfaces. If sufficient funds remain upon completion of the lab renovation, a customized anaerobic hood will be purchased and installed; the wiring and space will be ready for the equipment.

The Animal Traceability project began to address key barriers to electronic certification, such as reluctance of some auction markets to learn a new system. A Team of economists, transportation/logistics experts, and business specialists have begun a SWOT analysis of the business entities involved in this project to provide input to the business plan. Methods to incorporate the ILTP into the Iowa Department of Agriculture and the U.S. National Animal Identification Systems (NAIS) plans are still being discussed with IA Department of Agriculture. Additionally, GVL is working with USDA to develop their system consistent with the national program. Online version directed at the veterinary practice to comply with requirements of 'Green' and 'Gold' Preconditioning requirements is in final test and will be moved to production servers by early January 2008.

Bioeconomy
Project and Infrastructure funds are being used to support eight research projects (tasks) in addition to platform related infrastructure purchases made by the Colleges of Agricuture, Liberal Arts and Sciences, and Engineering.

Task 1. To produce syngas with properties that maximize growth and production of chemo-autotrophic microorganisms. A new gas cleanup system has been designed, the gasifier has been upgraded, the biomass feeder has been improved and the gasifier instrumentation is being replaced and repaired. Some repairs include replacing the existing data acquisition software to a new method to measure the overall volumetric syngas rate out of the gasifier. Finally, the safety equipment in the gasifier laboratory has also been upgraded.

Task 2 - Mass-Transfer Balance. In the past six months, different metal elements such as aluminum, titanium, zirconium and iron were introduced into the framework of MCM41 nanoparticles to adjust the surface

hydroxyl group characteristics. Preliminary results suggest the enhancement by salt addition is affected by the kind of metal ions and anions as well as their solution concentration. For most salts, the enhancement increased with salt concentration.

Task 3. A continuous syngas fermentation facility for the production of bio-plastic (polyhydroxy alkanoate) and bio-fuel (hydrogen) has been designed and constructed in Black Engineering. Gas flow control system installations have been completed. A clean laboratory room has been constructedto provide a proper environment for the wet chemistry required for the chemical and biological analysis of syngas fermentation. Infrastructure expenditures include: plumbing and flow controller system, spectrophotometer, fermentation system, clean room renovation, and electrical work

Task 4. The goal of this task is to examine an alternative route to ethanol production that avoids the high energy and water costs of distillation. Work conducted during this update period on genetically engineering *E. Coli* was aimed at improving acetaldehyde production by identifying and eliminating unwanted by-products.. and to genetically engineer *R. rubrum* for production of acetaldehyde from syngas. Based on results, we have begun work to genetically modify *R. rubrum* to prevent anaerobic acetaldehyde metabolism.

Task 5. Since the last report, we have assessed the effect of expressing each of these transgenes on PHA content in *R rubrum.* We are now expanding these characterizations to further understand the mechanisms by which PHA yields is controlled by these fermentation organisms.

Task 6. The original goal of building a new pyrolysis unit has been expanded with the receipt of $500,000 from U.S. DOE, to also purchase new feedstock preparation equipment and design and build more sophisticated bio-oil collection equipment. The reactor is being fabricated at the Chemistry Machine Shop and the cyclones are being built by Ames Lab. A new fractionating condenser system is currently being designed. A new laboratory is being set-up to characterize bio-oils. Infrastructure expenditures include: a 20kg Biomass Dryer/Humidifier, mercury porosimeter, microGC, and a hammer Mill Grinder.

Task 7. The goal of our task during the last six months has been focused on producing high-purity oleate esters from high-oleic soybean oil (HOSO). The purity of oleic acid in HOSO has been improved from 83.2% to 92.5% by means of low temperature crystallization. Different methods of filtration were examined to test the feasibility of scale-up. Our collaborators at UNI will evaluate the purified esters as lubricants.

Task 8. We have ordered a specially-designed high throughput reactor system consisting of 8 reactors that is due for delivery by February, 2008. The Battelle funds were leveraged with $23K from ConocoPhillips and a$29K equipment donation from Parr Instruments in purchasing this reactor system. Two bio-oil upgrading areas have been initiated through funding from ConocoPhillips. We have initiated research on reducing the organic acid content in bio-oil so as to make it more stable and transportable.

Information Solutions

On November 1st the CyberInnovation Institute hosted the Iowa Department of Economic Development's Information Technology Council. Doug Jacobson presented his plan for the "IT Adventures" program to be held spring 2008 in Hilton Coliseum. On November 13th the CyberInnovation Institute (CII) held its Industrial Advisory Board meeting. Continued infrastructure enhancement of CII space occurred. We secured our first startup companies using CII facilities, including Clearsighted, Inc., Visual Medical Solutions, and Concure Ltd. The Information Assurance Center, a founding member of the CII, moved all of its accounts to CII administration encompassing ten ongoing projects totaling $3.5M.

FULL REPORT

BATTELLE FUNDING: PROGRESS REPORT

Update Period:	July 01, 2006 – December 31, 2006
Title:	Large Animal Genomics Models for Animal and Human Health
Platform:	Animal Systems
Platform Chair:	Max F. Rothschild
Platform Expenditures:	$302,698.54
Platform Funding:	$626,000
Project Allocated:	$579,000
Project Obligated:	$ -
Inf. Allocated:	$47,000
Inf. Obligated:	$ -

PROJECT 1

Publications/presentations based on project:

1. Onteru, S.K., B. Fan, B. Mote, T. Serenius, M. Nikkilae, K. J. Stalder , M.F. Rothschild. SNP discovery in genes affecting leg health traits in pigs. 2007. Proc. International Symposium on Animal genomics for Animal Health, Paris, France, Oct. 23-25.

2. B. Fan., Onteru, S. K., B. Mote, T. Serenius, M. Nikkilae, K. J. Stalder, M. F. Rothschild. 2008. Association Of Genes Affecting Skeletal Design And Feet And Leg Soundness In Pigs. Plant and Animal Genome XVI Conference, San Diego, California, Jan. 12-16. (accepted)

3. Onteru, S. K., B. Fan, B. Mote, T. Serenius, M. Nikkilae, K. J. Stalder, M. F. Rothschild. 2008. Association of candidate genes to leg and body conformation traits in pigs. ASAS/ADSA Midwest Meeting, Des Moines, IA, Mar. 17-19. (submitted)

4. Onteru, S. K., B. Fan, B. Mote, T. Serenius, M. Nikkilae, K. J. Stalder, M. F. Rothschild. 2008. Determination of genes associated with leg and body conformation traits in pigs. Animal Industry Reports (submitted)

External funding applied for (indicate received/denied/pending):

Received

Association of genetic markers with structural soundness and sow longevity (M Rothschild, K Stalder)	National Pork Board	$86,000

Pending

Association of genetic markers with structural soundness and sow longevity year 2 (M Rothschild, K Stalder)	National Pork Board	$120,000

Progress Report (350 word maximum):
This grant supports research using the pig as an animal model to predict bone disorders in both pigs and humans. In this period, a total of 432 single nucleotide polymorphisms (SNPs) were identified in 174 porcine genes affecting skeletal development and mineral metabolism. By using the high-throughout Sequenom's MassARRAY system, 141 SNPs in 102 genes were successfully genotyped for 2066 commercial pigs which were scored for 17 traits describing various leg and feet and conformation conditions. Genotyping procedures were also implemented in the ISU Berkshire × Yorkshire (BY) resource family and 66 genes were mapped to the corresponding chromosome regions homologous to the human genome. The variability and normality of scoring data were tested for each trait. The association analyses were therefore carried out using mixed model procedures of SAS and over 61 genes showed significant associations with leg and body conformation traits. These genes are key molecules in the BMP, IGF1, TGFβ, FGF, cortisol, estradiol, Wnt, calcitonin, retinoic acid and interleukin signaling pathways. Genes such as COL1A2, COL2A1, CALCR, OPG, PTHR, APOE, IHH, MTHFR, WNT2 and WNT16 had high significant associations with leg movement and other bone traits. However, genes like LRP5, RANKL and VDR showed less interesting results. Some of these findings were presented as a poster in International Symposium on Animal Genomics for Animal Health held in France. Abstracts with new data were submitted to Plant and Animal Genome XVI Conference, 2008 and 2008 Midwestern section annual meeting. At present a bone marrow culture system is being developed and it can be utilized to conduct *in vitro* functional studies so the effect of gene SNPs on function can be explored in bone marrow cells. The genes having clear effects will be re-sequenced for SNP mining and the target SNPs will be determined. All this research helps to establish the pig as a model for human bone research. Platform leader Rothschild has met with new groups concerning expanded commercial activities in Iowa. One new company, Gold Dragon Research has now started in the research park thanks to efforts of Rothschild and other members of the animal sciences.

PROJECT 2

Progress Report (300 word maximum):

Work supported research in large animal based **1) neurologic and 2) ophthalmologic diseases**. A progress review follows:

Neurologic Conditions Goals

1. Develop a chaparonin base therapy for MPS IIIB. A Master's student has begun research. An extramural grant application to supplement this grant and an intramural seed money grant previously earned, is pending (decision due 2/1/2008. The goal is to generate preliminary data for NIH applications at the R03/R01 level.

2. Develop an enzyme fusion capable of crossing the blood brain barrier. Engineered proteins have been evaluated *in vitro* and in mice. Proteins are able to enter cells and function normally, and we can achieve with gene therapy up to 3 times normal activity in mice. Studies to test protection of mice from disease have begun, and if successful, will be tested in dogs as a pre-clinical evaluations.

