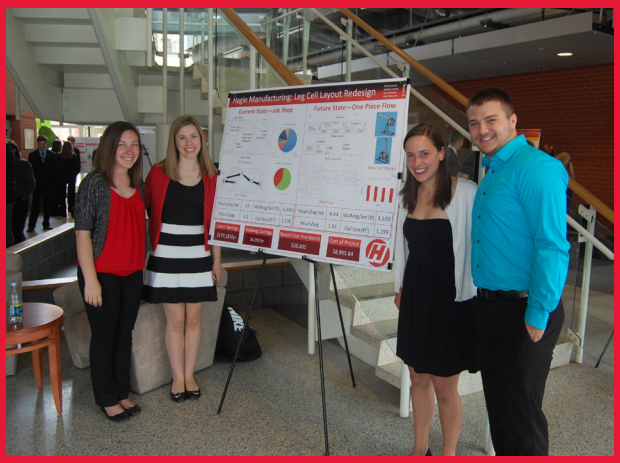
IOWA STATE UNIVERSITY

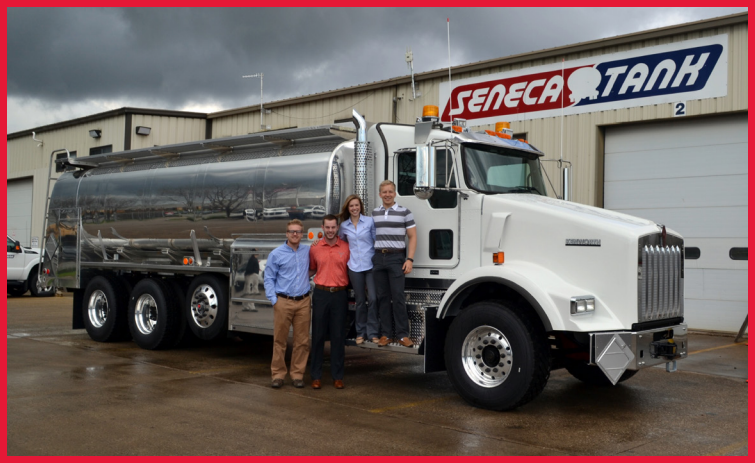
Department of Industrial and Manufacturing Systems Engineering

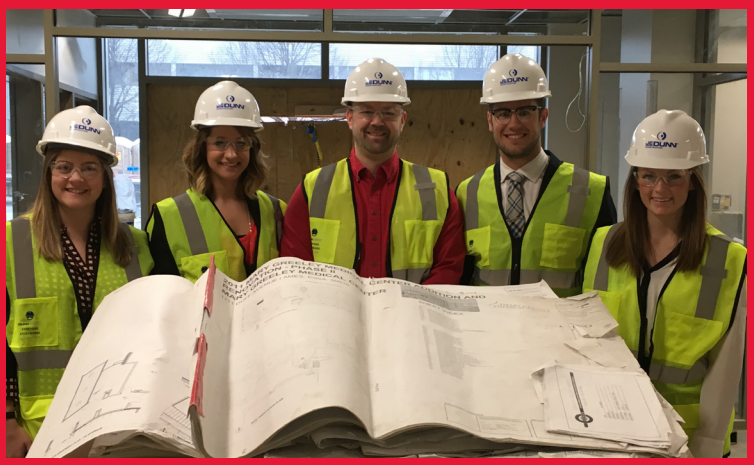
Industrial Engineering Capstone Design

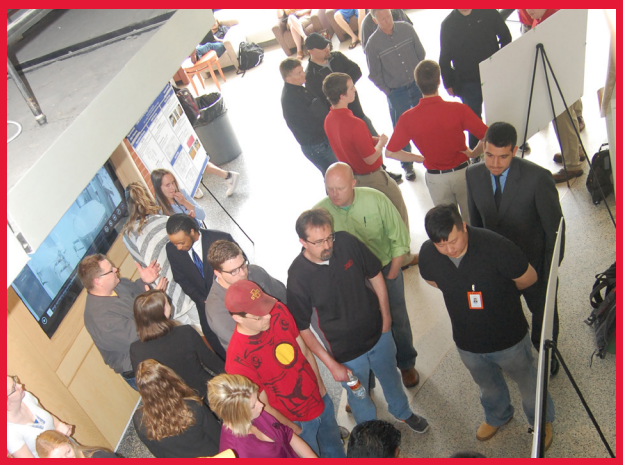
I E 422: Design and Analysis Applications for System Improvement

