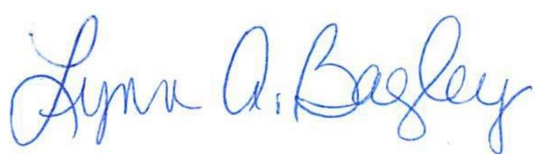
PROPOSAL SUBMISSION

Sponsor: The Ohio State University
Prime Sponsor: The Andersons Inc.

Title of Proposal:	Role of worker decision making in effective FSMA implementation
Principal Investigator:	Dr. Gretchen Mosher
Project Period:	June 1, 2018 – 5/31/2020
Requested Amount:	$50,000
ISU Reference Number:	GS 140293

Approved for Iowa State University by:



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Lynn A. Bagley, CRA
Pre-Award Administrator

Iowa State University
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The Andersons Research Grant Program

Project Title: Role of worker decision making in effective FSMA implementation

Principal Investigator(s):

Name	Institution/Agency/Other
Dr. Gretchen Mosher	Iowa State University

Project Contact (list one person to act as the primary contact):

Name:	Dr. Gretchen Mosher
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	605 Bissel Road, 3331 Elings Hall
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Period of Proposed Project Dates:

Beginning: June 1, 2018 Ending: May 31, 2020

Amount Requested (maximum $25,000 per year for two years):

Year 1: $25,000 Year 2: $25,000

Problem Identification and Related Research

The Food Safety Modernization Act (FSMA) represents one of the most sweeping reforms of the food legislation system in more than 70 years. Although the grain handling system in the United States has not traditionally focused on food safety concerns, the importance of ensuring safe grain in the food system cannot be discounted. A typical country elevator may handle as many as 4 million bushels of grain a year, sourced from an average of 250 suppliers and producers (Gordon, 2012). The bulk materials go on to be a part of hundreds of human and animal food and feed products (Friant, 2012). Clearly, the potential impact of safe food handling practices on the public is large.

The application of total quality management (TQM) in identifying preventive controls has been identified one potential method of meeting the food safety requirements of FSMA (Kheradia and Warriner, 2013). TQM programs generally focus on technical components such as process controls, standards, and benchmarking. However, as noted by Lunning and Marcelis (2007) and Nelson (2012), the effectiveness of a food handling system involves more than just technical aspects of a quality system – employee decisions and training also play a large role in the success or failure of a safe food system.

Very little research has examined how employees' perceptions and attitudes impact grain and food management programs, even though the perceptions could potentially play a significant role in the success or failure of such systems. Food safety-oriented duties often fall to employees. The seriousness with which they take on these tasks can have a large impact on the food safety outcomes in grain handling (Lunning and Marcelis, 2007; Hietschold, Reinhardt, and Gurtner, 2014). Specific food safety tasks where human factors play an important role include: the application of standards and tolerances, action on out-of-tolerance product, and the determination and implementation of critical preventive controls (Lunning and Marcelis, 2007; Kheradia and Warriner, 2013). All of these are important in the successful implementation of FSMA.

From a quality and food safety perspective, grain supply chains are unique in that they include products from many sources intended for diverse uses. As the products move through the supply chain, more and more grain lots are aggregated together (Thakur and Hurburgh, 2009). The result is the absence of a defined lot to identify or track complicates the identification and control of quality and food safety hazards (Thakur and Hurburgh, 2009). Furthermore, the grain handling supply chain is not well equipped to identify or measure low concentration food safety events. Threats occurring to grain-based food safety are often not large in their initial scope, but unique characteristics of the grain handling supply chain make it difficult to isolate and control hazards that do arise (Thakur et al., 2009).

Limited existing literature has examined the role of employee decision making processes in the success of grain-based quality and food safety systems (Mosher, Keren, and Hurburgh, 2013). Previous research by Mosher et al. (2013) examined the decision making process in a quality-oriented scenario, but did not examine food safety tasks. They found employees relatively disengaged with the impacts of quality practices within their organization.

