THE STATE OF WISCONSIN

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JOINT COMMITTEE ON FINANCE

MEMORANDUM

To: Members
Joint Committee on Finance

From: Senator Alberta Darling
Representative Dean Kaufert

Date: November 14, 2003

Re: UW System Industrial and Economic Development Report

Attached is a copy of a biennial report from the University of Wisconsin System, pursuant to s. 36.25(25)(c), Stats., which provides information on projects funded by Industrial and Economic Development Funds.

No formal action is required by the Committee. Please feel free to contact us if you have any questions.

Attachment

AD:DK:dh

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November 12, 2003

To: Senator Alberta Darling, Co-Chair
Representative Dean Kaufert, Co-Chair
Joint Committee on Finance

From: Katharine C. Lyall, President

Re: Industrial and Economic Development Research Report

Section 36.25(25) (c), Wis. Stats., requires the University of Wisconsin System to report biennially to the Joint Committee on Finance regarding projects funded as part of the industrial and economic development research program in the previous fiscal biennium and the relationship of the funded projects to the state's economy. The attached report was approved by the University of Wisconsin System Board of Regents at its November 7, 2003 meeting and is hereby forwarded to the Joint Committee.

If you need any additional information regarding the Industrial and Economic Development Research Report, please contact Assistant Vice President Larry Rubin (262-6717).

Attachment

cc: Cora. B. Marrett, Senior Vice President
Debbie Durcan, Vice President
Freda Harris, Associate Vice President
Larry Rubin, Assistant Vice President
Melissa Kepner, Director of Budget and Planning
Evan Norris, Senior Academic Planner
Bob Hanle, Department of Administration
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Industrial and Economic Development Research Fund
2001-03 Biennial Report

The Industrial and Economic Development Research Fund was established to enhance the relationship between UW System institutional research and Wisconsin industrial practices in an effort to promote the state's economic growth.

This report is divided into three sections. The first describes the Center for Dairy Profitability, an on-going UW-Extension and UW-Madison project that addresses economic challenges to the Wisconsin dairy industry. The second details the Industrial and Economic Development Research Program which was administered by the University-Industry Relations office (UIR) at the UW-Madison and is now administered by the UW-Madison Graduate School. The final section provides an overview of Applied Research Program projects, administered by the UW System Office of Academic Affairs.

Within the latter two programs, grants are competitively awarded. Researchers are encouraged to submit technically innovative proposals which interest a broad economic sector, and will immediately benefit Wisconsin's industrial and economic development. Grant summaries are provided in the appropriate sections.

The Industrial and Economic Development Research Fund has supported projects which have assisted a large number of Wisconsin enterprises. In the long run, many of these projects will improve the competitive position of Wisconsin firms.

A. Center for Dairy Profitability (UW-Extension/UW-Madison)

The University of Wisconsin Center for Dairy Profitability (CDP or Center) is a multi-campus extension unit with faculty and staff at UW-Madison, UW-Extension, UW-Platteville, and UW-River Falls. The Center develops, coordinates, and delivers interdisciplinary educational programs and emphasizes integrated production, financing, and marketing management systems to foster improved dairy profitability. The CDP's overriding goal is to improve the profitability and competitiveness of Wisconsin's dairy industry.

The Center receives a portion of its funding from the State of Wisconsin Industrial and Economic Development Research Fund (IEDRF). In the most recent fiscal year (2002-03), the allocation of IEDRF dollars was $242,589 to fund 3.18 FTEs that were allocated across UW campuses as follows: 2.49 at Madison; .29 at Platteville, and .40 at River Falls. Other IEDRF funds were also given to the Center to cover supply costs and other expenses.

The economic success of Wisconsin's dairy industry, which is estimated to contribute directly and indirectly nearly $20 billion to the Wisconsin economy, hinges largely on the knowledge and management skills of dairy farmers and agribusiness professionals who work with these dairy producers. They are making decisions that will determine whether the state's dairy industry is competitive and prosperous over time. Informed management decisions are key to dairy's long-run economic success; therefore, the CDP's emphasis is on educational programs that enhance the management skills and decision-making abilities of dairy producers and others who assist producers in management decisions.

This report details the programs of the CDP and briefly describes some of the key accomplishments of these educational program efforts. It also contains examples of how the CDP is attempting to facilitate the development of multi-disciplinary educational programs and partner with other institutions that share its goal of enhancing the profitability of the dairy industry both in Wisconsin and other states and nations.

Management Education Programs

The CDP is involved in a variety of management education programs that are intended to make farm managers and agribusiness professionals knowledgeable of the management practices that can be used to improve the performance and profitability of farm businesses. The following is a brief discussion of some of these programs.

AgVentures

The *AgVentures* program, coordinated by Jenny Vanderlin, is a fee-based management education program that is intended to help farm managers improve their prospects for success. Through this program, farm managers can become knowledgeable about management concepts and learn how to apply this knowledge to the problems they face when operating their farm businesses.

AgVentures has been designed to give farm managers ample opportunities to become very familiar with a number of management topics. Managers going through this program can select from modules that address various topics. Modules covering Strategic Planning, Financial Management and Analysis, Human Resource Management, Farm Transfers, Risk Management and soon Grains Marketing have roughly 15-20 hours of curriculum and are available on CD-ROM or through the Center's website: http://cdp.wisc.edu.

In addition to adding a Grains Marketing curriculum, the Financial Management & Analysis module has been revised to incorporate the use of the Bella Acres Case farm which is used both in the Risk Management and Farm Business Transfers modules. A Decision-Making module (Strategic Management) as well as an Environmental Management module are being developed.

Babcock Institute

The Babcock Institute for International Dairy Research and Development at the University of Wisconsin offers programs to foreign nationals, both in the United States and in other countries. Gary Frank has been an instructor in Institute courses for several years and has written several papers that have been translated into several languages.

Risk Management

The risk management work being conducted by the UW-Extension's Risk Management Team is part of a national risk management initiative funded by the USDA. Kevin Bernhardt of the CDP and UW-Platteville/Extension headed up this project with Bob Cropp of the UW-Madison/Extension Center for Cooperatives. A comprehensive risk management manual was produced as a part of this project. The target audience for this program was farm managers, but county extension agents and agricultural professionals have also participated in the training.

Economics of Dairy

Farm Financial Management Project

The CDP is working with the Lake Shore and Fox Valley farm management associations on a farm records project that is intended to increase our knowledge of the economic and financial operations of dairy farm businesses. The records data gathered by the farm management associations are used to compute costs of production of dairy farms and selected financial measures like rates of return on assets, rates of return on equity, debt to asset ratio, etc. These performance measures are widely used by county agents, lenders, policy-makers, and agribusiness professionals who work with producers on economics related problems and are available in hard-copy or accessible from the Center's web page.

For approximately ten years, Gary Frank and Jenny Vanderlin have been analyzing the records of dairy producers and assessing the costs of production and financial performance of a select group of dairy farms in Wisconsin. The Cost of Production and Financial Benchmark analyses, which are used extensively in dairy extension programs intended to help dairy farm managers become better managers and more profitable, are available on the CDP website: http://cdp.wisc.edu. In 2002, the average Rate of Return on Assets (ROROA) was 2.17 percent. This is the lowest ROROA in several years, reflecting the low milk price. The average Rate of Return on Assets was 5.57 percent in 2001 and 4.24 percent in 2000.

Regional/Multi-State Interpretation of Small Farm Financial Data
(USDA IFAFS Grant Agreement #00-52101-9708)

This three-year grant for $257,000 was received in October 2000 largely because of the efforts of Tom Kriegl and the CDP's ownership and development of AgFA@ (see Management Information Systems section of this report). Approximately half of these funds are being shared with the participating land grant universities in Illinois, Indiana, Iowa, Michigan, Minnesota, New York, Ohio, and Pennsylvania plus Ontario, Canada.

This project incorporates the grazing study that has been in progress for seven years at the CDP under the direction of Tom Kriegl. The grazing project was intended to enlighten farm managers, their advisors, and other interested parties on the costs and returns of Wisconsin producers who utilize various grazing practices on their dairy farms. Reports from the grazing project are available on the CDP website.

Dairy Modernization and Technology Adoption

During the last two year period Bruce Jones has made presentations at numerous meetings and programs that have considered the topic of dairy modernization and technology adoption. The key information shared in these presentations was the rate of return that can be earned from investments in dairy cows, milking parlors, and free-stall housing. The intent of these presentations was to show dairy producers that competitive returns can be earned on those key assets of dairy operations. Copies of this presentation were distributed to county agricultural agents throughout the state as a PowerPoint presentation.

Arlin Brannstrom has worked with the Dairy Modernization work group of the UW-Extension Dairy Team

to help them develop two CD ROMs containing educational presentations and publications related to low cost facilities and economics of modernizing dairy operations. A training program for county agents from the 4-State (WI, MN, IL, IA) dairy programming effort was held to demonstrate the use of the CD's and the presentations on them. These presentations are in PowerPoint format and streaming video. The PowerPoint presentations can be used by county agents and dairy professionals to educate themselves and their farmer clients. The streaming video can be used in the same way but they capture experiences "in their own words" of dairy farmers who have modernized their facilities and businesses. County agents who have shown the streaming video to producers considering modernization say the producers like the opportunity to see different facility options without having to spend so much time traveling to see so many sites.

Dairy Herd Management

Over the last two years Bruce Jones has been studying the calving interval strategies and culling practices of dairy herd managers in order to determine how dairy farm profits vary depending on the strategies and practices employed by dairy producers. This work is in collaboration with Paul Fricke and Kent Wiegel of the UW-Madison Department of Dairy Science.

In conducting the calving interval study, a spreadsheet was constructed which computes the annuity equivalent for the net present value of the cash returns and expenditures associated with calving intervals that were expressed in terms of how frequently dairy cows give birth to calves. Results obtained with this model generally suggest that maximum profits are obtained when dairy producers employ a breeding program that has cows calving every 13 months.

The culling practice study is a classic optimization problem where dairy producers must determine the optimal mix of various aged cows in their herds. Linear programming techniques were used in this analysis to determine the percent of the dairy herd that should annually be replaced with heifers in order to maximize profits. This linear programming model also determines the maximum number of periods a dairy producer would be willing to hold cows in the herd. The results obtained with this model suggest that the optimal annual culling rate is around 28 percent for a dairy herd with cows held for 6 to 8 lactations . This optimal culling rate is well below the 35-40 percent rate that is currently observed in most Wisconsin herds. Thus it appears that there is a need for producers to improve their culling practices.

Papers on the calving interval analysis and the culling practice study were prepared and presented at the 2001 Arlington Dairy Days program sponsored by the UW-Madison Department of Dairy Science which was attended by roughly 100 dairy producers and agribusiness professionals.

Replacement Heifer Enterprises

Bruce Jones and Brian Holmes were members of an inter-disciplinary team that developed and presented a case study that considered the problems and challenges confronting a heifer grower in Sheboygan, WI who was contemplating a modernization and expansion program. Holmes' contribution to this effort was to develop and present facility options and system costs that would result in improved animal performance and environmental protection. Jones prepared and presented analyses of the financial consequences of the various modernization options being considered by the grower. He did this work in consultation with the

agricultural engineers and dairy scientists that were a part of this work group.

The case studies developed by Holmes, Jones and others were presented at two national conferences. The first was the annual meeting of the Professional Dairy Heifer Growers Association held in March of 2001 in Seattle, WA. The second was a special session of the annual American Dairy Science Association meeting held in July of 2001 in Indianapolis, IN.

Packerland Dairy Beef Project

At the request of Dean Elton Aberle, Bruce Jones worked with representatives of Packerland, a major meat packer headquartered in Green Bay, on assessing the financial feasibility of cattle feeding operations in Wisconsin. Jones' role in this effort was to estimate the potential returns and costs for 5000 head feed-lot operations that would supply cattle to Packerland.

Jones presented the results of his analysis to a team that Packerland pulled together to work on this project. Packerland representatives have used Jones' work to show producers and investors the potential returns from feeding dairy beef for Packerland.

Brian Holmes worked with a group considering facility needs for the Packerland proposed 5000 head feed lots. Manure handling, environmental protection and animal comfort/protection were issues to be considered. Holmes was influential in convincing the principles in the project to develop a prototype housing system before promoting it to potential beef producers. This prototype system failed to receive approval of the county zoning board of adjustments.

Policy Work

Use-Value Assessments

Bruce Jones serves on the Farm Land Advisory Council and has taken the lead in developing some procedures for computing use-value assessments across the state. This work was in response to some complaints by farmers in the northern region of the state that the income measures used to compute their use-value assessments were above the norm for their region. Jones reviewed these claims, found them to be true, and then developed a procedure for accounting for the lower rents that are typically earned on farmland in the northern and central regions of the state. These new procedures for computing use-values were adopted by the Farm Land Advisory Council for use in 1999.

Management Information Systems

Agriculture Financial Analysis (AgFA@)

In 1999 work was initiated, under the direction of Gary Frank, on a computerized financial analysis system that dairy producers and others can use to summarize and analyze the annual financial performance of farm businesses. This financial summary package allows "farm advisors" or individual farmers to compile their annual financial reports and put their records into a standardized format that is compatible with the records of other farm managers.

AgFA@ is currently being used by the Lake Shore and Fox Valley farm management associations, several Wisconsin Technical College System and county educators. It is an integral part of the Farm Financial Management Project and was designed so that it could assume that task. AgFA@ is also part of the *AgVentures* Financial Management and Analysis curriculum.

The standardized financial records are being used to create benchmark information that can be used to monitor and evaluate the financial performance of Wisconsin farms (all types of farms, not just dairy farms, can be entered into the system). This work is yielding a lot of information about the financial status of Wisconsin farms and giving farm managers and their advisors some economic and financial benchmarks that they can then use to see how their farm business compares to others.

A number of publications using data from AgFA@ are published on the Center's website (http://cdp.wisc.edu). AgFA@ is the cornerstone of data collection of the Multi-State Grazing Project, headed by Tom Kriegl (see above).