I E 441: Industrial Engineering Design









Capstone Design is a one-semester senior design course in which students engage in industry projects and practice industrial engineering under the guidance of a experienced professor, as well as engineers and managers from the sponsor company. The objective of these projects is to provide economic value to the company and a practical education to the students.

The projects involve four stages of design (Problem Definition, Current State Analysis, Future State Collaborative Design, and Final Project Validation/Delivery). Students are required to perform in-depth quantitative analysis and design throughout the entire project with a group commitment of 60 hours per week for 14 weeks, and extensive on-site and web/phone company involvement to ensure success.

For the Bachelor of Science in Industrial Engineering curriculum, Capstone Design provides a culminating major design experience that (1) incorporates appropriate engineering standards and multiple constraints, and (2) is based on the knowledge and skills acquired in earlier coursework.

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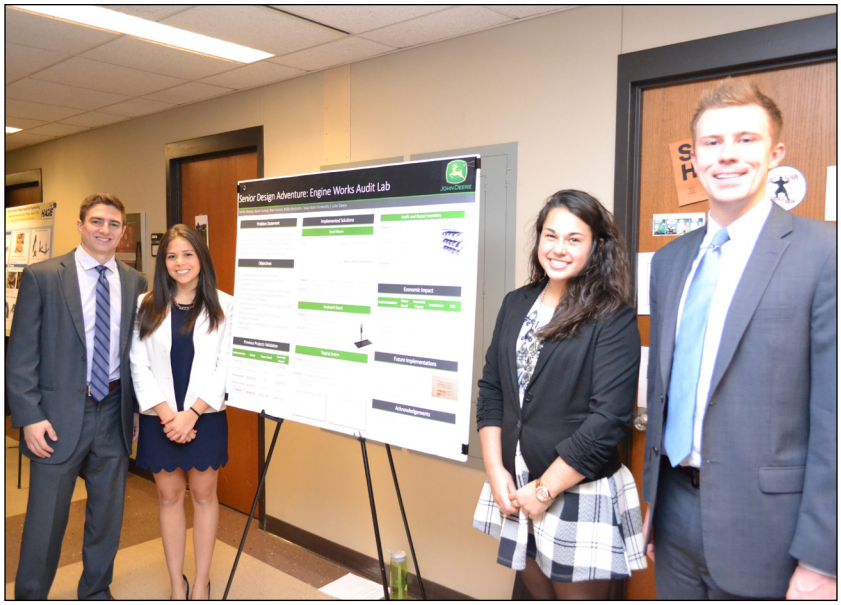
Selected Student Projects



Sponsor: John Deere

Group members: Ross Larson, Camila Dantas, Kellie McGrath, Kevin Guinan

The team members worked on a project in the John Deere Engine Audit Lab. The audit lab is dedicated to repairing engines and auditing engines. Engines that require repair do not come to the lab on a set schedule. Rather, the lab works on these engines on an as needed basis. Repair engines are where the lab spends the majority of their time. Audited engines are scheduled to come to the lab. The purpose of auditing an engine is to ensure that the engine manufacturing process is manufacturing engines to the proper specifications. The problem John Deere faced was that it was not meeting the industry standard for how many engines to audit each year. Therefore, the team focused on increasing throughput time for repaired and audited engines so that the lab could audit more engines. The team automated an excel macro to eliminate the amount of manual writing an operator had to complete. The team added a tagging system to the storage area to eliminate no value added time searching for parts. The team added wireless keyboard stands so the operator wouldn't have to walk back and forth to their computer stand to operate the computer. Finally, the team made future recommendations to the managers at John Deere.