Although the identification of preventive controls through FSMA has the potential to address several grain-based food safety risks, these hazards cannot be mitigated if employees fail to make appropriate decisions about the storage and handling of preventive controls. The role of decision making in a grain-based food safety risk model remains uncertain.

Objectives

The proposed research will address NC-213 Objective #2: "*to develop efficient operating and management systems that maintain quality, capture value, and preserve food safety in the farm-to-user supply chain*". The working hypothesis of this research is that worker decision making plays a significant role in successfully implementing FSMA management practices in a grain handling organization.

Judicious management of bulk grain products can deter many food safety issues. A more comprehensive understanding of the employee decision-making process in the grain handling context has the potential to support more efficient and effective operating and management systems training improvements. Yet, knowledge gaps exist in the agricultural-specific decision-making process. The aim of the proposed research is to address some of these gaps. Using decision-making analysis, I expect to answer two questions:

1. What is the level of employee awareness on specific tasks associated with the identification of hazards and preventive controls for animal foods?
2. What role do employee decisions play in the successful implementation of preventive control-related tasks in the grain handling organization?

Accordingly, the objectives of this research are to:

1. Utilize the Food Safety Preventive Controls Alliance process for identifying hazards and controls as the basis for constructing up to two decision making cases.
2. Administer decision cases to students who are/have completed / completing the Preventive Controls for Animal Food course at Iowa State University.
3. Utilize the information gathered to develop a decision tree to illustrate to grain handlers and processors the role of employee decisions in successfully administering FSMA preventive controls.

Methods

The subsections below explain the procedure that will be followed in this proposed study, separated by research objective. All work contributing to the project objectives will be carried out by Iowa State University personnel.

Objective 1 – Construction of two decision making cases

Using examples and concepts presented in the Preventive Controls for Animal Foods (1st Edition – 2016), two or more food safety-sensitive scenarios will be created. Decision-making cases are not written to have one correct decision alternative. Rather, the decision-making task involves weighing several options to determine the best response, given the scenario. Scenarios will be reviewed by grain professionals, extension personnel, and preventive controls instructors to ensure the situation presented is valid and realistic.

To facilitate the measurement of the employee decision making process, a modified version of the process-tracing methodology will be used. Process tracing uses a linear model to measure the intervening steps between information acquisition and the decision choice (Newell et al., 2007; Ford et al., 1989). A major reason for using process tracing is that it allows researchers to infer what strategy is used by decision-makers in gathering the information they use to make a decision choice.

For each simulation, a brief safety-oriented scenario is developed, along with four decision alternatives and four to six factors that are hypothesized to influence the decision choice. Decision alternatives could include options to follow preventive controls protocols, take a shortcut, ignore the protocol, or attempt to complete the protocol incorrectly. Potential decision factors in a preventive controls-based case could be time pressure, peer pressure, management support, and financial risk. The order of decision alternatives and decision factors are randomized to prevent the order of presentation from significantly influencing the outcome of the decision making case.

Scenarios will be drawn from actual incidents and from the Preventive Controls for Animal Food training curriculum (1st Edition – 2016). The target audience for the decision making scenarios are employees who have completed the Preventive Controls Qualified Individual training program as well as grain elevator employees who manage grain quality or food safety compliance.

Objective 2 – Administer decision making cases

Decision cases will be administered to grain handling employees who have completed Preventive Controls Qualified Individual training. Dr. Mosher has employee contact information for two completed training programs and this group will be the primary sample. Additional grain elevator employees who coordinate grain quality management or food safety will also be utilized as a sample group.

Employees will be sent an electronic link that will take them to two decision making cases. In each scenario they will be asked to read the scenario, view and rank the contributing factors in order of importance to their decision, and select a decision choice. Scenarios will be presented in random order to minimize any ordering bias related to decision choices and contributing factor selection. A weighted multi-voting procedure will be used to rank factors influencing the decision choice, similar to the procedure described in Grover, Chopra, and Mosher (2016). Limited demographic information will also be collected to determine each employee’s age, tenure with the grain handling organization, and their training history in grain-based food safety preventive controls.