3. Develop canine and feline mesenchymal stem cells to treat canine and feline models of human genetic diseases. Work is being conducted by Dr. Don Sakaguchi who has a funded graduate student in this area.

4. Develop a canine colony of GM1 gangliosidosis. Female beagle stock has been acquired and this model will be brought into the research colony by insemination with frozen semen in the Spring of 2008.

Ophthalmologic Conditions

1. Further characterize and maintain a feline congenital glaucoma model. This model is maintained to characterize this spontaneous and unique model for leading cause of blindness. Work has begun on developing a whole genome scan mapping technique to use in this population.
2. To found and characterize a novel retinal degeneration in the border collie. Frozen semen was used to inseminate on bitch, who failed to conceive. Semen exists for one further attempt, which will be conducted Spring of 2008.

PROJECT 2 INFRASTRUCTURE

Progress Report (300 word maximum):

Infrastructure funds have allowed for the improvement of facilities in the Kildee Hall Animal Facilities to allow expanded housing of canine and feline models. Specifically a biosecurity airlock foyer has been constructed, and unsealed concrete floors in a large animal room and the new foyer have been epoxy sealed and walls repainted. Caging for dog housing in the facility have been installed, and dogs have been on sight in the new facilities since August of 2007. The work came in under estimates, and bids will be sought to utilize further resources to further the infrastructure of the Kildee Hall Animal Facilities.

BATTELLE FUNDING: PROGRESS REPORT

Update Period:	July 01, 2006 – December 31, 2006
Title:	Advanced Food & Feed: Advanced Carbohydrates for Health
Platform:	Advanced Food and Feed
Platform Expenditures:	$ 10,036.82
Platform Co-Chairs:	Ruth MacDonald and Michael Budnick
Platform Funding:	$857,572*
Project Allocated:	$507,572
Project Obligated:	$350,000**
Inf. Allocated:	$ -
Inf. Obligated:	**$ -**

*****In addition to the Battelle funds, $330,000 from ISU's GIVF funding was used to support research projects associated with this platform.

****** This funding is reserved as a start-up package for the Director of the Nutrition & Wellness Research Center (to be hired)

Progress Report:
The Nutrition and Wellness Research Center renovation was completed in April 2007. This was funded by the ISU Central Administration ($700,000). During the renovation and through August 2007, Stephanie Kasper was employed as a Program Assistant who provided support for the NWRC. Stephanie was funded by the College of Human Sciences (CHS). Several human studies have been performed in the NWRC and are ongoing. The completed studies were sponsored by industry partners. During the spring of 2007, a national search for a Director was undertaken, and two excellent candidates were interviewed. Neither of these candidates accepted the position. In September 2007, Dr. Diane Birt was named Interim Director of the NWRC, and in October, Theresa Peterson was hired as an Administrative Specialist for the NWRC with CHS funds. Dr. Birt also serves as Director of the Center for Designing Foods to Improve Nutrition and she is in the process of merging CDFIN into the NWRC. Plans are in place to reopen the search for a Director in the spring of 2008. The funding within this proposal for the startup package for the Director has been retained and will be available for the new hire. Dr. Birt has established the infrastructure of the NWRC. She has put in place a fee structure for clinical research, steering committees for research activities, and financial goals and plans. She is in the process of defining the staffing requirements for the NWRC which will use the salary funds retained in this current project. The CHS has provided financial support to the NWRC in the form of staff and graduate assistantships to encourage research activity. It is expected that a clinical project manager will be hired soon to oversee and manage human subject research projects. The ISU Research Park has been an important partner in this endeavor through the recent recruitment of a marketing staff member. Dr. Birt and Dr. MacDonald have met regularly with the marketing staff to develop recruitment strategies for food companies. In addition, ISU RP has assisted with finding suitable renters for available office space in the building as well as the research laboratories.

BATTELLE FUNDING: PROGRESS REPORT

Update Period:	July 01, 2006 – December 31, 2006
Title:	Thermochemical Technologies for the Bioeconomy
Platform:	BioEconomy
Platform Chair):	Robert Brown
Platform Expenditures:	$ 1,058,662.23
Platform Funding:	$2,164,666
Project Allocated:	$1,054,666
Project Obligated:	**$ -**
Inf. Allocated:	**$**1,008,000
Inf. Obligated:	$ 102,000*

*Allocated to the College of Agriculture, account pending

Publications/presentations based on use of infrastructure:
David C. Chipman, Young S. Do, Dong-Won Choi, Samuel T. Jones, Alan DiSpirito and Robert C. Brown. 2007. Syngas Fermentation Research Facility at Iowa State University. Biobased Industry Outlook Conference. Poster presentation.

Invention disclosures utilizing infrastructure purchases:
IPDR entitled "Ethanol production by combined fermentation and chemical synthesis." was filed with ISURF.

External funding applied for utilizing infrastructure purchases (indicate received/denied/pending):
Funding received: Conoco-Philips. $150,000 (3/07-12/07)

Funding Pending: Conoco-Phillips and ADM $200,000 (1/08-12/08)

Funding received: Annotation of novel enzymatic functions in methanogens : Amount: $1.25M
Funding Agency: DOE-GTL : Dates: October, 2007-October, 2010

Funding pending: CPBR

Funding Received: Department of Energy under award number: DE-FG36-07Go87003.

Funding Received: Project Title: Fast Pyrolysis Process Development Unit for Validating Bench Scale Data
Duration: October 2007- September 30, 2008)
Amount of funds awarded by DOE: $500,000
Cost share from ISU: $125, 132

Funding received: Catalytic Upgrading of Bio-Oil, ConocoPhillips, $162,974 (5/07-12/08)

Funding Received: Condensed Phase Catalysis with Bio-Oil Species, ConocoPhillips, $70,000 (1/08-12/08)

Equipment Donation, Parr Instruments, $29,000

Task 1 Progress Report:
The objective of this task is to produce syngas with properties that maximize growth and production of chemo-autotrophic microorganisms.

Raw syngas from the gasification of biomass feedstocks contains many condensable liquid compounds that may inhibit growth and even kill is cases the Rhodospirillum Rubrum cells being used to convert carbon monoxide to hydrogen. The remove these and other compounds from the raw syngas, a new gas cleanup system has been designed and is being installed. The new gas clean-up system includes a pair of mini-cyclones, a hot gas filter, a tar condenser, an impinger train, a vacuum pump, a pair of toxin filters, and a oxygen filter. This gas clean-up system is capable of providing 10 L/min of cleaned syngas to the bioreactor containing Rhodospirillum Rubrum.

In preparation for evaluating the merits of perspective of feed stock such as: corn stover, switchgrass, corn fiber, and distillers' dried grains work has been completed to upgrade the gasifier. This work includes the addition of a steam generator such that the gasifier may be operated in the following modes: i) air blown, ii) air/steam blown, and iii) oxygen/steam blown. The biomass feeder has also been improved to reduce the difficulty involved with handling ground switch grass and corn stover. The primary cyclone on the gasifier is being replaced with two new high efficiency cyclones that will be designed to remove 99% of the char in the raw syngas. These new cyclones will improve the ability to complete detailed mass balances. The gasifier instrumentation is being replaced and repaired to facilitate detailed mass balances. Some of these repairs include replacing the existing data acquisition software with a new updated version of the software to improve system control and to facilitate improve data collection and a new method to measure the overall volumetric syngas rate out of the gasifier. Finally, the safety equipment in the gasifier laboratory has also been upgraded. These upgrades include replacing the aged carbon monoxide detectors with new industrial grade gas monitoring equipment that will monitor carbon monoxide, hydrogen, and oxygen levels to ensure a safe working environment.

Task 2 Progress Report:
As reported previously, MCM41 functionalized by 5% mole ratio mercaptopropyl groups showed the strongest enhancement of nearly a factor of 2 in the CO-water volumetric mass transfer coefficient (k_La). It was hypothesized that surface hydroxyl groups play an important role in this process. In the past six months, different metal elements such as aluminum, titanium, zirconium and iron were introduced into the framework of MCM41 nanoparticles to adjust the surface hydroxyl group characteristics. However, for these nanoparticles doped with other elements, only slight enhancements of 10~30% were observed at nanoparticle concentrations of 0.2 wt%, which was close to that of the pure MCM41 nanoparticles (25%). Instead, FTIR results suggest the existence of mercaptan groups on the MCM41 nanoparticle can stabilize the CO adsorption on the MCM41 nanoparticle surface in the gas phase, which may result in stronger enhancement when compared to pure nanoparticles.

Considering the coordination interaction between CO and the transition metal ions, different salts, such as ferrous sulfate, nickel sulfate, cobalt sulfate, and nickel nitration were dissolved into water to determine the best metal salts to enhance CO-water mass transfer, and to study the influence of salt concentration on the enhancement. Preliminary results suggest the enhancement by salt addition is affected by the kind of metal ions and anions as well as their solution concentration. For most salts, the enhancement increased with salt concentration. Manganese sulfate ($MnSO_4$) gave the strongest enhancement of all the salts (nearly a factor of 4) when the concentration was 5 wt%.

In the next six months, we will try to immobilize these active transition metal salts on MCM41 nanoparticles and measure the mass transfer enhancement when using these nanoparticles in fermentation media solution.