Sponsor: American Equity Investment Life Insurance Company®

Group members: Saif AlMarzooqi, Omar AlQattan, Eddie Berthold, Omar ElMenoufy, Cora Hicks

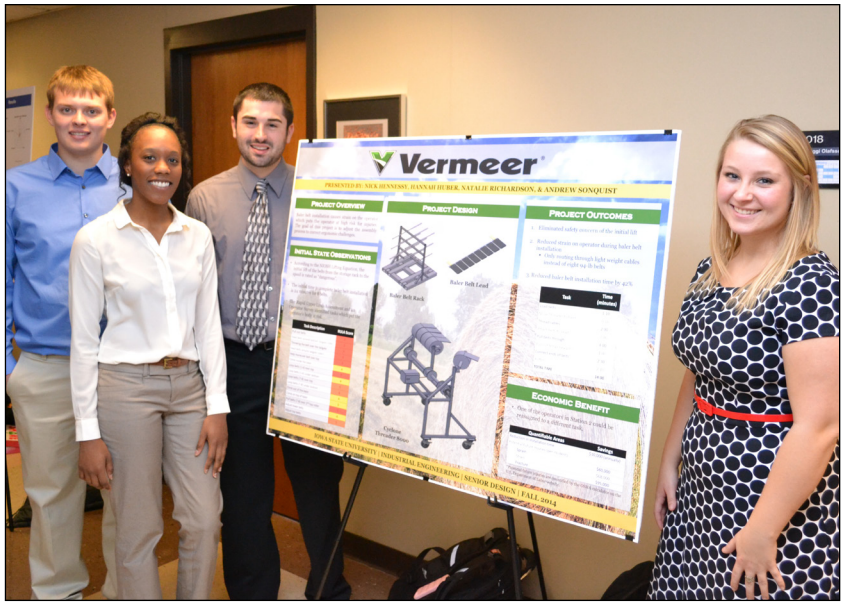
The group collaborated with the Customer Excellence Team to identify the causes and provide solutions to reduce the rate of customers submitting paper forms they found to be Not in Good Order (NIGO). They first implemented a data collection program to allow form processors to conveniently record the specific errors that led to these NIGO occurrences. The group applied the Pareto principle to analyze and identify the most frequent errors, as well. Then, in consultation with a graduate student in Human Computer Interaction, the group analyzed the root causes of these errors.

The group redesigned five forms based on design concepts that comply with users' mental models and reduce the cognitive load for American Equity's customer base. The expected 25% reduction in NIGO occurrences will save nearly $180,000 per year by reducing the time required to contact customers and gather additional information, and will also increase customer satisfaction.

Thank you to our sponsors!