Objective 3 – Decision tree development

Using decision data to predict the role of the employee in managing grain-based food safety has had limited exploration in the research literature. Historically, researchers and practitioners have utilized many techniques to quantify the role of hazards in work routines (Kingman and Field, 2005). Common examples include: cause and effect diagrams, fault tree analysis, and event tree analysis (Khakzad, Khan, and Amyotte, 2011). Event tree analysis (ETA) will be utilized in this case because of its binary logic modeling approach and the usefulness in evaluating management decision options (Clemens and Simmons, 1998; Mosher and Keren, 2011).

Construction of an ETA is a multi-step process. The end result is an examination of a system's response to an initiating event and the various paths of system successes and failures. However, the first step is identification of the initiating event. In this case, the initiating event is defined in the decision making scenario and will involve a grain-based food safety task. Once this event is defined, the next step is to isolate the countermeasures, events that influencing initiating event (also identified as part of the decision making scenario). Countermeasures may be technical, such as an equipment alarm, or administrative, such as a supervisor's approval or a permitting process (Rausand and Hoyland, 2004). Next, the sequences of events which occur following the initiating event are assigned probabilities. Probabilities of individual event sequences are multiplied together along each path to calculate the probability of system success and system failure.

There are several advantages to using ETA to quantify the role of the employee in the success of a FSMA program in the grain handling organization. The analysis provides a graphical depiction of factors contributing to the success or failure of an event. In this case, the event is defined as the successful implementation of FSMA preventive controls practices. Event tree analysis also facilitates the evaluation of system failures that contribute to system failures and may also allow the identification of ineffective countermeasures. Detailed knowledge on the specific consequence of each sequence of events is not necessarily for the ETA to function appropriately (Mosher and Keren, 2011).

The outcome of this analysis is a simplified decision tree document, illustrating clearly the role of poor employee decisions or employee inactions. A lack of understanding of the FSMA legislation was identified as a primary factor in Grover et al.'s 2016 research, and estimating and quantifying employee actions can be a complex process. Using ETA will facilitate a clearer presentation of the role engaged employees play in the successful implementation of FSMA preventive control practices in a grain handling facility.

Anticipated Results, Products, and Impacts

The proposed project will answer a long-standing question about food safety in the grain facility: "*What role do employees play in facilitating food safety practices in a grain handling facility?*" In the short term, the information provides valuable information on the effectiveness of preventive controls training offered by the Food Safety Preventive Controls Alliance. It will also provide a quantitative estimate of the role employees play in the successful implementation of FSMA preventive control practices in the grain handling environment.

In the long term, the information, data, and tools generated by this project will facilitate a better understanding of how to better incorporate human considerations into required training, including training on food safety, bioterrorism, environmental regulations, and occupational safety.

The decision tree graphic and decision making data will be shared with the research and practitioner community through peer-reviewed conference presentations and journal articles. The anticipated products will also be shared with the grain handling industry through GEAPS, the

National Grain and Feed Association, NC-213 members, Extension crops field specialists, Iowa State University's Ag Decision Maker program and other relevant audiences. If demand warrants, the findings could be incorporated into an Extension fact sheet or other formal Cooperative Extension programs within the NC-213 region through the use of Ag Decision Maker applications or through related multi-state committees.

Leveraging Resources

The successful completion of this project will provide the basis for further investigation on alternative approaches to evaluating employee training strategies for effectiveness in required compliance-based training. The National Institute for Food and Agriculture (NIFA) offered by the USDA will be explored, specifically programs in Food Safety. A second means of funding will be sought from the USDA Foundational Research Program, which has programs in Biosecurity, Agricultural Technologies, and Food Safety, all of which could be used to fund further research in the role of the employee in continuing FSMA training. The practical knowledge obtained from this work will be used to design training tools and modules for preventive control qualified individuals in the nation's grain handling facilities as well as for extension and research personnel.

Timetable

The following timeline is proposed for this research.