Task 3 Progress Report:
A continuous syngas fermentation facility for the production of bio-plastic (polyhydroxy alkanoate) and bio-fuel (hydrogen) has been designed and constructed in Black Engineering. The new facility now includes two major components; a fermentation unit and a clean laboratory. A fermentation unit consists of five laboratory-scale (14L) fermenters able to run in parallel or in series depending on needs to optimize syngas utilization. The first fermenter is designed to test biofilteration system to remove potentially toxic compounds from syngas. Syngas filtered through this biofilteration system will be fed into remaining four bioreactors for *Rhodospirillum rubrum* cultivation for the production of bio-plastic and bio-fuel. Gas flow control system installations have been completed which will allow us to monitor gas mass flow and pressure balance between gasifier and bioreactors continuously. A clean laboratory room has been constructed. This particulate-free, temperature-controlled room will provide a proper environment for the wet chemistry required for the chemical and biological analysis of syngas fermentation. Analytical instruments are being installed in this room.

In addition to the construction of a new syngas fermentation facility, this task has continued to focus on developing cost reduction strategies for the bio-plastic and bio-fuel production using syngas. This is still an ongoing project.

Task 3 Infrastructure expenditures

- Plumbing and flow controller system
- Spectrophotometer
- Fermentation system
- Clean room renovation
- Electrical work

Task 4 Progress Report:
The goal of this task is to examine an alternative route to ethanol production that avoids the high energy and water costs of distillation. An important milestone for this work is to genetically engineer *E. coli* to efficiently produce acetaldehyde and hydrogen. In prior work, *Escherichia coli* was successfully engineered to co-produce acetaldehyde and hydrogen from glucose. Work conducted during this update period was aimed at improving acetaldehyde production by identifying and eliminating unwanted by-products. HPLC analysis identified formate, succinate and acetic acid as the major unwanted by-products. In *E. coli* the primary route of acetate formation is via the Pta and AckA enzymes. To eliminate acetate production by this route we deleted the genes encoding these enzymes. Studies are underway to evaluate the effects of these deletions and to construct deletions that eliminate succinate and formate production. A second milestone of this project is to genetically engineer *R. rubrum* for production of acetaldehyde from syngas. The pyruvate decarboxylase (*pdc*) gene *Zymomonas mobilis* was cloned into *R. rubrum* and expression of the PDC enzyme was verified by in vitro assays. Under aerobic growth conditions, PDC expression increased acetaldehyde formation about 2,000%. However, during growth on syngas under anaerobic conditions, no increase in acetaldehyde production was detected. This indicates that *R. rubrum* metabolizes acetaldehyde in the absence of oxygen. Therefore, we have begun work to genetically modify *R. rubrum* to prevent anaerobic acetaldehyde metabolism.

Task 5 Progress Report:
For PHA metabolism, we have identified and are characterizing six *R. rubrum* genes that appear to be involved in PHA production. Since the last report, we have assessed the effect of expressing each of these transgenes on PHA content in *R rubrum.* We have found that these directed genetic manipulations increase the PHA concentrations in *R. rubrum* cultures. These increases range between 120% and 200% of wild-type levels. These manipulations indicate that we may have identified a mechanism by which we can increase the yield of bioplastics from syngas fermentation. We are now expanding these characterizations to further understand the mechanisms by which PHA yields is controlled by these fermentation organisms.

Task 6 Progress Report:
Work on task 6 focuses on generating bio-oil under well characterized operating conditions and characterizing physically and chemically the oil properties that influencing bio-oil stability.

The original goal of building a new pyrolysis unit has been expanded with the recent receipt of $500,000 from the U.S. DOE, which allows us to also purchase new feedstock preparation equipment and design and build more sophisticated bio-oil collection equipment. The reactor is currently being fabricated at the Chemistry Machine Shop on the campus of Iowa State University and should be completed by the beginning of the January 2008. The cyclones are being built by Ames Lab and will be completed early January 2008 as well. A new fractionating condenser system is currently being designed for use with the new reactor.

For the purpose of better characterizing bio-oils, a new laboratory is being set-up. At present, capabilities (i.e. instrumentations and technical personnel) of characterizing biomass, bio-oil and biochars, physically and chemically have been developed. Two recently purchased instruments are a microGC(from Varian) for analyzing synthesis gas and a mercury porosimeter (from Quantachrome) for analyzing the pore size distribution and surface area of bio-chars.

Task 6 Infrastructure expenditures

- 20kg Biomass Dryer/Humidifier
- Mercury porosimeter
- MicroGC
- Hammer Mill Grinder

Task 7 Progress Report:
The goal of our task during the last six months has been focused on producing high-purity oleate esters from high-oleic soybean oil (HOSO). The purity of oleic acid in HOSO has been significantly improved from 83.2% to 92.5% by means of low temperature crystallization. HOSO was esterified with butyl and isopropyl alcohols, respectively, both of which have low melting points. With 50 to 80% acetone by volume, the esters were subjected to a two-step crystallization at temperatures adjusted to their melting points. The solvent and two-step crystallization were employed to improve the efficiency of the fractionation. The fractionation temperatures were -27° C and -37° C for butyl ester and -30° C and -36° C for isopropyl ester, respectively. Stearate crystallized first followed by palmitate. Stearate decreased from 7.3% to trace amount (about 0.3%), but palmitate and oleate formed eutectic mixtures that left about 2% plamitate in filtrate. During these processes, the composition of the polyunsaturated fatty acids, linoleic and linolenic, remained essentially unchanged. After the two-step fractionation, the purity of oleic acid was 92% for the isopropyl ester and 92.5% for the butyl ester. Large crystals were formed by butyl ester, which made filtration easier and made possible the use of less solvent (50%) compared with isopropyl ester (80%). Different methods of filtration were examined to test the feasibility of scale-up. Probably centrifugation at low temperatures with a centrifuge that could periodically dump the precipitate would be more efficient than filtration. Palmitate, the major impurity, could also be removed by a slow distillation. Our collaborators at UNI will evaluate the purified esters as lubricants.

Task 8 Progress Report:
We have ordered a specially-designed high throughput reactor system consisting of 8 reactors that is due for delivery by February, 2008. The Battelle funds were leveraged with $23K from ConocoPhillips and a$29K equipment donation from Parr Instruments in purchasing this reactor system. Two bio-oil upgrading areas have been initiated through funding from ConocoPhillips. The projects are staffed with a post doctoral scholar and a graduate student. We have initiated research on reducing the organic acid content in bio-oil so as to make it more stable and transportable. A second area, which will begin next year, involves the condensed phase conversion of bio-oil molecules to produce molecules that can be more readily used as transportation fuel.

UPDATE: INFRASTRUCTURE FUNDS PROVIDED TO COLLEGES

Dr. Chris Williams has upgraded a servo-pneumatic testing machine for testing materials associated with bio-energy research. Research will be under contract within the next 6-12 months. A substantial amount of exposure is being received by the research team associated with utilizing bio-energy co-products in asphalt materials and this equipment will further expand their research capabilities and thus research exposure.

Dr. Terry Meyer purchased components for building a quadruple pulse laser system that will help develop technologies for alternative fuel processing and utilization.

Dr. Santosh Pandey has purchased a Leica Microscope with High-resolution Digital Camera & Vibration Isolation Table. This equipment will be used for testing characteristics of living cells and microorganisms under various stimuli. The electrically-active bio-nanoelectronic platform combines the versatility of nanoscale circuits with the flexibility of polymeric substrates to study biological processes. Our portable assay would allow label-free detection of a specific biological specimen and nanoscale probing of its characteristics. The electronic detection scheme would provide real-time information over a long time interval, which is not possible with optical or fluorescence-based assays. Combined with high-performance computing features and embedded systems, the microscope system can provide real-time monitoring of biological processes..
He also purchased a two-section glove box from MBraun Inc. for research in organic and bio-electronics of material which are sensitive to air and humidity.

Dr. Jaeyoun Kim purchased an optical table, its support, and a pneumatic controller. The heavy, very flat optical table stabilized by pneumatic floating will serve as the platform in various high-precision optical experiments. He will purchase lasers, optomechanical stages, and detectors. The equipment will be essential for the development of high-performance optical sensing, communication, and computing systems including surface plasmon resonance sensors and nanoscale optical waveguides.

BATTELLE FUNDING: PROGRESS REPORT

Update Period: July 01, 2006 – December 31, 2006
Title:
Platform: BioSecurity
Platform Chair): Manjit Misra
Platform Expenditures: $376,826.29
Platform Funding: $944,200
Project Allocated: $450,000
Project Obligated: $ -
Inf. Allocated: **$** 271,000
Inf. Obligated: $ 223,200*

* The infrastructure obligation if for the BL3 facility currently in the planning stages for the College of Vet Med ($62,000) and for the College of Agriculture ($161,000)

TASK 1 (Natural Antimicrobials) PROJECT FUNDS:

Publications/presentations based on use of infrastructure:
Lantz, A., Brehm-Stecher, B.F., and D.W. Armstrong. Combined Capillary Electrophoresis and DNA-FISH for Rapid Molecular Identification of *Salmonella* Typhimurium in Mixed Culture. Invited manuscript for special issue of Electrophoresis (under review).

B.F. Brehm-Stecher. 2007. "New Technologies for Imaging Individual Microbial Cells". *In* *Imaging Cellular & Molecular Biological Function*, F. Frischknecht and S. Shorte, (eds.) Springer-Verlag, Berlin.