Agricultural Accounting and Information Management Systems (AAIMS@)

The Agricultural Accounting and Information Management System (AAIMS@) is a computerized agricultural accounting system maintained by Gary Frank and Jenny Vanderlin. The AAIMS@ software allows users to enter data into program data files through a window format. Numerous updates have been made to the program itself and also to reports, payroll, and crop feeding and inventory sections. Version 9.04 allows conversion into AgFA@. Training workshops are held throughout the year for Extension and the Wisconsin Technical College System across the state. Since its latest release in January of 2002, several hundred copies of the program have been sold to farm managers, primarily those who are updating earlier versions of the program.

Agricultural Budget Calculation Software (ABCS@)

The CDP maintains a computerized system database that is used to estimate the cost of producing various crops under various systems. This budget generator, known as ABCS@, is used in evaluating the economics of various crop-related problems. Both the UW-Extension Grains and Forage teams produce enterprise budgets using ABCS@ that are placed on the Centers web site: (http://cdp.wisc.edu). CDP is currently in the process of updating all budgets available in ABCS.

Decision Making Aids

Dairy Pro-Forma Calculator

The Dairy Pro-Forma Calculator was developed by Gary Frank and is used to estimate the potential costs and returns for any dairy system a producer may be planning to use. County extension agents and financial consultants use the spreadsheet to help dairy farm managers put together the financial plans for modernization and/or expansion. The Dairy Pro-Forma Calculator is available on the CDP web site and complements the financial planning work that is being funded by the Wisconsin Department of Commerce.

Other Decision Making Aids

The CDP maintains a variety of computerized spreadsheets that may be used in making various management decisions. Enterprise budgets are available for dairy, replacement dairy stock, swine, and beef. Other spreadsheets are available for determining the value of silage, corn, and other feeds. Spreadsheets mentioned above and a host of others are frequently developed as producers and others who work with them need assistance in making management decisions. A section on the Center's website is dedicated to these decision-making tools.

Internet Sites

Center For Dairy Profitability Web Site
(http:\\cdp.wisc.edu)

The Center for Dairy Profitability's home page has existed since 1995. During the last year a major overhaul to the site was made to be in accordance with University policy of web accessibility. The new design of the homepage was developed for easy access and retrieval and is maintained by Jenny Vanderlin of the Center.

The Center for Dairy Profitability site has a wealth of information that is of value to dairy producers and professionals who advise dairy producers. The number of people visiting the site, downloading information, obtaining benchmark information, etc. increases substantially each day.

Team Forage – Harvest and Storage Web Site
(www.uwex.edu/ces/crops/uwforage/storage.htm)

Brian Holmes has worked with the Harvest and Storage work group of the UW-Extension Forage Team to develop a well respected web page dedicated to helping dairy farmers and those professionals advising them to make good decisions about forage harvest and storage. Through these efforts, producers improve their understanding of the ways in which forage can be properly stored to minimize the losse. Thousands of dollars are saved annually by the changes recommended in the information provided on the web site. A spreadsheet, jointly developed with Gary Frank, allows producers to evaluate the capital costs and annual costs of various silage storage systems. The spreadsheet is downloadable from the web site. Holmes presented a paper on how people have used and benefited from the web site at the Fifth International Dairy Housing Conference held in Fort Worth, TX in February 2003.

B. Industrial and Economic Development Research (IEDR) Program (UIR)

The office of University-Industry Relations (UIR), a unit within the Graduate School, administered the Industrial and Economic Development Research Program (IEDR) at the University of Wisconsin-Madison. With the dissolution of UIR on June 30, 2003, IEDR program administration has transferred to Graduate School Administration. Graduate School Administration will conduct future IEDR grant competitions with a continued emphasis placed on funding proposals that stimulate and enhance collaborations between Wisconsin industry and the UW-Madison for promoting economic development in Wisconsin.

This report describes projects selected through a competitive review process to further industrial and economic development research and outreach activities in Wisconsin. Review committees convened by UIR included technology transfer professionals and university faculty members. Proposal selection criteria included scientific merit and the potential for technology transfer through collaborations with Wisconsin companies.

During the fiscal year 2001-2002 grant competition, UIR received 54 new proposals requesting $1,663,258 in funding, and 26 projects totaling $625,142 were funded. During the fiscal year 2002-2003 grant competition, UIR received 36 new proposals requesting $1,240,469 in funding, and 26 project totaling $652,144 were funded. A table that identifies the principal investigator, project title, university department, and the amount of the award for each project is provided.

In addition to establishing new, and enhancing existing, collaborations with Wisconsin companies that resulted in direct technology transfer of the research, many other significant outcomes occurred from projects receiving IEDR funding, including submissions of disclosures about the intellectual property resulting from their research projects; application for patents by the Wisconsin Alumni Research Foundation (WARF); awarding of grants by the federal government and companies, either because IEDR funding was leveraged or IEDR "seed" funding enabled researchers to acquire the initial data necessary for their grant applications; receipt of training by Ph.D., masters, undergraduate and post-doctoral students; preparation of publications for peer-reviewed journals; establishment of new faculty collaborations, either with other faculty members in their own departments, or building on the multi-disciplinary strengths of the University, with faculty in other departments, schools, and colleges; development of new educational tools and have plans for creating new courses including research results from these projects.

Descriptions of the projects funded are as follows:

1. Novel Method for Killing Pathogens

The objective of this proposal was to test a novel technique called the "Trojan-horse" approach for killing unwanted bacteria in medical, veterinary, and agricultural environments. The concept of the "Trojan-horse" approach is based on introducing engineered plasmids with killing abilities into targeted, unwanted bacteria using harmless donor bacteria and the naturally occurring process of conjugation. This process requires cell-to-cell contact. The strategy relies on a specific and universal property of conjugative systems whereby plasmid-encoded information is expressed upon transfer to a recipient

cell. This is true even for self-destructive DNA sequences where expression results in cell death. Thus, bacterial conjugation systems are utilized to deliver efficiently a variety of "killer agents" or "conjucins" to targeted, recipient bacterial cells.

Two specific types of conjucins were tested. One type explored a feature of certain plasmids that contain unique mutations which lead to over-replication of plasmid DNA and, in so doing, kill the bacterial host. A second type of conjucin relies on the use of a bacteriocidal polypeptide. Many types of peptides exhibit antimicrobial properties. However, the delivery of peptides to a targeted cell can present a problem, since extracellular stability and efficient uptake into the recipient cell is required. Use of the "Trojan-horse" approach erases both of these difficulties due to efficient peptide delivery and its endogenous expression. The maintenance of killer plasmids is possible in special strains of *E. coli* that were engineered to protect the plasmid donors from self-destruction.

At the outset, it was evident that the "Trojan-horse" approach could have the potential to become a platform technology with many practical applications and would likely be of commercial significance in agriculture, veterinary medicine, food safety, anti-bioterrorism, and pharmaceutics. This understanding led Dr. R. Burgess (oncology professor, McArdle Laboratory, University of Wisconsin-Madison) and Dr. Filutowicz to establish a company, ConjuGon, Inc., in 2001.

2. Pilot Test of Environmental Management System for the Wisconsin Dairy Industry

This project tested new tools to help Wisconsin dairy farmers learn about and better address environmental impact concerns of their farming practices. The tools tested were web-based, on-line, interactive environmental assessments that yielded an integrated action plan with a timeline. Assessments addressed pollution risks, for example, to ground and surface water from nutrient management and manure application, manure storage, barnyard and feedlot management, milking center waste water, and farmstead facilities.

Pilot tests of the assessment tools were completed with 24 farmers. Farm advisors were trained to implement the pilot test. Not surprisingly, the most effective farm advisors were those who had a commitment to the tools. The farmers developed questions of their own about their practices and situation and generated demand for real time on-line supplemental information. The farmers provided feedback to improve the tools and add more user-friendly features. These changes were made in the following six months, and the tools have been made publicly available. In addition, the tools were adapted for distribution on compact disk for use on a laptop computer. The newer version of the tools has been used for a second phase of pilot testing in spring and summer 2003.

The environmental assessment tools tested through this project are part of a set of materials designed to help farmers reduce their potential for environmental liability, comply effectively with environmental laws, and satisfy the environmental concerns of their neighbors and communities. The on-line assessment tools are copyrighted, but they are available in the public domain on a web site. Thus, the tools assist Wisconsin dairy farms to maintain economic viability in the face of growing demands for environmental performance.

3. Commercial Feasibility Studies on Disposal of Spent Sausage Casings--Solid Substrate Cultivation for Production of Feed Quality Proteins

The Wisconsin sausage industries have serious problems disposing of spent sausage casings and waste byproducts, and are forced to pay heavy land-fill fees for disposing of the materials. The main objective of this work was to find alternative method(s) to degrade spent cellulose casings, bioconverting them to useful products such as proteins, enzymes and chemicals. Small scale bioconversion of the casings into useful products--enzymes, lactic acid and ethanol--was successfully demonstrated using cellulolytic fungi, lactobacillus, and yeasts.

Earlier work in this area led to a patent disclosure to WARF and a provisional patent being filed. This grant allowed continued work on this project, proving fungal interactions and bioconversion of spent cellulose casings, and enhancing the patentability of the previously-disclosed invention.

4. *Lactobacillus helveticus* CNRZ32 genome: Closing Gaps and Cloning Genes with Industrial Utility

The overall objective of this study was to develop bacterial cultures that will enhance and accelerate cheese flavor development. This project focused on a bacterial culture, *Lactobacillus helveticus* CNRZ32, and attempted to further the understanding of how this organism reduces bitterness and accelerates flavor development in cheese. This information will be utilized to construct or isolate bacterial strains, increasing cheese quality and reducing costs associated with cheese storage during ripening, to enhance the economic viability of the cheese industry.

A previous project resulted in an extensive, however incomplete, understanding of how a bacterial culture, *Lactobacillus helveticus* CNRZ32, reduces bitterness and accelerates cheese flavor development. The understanding was in the form of an incomplete genome sequence of this organism. This project filled in many of the holes (sequence gaps) in the understanding of how this organism enhances cheese flavor development and resulted in the cloning of a part of this genome believed to have a role in how this organism enhances cheddar cheese flavor development.

It is anticipated that these current and future studies will result in the isolation or construction of patentable bacterial strains that enhance or accelerate cheese flavor development. Wisconsin is a leading cheese producing state and has also developed a vibrant biotechnology industry. This project fostered technological innovation in both of these Wisconsin industries. Chr. Hansen, Inc.,a leading supplier of ingredients, including bacterial cultures, to the dairy manufacturing industry has been directly involved in this project.

5. Nutrient Cycling, Crops, Livestock, and the Environment (N-CyCLE): A Tool for Profitability and Environmental Management of Wisconsin Farms

The objective of this project is to develop an educational and research software tool to help dairy producers optimize farm management practices, improving profitability. This tool will allow students, producers, and consultants to simulate the management of a real farm to avoid purchasing unnecessary fertilizer or feed nutrient [nitrogen (N) or phosphorus], thus decreasing the cost of milk production and

reducing environmental impacts of excess nutrients on water and air quality. This project addresses the problem that three existing spreadsheet tools used to calculate N balance accounted differently for "natural" inputs (legume N fixation and natural nitrogen deposition), leading to different estimates of whole farm N balances.

The research has shown that some current recommendations, such as fertilization plans on farms relying heavily on manure and N fixation, may being made on the basis of incorrect information about environmental management of livestock operations. This allows researchers to generate data needed to validate the software tool that will estimate potential benefits/costs of improved nutrient management and optimize nutrient utilization on livestock farms.

This project will contribute to improving farm profitability by lowering the cost of milk production on dairy farms. The software will help quantify anticipated economic benefits from reducing the purchase of excess inorganic fertilizers for crops and feed nutrients for the dairy herd. In addition, the software will assist in examining the economic impact of environmental regulation on farm profitability. Although estimates of such costs are key to the future vitality of the dairy industry in the state (i.e., how much producers can "afford" to pay for environmental practices on the farm), they are simply not available today. It is anticipated that version 1.0 of the software will be available for distribution/commercialization this year. During this project, partnerships were established with the Professional Dairy Producers of Wisconsin (PDPW) and "Discovery Farms," an initiative led by producers and coordinated by UW-Extension under the Wisconsin Agricultural Stewardship Initiative (WASI).

6. Development of Novel Process for Large Scale Production of High-Purity Plasmid DNA

The goal of this project was to develop a manufacturing process that is capable of producing large quantities of plasmid DNA for clinical applications. To achieve this goal, the process must be scalable, validatable, and capable of producing DNA with low levels of impurities such as endotoxin and chromosomal DNA. An additional goal of the project was to develop analytical methods for quantifying different forms of plasmid DNA and associated impurities. A final goal was to produce plasmid DNA for a UW clinical development project and to produce a reporter plasmid to be used as a reference standard and as representative plasmid to be used in future stability and formulation studies.

A purification process was developed that was a unique lysis process followed by a two-step chromatographic purification and a final filtration step to produce high-purity plasmid DNA. The cell lysis process utilized a low shear method to break open cells. This resulted in decreased shearing of the bacterial chromosomal DNA and allowed it to be separated from the plasmid DNA. Analytical methods were developed for characterizing the resulting plasmid DNA, as well as for quantifying levels of impurities including endotoxin, host DNA, and host RNA. To demonstrate process reproducibility, several different plasmid DNA constructs were produced for use in pre-clinical testing.

Funding through the IEDR program allowed the researchers to develop this manufacturing process and associated analytical methods. NIH and other government agencies do not typically fund basic applied research such as process development. Manufacturing and testing procedures were transferred to Promega Corporation, Madison, Wisconsin. Promega will perform evaluation studies in the near future

to determine whether this process meets their current needs. The development of this process may allow Promega to manufacture certain products in Madison, rather than contract with another company outside of the state, as they currently do.

7. Metal-Oxide Thin-Films with Magnetically Tailored Nanoporosity as a Novel Energy-Separating Agent and Condensation Technology

This project entails the use of novel, nano-dimensional, nano-porous films that offer a tremendous and exciting opportunity for developing a new class of materials with unique physical, magnetic, and electrical properties that could be applied to the recovery of volatile organic compounds in vent gases in printing operations. The aim of the project is to determine the feasibility of applying a thin-film material to surfaces for the purpose of condensing liquids on them. The thin-film material has porosity and therefore much more surface area on which condensation can occur. If proven successful, these experiments should provide incentive to improve cooling/condensing surface behavior through enhanced heat transfer.