Development of decision making scenarios	June 2018 – November 2018
Testing and validation of decision making scenarios	November 2018 – March 2019
Submit Year 1 report	March 2019
Administration of decision making scenarios to target audience	March 2019 – May 2019
Analyze decision making data, contributing factor data	May 2019 – September 2019
Construct event tree analysis	September 2019 – March 2020
Submit Year 2 report (NC-213 presentation)	March 2020
Finalize event tree analysis	March 2020
Write and submit journal articles and other dissemination	March 2020 – May 2020
Submit final report (NC-213 report in March 2020)	May 2020

Literature Cited

Clemens, P.L. and Simmons, R.J. (1998). *System safety and risk management: A guide for engineering educators.* United States Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health. Downloaded June 7, 2011 from: www.cdc.gov/niosh/topics/SHAPE/pdfs/safriskengineer.pdf

Food Safety Preventive Controls Alliance. (2016). Preventive controls for animal food, 1st Edition.

Ford, J.K., Schmitt, N., Schechtman, S.L., Hults, B.M., and Doherty, M.L. (1989). Process tracing methods: Contributions, problems, and neglected research questions. *Organizational Behavior and Human Decision Processes*, 43(1), 75-117.

Friant, N. (2012). *Food and feed safety: What grain operators need to know*. Presentation given at the 2012 National Grain and Feed Association and Grain Journal Safety Health and Grain Quality Conference, Kansas City, Missouri, August 1st and 2nd, 2012.

Gordon, R. (2012). FSMA implementation … a grain and feed industry perspective. Presentation given at the 2012 GMA Science Forum, Washington, D.C., April 3rd - 6th, 2012.

Grover, A.K., S. Chopra, and G.A. Mosher. Food Safety Modernization Act: A quality management approach to identify and prioritize factors affecting adoption of preventative controls among small food facilities. *Food Control*, 66, July 2016, 241-249.

Hietschold, N., R. Reinhardt, and S. Gurtner. (2014). Measuring critical success factors of TQM implementation successfully – a systematic literature review. *International Journal of Production Research*, DOI: http://dx.doi.org/10.1080/00207543.2014.918288.

Mosher, G.A. and N. Keren. 2011. *Analysis of safety decision-making data using event tree analysis.* Association of Technology, Management, and Applied Engineering (ATMAE) 2011 Conference Proceedings Paper.

Mosher, G.A**.**, N. Keren and C.R. Hurburgh. 2013. Development of a quality decision-making scenario to measure how employees handle out-of-condition grain. *Applied Engineering in Agriculture*, 29(5), 807-814.

Khakzad, N., Khan, F., and Amyotte, P. (2011). Safety analysis in process facilities: Comparison of fault tree and Bayesian network approaches. *Reliability Engineering and System Safety*, 96(8), 925-932.

Kheradia, A. and Warriner, K. (2013). Understanding the food safety modernization act and the role of quality practitioner in the management of food safety and quality systems. *The TQM Journal*, 25(4), 47-370.

Kingman, D.M. and Field, W.E. (2005). Using fault tree analysis to identify contributing factors to engulfment in flowing grain in on-farm grain bins. *Journal of Agricultural Health and Safety*, 11(4), 395-405.

Luning, P.A. and Marcelis, W.J. (2007). A conceptual model of food quality management functions based on a techno-managerial approach. *Trends in Food Science and Technology*, 18, 159-166.

Nelson, L.D. (2012). Training is key to FSMA compliances. *Food Quality*, August/September, 13-14.

Newell, B.R., Lagnado, D.A. and Shanks, D.R. (2007). *Straight choices: The psychology of decision making*. New York: Taylor and Francis Group.

Rausand, M. and Hoyland, A. (2004). *System reliability theory: Models, statistical methods, and applications*. Hoboken, NJ: Wiley-Interscience.

Thakur, M. and Hurburgh, C.R. (2009). Framework for implementing traceability system in the bulk grain supply chain. *Journal of Food Engineering*, 95(4), 617-626.

Thakur, M. G.A. Mosher, B. Brown, G.S. Bennet, H.E. Shepherd, and C.R. Hurburgh. *Traceability in the Bulk Grain Supply Chain*. Resource Magazine – Food Safety Series, April/May 2009.