B.F. Brehm-Stecher "Methods for Whole Cell Detection of Microorganisms" *in* *Structure, Interaction and Reactivity at Microbial Surfaces*, T. Camesano and C. Mello (eds.), American Chemical Society, Washington, D.C. (*in press*).

Awards received related to infrastructure purchases:
None

Invention disclosures utilizing infrastructure purchases:
None

External funding applied for utilizing infrastructure purchases (indicate received/denied/pending):

Funded
Ahn, D. U., E. J. Lee, and A. L. Pometto III. 2007-08. Production of Ovotransferrin from Egg White for Antimicrobial Applications. Midwest Poultry Research Program. $44,421

Brehm-Stecher. 2007-2008. Antimicrobial Activities of Essential Oils Part II: Formulation Testing, Blend Optimization, Expanded Pathogen Testing, Activity Enhancement and Alternative Delivery Strategies. Industry/IPRT. $36,893.

Brehm-Stecher. 2007-2008. Testing the Antimicrobial Effects of QSI-Nano Metal Nanoparticles: Basic Research and Applications. Industry. $50,944.

Brehm-Stecher. 2007-2008. Simultaneous Concentration and Visual Identification of *Salmonella* and *Listeria* in Mexican-Style Soft Cheeses. Midwest Dairy Association. $31,068.

Brehm-Stecher. 2007-2008. Rapid Cytometric Detection of *Salmonella*, *Campylobacter*, *Yersinia* and *Listeria monocytogenes* in Pork Products – Assay Refinement, Extension and Technology Transfer. Food Safety Consortium. $17,794.

Brehm-Stecher. 2007-2010. Biomimetic Polymer-Based Antimicrobial Systems: Development and Applications. Industry. $117,300.

Mendonca, A, and A. L. Pometto III. 2007. Antimicrobial Efficacy of a Novel Antimicrobial Skin Cleanser against Foodborne Enteric Pathogens on a Model Skin Surface. IPRT ($12,057) and Northern Filtration Media ($12,065)

Pending

Brehm-Stecher. 2007-2008. Midwest Regional Center of Excellence for Biodefense and Emerging Infectious Diseases Research. Biomimetic Antimicrobial Systems for Biothreat and Emerging Pathogen Mitigation. $97,289.

Brehm-Stecher. 2008-2011. USDA-NRI. Rapid Separation, Concentration & Visual Molecular Identification of Foodborne Pathogens on Fresh Produce. $328,343.

Narasimhan, B., A. L. Pometto III, S. Mallapragada, and M. Misra. 2008-2013. NSF Engineering Research Center for Food Safety and Security. NSF $18.5 Million.

Munkvold, G., A.L. Pometto III, Kim, T., and Shetty, K. 2008-2011. Corn biomass quality for biofuel production; impacts of fungal pathogens and approaches for quality enhancement. Department of Energy. RD-RBP-BIOMASS-2007. $1,101,301.

Progress Report (350 word maximum):

The focus of this research was to expand our knowledge and applications of methanobactin, an ISU discovery, and evaluate the antimicrobials in grape seed extract. Our first 100 L fermentation produced methanobactin at significantly lower concentrations then bench scale (10 L). To increase the residence time for methane for methanobactin production, we need to further modify the 100-L fermentor by employing a down-draft marine agitator blade. For methanobactin recovery we had some start up difficulties with the organic solvent spray drier; we have received some new parts from the manufacturer. Our second pilot scale run will be late January. For the grape seed extract objectives, we decided to produce some Iowa grape extract. Working with the ISU organic grape extension farm in Gilbert, IA and with Dr. Paul Domoto in Horticulture, we now have six different wine varieties and dried pomace (skin and seed). Wine has been racked and shortly the dried grape skins will be separated from the seeds. The antimicrobial properties of grape skin extract will be evaluated on the Bioscreen using five strain cocktails of *Escherichia coli* O157:H7 and *Listeria*. Futhermore, the phenolic profiles and resveratrol concentrations for each skin extract and wine will be determined via the Infrastructure analytical HPLC. We expect to demonstrate superior health benefits and antimicrobial properties for Iowa grapes. Finally, Dr. Kalidas Shetty, Professor at University of Massachusetts, was an IFSS visiting professor this summer. His students worked with Dr. Colonna to evaluate the antimicrobial properties of his enhanced plant extracts using the Bioscreen, and the above food pathogen cocktails.

TASK 1 (Natural Antimicrobials) INFRASTRUCTURE FUNDS

Publications/presentations based on use of infrastructure:
Lantz, A., Brehm-Stecher, B.F., and D.W. Armstrong. Combined Capillary Electrophoresis and DNA-FISH for Rapid Molecular Identification of *Salmonella* Typhimurium in Mixed Culture. Invited manuscript for special issue of Electrophoresis (under review).

B.F. Brehm-Stecher. 2007. "New Technologies for Imaging Individual Microbial Cells". *In Imaging Cellular & Molecular Biological Function*, F. Frischknecht and S. Shorte, (eds.) Springer-Verlag, Berlin.

B.F. Brehm-Stecher "Methods for Whole Cell Detection of Microorganisms" *in Structure, Interaction and Reactivity at Microbial Surfaces*, T. Camesano and C. Mello (eds.), American Chemical Society, Washington, D.C. (*in press*).

Awards received related to infrastructure purchases:
None to report space is still under renovation

Invention disclosures utilizing infrastructure purchases:
None to report

External funding applied for utilizing infrastructure purchases (indicate received/denied/pending):

Funded
Ahn, D. U., E. J. Lee, and A. L. Pometto III. 2007-08. Production of Ovotransferrin from Egg White for Antimicrobial Applications. Midwest Poultry Research Program. $44,421

Brehm-Stecher. 2007-2008. Antimicrobial Activities of Essential Oils Part II: Formulation Testing, Blend Optimization, Expanded Pathogen Testing, Activity Enhancement and Alternative Delivery Strategies. Industry/IPRT. $36,893.

Brehm-Stecher. 2007-2008. Testing the Antimicrobial Effects of QSI-Nano Metal Nanoparticles: Basic Research and Applications. Industry. $50,944.

Brehm-Stecher. 2007-2008. Simultaneous Concentration and Visual Identification of *Salmonella* and *Listeria* in Mexican-Style Soft Cheeses. Midwest Dairy Association. $31,068.

Brehm-Stecher. 2007-2010. Biomimetic Polymer-Based Antimicrobial Systems: Development and Applications. Industry. $117,300.

Mendonca, A, and A. L. Pometto III. 2007. Antimicrobial Efficacy of a Novel Antimicrobial Skin Cleanser against Foodborne Enteric Pathogens on a Model Skin Surface. IPRT ($12,057) and Northern Filtration Media ($12,065)

Pending
Brehm-Stecher. 2007-2008. Midwest Regional Center of Excellence for Biodefense and Emerging Infectious Diseases Research. Biomimetic Antimicrobial Systems for Biothreat and Emerging Pathogen Mitigation. $97,289.

Brehm-Stecher. 2008-2011. USDA-NRI. Rapid Separation, Concentration & Visual Molecular Identification of Foodborne Pathogens on Fresh Produce. $328,343.

Narasimhan, B., A. L. Pometto III, S. Mallapragada, and M. Misra. 2008-2013. NSF Engineering Research Center for Food Safety and Security. NSF $18.5 Million.

Munkvold, G., A.L. Pometto III, Kim, T., and Shetty, K. 2008-2011. Corn biomass quality for biofuel production; impacts of fungal pathogens and approaches for quality enhancement. Department of Energy. RD-RBP-BIOMASS-2007. $1,101,301.

Equipment Purchased/Rennovations Made:

Progress Report (300 word maximum):
The Biosafety Level II research laboratory construction began September 2007. Most of the electrical and plumbing is close to completion. We reported last time that all the requested equipment has been purchased. The solvent hood and bioguard hoods installations are still in progress. Research lab benches will be fitted with working surfaces. If sufficient funds remain upon completion of the lab renovation, a customized anaerobic hood will be purchased and installed; the wiring and space will be ready for the equipment. IPRT/Industry grants continue to use the discovery initiative equipment scattered throughout the third floor of the Food Sciences Building
(see funded grants).

TASK 2 (Livestock Traceability) PROJECT FUNDS

Progress Report (300 word maximum):
- Began to address key barriers to electronic certification, such as reluctance of some auction markets to learn a new system by developing an off-line software program that is easier for sale barns to use.
- A Team of economists, transportation/logistics experts, and business specialists have begun a SWOT (strengths weakness, opportunities, threats) analysis of the business entities involved in this project to provide input to the business plan.
- Methods to incorporate the ILTP into the Iowa Department of Agriculture and the U.S. National Animal Identification Systems (NAIS) plans are still being discussed with IA Department of Agriculture. Additionally, GVL is working with USDA to develop their system consistent with the national program.
- Online version directed at the veterinary practice to comply with requirements of 'Green' and 'Gold' Preconditioning requirements is in final test and will be moved to production servers by early January 2008.
- Future funding for next phase is open – sources have not been solidified.