The test apparatus consisted of a (first) glass cylinder with a fluid (coolant) flowing inside the cylinder and effectively cooling the cylinder's inner surface. This cylinder is placed within another (second), larger glass cylinder. A gas at low concentration in a balance of air is passed through the cavity created between the outer surface of the first cylinder and the inner surface of the second cylinder.

WARF has base patents for this technology, and technology transfer is intended to be accomplished through licenses to multiple users. Wisconsin has a very large printing industry that this technology could assist. Northern Engraving Corporation, Sparta, Wisconsin, the industrial partner, committed funding for this project.

8. New Drugs for the Selective Destruction of Tumor Cells via Mitochondrial Targeting

The project objectives are the development of new cationic triarylmethane photosensitizers (phototoxic drugs) for the selective destruction of tumor cells, investigation of how the molecular structure of these new drugs affects tumor selectivity, and exploration of new strategies for cancer therapy. A new series of drugs was developed that show selective toxicity towards tumor cells and are bound to be more potent than drugs previously considered for this application.

This project has provided the means further to demonstrate the potential of a technology in which WARF had already shown interest. The patent application filed as a result of this study is the third patent application WARF is supporting on this specific technology. A new WARF patent application has been filed to protect our findings in this study. The technology has, the researchers believe, great potential for success, which will generate licensing revenue for the University.

9. High-Power Single-Mode Semiconductor Diode Lasers for Fiber-Optical Communications

As the need for information transmission grows exponentially, there is dire need for higher power devices for optical communication equipment. The main objectives of this project were: 1) to realize a semiconductor-laser of large transverse spot size to incorporate it in a high-power single-mode device,

doubling the power of current devices; and 2) to confine tightly the injected carriers to the active region.

The results can be summarized as follows: 1) The researchers developed the quaternary compound InGaAsP of 1.8 eV bandgap energy and incorporated it into a structure that allowed, for the first time, the realization of very large transvers spot size (> 0.8 microns) devices; 2) By using a high-bandgap (i.e., InGaAlP) barrier between the upper InGaAsP confinement layer and the p-InGaP cladding layer, the researchers were able to achieve tight carrier confinement of the carriers, which manifested itself in low temperature sensitivity for both the laser threshold current as well as for its slope efficiency. Two publications in archival journals, and a presentation and proceeding publication at an international conference resulted from the research efforts.

An existing patent on this technology was strengthened by this research project, resulting in a patent that was exclusively licensed by WARF to AlfaLight Inc., a start-up company in Madison, Wisconsin. It allowed AlphaLight to develop a high-power (> 0.45 W in CW operation) single-mode semiconductor diode laser. The device, which has a spot size 3-4 times larger than that of commercially available single-mode devices, will be much more reliaible at the same power level than all commercially available single-mode diode lasers. AlfaLight plans to introduce the developed laser as a commercial product soon.

10. Development of a Medical Safety Reporting System in Primary Care Settings

The objectives of the project were to discover what efforts were needed to create a statewide medical error reporting system for family medicine practices that would be both usable and useful. Specifically, the researchers wanted to work with family physicians and other family medicine clinicians, such as nurses and medical assistants, to understand what features in the technical design, implementation, and use of a medical error reporting system would cause them either to want to use it or not want to use it.

They discovered that physicians and other clinicians share some ideas of how to create a successful error reporting system, but they also differ on many factors. Thus, any system that is developed will have to be designed to accommodate the needs and uses of both groups. Some of the specific findings were: multiple methods for inputting information will be necessary; the system will have to work in connection with existing facility systems; software architecture will have to include algorithms built on existing taxonomies of medical errors; legal protections will be necessary; and massive state or health care organization funding will be required to support the maintenance, analysis, and dissemination of medical error reporting data.

The purpose of this project was to begin the system development process and was very successful. There is strong interest from the State of Wisconsin legislature and State Medical Society in the process, and the results have even been circulated abroad in the UK. If the researchers succeed in developing the medical error reporting system, it will lead to hazard control methodologies that will reduce the number of medical errors occuring in Wisconsin. Such a program can have a significant economic impact on Wisconsin industries. The medical provider industry expects an economic benefit from reduced litigation and medical costs that will accompany a reduction in errors. Fewer medical errors translate into less litigation and less remedial medical care, which means lower health care costs and lower insurance premiums paid by employers.

11. Stream-of-Variation Modeling and Analysis for Multi-Station Manufacturing Processes

Some of the most critical factors and barriers in the competitive development of modern production systems are in the largely uncharted area of predicting production system performance during the design stage. The overarching goal of this area of research is to develop a new simulation methodology and software called "Stream-of-Variation Analysis" (SOVA) system for precise modeling, analysis, synthesis, and control of process variation for multi-stage manufacturing systems. The specific objective of this project is the ramp-up phase—real time automatic dimensional fault identification, root cause isolation, and resolution based on measurements of product design features.

Major technical tasks for this project are: 1) modeling of stream-of-variation in multi-stage manufacturing—construction of state-space framework; 2) model evaluation and validation; and 3) sensing strategies for optimal analysis of manufacturing data and fault isolation.

A variety of industries will be impacted. Expected benefits include faster time to produce manufactured products, quicker introduction to the market, rapid capture of market growth, reduced overall manufacturing system development costs, and reduced installation, debug and ramp-up time. GM North American, Janesville, Wisconsin, is the industrial partner on this project, providing access to its facilities for needed information and allocation of engineering time for discussion and progress review.

12. Investigation of Alternative Methods to Provide On-Line Destruction of Pathogenic Bacteria in Brine Chilling of Packaged Food Products

This project was concerned with control of *L. monocytogenes* and other pathogens on prepared meat and poultry products such as hot dogs, sliced ham, and turkey. Analyses indicate that microorganisms can be introduced onto the product surfaces during product cool-down and packaging. The intention was to work with a company that produced commercial meat processing equipment (ALKAR) in an investigation of alternative brine treatment concepts that can result in reliable pathogen control with equipment that has lower initial and operating costs and reduced environmental impact. The plan was to focus on using ozone, in place of chlorine, as a biocide in the brine solution that is used to rapidly chill the cooked product.

The industrial partner, ALKAR, promised financial and technical support. However, shortly after the project started, ALKAR filed for bankruptcy and was unable to provide either type of support. A student was already starting on this project when this occurred. The student completed his research that semester and the project was abandoned.

13. Plasma Surface Treatment of Thermally Sprayed Dielectric Coatings

Thermal Spray Technologies located in Sun Prairie, Wisconsin, is working with nationally leading microelectronics companies to apply its specialty, plasma spraying, to the microelectronics industry. Specific application involves plasma spraying an aluminum-oxide diffusion barrier coating on aluminum substrates followed by plasma spraying of copper on the aluminum-oxide coating. The problem, however, is that some copper, because of its fluidity and possibly evaporation, works its way

through the pores in the aluminum-oxide coating and contacts the underlying substrate, thereby "shorting" the microelectronics' circuit. Pores are inherently present in plasma-sprayed coatings. The objective of this proposal is to use low-pressure plasma processes, such as those developed at the University of Wisconsin, to close the pores in the aluminum-oxide coating and prevent migration of copper into the underlying substrate. To achieve this, two types of migration barrier films are being explored, a diamond-like carbon (DLC) coating synthesized for an acetylene plasma and a hydrophobic silicon-bearing diamond-like carbon coating synthesized using a hexamethyl disiloxane plasma.

Thus far, diamond-like carbon films and silicon-containing diamond-like carbon films have been successfully deposited, using acetylene and hexamethyl disiloxane precursor plasmas. This was performed at the UW-Madison Center for Plasma-Aided Manufacturing onto plasma sprayed aluminum-oxide substrates deposited at Thermal Spray Technologies. The researchers are awaiting results of testing of electrical resistivity measurements by their industrial partner before disclosing this technology to WARF.

A benefit of this research is that it will strengthen ties between Thermal Spray Technologies, a Wisconsin company, and national microelectronics companies like Motorola. In over ten years of existence, Thermal Spray Technologies has focused mainly on mechanical applications of such coatings. This research provides the platform for applying its technology to the high-tech microelectronics industry. Generally, manufacturers in the communications industry are located outside Wisconsin. Because the technology developed has a direct impact on the development of corrosion resistant coatings, it could have an impact on drug preparation, food processing, and the automotive industry as well. The research effort funded by the grant will have been central to any patentability or licensability possibilities that come up in the future.

14. Innovations and Process Optimization for Injection Molding

This UIR-sponsored research was aimed at strengthening Wisconsin's injection molding industry by collaborating with its industrial partners to develop competitive processes, engineering know-how, production enhancement tools, and a skilled workforce. The proposal sought "seed" money to launch a university-industry-government collaborative initiative and to leverage additional financial support from government and industry.

Results of this project include: 1) Creation of the Polymer Engineering Center (PEC), which just recently became a multi-university research site of the National Science Foundation (NSF) Industry/University Cooperative Research Center (I/UCRC). 2) An invention disclosure on "Employment of Nano-Scale Fillers to Promote Homogenous Microcells in Microcellular Injection Molded Parts" filed with WARF. 3) Receipt of a $280,000 grant from NSF on "An Innovative Process for Producing Complex Injection Molded Parts" as a result of this project and related industry support.

The UIR award allowed the resarchers to prove their idea by providing seed money to carry out the initial research and to contact the industrial companies. The establishment of the Polymer Engineering Center and its Industrial Consortium provides a mechanism for transferring this technology to Wisconsin companies, for workforce training, and for infrastructure development. This enables

Wisconsin plastics manufacturers to provide the kind of high value-added products that will maintain competitiveness and support the standard of living of our workers.

15. Near-Field Biological Imaging with a Microfabricated Aperture Array

Near-Field Scanning Optical Microscopy (NSOM) allows nanometer resolution range, between the resolution of conventional and electron microscopy, but it has limited application to imaging of biological samples. The goal of this project was to fabricate and test a novel, prototype aperture array that would allow for high resolution imaging of fluorescent probes within living cells that would be useful for looking at biological functions without using a commercial NSOM instrument.

The researchers were able to fabricate an array, but not on the substrate necessary for use in optical biological imaging. The limitations on fabricating the substrate were primarily related to the difficulty in micromachining glass. In collaboration with Prof. Robert Blick, the researchers have now acquired a UV laser and hope to realize this design now. The funding allowed them to do test fabrications on several substrates using two primary techniques. The researchers have discovered which process would be applicable to their research goals, and the problems that need to be addressed to fabricate a usable near-field array. This has put them very near to accomplishing their goals with additional attention to the processing of the wafers. Although the funding has elapsed, the researchers continue to work on the project and are hopeful that all of the original goals can be met.

If successful in fabrication, there would be a market for this technology in the research community. It would be a product that would be sold through an existing marketing relationship.

16. Self-Powered Brake Pads Consumption Monitoring System

The commercial vehicle segment of the transportation industry is facing increasing pressure in the areas of commercial vehicle regulations and public safety. This project would develop a new technology called "self-powered brake pads consumption monitoring system." Using acoustic waves generation and reflection and self-powered by piezoelectric ceramics energy scavenging material, brake pad usage ultrasonic sensors would determine the wear and tear on each pad when brakes are applied. Specific work on this project involved experiments to design the sensors to collect, compile and compute data and display circuitry.

According to results of a non-scientific opinion survey of the transportation companies within Wisconsin, 13% of gross revenues are lost in non-compliance fines related to safe brakes operation, emergency repairs, and delays caused by existing inspection systems. The researchers hope that, as a result of development and implementation of this new technology, losses will be reduced by at least 10%. A Madison-based company, Intuit Inc., committed the services of engineers, software developers, and other research assistance to the supplement the research effort. Based on favorable outcomes from the project, they will pursue trials, develop marketing plans, design the product for commercialization, and provide commercial manufacturing assistance.

17. Broad Spectrum Microarray Assays for Human Viruses

The specific aims of the project were: a) to develop screening methods based on modern DNA microarrays, "gene chip" technology for simultaneous detection of many different viruses and pathogens in biological specimens, like blood and tissue biopsies; b) to use these screening methods to study the molecular biology of diseases, including some cancers, that are currently known to be associated with specific viruses; and c) to discover new virus-disease associations. NimbleGen Systems, Inc., Madison, Wisconsin was identified as the industrial collaborator for this study.

The researchers have developed gene chips and have improved technologies for biological sample analysis. They are currently implementing the use of the chips in two large studies on the detection and involvement of Epstein-Barr virus in nasopharyngeal carcinoma and that of human papillomavirus in head and neck cancer. Using the information that has become available in the post genomic era, the experimental approaches aim at development of new, and improvement of existing, disease screening procedures. In conjunction with in-depth studies of molecular signatures and biological mechanisms of particular virus-associated cancers, the research should facilitate making improved, cost-effective patient care decisions regarding prevention, diagnosis, prognosis, and choice of treatment.

Using this funding, the researchers have initiated experiments that have generated preliminary data essential to securing federal funding (NIH/NCI, $960,000). The federal funding has allowed the researchers to support three prostdoctoral researchers and expand the research. The resulting approaches of these studies could be the basis for new, high-value clinical tests that could be developed and marketed by Wisconsin biotechnology companies, such as NimbleGen.

18. Development of Application Principles of Polymer Dispersants and Surfactants

The objective of this research was to develop formulation principles for polymer dispersants and surfactants. These materials are used over a wide range of applications such as protective coatings for interior floors of buildings, dispersions for insect repellents, household cleaners, personal care items, and for many chemical processes. Johnson Polymer, Sturtevant, Wisconsin is the leading manufacturer of these polymers and is the cooperating industrial partner for this project, providing experimental polymer samples and end-use performance tests to this laboratory.