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors in the order listed on Form Page 2.
Follow this format for each person. **DO NOT EXCEED FOUR PAGES.**

NAME Gretchen Ann Mosher	POSITION TITLE Assistant Professor
eRA COMMONS USER NAME (credential, e.g., agency login) gamosher	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	MM/YY	FIELD OF STUDY
Iowa State University, Ames, Iowa	B.S.	8/1996	Food Science
Iowa State University, Ames, Iowa	M.S.	12/2002	FCS Education & Studies
Iowa State University, Ames, Iowa	Ph.D.	5/2011	Agricultural & Industrial Technology

Professional Experience:

Iowa State University, Agricultural & Biosystems Engineering, Assistant Professor, August 2011-present
Iowa State University, Agricultural & Biosystems Engineering, Lecturer, August 2011 – August 2012
Iowa State University, Agricultural & Biosystems Engineering, Post-Doctorate Researcher, May 2011 – August 2011
Iowa State University, Agricultural & Biosystems Engineering, Graduate Research Assistant, August 2006 - May 2011
Iowa State University, Apparel, Educational Studies, & Hospitality Management, Lecturer, August 2003-August 2006
Iowa State University, Animal Science, Research Associate, October 1996 – March 2004

Professional Membership:

American Society for Engineering Education (ASEE), 2006 – present
Association of Technology, Management, and Applied Engineering (ATMAE), 2006 – present
Epsilon Pi Tau, technology honorary, 2008 – present
Gamma Sigma Delta, agricultural honorary, 2007 – present
International Society for Agricultural Safety and Health (ISASH), 2010 – present

Honors and Awards:

- 2017 ASABE Educational Aid Blue Ribbon Award for Electronic Delivery for "Training on Prevention of Grain Dust Explosions", R.P. Kingsly Ambrose, G.A. Mosher, D.E. Maier, (July 2017)
- 2016 Andersons Cereals and Oilseeds Early-in-Career Award of Excellence, North Central (NC) 213 Quality Grains Research Consortium (March 2016)
- 2015 ASABE Superior Paper Award for "*Development of a safety decision-making scenario to measure worker safety in agriculture*" by G.A. Mosher, N.Keren, S.A. Freeman, and C.R. Hurburgh, (July 2015)
- Miller Faculty Fellow – Teaching fellowship (2013-2014), (2015-2016), Iowa State University
- 2011 Warner Graduate Student Research Award (Region 4), Epsilon Pi Tau (March 2011)
- 2010 Graduate Research Award. Association of Technology, Management and Applied Engineering (October 2010)

- 2008 Best Conference Paper Award for "*Food traceability using quality management systems to meet the Food and Drug Administration Bioterrorism Act of 2002*" by C.M. Laux, G.A. Mosher and C.R. Hurburgh. National Association of Industrial Technologists – (now ATMAE) (November 2008)
- 2008 Wakonse College Teaching Graduate Fellowship, Center for Excellence in Learning and Teaching, Iowa State University, Ames, IA
- 2005 Outstanding Advisor Award, College of Family & Consumer Sciences, Iowa State University, Ames, IA
- 2002 - Master's thesis awarded Research Excellence Award, Iowa State University Graduate College

Synergistic Activities:

- **September 2013 – present:** Project Director and Institutional Representative for Iowa State University on the Multi-State Committee – Marketing and Delivery of Quality Grains and Bioprocess Coproducts, Multi-state number NC 213
- **September 2010 – present:** Developed and taught GEAPS 530 – Quality Management Systems, non-credit online course offered by the Grain Elevator and Processing Society (GEAPS), as part of the Grain Handling Credential

Selected Publications:

- Ryan, S.J., C.V. Schwab, and **G.A. Mosher.** 2017. Agricultural worker injury comparative risk assessment methodology: Assessing corn and biofuel switchgrass production systems. *Journal of Agricultural Safety and Health*, 23(3), 219-235.
- Ramaswamy, S.K. and **G.A.Mosher.** 2017. Using workers' compensation claims data to characterize occupational injuries in the commercial grain elevator industry. *Journal of Agricultural Safety and Health*, 23(3), 203-217.
- Grover, A.K., S. Chopra, and **G.A. Mosher**. 2016. Food Safety Modernization Act: A quality management approach to identify and prioritize factors affecting adoption of preventative controls among small food facilities. *Food Control,* 66, July 2016, 241-249.
- Ramaswamy, S.K. and **G.A. Mosher**. 2016. Approaching safety through quality: Factors influencing college student perceptions. *Journal of Agricultural Safety and Health,* 22(2), 149-165.
- Laux, C.M., G.A.Mosher, and C.R. Hurburgh. 2015. Application of quality management systems to grain: An inventory management case study. *Applied Engineering in Agriculture,* 31(1), 313-321.
- Mosher, G.A., N. Keren, S.A. Freeman, & C.R. Hurburgh. 2014. Development of a Safety Decision-Making Scenario to Measure Worker Safety in Agriculture. *Journal of Agricultural Safety and Health*, 20(2), 91-107.

Selected Proceedings Papers:

- Ramaswamy, S.K., Rosentrater, K.A., and **G.A.Mosher**. 2016. Does a NIR system provide low-cost alternative to on-farm feed and forage testing? A techno-economic analysis. ASABE Meeting paper #2460922. Orlando, FL: American Society of Agricultural and Biological Engineering (ASABE) International Meeting.
- **Mosher, G.A**. and N. Keren. 2011. Analysis of safety decision-making data using event tree analysis. *Association of Technology, Management, and Applied Engineering (ATMAE) 2011 Conference Proceedings Paper.*

Presentations: Dr. Mosher has made 73 research presentations and 26 invited presentations.

Teaching and Graduate Student Advising: Dr. Mosher teaches courses in total quality management and technology senior capstone design; she advises 8 total graduate students, 4 doctoral and 4 masters students.

CURRENT & PENDING SUPPORT

Name: Gretchen A. Mosher

Instructions:
Who completes this template: Each project director/principal investigator (PD/PI) and other senior personnel that the Request for Applications (RFA) specifies
How this template is completed:

- Record information for active and pending projects, including this proposal.
- All current efforts to which PD/PI(s) and other senior personnel have committed a portion of their time must be listed, whether or not salary for the person involved is included in the budgets of the various projects.
- Provide analogous information for all proposed work which is being considered by, or which will be submitted in the near future to, other possible sponsors, including other USDA programs.
- For concurrent projects, the percent of time committed must not exceed 100%.

NAME (List/PD #1 first)	SUPPORTING AGENCY AND AGENCY ACTIVE AWARD/PENDING PROPOSAL NUMBER	TOTAL $ AMOUNT	EFFECTIVE AND EXPIRATION DATES	% OF TIME COMMITTED	TITLE OF PROJECT
	Active:				
Mosher, G.A.; R.P.K. Ambrose (Purdue); D. Maier (ISU)	Department of Labor, OSHA, Susan Harwood Follow-on Grant	$126,000	October 1, 2016 – December 29, 2017	7%	Continuation of training to prevent grain dust explosions
Mosher, G.A.; R.P.K. Ambrose (Purdue)	The Andersons Research Grant Team Program	$150,000	May 1, 2017 – April 30, 2019	10%	Segregation strategies for non-GM corn: Improving effectiveness through an analytical modeling approach
Mosher, G.A.; S. Chopra; C.R. Hurburgh (all ISU)	National Institute of Standards and Technology (NIST)	$349,400	August 1, 2017 – July 31, 2019	10%	Development of standards and protocols for a comprehensive traceability system for the U.S. grain and feed supply chain
Mosher, G.A; C. Bern; S. Chopra; C. Hart, C. Hurburgh, K. Rosentrater; A.Shaw (all ISU)	NC 213 Multi-state Hatch (NIFA)	No monetary allocation	10-1-2013 – 9-30-2018	3%	Marketing and Delivery of Quality Grains and BioProcess Coproducts
	Pending:				
Mosher, G.A.; R.P.K Ambrose (Purdue); D. Maier (ISU)	Department of Labor, Susan Harwood	$145,840	September 30, 2017 – September 30, 2018	5%	Training to prevent grain dust explosions