BATTELLE FUNDING: PROGRESS REPORT

Update Period: July 01, 2006 – December 31, 2006
Title:
Platform: Information Solutions
Platform Chair): Jim Oliver
Platform Expenditures: $ 663,545.83
Platform Funding: $1,718,000
Project Allocated: $650,000
Project Obligated: $ -
Inf. Allocated: **$**1,068,800
Inf. Obligated: $ -

PROJECT FUNDS
External funding applied for (indicate received/denied/pending):
"Multi-Touch Technology: Applications to Homeland Security and ISU Research," Grow Iowa Values Fund, $100,000, Jan 1, 2008, December 31, 2008. Partners: Priority5 (Allen Bierbaum), ISU (Stephen Gilbert) awarded

"Center for Information Protection: NSF IU/CRC Industry Memberships," Doug Jacobson, PI, $150,000. awarded

"Bio-inspired Fault-tolerant, Adaptive, Decentralized, and Stable Decision-making and Control for Dynamic and Concurrent Coalitions of Vehicle-Human Teams," James Oliver, PI, with ISU Co-PI's Soon-Jo Chung, Arun Somani, Stephen Gilbert, and MIT Co-PIs Jean-Jacques Slotine and David W. Miller. $6,891,646, Office of Naval Research, pending.

"An Interdisciplinary Methodology to Measure the Social and Emotional Aspects of Communication in Health Care," Debra Satterfield, PI, with Co-PI's Sung Kang and Nora Ladajahasen, $108,498, National Institutes of Health, pending.

"EFRI: Development, Validation, and Use of Sense of "Self" in Robots," Alex Stoytchev, PI, with Co-PI's Nicola Elia, Akhilesh Tyagi, Umesh Vaidya, James Bloedel, and Srikanta Tirthapura, $1,948,294, National Science Foundation, pending.

"A Distributed Peer to Peer Investigation Tool Kit," Doug Jacobson, PI, $558,110, National Institute of Justice, pending.

Progress Report:

On November 1st the CyberInnovation Institute hosted the Iowa Department of Economic Development's Information Technology Council. In addition to normal council business, we were able to brief the Council on CII's progress and Doug Jacobson presented his plan for the "IT Adventures" program to be held spring 2008 in Hilton Coliseum.

On November 13th the CyberInnovation Institute (CII) held its Industrial Advisory Board meeting. This meeting, attended by representatives from Wells Fargo, Deere, Rockwell Collins, Team Technologies, ATG, and Priority5, focused on refining the CII's membership offerings.

INFRASTRUCTURE FUNDS

Publications/presentations based on project:

On August 9th, the The CyberInnovation Institute (CII) hosted a corporate retreat for Wells Fargo Home Mortgage. Attended by more than 50, the morning session was devoted to CII's leadership describing near-future term technology developments that could impact the finance industry. Several promising relationships were developed as a result.

CII Director James Oliver was invited to present informational seminars describing the CII and its benefits to the Departments of Aerospace Engineering, and the Department of Electrical and Computer Engineering at ISU.

Through fall 2007, CII representatives Oliver, Hanovar, Jacobson, and Kothari visited companies including Principal Financial, Wells Fargo, Pella, Deere and Rockwell to describe CII capabilities and benefits of membership.

Progress Report:

Continued infrastructure enhancement of CII space at 2321 North Loop Drive in Ames, including additional (used) furniture, signage, telecommunications, etc.

Secured first startup companies using CII facilities, including Clearsighted, Inc., Visual Medical Solutions, and Concure Ltd. Also presented facilities to EndoMetric and Phasient Technolgies, and hope to secure one of them Q1 2008.

The Information Assurance Center, a founding member of the CII, moved all of its accounts to CII administration encompassing ten ongoing projects totaling $3.5M.

Continued enhancement of CII website.

UPDATE: INFRASTRUCTURE FUNDS PROVIDED TO COLLEGES

College of Liberal Arts and Sciences
Equipment Purchased/Rennoations Made: Twelve Dual Opteron Compute Nodes

Publications:

"Direct Dynamics Trajectory Study of F^- + CH_3OOH Reactive Collisions. An Important Non-IRC Reaction Path", J.G. López, G. Vayner, U. Lourderaj, S.V. Addepalli, S. Kato, W.A. deJong, T.L. Windus, and W.L. Hase, *J. Am. Chem. Soc*, **2007***,* 129, 9976 -9985

"Tackling Component Interoperability in Quantum Chemistry Software", F.Peng, M.S. Wu, M. Sosonkina, T.L. Windus, J. Bentz, M.S. Gordon, J. Kenny, C. Janssen, *Proc. of HPC-GECO/CompFrame 2007*, **2007**, 101-110

Presentations:

"Monte Carlo simulation of cluster nucleation using quantum mechanical potentials", L.D. Crosby, S.M. Kathmann, and T.L. Windus, 234th ACS National Meeting, Boston, MA, August 19-23, 2007.

External funding applied for utilizing infrastructure purchases (indicate received/denied/pending):
Received:

- Co-PI on "Simulation of Electronic Non-Adiabatic Dynamics for Reactions with Organic Macromolecules Liquids and Surfaces" funded by NSF-OISE ($110K per year to Windus)
- Co-PI on "Enabling Petascale Applications in the Chemical Sciences" funded by NSF-OCI (approx. $60K per year to Windus)

Pending:

- Co-PI on "Mid-Range Instrumentation: Computer Hardware for Computational Science and Engineering", DOE-BES ($939K)
- Co-PI on "Nanostructured Organic-Inorganic Hybrid Long-Range Charge Separation System for Photocatalysis and Photovoltaic Applications", DOE-BES ($3M)
- Co-PI on "Ames Laboratory Chemical Physics Program", DOE-BES ($3M)

Progress Report (300 word maximum):
During this year, we have had several significant research accomplishments associated with our overall work in combining quantum mechanics with methods traditionally used with classical molecular mechanics. One of these methods is the use of semi-classical trajectories for reactions such as F^- + CH_3OOH collisions. This research, in addition to the chemical insights gained through using quantum mechanics, also represents an example of our collaborative research with leaders in the field. In another major research effort, we have been using dynamic nucleation theory Monte Carlo to examine small water clusters using ab initio methods – their reaction rates, energy distributions and properties. In our quest to reduce the number of quantum mechanical evaluations, we have developed a method to scale configurational probability distributions obtained at high temperatures to lower temperatures without any additional evaluations. These results will be submitted for publication early in the next year.

In addition, we have made significant inroads into the computational science of component development and data definitions. On the component front, we have been tackling the complex issue of developing components for interoperability of integral codes between three computational chemistry codes, NWChem, GAMESS and MPQC. While the final work is still in progress, the interfaces have been defined and a significant portion of the interfaces have been implemented. For data definitions, we have made an extensive description of the Gaussian basis sets and the portal that accesses the basis sets (the Basis Set Exchange).

This is a world-wide resource to the quantum chemistry community that is highly used and the work has already been well cited.

College of Liberal Arts and Sciences
Equipment Purchased/Renovations Made: Photonmax 512B System

Publications/presentations based on use of infrastructure:

"General Fluorescence Resonance Energy Transfer Assay for the Study of Cell Membrane Protein Clustering" University of St. Thomas, St. Paul, MN, November 30, 2007.

"General Fluorescence Resonance Energy Transfer Assay for the Study of Cell Membrane Protein Clustering" Emily A. Smith, Deepak Dibya, Suzanne Sander, Nuha Salem. Midwestern Universities Analytical Chemistry Conference, Urbana, IL, November 1-3, 2007.

"General Fluorescence Resonance Energy Transfer Assay for the Study of Cell Membrane Protein Clustering" 34th Federation of Analytical Chemistry and Spectroscopy Societies, Memphis, TN, October 2007.

Awards received related to infrastructure purchases:
Society of Analytical Chemists of Pittsburgh Starter Award (2007)

Invention disclosures utilizing infrastructure purchases:

External funding applied for utilizing infrastructure purchases (indicate received/denied/pending):

<u>Funded</u>	
Plant Sciences Institute Arrays for Measuring Cell 7/1/2007-6/30/09	"High-Throughput Raman Imaging Studies of Plant Tissue Wall Content and Degradation" $60,000 (total direct costs)
Society of Analytical Chemists of Pittsburgh 5/1/07 4/30/08	"Development of Raman and Fluorescence Imaging Methods for the Study of Cellular Processes and Biological Materials in Diverse Applications" "Single-Molecule Immunoassay and DNA $20,000 (total direct costs)
Roy J. Carver Charitable Trust 11/1/2007-10/30/1009	"Novel Fluorescence Resonance Energy Transfer Studies of Cell Membrane Dynamics: Unraveling Integrin Cluster Mediated Signaling Pathways" $239,000 (total direct costs)
<u>Pending</u>	
U.S. Department of Energy 2007-2010 (current project)	"Chemical Analysis of Nanodomains" $750,000 (per year) (Co-PIs: V. Lin, J. Petrich, N. Pohl, R. S. Houk, E. S. Yeung, M. Pruski)
Arnold and Mabel Beckman Foundation	"A Novel Method for Studying Cell Membrane 2007-2010 Proteins: Combining Surface Chemistry, Model

	Lipid Bilayers and Raman Microscopy" $300,000 (total direct costs)
Searle Scholars Program	"Elucidating Cell Membrane Protein Dynamics 2008-2011 with Fluorescence and Raman Imaging" $240,000 (total direct costs)
U.S. Department of Agriculture, U.S. Department of Energy (co-PI: Thomas Lubberstedt) 2008-2011	"Diagnostic DNA Markers for High Ethanol and Biomass Yield in Maize and Other Energy Grasses" $250,000 (total direct costs per year)
Camille Dreyfus Teacher Scholar Award 2013	"Development of Raman and Fluorescence Imaging 2008- Methods for the Study of Cellular Processes, Catalysis, and Lignocellulosic Materials" $75,000 (total direct costs)
<u>Denied</u>	
Petroleum Research Fund Type G Grant	"Raman Spectroscopy Studies of Bifunctionalized Mesoporous Silica Nanosphere Catalytic Systems" $50,000
National Institutes of Health 2007 Director's New Innovator Award Program (DP2)	"Unraveling and Inhibiting Advanced Glycation End Products (AGE) *in vivo*" $1,500,000
Midwest Forensics Resource Center Competitive Research Program	"Raman Imaging for the Detection of Latent Fingerprints on Traditionally Hard to Visualize Surfaces and the Measurement of Endogenous Compounds in Fingerprint Residue" $57,106

Progress Report (300 word maximum):

We are developing imaging instrumentation and methods, and subsequently applying these techniques in a diverse set of applications, including the study of cellular processes that are initiated at the cell membrane, lignocellulosic biomass, and catalytic systems. Two goals of this work are elucidating how properties of the cell membrane influence cell signaling events across the membrane, and developing methods to study reactions utilizing chemical and biological catalysts. The analysis techniques that we use include fluorescence and Raman scattering. Raman imaging is a particularly attractive imaging mode since it provides spatially-correlated chemical content data without the need to destroy or modify the sample under study. Fluorescence imaging can provide kinetic and thermodynamic information concerning biological interactions, and can also provide spatial data below the diffraction limit.