Polymers form spontaneously thin films and monolayers at the air/water interface by virtue of the surface activity. The research involves a method recently developed in this laboratory for the surface viscoelastic characterization of amphiphiles by laser light scattering. It is expected that with successful test results of the formulation principles, this project can have direct and immediate impact on Johnson Polymer, broadening its platform technology so as to enhance market shares of their products. These products have a gross sale potential of $5,000,000 per year if the formulation process is streamlined to tailor to individual applications and end uses.

19. Comparison of Two Types of Knowledge-Based Start-Up Firms

This pilot project on knowledge-based start-up firms in Dane County had three goals: 1) to develop a complete sample of all Dane County knowledge-based firms created after 1996 and research

instruments to use in continuing research on these and other science start-up companies; 2) to develop information on patterns of advisors of founders of knowledge-based firms, such as who advises whom, backgrounds of advisors, and perceived effectiveness; and 3) to understand how founders deal with surprises during the founding process in knowledge-based firms and to develop insights and questions for further study on handling surprises in start-ups.

This project is ongoing. Results of work to date include: 1) completion of 62 interviews, creation of 1,693 pages of interview transcripts, refinement of interview protocol, development of research instruments to code data, development of key sampling data and sampling frame; 2) preliminary analyses of patterns in types of advisors chosen by founders and how they are perceived; and 3) insights into some processes founders use to deal with surprises during early years after founding companies. The UIR funding has permitted the researchers to develop several research tools, including interview protocols and coding manuals. Also, they are building a Dane County knowledge-based start-up cohort database for a specific time period.

Both the research tools and database have the potential for licensing for research and commercial purposes. Results to date suggest some patterns of advisors that the researchers will share with appropriate professionals actively working with start-up companies. This research will also assist in the long-term economic development of Wisconsin in several ways. As social science research, this project will not create specific new products, but rather will help entrepreneurs, entrepreneurinal service providers (law firms, angel investors, etc.), university and other professionals involved in facilitating start-ups, and policy makers. For entrepreneurs, this work will help clarify different ways to deal with surprises. Additional descriptive knowledge about advisng patterns should be useful to university offices and service providers in working with knowledge-based firms to avoid unintended outcomes, thus assisting in the economic development of Wisconsin.

20. Expression Cloning of the P-Selectin Ligand System in the Horse

Gastrointestinal (GI) disease accounts for the greatest loss of use and life in adult horses. In addition, horses that survive life-threatening GI disease are at risk of developing laminitis (inflammation of the foot), and/or peritonitis, which can affect their life-long use or can result in their destruction. Inflammation can arise from infections (e.g., bacteria) and non-infectious ischemic injury to an organ, such as the intestinal tract. Inflammation and thrombosis are coordinated through adhesion molecules, such as P-selectin and its counter ligand P-selectin glycoprotein ligand (PSGL). Recent studies have shown that blocking PSGL binding reduces inflammation and thrombosis during bacterial and ischemic conditions. The objective of this proposal was to sequence and clone equine PSGL for the purpose of developing a patentable equine recombinant PSGL chimera immunoglobulin (ePSGL-Ig) to treat intestinal inflammatory and ischemic conditions in the horse.

This grant allowed the researchers successfully to sequence the entire equine PSGL. Specific amino acid residues have been identified on the external portion of PSGL as the potential site for binding P-selectin, the natural ligand of PSGL. Targeting P-selectin with an anti-adhesion molecule PSGL chimera in conjunction with non-steroidal anti-inflammatory drugs may offer the best results in treating infections and inflammation. Discovery of the equine sequence of PSGL will enable the researchers to develop and test the efficacy of a therapeutic equine-specific anti-adhesion molecule in the treatment of

bacterial infections, GI inflammatory and ischemic disorders.

The researchers anticipate that this compound will not only save lives but also reduce hospitalization time and complications associated with these disorders. Not only does this drug have the potential to improve animal health and well-being while reducing medical costs to the horse owner, it has the potential to reduce the frequency and severity of medical complications, which can affect the life-long use of the horse.

There are 120,000 horses in Wisconsin (1999 census). These findings have interested one veterinary pharmaceutical company (Fort Dodge Animal Health) to request a proposal to generate the therapeutic molecule and conduct studies for proof of efficacy. After submitting an intellectual property agreement and showing interest by Fort Dodge for potential licensure, WARF has decided to pursue patenting of the molecule. When licensed, revenue will flow back to the University of Wisconsin.

21. Developing Methods for Genomic Research in AT-rich Industrial Bacteria

The objective of this project is to develop molecular biology methods and tools for the generation of random genomic libraries from AT-rich industrial bacteria. These would be used to construct or isolate microbial cultures that are well suited for the production of fermented dairy products with consistently high-qualtiy flavor attributes. The specific aim is to validate these tools through the generation of a data set from a library of *Lactobacillus helveticus* CNRZ32, an organism sold by Chr. Hansen, a Milwaukee, Wisconsin food ingredient firm, to enhance cheese flavor development.

A low-copy vector was developed and validated for the generation of random libraries from recalcitrant organisms. This tool, pSMART LC vector series, is currently being sold by Lucigen Inc., a Middleton, Wisconsin biotechnology company. The dataset developed to demonstrate the effectiveness of the pSMART vector system resulted in a previous, inadequate dataset becoming sufficiently complete that it will be the subject of a global meeting sponsored by Chr. Hansen in October of 2003. Recently, a sponsor option agreement has been signed between Chr. Hansen and WARF to cover intellectual property developed from this dataset.

This work extended the product line of Lucigen Inc., a biotechnology company in Middleton, Wisconsin. It provided the raw material for a draft genomic sequence of an organism sold by Chr. Hansen. This draft sequence is expected to enhance the development of intellectual property related to bacterial strains used in the cheese industry.

22. Bioavailability of Betalains as Cancer Chemopreventive Agents and Antioxidants *in vivo*

The objectives of this project are as follows: 1) isolate a highly enriched, or "pure," betalain pigment preparation from red table beet root tissue to support animal feeding trials; and 2) conduct feeding trials to determine if the intake of a beet pigment preparation can induce cancer chemopreventive enzymes and antioxidant capacity of various animal tissues.

The researchers successully isolated a sufficient amount of pigment to conduct rat feeding trials. Two

isolates were used to supplement standard rodent diets, and diets were administered over two months with analysis of effects at monthly intervals. Rats fed beet pigment-supplemented diets did not have elevated levels of quinone reductase and glutathione-S-transferase (detoxification enzymes) in colon, liver, kidney, intestine, or lung tissues compared to control rats fed standard diets alone at any interval during the study. Experimental results also showed no statistical improvement of defense against oxidative stress in homogenates of these tissues obtained from rats fed beet pigment-supplemented diets relative to control animals.

This project was conducted to help elevate the potential for licensing of a patent application already submitted on the use of beet pigment isolates as cancer chemopreventive preparations. The need to test *in vivo* efficacy was recognized and this project supported those tests. While the results did not show *in vivo* efficacy under the conditions evaluated, we remain optimistic that beet pigments are efficacious. Critical decisions need to be made before pursuing the opportunity further, such as whether to use animal or human trials, as different responses may very well be encountered, how to administer the isolate, etc. Wisconsin is the largest producer of beets in the U.S. Any technological development that can add value to beets or waste streams from beet processing will benefit vegetable growers and processors in the state.

23. Method of Displacing Plasmids from Bacterial Populations

Drug resistance of bacterial pathogens is presently the major cause of failure in the treatment of infectious diseases. Drug resistance genes are commonly found in a large variety of bacterial plasmids that can be maintained in pathogens as well as non-pathogens. Presently there is no known method by which to avoid the selection of antibiotic-resistant bacterial mutants that arise as a result of the many standard applications of antibiotics in the modern world. Likewise, many virulence genes are frequently plasmid-encoded. Accordingly, a need exists to develop alternative strategies of atenuating unwanted bacteria. The research objective was to design a new method in an unwanted trait would be eliminated from target bacteria without killing them.

The researchers developed a method in which a harmful plasmid that relies on its iteron sequence to replicate in target bacterial cells is displaced by a non-harmful plasmid, without killing the bacterial cells. In this method, "displacing a harmful plasmid" means reducing the number of, or evicting completely, the plasmid from a target bacterial population. They genetically engineered several copies of the iteron sequence of a harmful plasmid into a non-harmful plasmid. When such a non-harmful plasmid is introduced into a target bacterial cell containing the harmful plasmid, it binds to replication proteins that would have otherwise bound to the iteron sequence on the harmful plasmid. Thus, the non-harmful plasmid inhibits the replication of, and ultimately displaces, the harmful plasmid. A harmful plasmid confers an unwanted trait to a host bacterial cell while a non-harmful plasmid does not confer any unwanted trait to either a donor bacterial cell or a recipient bacterial cell. Thus, the strategy allows for converting target bacterial cells with an unwanted trait to cells without the unwanted trait.

UIR support was essential for turning the idea into verifiable lab data. The results generated are described in the provisional patent. The researchers will apply for additional funding to expand the breadth of their claims, which will allow WARF to file the patent application. In April of 2001, Dr. Richard Burgess and Dr. Filutowicz founded a new Madison-based company, ConjuGon, Inc., to

advance and commercialize ideas and technologies that have been developed in their laboratories during the last five years. The long-term goal is to develop a broad technology platform for killing/attenuating bacterial pathogens. The IEDR grants awarded to this laboratory were critical in testing some of the ideas and developing important tools for the technology. The company has secured venture investments, a federal SBIR grant from NSF, and a state loan. It has four full-time employees and the burn rate is $30,000/month. The idea of displacing the antibiotic-resistance or virulence plasmids from bacterial populations is an excellent complement and expansion of the future R&D directions at ConjuGon.

24. Detection of Viruses Using Surface Plasmon Resonance Imaging

The objective of this grant was to demonstrate the utility of a label-free (no flouresence), real-time (extremely fast) rapid microarray technology (Surface Plasmon Resonance Imaging) for detecting viral material including RNA and protein. The researchers attached DNA probes specific for each of two viral RNAs (different viruses), then applied and detected the hybridization of each viral RNA specifically to the appropriate DNA capture probe. Finally, they used these DNA:viral RNA complexes to capture a viral protein specific for one of the viral RNAs being tested to the appropriate DNA:viral RNA complex.

They were succesfully able to detect specific hybridization of two viral RNA molecules to their appropriate DNA capture probe with near absolute specificity and were able to demonstrate preferential binding (not absolute specificity) of the viral protein in question to the appropriate DNA:viral RNA complex on the microarray surface. The funding by UIR allowed them to demonstrate proof of concept for one utility of this extremely versatile microarray platform.

UIR funding allowed the researchers to complete this important research, and a disclosure and patent application resulted from this project. They have transferred this new technology to two local start-up companies, both resulting from research based at the University of Wisconsin-Madison. Additionally, the project led to a poster presentation at a international virology meeting and the introduction of this technology to the virology community. Also, a graduate student in the lab has subsequently identified other areas of industrial interest related to this technology, and they are now working on these areas. They are confident that the further development of this technology will make a strong contribution to economic development, in both instrumentation and in applications, for industry in Wisconsin.

25. Sorghum Proanthocyanidins and Atherosclerosis

The researchers' industrial partner, Natural Ovens Bakery, Inc., Manitowoc, Wisconsin, is currently using high tannin sorghum proanthocyanidins (PA) in bakery products and is interested in the potential health promoting effects of these compounds on the development of cardiovascular disease as related to hypercholesterolemia and atherosclerosis. Specific research goals were: 1) Determining differences among sorghum PA oligomers in their association with LDL and inhibition of Cu2+ induced oxidation; 2) Determining the inhibitory effects of sorghum PA on the atherosclerotic inflammatory response of macrophages and porcine aortic endothelial cells; and 3) Developing an *in vitro* cell culture model using CACO-2 cells to study enterocyte absorption and metabolism of sorghum PA.

The combination of liquid chromatographic separation and mass spectrometry to characterize sorghum polyflavans indicates that the structural heterogeneity is much greater than previously described. The results from this work have been published in the Journal of Agricultural and Food Chemistry. All polyflavan-3-ol fractions increased lag time of LDL oxidation. Lag time of LDL oxidation increased as the average molecular weight of fractions increased. Polyflavan-3-ols with masses higher than 2000 often completely prevented oxidation when added to serum at concentrations of 5 ppm and had significant effects at concentrations of 2.5 ppm. Sorghum polyflavan-3-ols specifically associate with LDL in serum.

Results from the first year of research of this project will be directly transferable to the manufacturing of bread and other cereal-based products by Natural Ovens Bakery Inc. This family-owned business is currently producing bread that incorporates high tannin sorghum (HTS) at 10%. In addition, the company also manufactures a cereal-based drink and a healthy cookie that incorporates HTS. These products are advertised as rich in natural antioxidants, in part because the tannins are effective in preventing the oxidation of lipids. The results will assist Natural Ovens Bakery better to formulate their sorghum products.

26. Decrease Lipid Oxidation in Food with Natural Antioxidant in Cranberries

Technology aimed at incorporating the "natural" and "health promoting" antioxidants of cranberries into foods to extend food shelf life should raise the value of Wisconsin cranberries and benefit Wisconsin food industries by extending the shelf life of their products. Wisconsin produces around 50% of the cranberries that are harvested in the United States. The project was desinged to: 1) Determine the minimum amount of cranberry powder that is needed to inhibit off-odor and off-flavor in various food systems; 2) Isolate six different classes of antioxidants from cranberries and investigate their ability to extend shelf life in the food systems; 3) Examine press cake, the material that is left after squeezing juice from the berries, as a source of antioxidants; and 4) Determine if fruity odor or berry color is detected in food systems at concentrations used to prevent off-odor and off-flavor formation.

The researchers found that fraction 4 was the most effective cranberry fraction at preventing flavor deterioration in various systems including washed cod muscle, mechanically separated turkey, and cooked pork sausage. The level of fraction 4 required to protect flavor was around 0.005 to 008% of the sample weight. Larger amounts of unfractionated cranberry were needed to effectively inhibit flavor deterioration compared to fraction 4. Cranberry press cake appears to be a substantial source of cranberry antioxidants. Adding cranberry antioxidants did not incur fruity odor or negative color impact at the inhibitory concentrations.