Mosher, G.A.	University of Nebraska Medical Center	20,000	January 1, 2018 – June 30, 2019	5%	Prevention of grain dust explosions: How effective is existing programming?
Mosher, G.A.	Anderson Research Grant Program	$50,000	June 1, 2018 – May 30, 2020	5%	Role of worker decision making in effective FSMA implementation
Mosher, G.A. and S. Freeman (both ISU)	Department of Labor Research and Evaluation Grants	$224,752	December 1, 2016 – November 30, 2018	2%	Returning to work: Evaluation and analysis of costs in the grain elevator

This file MUST be converted to PDF prior to attachment in the electronic application package.

ANDERSONS RESEARCH FUND – RESEARCH PROPOSAL BUDGET

Category	Year 1 Amt. requested from Andersons	Year 2 Amt. requested from Andersons	Total
Salaries and Wages*			
Post-Ph.D. research associate(s)			
Graduate assistant			
Stipend	**$ 17,808**	**$ 17,634**	
Tuition and fees	**4,547**	**4,738**	
Hourly wage			
Other (specify in Budget Narrative)			
Total	**22,355**	**22,372**	**44,727**
Fringe Benefits			
Post-Ph.D. research associate(s)			
Graduate assistant	**1,745**	**1,728**	
Hourly wage			
Other			
Total	**1,745**	**1,728**	**3,473**
Materials and Supplies			**0**
Equipment (List individual pieces of equipment that are essential to the project in the Budget Narrative.)			**0**
Travel	**900**	**900**	**1,800**
Publication charges			**0**
Indirect costs**			
Total (Max. $25,000/yr. from Andersons Research Grant Program)	**$ 25,000**	**$ 25,000**	**$ 50,000**

*Andersons funds cannot be used for faculty salaries, departmental space, or facilities.

**The Andersons Research Grant Program policy specifies that no indirect costs can be charged to this project.

BUDGET NARRATIVE
IOWA STATE UNIVERSITY
Sponsor: The Ohio State University
Prime Sponsor: The Andersons Inc.
ISU GoldSheet #: 140293 - Mosher

SALARY AND WAGES

- ***Senior Personnel:***

Principal Investigator – Dr. Gretchen Mosher: no salary support is requested. Dr. Mosher will be responsible for coordination of the project experimental design, supervising the Graduate Research Assistant, and dissemination of project results.

- ***Other Personnel:***

1 - Graduate Research Assistant (GRA), MS, Non-engineering – 8.5 months of stipend support requested in Year 1 and 8.2 months is requested in Year 2 for half-time effort of the GRA. He or she will be responsible for completing research tasks and will be closely involved in dissemination of the project results. Labor costs for the Graduate Research Assistant include projected costs based on current monthly stipend rates, plus a 3% increase for Year 2.

TUITION: Year 1 - $4,457 Year 2 - $4,738

ISU's tuition scholarship policy requires sponsors to provide 50% in-state tuition support for MS Graduate Research Assistants. Tuition is listed at the rates approved by Iowa State University.

FRINGE BENEFITS
Fringe benefits are specifically identified to each employee at Iowa State University and charged individually as direct costs. These costs are budgeted as a percentage of an individual's salary based on his/her labor category. Current rates for applicable labor categories are as follows:
Graduate Research Assistants – 9.8%

TRAVEL
Domestic - Funds are requested to cover expenses for the PI and GRA to attend the annual NC-213 conferences during the two-year award period to present new project results to the scientific community as they become available. Funds are also requested for the GRA to attend the domestic research conference (American Society of Agricultural and Biological Engineering – ASABE or similar) to present research results.

INDIRECT COSTS
The indirect cost applied to this proposal is $0, per the restriction in the sponsor's guidelines (page 9).

BUDGET SUMMARY	
Total Direct Costs	$50,000
Indirect Costs	$ - 0 -
TOTAL PROJECT COST	**$50,000**