The lab has built two imaging instruments, one capable of Raman microspectroscopy and Raman imaging measurements and one suitable for several fluorescence techniques. The Raman instrument uses fiber bundle image compression to obtain complete spectra from several areas of the sample surface simultaneously. The second instrument is a fluorescence microscope that is set-up for fluorescence resonance energy transfer, single molecule fluorescence, and fluorescence immunohistochemistry measurements, and is used with either total internal reflection or wide-field excitation. The Photonmax 512B can be used in either instrument set-up. These instruments are used in several diverse projects that have been initiated in the

laboratory, including the study of: cell membrane receptor signaling events, receptor clustering, receptor conformational changes, and chemical transformations catalyzed by enzymes.

College of Engineering:

Andrew Hillier. $120,000 is currently encumbered on this fund. It is match support for the Keck Grant. Dr. Andy Hillier has placed a purchase order to AJA International, Inc. for an ATC Series Combinatorial/Conventional Sputtering System. The W. M. Keck Foundation established the W. M. Keck Laboratory for High Throughput Atom-Scale Analysis to drive the frontiers of combinatorial science and atom-scale materials research. This lab provides sample preparation and characterization facilities in support of the research activities performed by members of the Institute for Combinatorial Discovery as well as researchers throughout Iowa State University and the public. The laboratory provides unique materials preparation and characterization facilities that support a range of research and educational projects.

Dr. James Alleman purchased a Dual Core Intel Xeon 5050 Server for the Civil Construction and Environmental Engineering Department. The new server provides the capability of larger memory storage and real-time computer access for the entire research group.

Dr. Song-Charng Kong purchased time on the Lighting Cluster (high performance computing). This computer time will allow him to perform combustion process modeling which is vital to his effort to find better ways to burn bio-renewable fuels in engines cleanly, efficiently and effectively. If we want to increase use of bio-renewable fuels to lessen our dependence on petroleum based engine fuels, this kind of research must occur.

Dr. Krishna Rajan spent $81,000 of the Battelle funds to purchase a Nano Test Platform and NTX Controller with High Temperature option and High temperature extension. The equipment was purchased from Micro Materials Limited. The total cost of the equipment was $188,905. The benefits of the equipment are various including the ability to collaborate with several other faculty members at ISU and support industrial sponsored projects in the areas of mechanics of materials and high temperature behavior of materials.

Dr. Richard LeSar spent $80,000 of the Battelle funds to purchase a portion of the large computer system. This equipment is essential for Dr. LeSar's work on computational materials science, providing the ability to model a wide range of materials behavior. Results of this work enable the ability to collaborate with other ISU researchers and to develop strong and active ties with industry and governmental research efforts.

BATTELLE FUNDING: PROGRESS REPORT

Update Period: July 01, 2006 – December 31, 2006
Title:
Platform: Advanced Manufacturing
Platform Chair): Ron Cox
Platform Expenditures: $ -
Platform Funding: $100,000
Project Allocated: $100,000
Project Obligated: $ -
Inf. Allocated: **$** -
Inf. Obligated: $ -

Progress Report:
We continue to partner with John Deere to provide lean training to some of their suppliers. This is funded by Deere and CIRAS as part of our NIST/MEP grant. We have been funded by EDA to investigate biobased product supply chains. This work will begin this summer. We are working with the Economics Department at ISU to review the Battelle report and the Monitor report. We are looking at a simplified approach to analyzing clusters/supply chains to rank Iowa clusters and to determine what are the top 2 or 3 we should be focusing on. We are ranking these based on recent growth rate, importance to the Iowa economy, wages, and the extent of the supply chain. We hope to have this completed by the 10th or 11th. (We anticipate that ag equipment will end up in this short list.). We are nearing completion of the ag equipment supply chain proposal and plan to proceed with this effort, unless the analysis (item 3) steers us somewhere else. I will add some verbiage on the lean institute. I do not want to complete a detailed analysis of an institute. I would rather spend funds to implement lean/six sigma/TOC projects with suppliers and then survey OEMs and suppliers on what works and does not with the approach. Based on what we learn, we will offer our opinion on how this might be structured. Does that work? We have created a Supply Chain Advisory Committee from members of the CIRAS Advisory Council to provide advice to us as we proceed. We still have almost all of the funds available from central ISU for the supply chain work that was awarded a year or two ago; We have not spent this yet because I want to make certain we are all on the same page with the IDED Advanced Manufacturing Group

BATTELLE FUNDING: PROGRESS REPORT

Update Period: July 01, 2006 – December 31, 2006
Purpose: Endowed Chairs
Purpose Funding: $2,000,000
Purpose Expenditures: $ -
Purpose Obligations: **$** 500,000

Progress Report:
Iowa State University received $2 million in funding to be used for matching dollars for endowed chairs. ISU determined that these dollars would be used to leverage private gifts with a $2 private to $1 public match to create a total of $6 million for endowed faculty positions. One million was allocated to the general university and the remainder was allocated to the Bioeconomy Initiative. Deans and others submit their proposals for consideration to the Provost and President for approval before presenting to donors. The ISU Foundation has offered this incentive to donors on a basis that the first to commit will receive the matching dollars.

April 2007, the ISU Foundation received $1M in private funds from Dr. Eugene and Linda Lloyd to create the W. Eugene Lloyd Chair in Toxicology in the College of Veterinary Medicine. This endowment was matched with $500,000 from Battelle funds. A national search was done for this position and an offer is pending, thus no expenditures have been made from this endowment.

New proposals are pending for the remaining $1.5 million in matching funds for endowed faculty chairs but no commitments have been secured that meet the strict criteria for these funds.

University of Northern Iowa
Battelle Projects
As of 12/31/2007

The University of Northern Iowa was awarded $3.18 million to develop research capacity related to key economic development clusters identified in the Battelle Reports. UNI invested these funds in key research programs that have the greatest potential to contribute to economic development in the state of Iowa. By supporting a portfolio of near, mid and long-term projects, UNI seeks to expand a pipeline of research that will create opportunities for technology transfer in the coming years.

Since 2006, UNI has accelerated the research agendas of 13 projects in biosciences, information solutions and advanced manufacturing. The Battelle funding will not only make it possible for new products developed at UNI to reach the market, but it has also provided enhanced research opportunities for graduate and undergraduate students, and will contribute to an advanced workforce.

The Battelle Report, *Iowa's Bioscience Pathway for Development*, outlined the following three actions for building research capacity at the Regents Universities in Iowa.

1. Undertake key recruitment, capacity building, and required investments to ensure rapid progress in the Battelle platforms. $923,049 expended through 12/31/07

UNI has allocated $1 million in Battelle funds to provide salary support for faculty members engaged in research projects with the potential for commercialization. Since 2006, faculty members received support to work on 12 projects. Seven of these projects were in the Biosciences. These funds supported 6 new faculty members whose primary research focused on creating new products related to the bioeconomy and advanced manufacturing. These funds were used to accelerate the establishment of their research programs of these key contributors to technology transfer. Funds were used to support new faculty on some of the research grants identified in Section 3, as well as for the following research:

- A "phase 2" orthotic insert for lower leg amputees.
- A patentable neural network-based and other data-mining algorithms for mining Enterprise Resource Planning (ERP) databases.
- The integration of UNI grapevine identification data with the international plant germplasm database.

2. Invest in strategic technology development infrastructure to strengthen and accelerate the scientific and commercialization work of the core platforms.
$925,167 expended through 12/31/07

UNI received $1.36 million to renovate and equip research laboratories used in the Battelle projects. In April of 2007, $133,797.00 purchased fixed equipment from Wynn O. Jones for the appurtenant rooms in Physics, McCollum Science Hall and the Greenhouse. That equipment has been received, installed and is paid out at 100%

Appurtenant infrastructure components (bricks and mortar) include but are not limited to: New Research Greenhouse, New Greenhouse Research Lab and cooler – Biology Research Rooms 107, 109 & 109A – Chemistry Research Rooms 111 & 260 – Physics Research Rooms 001, 202 & 302

Overall construction progress is over 95% complete for the Physics contract and over 95% for the McCollum/Greenhouse contract. The work in many areas is 100% complete. All of the areas are substantially complete. The work has been reviewed for correctness and acceptability. Lists have been generated detailing corrective measures necessary to comply with the contract documents. The contract requires that the University hold 5% of the total amount until final acceptance. Final Acceptance can occur when all of the contractual obligations have been met by the contractor. We anticipate paying out the remaining funds in early 2008.