The studies resulted in an invention that is now at the provisional patent application stage. The Wisconsin Cranberry Board, Oscar Mayer, Ocean Spray, and Sara Lee Foods were partners in this research.

27. Altering the Sex Ratio on Wisconsin Dairy Farms Using Low-Cost *In vitro* Embryo Production with Sexed Semen

Dairy replacement heifers are in high demand in Wisconsin, and heifer prices recently reached historically high levels. Over the past decade, dairy farms in Wisconsin have been expanding rapidly to gain economies of scale that are needed to compete with large dairies in California and neighboring states. Unfortunately, high heifer prices have nearly stifled dairy expansions in our state. The objectives of this project were to: 1) Evaluate the ability of new reproductive technologies to alleviate the shortage of dairy replacement heifers in Wisconsin; 2) Assess whether or not sexed (sorted) sperm is ready for commercial application in Wisconsin dairies; 3) Demonstrate the benefits of low-cost systems for *in vitro* production of dairy embryos; and 4) Explore the synergies between sexed semen and *in vitro* embryo production technologies.

The researchers obtained the following results: 1) Enlisted seven commercial dairies, one breeding stud, and an embryo production lab in a cooperative field research project; 2) Retrieved ovaries from approximately 100 "cull" cows (sick, injured, etc.) on Wisconsin farms; value of these animals was limited to market beef price of $400-$600 each; 3) Aspirated follicles from these ovaries and created about 350 female embryos that were transferred back into recipient cows and heifers on the same farms; 4) Assessed conception rates and monitored sex and birth weight of resulting calves; 5) Evaluated genetic gain achieved by creating extra offspring from high merit donor cows; and 6) Assessed the economic gains achieved by generating this value added product (female embryos) from otherwise "useless" dairy cull cows.

The project provided a novel method of producing additional replacement heifers in a cost-effective manner. In addition, it provided Wisconsin dairy breeding companies and embryo laboratories with a new product line (additional replacement heifers) to offer their customers. The project also: 1) Greatly enhanced the visibility of a UW start-up company, BOMED, Inc., within the Wisconsin dairy genetics industry; 2) Assisted Wisconsin dairy breeding companies (ABS Global, Accelerated Genetics, Alta Genetics, Genex Cooperative) in their efforts to evaluate the commercial viability and potential economic benefit of sexed semen; 3) Developed novel breeding strategies that will allow Wisconsin breeding companies to license and profit from this technology, despite its present limitations; 4) Educated dairy producers, other scientists, extension field staff, and the public about two exciting new technologies; and 5) Demonstrated to industry decision-makers the benefits of investing in these technologies.

28. Identification of Microbial Species Common to Potatoes with Pink-Eye Disease

One of the most frustrating diseases for potato growers in North America is pink-eye of potato, which is characterized by swollen pink lesions around the potato eyes on the bud end of potato tubers. The cause of pink-eye is unknown and the control has not been determined. The researchers hope to determine the cause of this disease and to develop a diagnostic test for it as a first step to combatting this problem. Potatoes with pink-eye are more susceptible to rotting in storage, and those potatoes that do not rot are difficult for processors to peel when making chips or fries. Despite its significance, there has been very little work done on this disease, and only four peer-reviewed publications have been published on this

problem in the past 40 years. Wisconsin potato growers and processors need a predictive test for development of pink-eye, and they need control measures for this disease. The researchers proposed to use a polymerase chain reaction (PCR) based method combined with DNA sequence analysis to identify microbial species associated with pink-eye with the goal of developing a DNA-based test that can be used to help predict the development of this disease and to aid in its diagnosis.

This grant enabled them to identify candidate causal organisms and to clone portions of their DNA. There were several bacterial species and a few fungal species regularly associated with diseased potatoes, and this project is being continued to attempt to determine if any of these candidates are indeed the pathogen causing pink-eye. They are also attempting to determine if any of the species isolated can cause pink-eye disease under greenhouse conditions. If one of these microbes proves to be the pathogen, the cloned portion of its DNA will be the basis for a diagnostic assay for this disease. They have received additional funding from a potato processing company to continue this work.

Pink-eye causes significant losses each year. Individual farms in Wisconsin lost over $500,000 due to this disease in 2001. The economic loss due to this disease in Wisconsin is best described in a letter received from a local potato grower. He stated, "The crop years of 1999 and 2001 were epidemic for pink-eye resulting in high storage losses. These industry-wide catastrophes can be directly attributed to pink-eye and the ensuing soft rot. Our farm lost 76,000 cwt weight of stored potatoes during these two years. With a projected income of $5.75 per cwt, the direct costs amounted to $437,000. Removal of rotted potatoes and washing and grading of the remaining potatoes (an extra step necessary to process bins affected by pink-eye induced rot) resulted in another $69,000 loss. The total loss was $506,000. This scenario was the rule rather than the exception for central Wisconsin. Continued losses at this level endanger the viability of the potato industry in Wisconsin (also our farm)."

29. Laser-Based Versatile Automated System for Cheese Cutting and Marking

The goal of this research program is to develop an economically feasible cheese manufacturing process that uses UV laser-assisted machining and marking and to transform the research into compelling business solutions for the Wisconsin dairy industry. Specifically, the research program is to investigate the relationship between cutting and marking speed and various laser parameters (focus spot size, repetition rate, and laser power) on cheese.

A laser control system employing software was used to drill, cut, and machine cheese with flexible patterns. It is anticipated that novel UV laser sources with a higher cutting speed and power are possible in the future. Funding for this project makes it possible to verify the concept of laser machining of cheese, which was generally thought to be impossible due to burning of the cheese.

Lasers can serve as a single versatile and inexpensive cheese-handling tool that allows various customer-designed high quality shapes or attractive markings on cheeses, and importantly, without contamination. The results of this study will enhance significantly the licensability of the technology in the near future. The project helps to bridge the gap between university researchers and industry engineers. It also was a real-world project for the training of one Ph.D., two Masters, and six undergraduate students.

30. Educational Tourism: Making the University Campus a Destination for Exploration

The goals of this project were to: 1) Produce a directory of science outreach programs on campus that is based on a census performed by graduate students from the Bolz Center for Arts Administration, UW-Madison; 2) Compile a web site that organizes science outreach resources on campus; 3) Organize a "Science Alliance" to synergize researchers and science outreachers to increase the capacity of the university for welcoming visitors to campus to explore science; and 4) Write and submit a grant proposal to fund further research in organizing science outreach in the second century of the Wisconsin Idea.

The project:

a) Formed "Science Alliance," an organization of researchers and science outreach personnel dedicated to improving the science outreach mission of the university by enhancing capacity for welcoming visitors to campus to explore science (http://www.biotech.wisc.edu/Education/alliance/index.html);

b) Established "Science Expeditions," a new perennial science outreach event on campus, with an additional $20,000 grant from UW Foundation. "Science Expeditions" will build educational tourism for the hospitality industry in Dane County (http://www.biotech.wisc.edu/Education/xenium/index.html);

c) Established "Forum on the Future of Science Outreach: Envisioning the Second Century of the Wisconsin Idea," by the "Science Alliance" to sustain and further work into finding new ways of organizing, funding, facilitating, staffing and evaluating science outreach (http://www.biotech.wisc.edu/Education/alliance/forum.html);

d) Began planning "Envisioning the Second Century of the Wisconsin Idea," a conference scheduled for Spring 2004, resulting from a $25,000 grant from the UW-Madison for this cooperative effort among Science Alliance, Center for Biology Education, and the Biotechnology Center;

e) Re-designed two web sites that help learners identify and tap into the science outreach resources on campus: (http://www.dcs.wisc.edu/outreach/science.htm and http://www.dcs.wisc.edu/outreach/teachers.htm);

f) Established a portal to do for science what the web site of the Arts Institute has done to help welcome the public to campus for arts events, in cooperation with the Office of University Communications (www.science.wisc.edu); and

g) Wrote a proposal submitted to NSF, intended to lead to a Center on the Future of Science Outreach.

The recurrent theme among these efforts is "Sharing Science with Wisconsin." The link to the Wisconsin tourism industry is our commitment to finding ways to welcome people to campus every day in an organized way to explore science as a way of probing the unknown. The grant recipients believe that research showing new ways for large, complex scientific institutions to organize and synergize, to welcome the public to explore science will enhance the tourism industry by bringing overnight visitors to campus for multi-day series of science explorations.

31. Genomic Micro-Arrays for the Diagnosis of Developmental Delay and Mental Retardation

Up to 3% of children are born with conditions causing developmental disabilities; however, diagnosis is often imprecise and late in coming, thereby denying patients the many benefits of tailored evaluation and early intervention. Rapid advances in the Human Genome Project have contributed to the identification of many genetic variations associated with, or causing, these disorders. However, technical hurdles have precluded transfer of this knowledge to the service of patients and their families. The aim of the project was to design, validate, and market a novel method of mutation detection that combines micro-array analysis at low cost per allele with the clinical precision needed to diagnose children with developmental disabilities.

The researchers secured Institutional Review Board and Health Insurance Portability and Accountability Act approval, recruited participants, collected specimens on about 20 probands and parents, isolated DNA, and defined their mutations using conventional genetic methods for comparison to the proposed novel method.

The technology transfer plan of the proposal for this project represents a collaboration between Waisman Center scientists and clinicians and their collaborators at NimbleGen Systems. However, their industrial collaborator had a change in management and did not follow through on the project commitment thereafter.

32. Reusable Cold Wall Vortex Liquid O2 Combusion Rocket Engine

The project objective was to measure the flow velocities in a vortex combustion engine to aid in the design of reusable rocket engines by an industrial partner, Orbitec of Middleton, Wisconsin. Velocity measurements were made for several different locations and aspect ratios in a cold flow engine. The particle image velocimetry technique was used, and it was possible to obtain velocity vectors of the flow field. These data were used, together with some work conducted at Orbitec, to help secure a phase II SBIR project though NASA.

Orbitec already holds a patent on the vortex engine design and this work was used to aid in further designs. This project will help Orbitec obtain future funding from the Army and NASA for the development and testing of the vortex engine, and may eventially become a production type engine.

33. Construction of New Recombinant Immunotoxins Directed at Activated Alloreactive T Cells Responsible for Graft Rejection

Alloreactive T cells are responsible for rejection of organ transplants, and therefore depletion of these cells with specific recombinant immunotoxin would prevent transplant rejection. The goal of this project was to develop a potent alloreactive T cell specific recombinant immunotoxin, establishing a set of technologies that can be patented.

This grant allowed the researchers to initiate a study, aimed at developing novel reagents useful in prevention of transplant rejection, and they have made a good start with this support. They have constructed and characterized several recombinant immunotoxins. These have been shown to be very

potent in killing T cells that are activated by alloantigens (protein molecules which induce transplant rejection) both *in vitro* and *in vivo*. The researchers will examine their usefulness in prevention of transplant rejection in rodents.

Although the reserachers have obtained promising results with the recombinant immunotoxins as a result of the funding of the current grant, these bioactive reagents need to be improved and tested in animal transplant experiments. They plan to use the preliminary data obtained to date to apply for grants from other funding sources for the continuation of the study. The recombinant immunotoxins developed are aimed at eventual use in organ transplantation. If the researchers are successful with animal studies, they hope to be able to license the technology to local biotech companies. Renovar, Incorporated, Madison, Wisconsin, collaborated on this project.

34. Support for Endocrine Disruption International Cooperative Research (EDICOR)

EDICOR (Endocrine Disruption International Cooperative Research) is a unique collaboration between industry and the environmental communities. S.C. Johnson and Son, a Wisconsin company, together with the World Wildlife Fund and The Procter & Gamble Company are the charter founders of EDICOR. Endocrine disrupting chemicals have been a major public policy, human and environmental health, and corporate concern since the mid-1990s. Yet few scientists have expertise in both toxicology and endocrinology and existing research programs needed to make informed decisions about endocrine disruption. The objectives of this project were : 1) to support bringing the development of the EDICIOR Center here at UW-Madison, rather than at another competing university, thus establishing UW-Madison as the premier university in the field; 2) to conduct further work needed to develop policies and procedures for planned EDICOR activities, including administration of intramural and extramural research programs; and 3) to produce promotional materials and fundraising.

An EDICOR prospectus and an EDICOR question and answer brochure were developed and used for fund raising. A poster suitable for use at scientific meetings was prepared and shown, and EDICOR was publicized at a separate meeting of leading endocrine disruption scientists.

The researchers believe that IEDR support from UIR was important in the selection of UW-Madison to host EDICOR, and that funding by UIR was important to the receipt of the additional $100,000 from an outside sponsor. The $100,000, in turn, is critically important to their chances of attracting major funding sufficient to achieve EDICOR's goals. Fund-raising efforts continue, with a reasonable chance of a major contribution from an overseas group. If EDICOR is successful at meeting its original minimum budget, it will bring at least $1,500,000 annually into the state of Wisconsin.

35. Novel Cost Effective Production of White-top Linerboard

The primary objective of the project was to find ways in which to improve the properties, efficiency of production, and cost of white-top linerboard materials produced by the Wisconsin paper industry. Linerboard is a major packaging product used for a wide range of materials. The use of the white-top for the linerboard improves printability but increases cost. Specific project objectives were to determine how modification of the white-top linerboard affected corrugated container properties, to develop a model to predict linerboard properties from properties of the individual layers, and to verify the model

with commercial linerboard material.

Based on the results of the studies, a model has been developed which can be used to predict the most efficient method for production of the linerboard white-top sheets. The model is now being verified with commercial linerboard materials.

Linerboard is the major packaging material produced by the paper industry and the paper industry is an important component of the Wisconsin economy. Improving the properties and efficiency of linerboard production will result in increased marketability of Wisconsin-produced linerboard.

36. Laser-Based Sensors for Rocket Engine Development

The goals of this project were: a) to develop laser-based sensors for measuring gas properties in rocket engines at Orbitec and apply sensors to Orbitec engines; b) to use measured gas property data to enhance engine development programs at Orbitec; and c) to secure follow-on federal funding for continuing the work.

All objectives were accomplished. Sensors were constructed and applied to Orbitec engines. The results have improved Orbitec's knowledge of engine performance, thus accelerating engine development. Army ($36,375) and NASA ($57,000) funding has been secured to further the sensing work and the Orbitec-UW connection. Both the continuing research relationship with Orbitec, and follow-on government funding, would have been difficult to secure without the UIR seed funding.

The project has begun to accelerate Orbitec's rocket engine development work. It is hoped that enhanced engine development will, in turn, promote Orbitec's growth and ultimately stimulate a more significant aerospace industry in Wisconsin.

37. Optimization of Spray Evaporative Cooling for Multi-Chip Modules

Industrial partners on this project were Cray, Incorporated, of Chippewa Falls, and Eaton Corporation, of Milwaukee. The primary goal of this project was to obtain sufficient understanding of the direct cooling of electronics using liquid sprays. This would enable Cray to implement an effective cooling strategy in its next generation of supercomputers. The heat generated by computer chips is rapidly approaching levels like those felt by spacecraft re-entering the earth's atmosphere. For Cray to remain competitive, it must have the ability to increase the heat removal capability of its cooling systems. The system in which Cray had invested had reached its operational limits. This work focused on the fundamental behaviors of spray cooling to generate better predictions, as well as to determine if the current limits could be overcome.

This project has resulted in several significant findings. One of the most important is that the current limits on maximum heat removal rates can be raised through improved design. The researchers have also determined how non-uniform cooling may be avoided, potentially increasing the reliability of the computer hardware. In addition, the knowledge gained has led to recommendations for designs that greatly increase the flexibility of hardware and the placement of components within the system. Significantly, this work was performed quickly enough to impact the next product design cycle, which

is rare for fundamental university research.

The current process has been patented by the companies involved. Future designs based on this research may produce valuable intellectual property. In the near term, the results of this project may directly influence the design of Cray's next generation of supercomputers, allowing the company to recover initial investment costs in spray cooling development. It is possible that this could be an enabling technology for Eaton Corp., a major military contractor, for future military products.

38. Development of Antibodies to Aid in the Disarming and Killing of Pathogenic Bacteria

Antibiotic resistance of bacterial pathogens is a widespread public health problem. The Madison-based company, ConjuGon, the industrial partner, is developing technologies that avoid use of traditional antibiotics and produce novel anti-microbial agents that kill pathogens while minimizing bacterial resistance. The goal of this proposal was to explore the use of monoclonal antibodies (MAbs) that will enhance the ability of our biotherapeutic agent to seek out and disarm pathogenic bacteria, prior to killing them. The researchers will use bacterial conjugation to deliver a variety of "killer genes" to pathogenic bacterial cells separately or in various combinations to provide for redundant killing.

The researchers have prepared four different MAbs to react to a toxin of the pathogenic bacterium *E. coli* O157:H7. They have also obtained MAbs that react specifically with the outside surface of *E. coli* O157:H7. These MAbs are being tested to see if any of them can neutralize the effects of the toxin. They have spent a great deal of time trying to convert another MAb into a simpler, single chain version of the MAb, called a scFv MAb. This proved more difficult than expected, so the procedure has only recently begun working. In the future, they will work to convert that *E. coli* O157:H7 specific MAbs to the scFv versions. The research efforts were designed to begin testing several new ideas.
The researchers have made good progress and expect that future work will result in invention disclosures to WARF. This project was designed to develop several new ideas that would be of great value to ConjuGon. Any technology that arises out of this project will be disclosed to WARF and licensed to ConjuGon to strengthen its intellectual property portfolio relating to its core technology of killing bad bacteria with good bacteria. Licensing to ConjuGon will bring revenue for future research back to the University. This IEDR project helped to create the critical mass of related activity that got ConjuGon off the ground and made it able to raise $500,000 of angel investment.

39. Interactive Exploration of Multi-Dimensional Data

The project was focused on the development of software technology for visualization and exploration of three-dimensional field data, and the integration of the developed techniques with commercial computer-aided design (CAD) systems and internet technologies. The researchers made substantial progress in all areas of the project proposal. In particular, they developed tools for visualizing arbitrary field data over solid models, and integrated these tools with a commercial solid modeler (Parasolid). They also demonstrated an important application of this technology, automated engineering analysis over the internet, in which a problem description is entered using a standard browser and is sent to a remote host computer for a solution. The solution visualization is then sent back to the browser on demand.

The developed technology was instrumental in developing new methods for computer modeling of heterogeneous materials. A provisional patent application was filed by WARF in July 2003. Matching funds of 20% for the project were provided by Intact Solutions, LLC, a Madison based software provider that is developing customized sofware solutions for engineering analysis.

40. Statistical Control Algorithms to Identify Systematic Quality Problems in Manufacturing Environments

The quality of a product is partially determined by the variability of the distribution of values of a characteristic. In the long run, the smaller the variability, the better the product. The aim in this project, a collaboration with Springs Window Fashions, Middleton, was to put into practice a methodology that uses design of experiments (DOEs) to discover the factor(s) that drive critical variables and to control and monitor those variables to improve quality.

This is a continuation of efforts to improve the pleating and gluing machine performance at Springs. The researchers illustrated the effectiveness of this process improvement methodology using an industrial case study that identified and eliminated a recurring output quality. They conducted some experimental designs with the goal of fine-tuning the adjustment equation they obtained in their previous work with this company.

Springs estimated its cost of conducting the DOE project at $15,000. This cost included the scrap, machine downtime, and labor. The payoff for this investment, however, was a significant improvement in quality and production. Company managers conservatively estimate that $100,000 in savings can be directly related to this project. Many other process-oriented manufacturing companies, such as paper, food and beverage and pharmaceuticals, may benefit economically from the quality improvement approach developed in this project. The PI and a colleague envision this work becoming a part of the case studies in a new course they hope to develop.

41. Development of Web-Enabled Advanced Planning and Scheduling Tools

This research project aims to develop web-enabled, high quality, flexible, and adaptive planning and scheduling tools for manufacturing systems. Effective use of manpower, equipment, financing, and time requires a tool that accurately reflects all operational constraints

John Deere-Horicon committed $27,000 to investigate inventory planning, improvement, and optimization on this project. This research effort builds on recent innovative research in the researcher's laboratory in the areas of large-scale optimization, particularly the newly-developed methodology of Nested Partitions (NP). The research study shows that the NP method and its hybrids have been very effective in a wide variety of planning and scheduling environments. In this project, the researchers have developed a rough scheduling prototype that could be tested on the internet by many manufacturing firms in Wisconsin. By having industry partners try the prototype on actual systems, obtaining feedback on the performance of the prototype, they could improve both basic methodology

and prototype to transfer quickly their research results to Wisconsin industrial users. Moreover, successful development of the proposed prototype may well lead to fruitful attempts to develop and commercialize decision support software tools that can be used for many industry sectors.

This research effort will help companies efficiently plan and schedule their resources for optimal operations and will significantly improve their daily performance. It will provide significant benefits to Wisconsin manufacturing industry.

42. Field Controllable Self-Assembly of Polymer-Based Composites

Field-aided self-assembly technology provides greater flexibility in forming structures than traditional composite fabrication processes. This includes the ability to create regions of desired stiffness or material orientation. The proposed method involves applying electric fields to plastic composites in their liquid form to rearrange inclusions, thereby creating a new structure, i.e., effective "pseudo fibers." This technology will be applied to several sample configurations to demonstrate the feasibility of the developed approach.

The researchers developed a new manufacturing approach based on electric field-aided self-assembly in composites. Several composite systems have been tested. In addition to transferring the technology to cooperating partners on the project, results were presented at several conferences, and three journal, peer reviewed articles are in preparation.

The State of Wisconsin has an extensive plastics industry. This research is a part of the overall activity of College of Engineering Polymeric Rearch Center (a NSF-funded consortium). Stress Photonics, Madison, Wisconsin, contributed the use of its TSA Delta Therm system and other equipment, valued at $12,000 to this project, and Phillips Plastic Corporation, Prescott, Wisconsin donated a $40,000 injection molding machine to be used for this and other projects. Industrial members of the consortium are receiving updated information from this project on a regular basis, and the researchers anticipate that several Wisconsin companies will be interested in this technology. The results of this study helped the researchers to apply for and receive a $315,000 award from NSF.

43. Experimental and Numerical Study of the Pultrusion Process

Major plastics industry concerns about the continuous processing method of pultruded products include curing or conversion, dimensional consistency, void removal, and economic and environmental concerns. The project was developed to study the pultrusion process from a theoretical as well as experimental point of view. This was done by fully characterizing the materials used in pultrusion and fitting these into models that could be used to actually simulate the process.

The researchers fully characterized a standard material used at Teel Plastics, Baraboo, Wisconsin. They also simulated one of their processes. With the results of this study they were able to optimize the process, resulting in shorter cycle time and high part quality. The new measuring techniques are now covered in the course, Mechanical Engineering 418, Engineering Design with Polymers, and the techniques are taught through an outreach program. The results also were published at the Annual

Technical Conference of the Society of Plastics Engineers.

The study helped the researchers and their industrial partners better understand the process, and thus, eventually lead to process and product improvement. They continue to work on the process with the industrial partners. The simulation and techniques that resulted from this project have served as a catalyzer for new projects with Wisconsin companies. It also was key to receiving a $200,000 NSF grant for the "Partnership For Innovation" program that links Wisconsin schools with a plastics program (Platteville, Stout, and MATCs in Madison and Milwaukee) and various Wisconsin industries. Teel Plastics and Simtec provided an addtional $15,000 support for this project.

44. Enhancing Ability of Bovine Sperm to Survive Cryopreservation with Cyclodextrin and Cholesterol

It is the goal of this project to increase the survival of bovine sperm during cryopreservation, thereby increasing the number of insemination doses that can be obtained from an ejaculate. To accomplish this, the researchers proposed modification of sperm membranes by adding cholesterol via cyclodextrin. The specific objectives were: 1) to determine the optimal dose of cyclodextrin-cholesterol needed to enhance cryosurvival of bovine sperm; 2) to determine how variable the response is among bulls; 3) to determine if the response to cyclodextrin-cholesterol varies among collections within a bull; and 4) to determine if there are characteristics in the semen that would allow us to predict which level of cyclodextrin-cholesterol to use for a particular bull to achieve an optimal response.

A total of 20 bulls from ABS Global, Deforest, Wisconsin, were evaluated in two trials for sperm cryosurvival following treatment with cholesterol loaded cyclodextrin. Sperm were evaluated for post-thaw motility, viability, resistance to hyperosmotic swelling, acrosomal integrity, and capacitation status. The experiment established optimal doses of cholesterol-loaded cyclodextrin to be added to bovine sperm to increase cyrosurvival in a commercial semen processing setting. The approach was unique in that the test compound was added directly to ejaculated semen prior to processing, regardless of semen concentration.

The project was intended to increase the doses of semen that could be sold by reducing the number of sperm needed per insemination dose. While the goal was accomplished, any potential products from this research will depend on future field fertility tests of the procedure in which cows are bred with the semen to determine fertility. Negotiations with ABS Global are underway to determine if this will be done during the coming year. Wisconsin is home to four of the five major bull studs in the US. These four bull studs maintain approximately 75% of the Holstein bulls used for insemination of dairy cattle. A conservative estimate is that semen produced in Wisconsin from all four companies results in gross receipts of approximately $300,000,000. These organizations are facing reduced sales as dairy cattle numbers decrease in Wisconsin and the U.S. in general. To maintain the economic vitality of the industry, new approaches must be sought to reduce production costs and increase revenue if they are to remain viable enterprises.

45. Engineering Scale Up and Economics of Biopulping: A New Energy-Efficient and Environmentally-Friendly Technology for Papermaking

The long-range goal of the project is to implement biopulping (a technology developed at the University and patented through WARF) at the SENA pulp mill in Whiting, Wisconsin. Biopulping International of Madison and SENA received a USDOE grant to conduct pilot and mill-scale trials at SENA. Follow-through implementation at the mill will require determination of the rate-of-return economics. This requires an accurate capital cost estimate for the biopulping process, and this work is not funded by the DOE grant. The project objectives included development of a full-scale design for implementing biopulping at the mill and the corresponding capital cost estimate. The researchers directed the design functions provided by the Harris Group, of Appleton, Wisconsin and Portland, Oregon. Other objectives included bench-scale experiments to collect data needed for scale up.

The requisite capital cost estimate was performed. This work was completed by Harris and transmitted in the formal report "BioPulping System--Feasibility Grade Scope and Estimate." In addition to work on the Harris study, the researchers designed and supervised the construction and operation of a bench-scale reactor to collect engineering data for scale up, including reaction calorimetry and hydrodynamic behavior. Critical data for the industrial-scale system design were obtained.

The design study and capital estimate produced by the project provides one of the last pieces of information needed to complete the commercialization of biopulping. In the near future, the PI expects to provide technical assistance in conducting the mill scale trials. Upon a successful in-mill demonstration, the research team hopes that the decision to implement the technology in commercial operation will be positive, resulting in the first commercial license. The paper industry in Wisconsin and nationally is facing significant economic pressures that are expected to increase. The process being developed would boost the competitive position of this industry by reducing the cost of pulp production significantly. The biopulping process improves downstream pulping processes, leading to more efficient conversion of wood materials into value-added high quality pulps. It saves a substantial amount of electricity (30%), improves paper quality, and reduces the environmental impact of pulping, thereby enhancing economic competitiveness. An economic analysis conducted for a mill processing 242 tons of feed chips per day demonstrated a $7.5 million potential annual savings. The impact on the economics of the industry would be significant.

46. Development of the California Mouse (*Peromyscus californicus*) as a Model of Hyperlipidemia and Type II Diabetes Mellitus

The purpose of this project was to develop the California mouse (*Peromyscus californicus*) as a model of high blood lipid levels and metabolic changes that often precede type II diabetes. It had already been determined that some of these mice developed high blood lipid, insulin, and glucose levels after being fed a moderately high fat diet. Some mice became diabetic. Mice were selectively bred to produce mice that have either high or low blood lipid responses after high fat feeding. Many laboratories are interested in the role that the chemical leptin plays in the regulation of blood lipid concentration and glucose tolerance. In order to further develop the California mouse model, the researchers proposed to measure blood concentrations of leptin and the number of leptin receptors in selected tissues (brain, liver, pancreas, and white fat).