3. Institute a grant program to support research in the core platforms.
$439,451 expended through 12/31/07

UNI held an internal competition to select applied research projects with the greatest potential technology transfer and commercialization. With input from the Technology and Commercialization Resources Organization, 8 projects were funded. Eleven UNI undergraduate and 9 graduate students have participated in these research projects thus far.

Progress of Battelle Projects

So far these projects have leveraged an additional $427,000 from industry and government sources. The following industry partners are collaborators on Battelle research projects:

Department of Energy
Golden Grain Energy
Renewable Energy Group
Environmental Lubricants Manufacturing
Montana Polysaccharides
American Metalcasting Services
Recon Robotics
Rockwell Collins
Doerfer Corporation
DisTEK
Iowa Energy Center
Team Technologies
TeraGrid
FastServers Inc.
S.S. Steiner, Inc.
Bio:Neos
Pharmacon
TDS Automation

Within 30 months, some of the Battelle projects are expected to result in new products or services, including: new biolubricants, a biobased foundry binder, a software application for protein structure prediction, and a commercial computing grid. The following Iowa companies have been identified as likely licensees or consumers of these products:

Environmental Lubricants Manufacturing Inc.
Bender Foundry Services
Bio:Neos
John Deere
Pharmacon

The following projects are currently underway:

Bioeconomy

Ethanol & Biodiesel Byproducts as Base Oils for Biobased Industrial Lubricants. The intent of this research is to determine whether corn oil and glycerin, byproducts of ethanol and biodiesel production,

respectively, have potential for use in the development of biolubricants. NABL secured 1:1 matching funds from the US Department of Energy to leverage the State's Battelle funding for this research. Tribological and performance testing were conducted to evaluate each of the samples collected within each category of byproduct, including byproduct corn oil, glycerin, and methyl esters. These byproduct samples were obtained from Renewable Energy Group (REG) of Ralston, Iowa, and Golden Grains Energy, of Mason City, Iowa.

After identifying the relative benefits of each byproduct tested, NABL scientists were able to compare the byproduct strengths with qualities needed for many common lubricant products. After looking at several possibilities, NABL settled on the development of a product to be used in the drilling of petroleum oil wells, common throughout the southern United States, and elsewhere.

Several companies involved in the oil well drilling industry have been contacted, and one has agreed to partner with NABL to develop a product competitive with the petroleum oil-based formulation currently in use by the industry. After a visit by three NABL staff members to an actual oil well drilling site in Texas, and subsequent discussions with the company, a non-disclosure agreement has been signed. The company is expected to send representatives to visit the NABL Center soon, with additional development work to follow, and eventual field tests in Texas, if the product successfully passes bench scale laboratory testing at NABL.

Development and Commercialization of a foundry Binder System Based on Polysaccharide bio-feed stock. The overarching goal of the UNI Metal Casting Center's research in foundry binder systems is to find bio-based substitutes for the current petroleum based binder systems that hold sand in the shape of a mold in which to cast molten metal. The specific binder system is the phenolic urethane system, which currently holds about 80% of the foundry binder market. This system is composed of three parts:

- Part I: the phenol-formaldehyde resin
- Part II: the isocyanate resin
- Part III: the tertiary amine catalyst, which could be in either gaseous or liquid form

Battelle research completed thus far indicates the best prospect for commercialization is a Part I replacement consisting of corn syrup with a solvent package involving an alcohol (such as methanol, ethanol, or isopropanol). This new system utilizes Iowa grown corn syrup and has shown great promise in both replacing petrochemical materials as well as reducing hazardous air emissions of the ferrous and non ferrous casting process. This material has exhibited improved physical properties to conventional polymers based on petrochemical feed stocks and has shown to be superior in environmental characteristics. The material is also very cost competitive with conventional materials. In December of 2007 the center applied for a provisional patent to protect the intellectual property.

Several companies have expressed interest in negotiating with the university in an effort to license the technology for commercial use. The center is requiring that interested companies sign a non-disclosure agreement in order to add an additional layer of security for the technology. The market for the technology is estimated at 1-1/2 billion dollars on a worldwide basis. Future efforts will include the submission of the formal patent application and the negotiation of terms for the licensing of the technology.

Biodefense and Biosecurity

Robotics-Deployed Detection of Biological Agents. Following reconsideration of the market potential, intellectual property value, prototype design and proof-of-concept constraints and following consultations with local engineers, Michael Walter altered his research focus to a more productive and profitable development of a sensor, rather than on narrow robotics deployment of the original proposal. More

specifically, Walter is developing a prototype anthrax detection sensor based upon phage affinity reagent (PAR-), QCM based sensing capabilities. The prototype will be used to achieve proof of concept for the sensor with live anthrax agent (at approved BSL3 facilities).

Phase I of this project aims to produce a design and bid for building a prototype that can be bench-tested with both safe and lethal anthrax spore strains, which will complete our proof of concept level studies. In collaboration with partners from Doerfer Corporation and TDS Automation (Waverly, Iowa), impressive progress has been made on the design of the initial 'book sized' small prototype of a complete bio-agent detector. We are now ready to move the Phase I stage into contract-based work. We have completed discussions regarding design of the initial prototype, including design constraints, size, orientation, flow tolerances, redundancy testing, sample processing etc.

This fluid-handling 'manifold' will collect air samples, suspend particulates from samples in buffer and route the buffer-suspended particles though bubble removal devices and on to 'test chambers' where the samples will be tested for the presence of airborne spores or bacteria of bio-agents. The manifold consists of a plastic block containing various buffer and waste reservoirs, check valves, chambers and pumps, designed to handle small amounts of sample fluids.

UNI will contract with TDS Automation in the next month to manufacture the small prototype. Phase II of the project includes miniaturization of the detector prototype (Prototype II), which will be used in further testing with lethal Ames strains of anthrax at an appropriate BSL3 facility.

Post Genomic Medicine

Commercialization of protein structure prediction technology. Alexsandar Poleksic and Mark Fienup proposed to develop novel and improved methods for computational protein structure determination from the sequence of amino acids, and commercialize a software package based on their innovations.

To carry out the work proposed, Fienup and Poleksic configured and installed the necessary hardware and software. Following computer lab completion, they built a computer cluster for benchmarking and software development, with alll seventeen computing nodes now completed and tested. A database of protein models has been created and loaded with approximately 20,000 representative protein structures to serve as templates in the protein modeling process. This past semester, they created a relational database of the experimental protein 3-dimensional structures consisting of X-ray and NMR atomic coordinates of all proteins of known structure. This database is used as the "template library" for the structure prediction algorithm. Next steps include completion of an accurate protein three-dimensional structure determination algorithm and development of a Web interface for the algorithm.

Advanced Food and Feed

Identifying drought tolerance genes in the reproductive structures of barley. Tilahun Abebe and colleagues plan to discover genes for drought tolerance in barley flowers that can be used to develop new Iowa crops resistant to drought in the sensitive reproductive stage. The project has two main objectives 1) determine gene expression at the transcription (mRNA) level in drought-stressed tissues using the Affymetrix Barley1 GeneChip, and 2) analyze gene expression in drought-stressed tissues at the proteome (protein) level using two-dimensional protein gel electrophoresis (2-D protein gel).

A postdoctoral research associate was hired to assist with this project. Dr. Abebe and his research team have completed the growth of barley plants in a controlled environment chamber, exposed them to drought, collected tissues (husk, awn and seed) and extracted ribonucleic acid (RNA) from drought-stressed and non-stressed (control) tissues. Preliminary analysis of the hybridization data revealed that

more genes were induced by drought in the awn and husk (consists of lemma and palea), compared with the seed.

Gene expression at the protein level was studied using 2D gels and peptide mass-fingerprinting. Total protein was extracted from stressed and control awn, lemma, palea and seed. Equal amount of protein (1.5 mg) from each tissue was separated using 2D gel electrophoresis followed by coomassie blue staining. Over 600 protein spots were identified from each tissue regardless of stress . Awn, lemma and palea had more proteins up-regulated during drought than the seed. Awn, lemma and palea have many proteins that are similar.

Representative proteins that were up-regulated in stressed tissues were cut from the gel and digested with trypsin to determine identity of proteins by peptide mass-fingerprinting at Iowa State University Proteomics Facility.

Faculty/Student Collaboration on Commercializable Research. Two UNI faculty proposed to work with students to discover plant genes that would be used to develop plant-made pharmaceuticals and fungus resistant crops.

Fungus resistant crops

Dr. Jurgenson and his research team have isolated F.verticilliodes resistant variants of the native grass Tall Dropseed (Sporobolus compositus (Poir.) Merr.). In these experiments seedlings of this grass have been challenged with massive numbers of infectious spores of the plant pathogenic fungus. About 1-2% survive, apparently unscathed. Our researchers have been able to grow these plants and get them to flower. Since this project has been going only for a year, there has not yet been a large amount of seed from these resistant plants. Researchers have finally been able to get seeds produced by some of the resistant plants (12 resistant plants were isolated). Seeds from these plants were collected and stored in the freezer for 6 weeks to induce germination. The seeds were then sterilized and plated on germination media to determine the viability of the seeds. Some of the seedlings were exposed to fungi and survived the assault and so appear to also be resistant to fungal infection. However our numbers are too small at this time to be statistically significant.