Tissues have been collected for analysis of leptin receptor and will be analyzed using PCR technology. The researchers have also determined that California mice fed a high-fat diet for 12 weeks develop fatty livers and a condition called nonalcoholic steatohepatitis (NASH). Their findings make the California mouse a unique naturally-occuring model of NASH. A new collaborator has joined this effort and additional experiments are planned using the California mouse as a model of human liver disease. Additionally, the researchers expect to meet with representatives from the Japanese pharmaceutical company, Sankyo, to discuss potential sale of a license for these mice.

This funding has kept the high blood lipid and low blood lipid mouse colonies going while the researchers have acquired additional collaborators and interest from pharmaceutical firms. They hope to breed and sell these mice to pharmaceutical companies.

47. MEPP Internal Combustion Engines Program

The objective of this project was to determine the feasibility of a distance education Master's Degree in Internal Combustion Engine Design. The researchers needed to develop a business plan, survey the market needs, and design a curriculum to meet the needs of this specialized clientele. The UIR funding allowed the initiation of this program. Without the funding the program would not have been started. It resulted in market studies and a business plan that allowed the new degree program to be approved. The program admitted applicants for a pilot class to begin studies in June 2003. The results were positive and there are now a group of students from industry, mostly from Wisconsin, to test the quality of the plan which started in the Fall of 2003.

The project will result in practical advanced degrees for engineers working in engine design. Wisconsin has many companies involved in engine design, and this program provides the knowledge and skills that will increase the capabilities of the engineering workforce for these companies. Some Wisconsin companies that expressed interest in this project are Harley-Davidson, Waukesha Engine, Daimler-Chrysler, and Mercury Marine. Additionally, several large companies outside of Wisconsin expressed interest in this project, among them: John Deere, International Truck, Borg Warner, and Arctic Cat.

48. Building Community Knowledge Base: A Large-Scale Network Analysis Program

The goal of this grant was to develop a working model of software that maps civic and community networks, central to organizational life in business and government, that could be used by non-specialists. The software included an interface, a matrix database, and a network visualization output.

The project has largely succeeded. The researchers have an alpha model of the software with each of the three components. It is heading into a beta phase, as they seek to refine each of the components, particularly the visualization module. They are trying to move from a package that moves from input, to analysis, to output in a single step (which we have achieved) to improved speed and quality of visualization. They are in the second year of a test, working in collaboration with Dane County United Way, WISC-TV, and Edgewood College. If successful in receiving a $280,000 grant from the W.T. Grant Foundation (award decision in December 2003), they will expand the project into a three-city

field test.

They have discussed the project with WARF and believe that licenses will be forthcoming, possibly in 2005, as they move from the testing phase. If successful, this may become a model for civic mapping in many communities across the U.S. The model is targeted toward both large, central non-profit community organizations (e.g,. United Way) and civic oriented news organizations. There are roughly 1100 United Way organizations in the U.S. and at least 375 civic news organizations. The researchers believe that the software and mapping process together should yield a minimum of $10,000 per community (possibly as high as $30,000, depending on community size). 10% of United Ways adopting the process at the conservative lowest rate would yield $1,100,000. 10% of civic news organizations would yield $370,000. In addition, they are partnered with the Search Institute of Minneapolis, which consults with 600 communities nationally, and is promoting the process, which would yield, at a conservative 10% adoption rate, $600,000 in revenue. This is a return of roughly $2,000,000, with growth potential throughout these three markets.

49. Hewlett-Packard Mobile Technology Solutions/L&S Learning Support Services

The College of Letters and Science (L&S) Learning Support Services staff conducted the research activities related to this grant. The grant was to provide student programming help for L&S Learning Support Services in support of a grant from Hewlett-Packard Corporation to create a mobile (wireless) language learning environment. In particular, student programmers were to develop a language lab player/recorder that could be used in place of traditional commercial, fixed installation language labs. They were also to help faculty develop web-based, wireless language learning activities.

The above objectives are being met, with the player/recorder still a work in progress. Thus, they have been able to create an environment in which students and faculty can use language learning activities anywhere in Van Hise Hall, using wireless networking technology. Several projects conducted activities in class settings. Others allowed students to work independently outside of class, and a few used fixed lab settings (e.g., for testing ESL proficiency.) Learning a foreign language and becoming more culturally aware will help Wisconsin students prepare to be better members of the industrial workforce. Although the number of students affected is initially small, over the years thousands will benefit.

50. Pilot Project to Evaluate the Commercialization Feasibility of Faculty and Staff Start-Up Companies Based on UW-Madison Technologies

The aims of this research were two-fold: 1) to provide faculty entrepreneurs with business assistance in developing marketing and business strategies for their emerging companies; and 2) to provide second-year MBA students in the School of Business with additional opportunities to apply their classroom learning experiences to practical situations in assessing the business feasibility of the technologies and inventions that come out of research laboratories on the UW-Madison campus.

During the school year the team worked on the following projects: a) Analysis of trends in Wisconsin Venture Capital investment. A detailed database of venture capital investment in Wisconsin companies for the period 1992-2002 developed and a software tool was developed to allow analysis of the

information; b) Preparation of a comparative evaluation of Wisconsin and Minnesota in terms of the climate for high tech investing and the factors that contribute to differences between the two states related to high technology company growth; c) School of Human Ecology Helen Louise Allen Textile Collection business feasibility assessment; d) Business feasibility and market assessment for Intact Solutions, a software company offering products for engineering analysis; and, e) Brain Research Laboratories, a concept stage company under consideration by Dr. Charles Garell, Department of Surgery, Medical School. (Dr. Garrell asked for guidance in exploring the potential for a medical device business focused on wireless intra-cranial monitoring for ambulatory stroke and head trauma patients.)

This project facilitated development of early stage companies based on UW-Madison research. Such companies are a strong component of economic growth in Wisconsin. This research was of significance in that it provides faculty entrepreneurs with business assistance in developing marketing and business strategies for their emerging companies. At the same time, it provided MBA students in the School of Business with additional opportunities for applying their classroom learning experiences to practical situations in assessing the business feasibility of the technology and inventions that come out of research laboratories on the UW-Madison campus. For each of these benefits there are few alternatives available, and without this funding this kind of help would not be available.

C. Applied Research Program

Applied Research Program projects are funded through a competitive process administered by the UW System Office of Academic Affairs. All proposals were first evaluated by an institutional review panel before being submitted to UW System Administration.

In 2001-02, a total of 27 proposals requesting approximately $1,100,000 were submitted for review to the UW System. In 2002-03, a total of 22 proposals requesting approximately $850,000 were submitted. Each proposal was then reviewed and rated by a UW System review panel comprised of five to seven representatives of UW System institutions, a representative from the Wisconsin Department of Development, and a staff member from the UW System Office of Academic Affairs.

In addition to the quality of the research design and likelihood of successful completion, a major criterion for selection was the potential impact of the project on Wisconsin's economy.

2001-2002

1. Assessment of Potato Breeding Materials for Resistance to Late Blight Disease

This project screened newly-developed potato lines for their relative resistance to the fungus *Phytophthora infestans*, which causes potato blight. Twenty-nine varieties were tested during the summer of 2001, and another 34 varieties were tested during the summer of 2002, with known susceptible varieties used as controls. Four lines demonstrated high levels of resistance to the disease and will be used in further breeding work. New varieties developed as a result of this research will enable potato growers significantly to reduce their costs associated with chemical control of this disease.

2. Novel Micro-pore Filter Technique for Brewing Process

This research investigated the use of pressurized carbon dioxide micro-filtering as a replacement for heat sterilization traditionally used in the brewing process. The research results indicate that, while this process cannot yet be applied to the brewing of beer, it does effectively eliminate microorganisms and can be used for the pasteurization of other beverages. The implementation of this process non-heating, micro-pore filter pasteurization promises to increase product quality and productivity while greatly reducing equipment and operation costs.

3. Development of Mesoporous Media for Removal of Arsenic in Groundwater

The objective of this project was to develop and assess materials for the removal of arsenic from drinking water through a process of adsorption. This project demonstrated that the experimental material was much more effective and less expensive than activated alumina, which is currently the most widely used medium for arsenic removal. The direct result of this research has been the application for patent and completion of an agreement for commercialization of this technology.

4. Farm Technology to Utilize Fish Processing By-products

The objective of this project was to develop a low-cost technology for production of fish feed pellets from trout by-products. The process for pellet production has been developed and the fish feeding trial is on-going. This process provides a resource recovery system that will greatly increase utilization of harvested fish. Results of this research are being shared with fish farmers through collaboration with the Wisconsin Aquaculture Association.

5. Firmware Development for an Optical Workstation Designed for the Study of Living Specimens

This project resulted in the development of a flexible, high-performance scan generation system for the laser-scanning microscope component of our optical workstation that does not use purpose-designed electronics. This system is very flexible, in that all the functionality of the system is achieved by firmware. New functionality can be added to the system without any hardware design or reconfiguration. Researchers are now working with our industrial partner in an R&D phase to incorporate this firmware in their commercial instrumentation.

6. Concrete Brick and Block Manufacturing Using Wood Ash Generated from Wisconsin Pulp and Paper Industry

This project demonstrated the use of wood ash as a cost-saving alternative in brick and block manufacturing. Research in this project indicated that concrete block mixtures may successfully incorporate up to 35% wood ash. Implementation of these research findings can provide the base for beneficial economic ties between the pulp and paper industry and concrete products manufacturers.

7. Developing Predictive Thermal Optimization Tools for Laser-assisted Manufacturing

The objective of this proposal is to apply predictive models for the optimization of heat removal in laser-assisted manufacturing to optimize the quality of the manufactured products. The primary benefit of this research will be the elimination of heat-induced effects, such as distortion, thermal residual stresses, and cracking, in the contact zone. Given the promising results so far, research on this project has been extended through the coming funding cycle.

8. Velocity, Shear Rate, and Temperature Balance of Polymer Flow Through Extrusion Dies

The goal of this project was to develop an iterative numerical algorithm for improving the die performance, and to implement the algorithm in die design programs for a partner firm in Wisconsin. The results of this research project led to more accurate design of dies, especially for the extrusion of degradable and multi-layer materials. The results of the project will also help better understand polymer behavior, which will in turn, support the extrusion and mold-design industries in Wisconsin.

9. Development of a Computer Model to Predict Knocking in a Small Utility Gasoline Engine

The purpose of this research project was to develop a computer model that would identify the conditions under which knocking occurs in a small-size utility engine. The project research was conducted in collaboration with a Wisconsin manufacturer and did result in a successful computer model. A technical paper detailing the development and application of this model will be published by the Society of Automotive Engineers.

10. Evaluation of a Temperature-phased Anaerobic Digestion System for the Dairy Industry

The objective of this project was to monitor and test the performance of the Temperature-phased Anaerobic Digestion (TPAD) system at Tinedale Farm in Wrightstown, Wisconsin, during the first year of operation. This was the first installation of a TPAD system for the dairy industry in the United States and it was therefore important to demonstrate that this type of anaerobic digestion system could be operated efficiently and economically by the dairy industry. Research on this project will continue through the coming year. Knowledge gained during this evaluation process is expected to contribute to the widespread implementation of this digester technology to the dairy industry in Wisconsin and nationally.

11. Development of Robust Torsional Disturbance Rejection Algorithm for Motor Drives

The objectives of this project were to develop a new motor control algorithm to reduce the effects of mechanical load, to validate experimentally the effectiveness of the proposed algorithm by experiments, and to disseminate the validated algorithm to the automation industry in Southeastern Wisconsin. The experimental modeling was successful and results have been shared with industrial partners in Wisconsin for commercialization.

2002-03

1. In-Line Viscosity Monitoring of Polymer Melts Using Dielectric Measurements

The objective of this research project was to design a hardware and software system capable of measuring various parameters of the polymer melt in real-time and without disturbing the flow of fluids in the extrusion process. Experimental results are promising and will be the basis of further funded research in this area.

2. An Enemy Within: Epidemiology and Control of Apple Scab in Wisconsin

This project investigates the over-wintering relationship between the apple scab pathogen in Wisconsin, *Venturia inaequalis*, and the plant host. Evidence was obtained that *V. inaequalis* survives in buds, whereas dogma holds that the pathogen survives the dormant season in apple leaf litter on the orchard floor. This discovery has implications for control of the disease. Apple scab is the most important disease of apples in Wisconsin and control typically requires some 8-15 fungicide sprays annually. Better knowledge of the life cycle of the pathogen is essential for the development of better controls.

3. New System for the Production of Commercially Important Proteins

The goal of the proposed work is the development of a bacterial host/vector system for the production of membrane proteins. Wisconsin is positioned to be an international leader in production of recombinant proteins. However, a barrier exists in the production of membrane proteins. As a result of this research, factors were identified that either increased the level of recombinant membrane protein produced. Extension of the capacity to produce membrane proteins would enhance production of molecular biology tools by Wisconsin biotech companies. On this basis, further development is proposed and is the subject of a pending grant proposal from a Wisconsin sponsor.

4. Heat Protection of Egg Yolk Antibody, and The Use of Egg Antibodies as an Alternative to Antibiotics in Animal Feeds to Improve Growth and Feed Efficiency

The goal of this project is to develop a method so that we can protect egg yolk antibodies from the high-heat, high-moisture conditions in commercial feed pelleting machines. The research has resulted in a technology to encapsulate egg antibody which can withstand the pelleting process and retain reasonable antibody activity. This new technology invention has been submitted to WARF and is being processed for patent application.

5. Optimum Experimental Design of a General Purpose Load Transducer

The objective of this project was the development of a computational methodology to select the number, locations, and angular orientations of strain gages that would provide the most precise load estimates. One of Wisconsin's manufacturers, Harley-Davidson, has already begun to implement the procedures developed during the course of this research. The Buell Motorcycle Company is also interested in utilizing these procedures. Since the proposed procedures are expected to shorten the testing-time associated with the development of new products, the outcomes of this research will help companies develop cost-effective products in a shorter time.

6. Characterization of Polymer Cleaning of Precision Optics and Surfaces

The objective of this project is the development and testing of a polymer strip coating that is residue-free at the molecular level. The resulting polymer will be of value for improving performance of high-resolution optical system, such as telescopes and CD-equipment. This product has a world market and can be commercialized in Wisconsin.

7. Cultivar Confirmed - A DNA Fingerprinting System for Soybean

The object of this project was to whether DNA markers extracted from seed as well as leaf material can be used to identify closely related soybean cultivars. This information would be valuable not only for varietal identification prior to selling the seed lot, but also for varietal patenting, and assessment of contaminated seed lots. The procedures developed in this research are being commercialized in Wisconsin.

8. Determination of Profitability Potential of New Strawberry Cultivars in Wisconsin

The objective of this project is to evaluate new North American strawberry cultivars for yield, vigor, plant stand, winter hardiness, disease susceptibility and fruit quality. Results of research will be made available for commercialization through Wisconsin grower associations.

9. Identification of Enzymes and Metabolic Pathways Used by Lactobacillus Casei to Enhance and Intensify Cheese Flavor

The objective of this project was to develop DNA microarrays that encode enzymes involved in metabolic processes linked to flavor development in bacterial-ripened cheeses and to determine the effect of cheese ripening conditions on expression of these genes. As a result of this research, all of the necessary protocols have been developed for the use of DNA microarrays to evaluate the expression of lactic acid bacteria in dairy related environments and further funding is being sought to bring this process closer to commercialization.

10. Web-based Knowledge Management System for the Wisconsin Plastics Industry

This project is aimed at developing a structural approach and sustainable knowledge management framework which organizations such as Wisconsin plastics companies can use for networking, collaboration, problem-solving and entrepreneurship to catalyze innovation and to capitalize on innovation-based opportunities through collaborative product development and commercialization. To date, a prototype of the Web-based knowledge management system has been developed and is being tested.

11. Virtual Meter Technology for Large Electrical Systems

The objective of this project was to develop an optimal meter placement algorithm for distribution systems to reduce the investment in meters while ensuring accurate monitoring and control. An algorithm for distribution networks has also been developed that utilizes the measured data from the meters. Simulation results demonstrated the advantages of this algorithm when applied to several test systems. Currently several papers related to this project are being prepared for publication and further funding from WE-Energy is anticipated.

12. Outdoor Image Segmentation in an Automatic Occupancy Sensing System

The objective of this project is to develop an automatic occupancy sensing system that will be deployed in automobiles to prevent air-bag related injuries to infants and small children. Results of this research will be commercialized in collaboration with a Wisconsin manufacturer.

Appendix A

Industrial & Economic Development Awards (UIR)
2001-02

Project numbers refer to the numbers in the text.

Proj. No.	Project Title	Principal Investigator (PI)	Department	Amount
1	Novel Method for Killing Pathogens	Marcin Filutowicz	Bacteriology	$29,500
2	Pilot Test of Environmental Management System for the Wisconsin Dairy Industry	Gary Jackson	Environmental Resources Center	$21,500
3	Commercial Feasibility Studies on Disposal of Spent Sausage Casings—Solid Substrate Cultivation for Production of Feed Quality Proteins	Hassan Sreenath	Biological Systems Engineering	$34,120
4	*Lactobacillus helueticus* CNRZ32 genome: Closing Gaps & Clining Genes with Industrial Utility	James Steele	Food Science	$17,500
5	Nutrient Cycling, Crops, Livestock, and the Environment (N-CyCLE): A Tool for Profitability and Environmental Management of Wisconsin Farms	Michel Wattiaux	Dairy Science	$28,669
6	Development of Novel Process for Large-Scale Production of High-Purity Plasmid DNA	Derek Hei	Waisman Center for Developmental	$30,000
7	Metal-Oxide Thin-Films with Magnetically-Tailored Nanoporosity as a Novel Energy-Separating Agent and Condensation Technology	Dean Tompkins	Water Chemistry Graduate Program	$22,199
8	New Drugs for the Selective Destruction of Tumor Cells via Mitochondrial Targeting	Guilherme Indig	Pharmacology	$30,000
9	High-Powered Single-Mode Semiconductor Diode Lasers for Fiber-Optical Communications	Daniel Botez	Electrical & Computer Engineering	$50,000
10	Development of a Medical Safety Reporting System in Primary Care Setting	Ben-Tzion Karsh	Industrial Engineering	$23,692
11	Stream-of-Variation Modeling & Analysis for Multi-Station Manufacturing Processes	Dariusz Ceglarek	Industrial Engineering	$18,650
12	Investigation of Alternative Methods to Provide On-Line Destruction of Pathogenic Bacteria in Brine Chilling of Packaged Food Products	Sanford Klein	Mechanical Engineering	$14,000
13	Plasma Surface Treatment of Thermally-Sprayed Dielectric Coatings	Kumar Sridharan	Center for Plasma-Aided Manufacturing	$15,641
14	Innovations and Process Optimization for Injection Molding	(Tom) Lih-Sheng Turng	Mechanical Engineering	$26,756

15	Near-Field Biological Imaging with a Micro-Fabricated Aperture Array	Daniel van der Weide	Electrical & Computer Engineering	$29,000
16	Self-Powered Brake Pads Consumption Monitoring System	Amit Lal	Electrical & Computer Engineering	$20,850
17	Broad-Spectrum Micro-Aarray Assays for Human Viruses	Paul Ahlquist	Oncology	$30,000
18	Development of Application Principles of Polymer Dispersants and Surfactants	Hyuk Yu	Chemistry	$18,350
19	Comparison of Two Types of Knowledge-Based Start-Up Firms	Anne Miner	Management and Human Resources	$25,000
20	Expression Cloning of the P-Selectin Ligand System in the Horse	Benjamin Darien	Medical Sciences	$22,580
21	Developing Methods for Genomic Research in AT-Rich Industrial Bacteria	James Steele	Food Science	$30,000
22	Bioavailability of Betalains as Cancer Chemopreventive Agents and Antioxidants in vivo	Kirk Parkin	Food Science	$23,250
23	Methods of Displacing Plasmids from Bacterial Populations	Marcin Filutowicz	Bacteriology	$18,125
24	Detection of Viruses Using Surface Plasmon Resonance Imaging	Robert Goodman	Plant Pathology	$30,000
34	Support for Endocrine-Disruption International Cooperative Research (EDICOR)	Richard Peterson	Pharmacy	$8,760
47	MEPP Internal Combustion Engines Program	John Klus	Engineering Professional Development	$7,000
	TOTAL			$625,142

Appendix B

Industrial & Economic Development Awards (UIR)
2002-03

Project numbers refer to the numbers in the text.

Proj. No.	Project Title	Principal Investigator (PI)	Department	Amount
10	Development of a Medical Safety Reporting System in Primary Care Setting	Ben-Tzion Karsh	Industrial Engineering	$5,643
25	Sorghum Proanthocyanidins and Atherosclerosis	Jess Reed	Animal Sciences	$31,621
26	Decrease Lipid Oxidation in Food with Natural Antioxidant in Cranberries	Mark Richards	Animal Sciences	$35,348
27	Altering the Sex Ratio on Wisconsin Dairy Farms Using Low-Cost *In Vitro* Embryo Production with Sexed Semen	Kent Weigel	Dairy Science	$30,000
28	Identification of Microbial Species Common to Potatoes with Pink-Eye Disease	Amy Charkowski	Plant Pathology	$26,975
29	Laser-Based Versatile Automated System for Cheese Cutting and Marking	Xiaochun Li	Mechanical Engineering	$32,900
30	Educational Tourism: Making the University Campus a Destination for Exploration	Thomas Zinnen	UW Biotechnology Center	$30,000
31	Genomic Micro-Arrays for the Diagnosis of Development Delay and Mental Retardation	Kirk Hogan	Waisman Center on Mental Retardation and Human Development	$31,588
32	Reusable Cold Wall Vortex Liquid O2 Combustion Rocket Engine	Mark Anderson	Engineering Physics	$20,586
33	Construction of New Recombinant Immunotoxins Directed at Activated Alloreactive T Cells Responsible for Graft Rejection	Huaizhong Hu	Surgery	$32,956
34	Support for Endocrine-Disruption International Cooperative Research (EDICOR)	Richard Peterson	Pharmacy	$8,760
35	Novel Cost-Effective Production of Whitetop Linerboard	Raymond Young	Forest Ecology and Management	$20,088
36	Laser-Based Sensors for Rocket Engine Development	Scott Sanders	Mechanical Engineering	$22,969
37	Optimization of Spray Evaporative Cooling for Multi-Chip Modules	Tim Shedd	Engineering Physics	$26,088
38	Development of Antibodies to Aid in the Disarming & Killing of Pathogenic Bacteria	Richard Burgess	Oncology	$35,000
39	Interactive Exploration of Multi-Dimensional Data	Vadim Shapiro	Mechanical Engineering	$36,780
40	Statistical Control Algorthims to Identify Systematic Quality Problems in Manufacturing Environments	Harriet Nembhard	Industrial Engineering	$30,000

41	Development of Web-Enabled Advanced Planning and Scheduling Tools	Leyuan Shi	Industrial Engineering	$18,710
42	Field Controllable Self-Assembly of Polymer-Based Composites	Yuri Shkel	Mechanical Engineering	$27,588
43	Experimental and Numerical Study of Pultrusion Process	Tim Osswald	Mechanical Engineering	$23,388
44	Enhancing Ability of Bovine Sperm to Survive Cryopreservation with Cyclodextrin and Cholesterol	John Parrish	Animal Sciences	$7,650
45	Engineering Scale Up and Economics of Biopulping: A New Energy-Efficient and Environmentally-Friendly Technology for Papermaking	Ross Swaney	Chemical Engineering	$30,000
46	Development of the California Mouse (*Peromyscus californicus*) as a Model of Hyperlipidemia and Type II Diabetes Mellitus	Lisa Krugner-Higby	Research Animal Resources Center	$15,000
48	Building Community Knowledge Base: A Large-Scale Network Analysis Program	Lewis Friedland	Journalism & Mass Communication	$30,000
49	Mobile Technology Solutions/L&S Learning Support Services	Mary Anne Fitzpatrick	Communication Arts	$20,000
50	Pilot Project to Evaluate the Commercialization Feasibility of Faculty and Staff Start-Up Companies Based on UW-Madison Technologies	Allen Dines	Weinert Center for Entrepreneurship	$22,506
	TOTAL			$652,144

Appendix C

Applied Research Program Awards
2001-2002

Principal Investigator	Campus	Amount	Title
Terese Barta	UW-Stevens Point	$23,600	*Assessment of Potato Breeding Materials for Resistance to Late Blight Disease*
Ryo Amano	UW-Milwaukee	$50,070	*Novel Micro-pore Filter Technique for Brewing Process*
Jae K. Park	UW-Madison	$13,599	*Development of Mesoporous Media for Removal of Arsenic in Groundwater*
Gour Choudhury	UW-Stout	$49,312	*Farm Technology to Utilize Fish Processing By-products*
John White	UW-Madison	$41,081	*Firmware Development for a Optical Workstation Design for the Study of Living Specimens*
Tarum R. Naik	UW-Milwaukee	$45,817	*Concrete Brick and Block Manufacturing Using Wood Ash Generated from Wisconsin Pulp and Paper Industry*
Tien-Chien Jen	UW-Milwaukee	$48,056	*Developing Predictive Thermal Optimization Tools for Laser-assisted Manufacturing*
Mohamed Elgindi	UW-Eau Claire	$20,249	*Velocity, Shear Rate, and Temperature Balance of Polymer Flow Through Extrusion dies*
Rolf Reitz	UW-Madison	$35,216	*Development of a Computer Model to Predict Knocking in a Small Utility Gasoline Engine*
John Katers	UW-Green Bay	$44,424	*Evaluation of a Temperature-phased Anaerobic Digestion System for the Dairy Industry*
Wonshik Chee	UW-Milwaukee	$49,813	*Development of Robust Torsional Disturbance Rejection Algorithm for Motor Drives*
TOTAL		$421,237	

Appendix D

Applied Research Program Research Awards
2002-2003

Principal Investigator	Campus	Amount	Title
Nidal Abu-Zahra	UW-Milwaukee	$49,253	*In-Line Viscosity Monitoring of Polymer Melts using Dielectric Measurements*
John Andrews	UW-Madison	$22,461	*An Enemy Within: Epidemiology and Control of Apple Scab in Wisconsin*
M.L.P. Collins	UW-Milwaukee	$48,092	*New System for the Production of Commercially Important Proteins*
Mark E. Cook	UW-Madison	$36,426	*Heat Protection of Egg Yolk Antibody, and the Use of Egg Antibodies as an Alternative to Antibiotics in Animal Feeds to Improve Growth and Feed Efficiency*
Anoop K. Dhingra	UW-Milwaukee	$44,724	*Optimum Experimental Design of a General Purpose Load Transducer*
James P. Hamilton	UW-Platteville	$42,399	*Characterization of Polymer Cleaning of Precision Optics and Surfaces*
Brad Mogen	UW-River Falls	$29,247	*Cultivar Confirmed – A DNA Fingerprinting System for Soybean*
Brain R. Smith	UW-River Falls	$16,197	*Determination of Profitability Potential of New Strawberry Cultivars in Wisconsin*
James L. Steele	UW-Madison	$34,522	*Identification of Enzymes and Metabolic Pathways Used by Lactobacillus Casei to Enhance and Intensify Cheese Flavor*
Lih-Sheng Turng	UW-Madison	$47,945	*Web-based Knowledge Management System for the Wisconsin Plastics Industry*
David C. Yu	UW-Milwaukee	$38,642	*Virtual Meter Technology for Large Electrical Systems*
Jun Zhang	UW-Milwaukee	$49,678	*Outdoor Image Segmentation in an Automatic Occupancy Sensing System*
TOTAL		$459,586	