The next step in the characterization of this Resistance trait is to locate the gene. The most reliable way to do this is through genetic mapping. This can only be done with a set of recombinant progeny (called a mapping population) from a genetic cross between our resistant strain and a susceptible strain. Alternatively, it may be possible to use tissue culture methods to develop a mapping population from our resistant strain through the culture of pollen grains, which can be induced to grow into mature inbred plants. This effort is ongoing at this time.

Ultimately, our research team wants to know if this gene will protect corn from infection by Fusarium verticilliodes. To learn the answer to this question, the gene will be inserted into the genome of corn so that it is expressed. Protection will be observed by challenging these modified corn seedlings with infectious fungi.

Plant-made pharmaceuticals

The proposed project aimed at genetically engineering the hop plant (Humulus lupulus L.) for increased production of pharmaceutically valuable compounds. Battelle funds were used to initiate and optimize hop tissue culture and in vitro propagation.

Hop calli have been established during Summer and Fall 2007 from sterilized greenhouse explants. The effect of 6 different hormone combinations on callus growth has been investigated in detail during summer 2007. Approximately half of the calli turned green and seem to be proliferative in tissue culture. These calli were used to initiate shoot cultures in the temporary immersion system. Our data provide a new ground for improving hop transformation via callus transformation (either by using the gene gun or Agrobacterium). Callus transformation has not been reported yet for hops and may result in improvments over existing protocols. Besides establishing callus lines, suspension cell lines could be initiated from callus. Callus and suspension cell lines will both be useful tools for investigating environmental factors affecting production of phytopharmaceuticals in hops. They will also be useful for the eventual establishment of a gene knockout system for hops.

Based on the promising work thus far, a corporate partner has agreed to support the ongoing hop transformation effort in our UNI laboratory. This corporate partner has agreed to fund salary, travel, and supplies for a shared postdoctoral researcher and a visiting Ph.D. student to work on the next stages of hop transformation.

Information Solutions

Commercial Computing Grids. Paul Gray proposed to create a High Performance Computing grid to provide academia and industry with accessible, secure, and scalable computing infrastructure. This statewide resource will provide a computing fabric needed to support new economic development in financial services, engineering and biotechnology in Iowa.

A majority of efforts this quarter focused around re-integration of the Battelle computational resources back onto the UNI campus. Part of the first-year project endeavors involved assembly of computational components in rack space at the TEAM data center in the CF Industrial Parkway. The cost of a one-year service agreement was part of the matching costs of the grant provided by TEAM. Due to significant growth at the TEAM data center in Cedar Falls this year, TEAM was unable to extend the cost-sharing component of data center space into the second year. The move of systems from TEAM back to UNI is not a setback, but rather a necessary aspect of the three-year project development.

The computational components are currently awaiting re-integration into the new UNI data center facility located in ITT 128. Prior to the migration, project development had reached the pricing and accounting stage.

The business model being developed centers around the ability to distribute computational tasks across otherwise-idle computer systems. Software support for this paradigm has been developed and implemented during this first year. At this point in the project, our efforts are focused on being able to implement an accounting mechanism on top of the existing software stack. Once a mechanism for tracking system utilization is integrated, our attention will turn to establishing a valid pricing model. These facets of the project will start up again once the migration of the systems back to UNI is completed.

Faculty/Student Collaboration on Commercializable Research. A faculty team proposed to work with students to develop a novel system for automatically reading utilities meters using wireless mesh networks. Automatic Meter Reading (AMR) is an electronics system that provides remote meter reading of usage rate of electricity, gas, water and other related information. The primary goal of this project was to build an IEEE 802.15.4-compliant wireless mesh network based AMR system that is more cost-efficient and able to implement real-time data collection. This utility data collection system will utilize the

two-way communication between AMR nodes to forward the readings back to a collection center or AMR server and therefore minimize the use of other infrastructures.

The CC2430ZDK IEEE802.15.4/Zigbee development kits and IAR Embedded Workbench have been used to develop the experimental models. The CC2430EM module has been tested and studied. We have designed a routing protocol for a small-scaled mesh network with 10-20 nodes. A four-node communication model has been successfully tested. We expect to demonstrate the prototype of a 6-10 node network in the laboratory during summer semester of 2008.

Advanced Manufacturing

Commercialization of Leading Edge Paint Removal Technologies. The Iowa Waste Reduction Center (IWRC) staff have developed a VirtualBlast system based on their existing VirtualPaint™ virtual reality training tool. The VirtualPaint Blasting patent is currently in draft revision. The application should be completed and filed in early 2008. The expected public release of the abrasive blasting simulator is March 2008 at the Corrosion 2008 Convention in New Orleans, LA

An additional tool to aid in paint removal, a laser-guided depainting attachment (LaserBlast) was patented. Initial talks with Marco (of Davenport, IA) were halted. New lines of communication with other businesses/organizations are being opened to integrate IWRC developments into current product lines

Faculty/Student Collaboration on Commercializable Research. Three faculty teams will work with students to enhance the properties of materials used for novel nanoscale devices and miniaturization of components; to prove the utility of a novel laser interferometer for non-contact measurement of nanoscale surface vibrations; and to compare the performance of bio-based with petroleum-based cutting fluids during machining.

<u>Novel nanoscale devices</u>
Three separate projects related to nanoscience research were initiated during the past year:

- The first area of research is in utilizing quantum dots for improving the efficiency of solar cells. Researchers hope to develop a solar cell prototype far more efficient than the present standard. The two materials were chosen for their ability to create multiple electrical carriers from a single photon of light. We are attempting to investigate PbSe quantum dots for use in solar cells as grown on silicon substrates. Quantum dots are a small collection of molecules with properties that differ significantly from the standard bulk material. In the case of PbSe, it has been shown that PbSe quantum dots can harness a much greater portion of the solar spectrum than usual. This would enable a solar cell made from this material to be much more efficient than current devices. By enabling growth on silicon, this will allow for the development of relatively economical solar cells that retain the high purity needed for optimal conversion of solar energy to electricity. In the past three months, we have been able to create large quantum dots of this material, although we still need to attain a better control over size and spacing between the dots.
- The second project involves the study of transition metal dichalcogenide materials (TMDC's). TMDC's are layered materials that are highly two dimensional in nature, with a separation between the layers of 0.6 nm. It is possible to incorporate different atoms between the layers, making them attractive for hydrogen fuel cell applications and rechargeable batteries. The samples are also bonded very weakly between these layers, so that they exhibit excellent qualities for lubricants. We have created several materials in collaboration with Dr. Strauss of the Chemistry and Biochemistry department for study. Our initial results have shown that the incorporation of small amounts of Manganese ions can weaken the layer bonding and perhaps

optimize the crystals for use as lubricants. We have also begun a collaboration with Dr. Tao Xu of N. Illinois University to investigate the abilities of TiSe2 and modified TiSe2 for hydrogen storage. Future work includes the development of nanotubes made from these materials, creation of different novel systems, testing of macroscopic lubrication properties, and magnetic and electrical property measurement with Dr. Shand of the Physics department.

- The third project involves using nanoscale films to reduce corrosion in metals. These films could be economically viable for use in situations where standard techniques can not be applied. Our initial investigations used gold films of thickness no greater than 100 nm. The films were applied in vacuum with no post deposition heat treatment. We have explored the oxidation process in 316 stainless steel both heated in air and exposed to saltwater (concentration similar to that in seawater) at elevated temperatures. We have found that while the coatings do somewhat inhibit oxidation at elevated temperatures in air, the adhesion of the films to the stainless steel is not yet sufficient. Atomic force and optical microscopy reveals a clumping of the gold atoms on the surface that leaves too much of the steel exposed. We have successfully completed an in depth study of the oxidation process for 316 stainless steel at elevated temperatures in air, however. This will be useful as a standard of comparison for future film studies. We will continue the research by utilizing different films, introducing post vacuum heat treatments, and more easily corroded steels.

Performance of biobased versus petroleum based cutting fluids during machining

Tool life and surface roughness are two important measurements to study the bio-based cutting fluids. A fixture was designed and fabricated in the Production Lab in order to measure workpiece surface roughness without interrupting turning operation setup. With the initial machining parameters such as cutting speed, feed rate, and depth cut defined in the previous stage, 4140 steel and carbide insert (insert code: CNMG432 K313) were applied in numerical trial experimental runs under dry cutting conditions to estimate tool life. Copper coolant tubes and accessories were fabricated and installed in the CNC lathe. Following the manufacturing suggestion and literature review, petroleum based cutting fluid (5% of Castrol Clearedge 6550) has been used to test the CNC lathe coolant system. Next steps include hiring a student research assistant to begin collecting experimental data.

The use of a novel miniature laser interferometer for two commercial applications

Researchers have demonstrated the ability to detect very minute vibrations of solid surfaces by laser interferometry. Specifically, they can detect, with no contact with the surface, the amplitude of vibrations to better than ±5 nanometer. Nanoscale detection of surface vibrations has possible applications in early detection of miniature cracks and other surface defects. Patenting is in process for this technology.

Researchers have also been able to excite and measure the resonance frequencies of a very small volume of fluid. The data yields the surface tension with no contact with the fluid. Our test measurements on pure water and a number of other fluids and mixtures are quite promising. A patent disclosure has been submitted to the UNI Intellectual Property Committee. Patenting is in process.