Sponsor: Vermeer

Group members: Andrew Sonquist, Natalie Richardson, Nick Hennessy, Hannah Huber

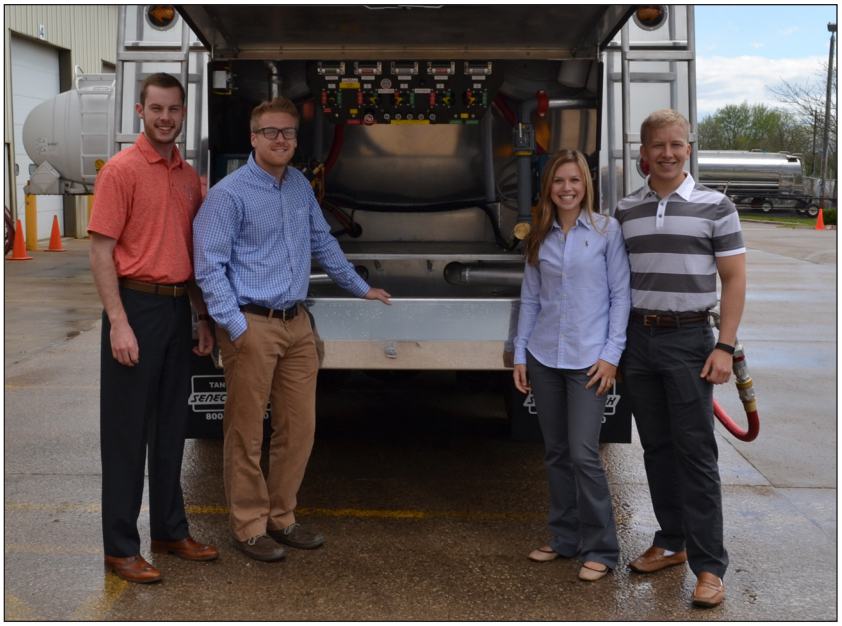


Vermeer Corporation focused attention on the round baler production process to ensure safety of front-line employees and to decrease baler belt installation time. The primary goal of this project was to design a tool or process to correct ergonomic challenges which would be applicable to multiple baler types. The secondary goal was to implement time saving improvements for baler belt installation.

The results of the ergonomic assessments the team conducted during the Current State Analysis supported Vermeer's initial theory that the operator's body is at risk throughout baler belt installation. The scores from the Rapid Upper Limb Assessment (RULA) and the NIOSH Lifting Equation suggested alterations to the belt installation process were necessary. To reduce the time required to install the belts, the team designed a rack to hold the baler belts for transportation from the vendor to the assembly line. These racks will reduce the strain on the operator's body when transferring the belts from the rack to the belt spindle. Second, the team designed a process to feed the belts through the baler that will minimize the physical strain on the operator. The project design will reduce the scores of the RULA and completely eliminated the belt-lifting process which will help eliminate the risk of injury to the operators and unwanted cost to Vermeer. A recognizable savings of at least $10,000 annually is anticipated with the implementation of these new designs.

Sponsor: Seneca Tank

Group members: Justin Danko, Daniel Thayer, Emilee Nyberg, Matt Ehresmann



A student group worked with Seneca Tank on the Ready-To-Deliver 2700 tank truck. Seneca Tank is located in Des Moines and is an international supplier of new and used petroleum tank trucks, transports, and truck tank parts. The students made recommendations to the company that would increase efficiency in the assembly process and introduce kits with standardized parts into the production process.

The team addressed issues with variability in Seneca Tank's manufacturing process of the Ready-To-Deliver 2700 tank truck, and had a one-year economic payback of $600,000.

Why participate in capstone?

In Spring 2016, 15 projects were performed at 15 different companies. These companies were asked to provide their personal realistic estimate of the economic value of their student projects. The project values ranged from $25,000 to over $2 million with an average value of $936,000. Four projects exceeded $1 million in financial impact. Since these projects cost $5,000 per company, the average returns are substantial. Companies agreed to implement between 70% and 100% of student recommendations. Over 85% of our students have industry experience, and 25% have international experience, prior to working in Capstone. These engineers are mature, experienced and motivated, and receive extensive oversight.

What types of projects?

Our students are educated in Workplace Design, 5S/VSM and LEAN, Time Estimation and Process Engineering, Factory Layout, Scheduling, Inventory Analysis (Kanban/Kitting/Classification/EOQ), Product/Process Quality Analysis, Process Simulation, Ergonomics, Optimization, Data Mining and Statistical Analysis, Manufacturability Analysis, Economic Modeling, VB.NET/VBA/SQL Programming and Industrial Automation CNC/RFID/BarCode/PLC Prog/Transducer Selection. We look for projects with an economic impact potential of over $50,000 (Net Present Worth at your expected rate of return).

What is new?

Intense focus on achieving BUSINESS VALUE in mostly economic terms. Objective is to leverage solid engineering fundamentals packaged within a systematic workflow to deliver results with an independent and objective perspective.

What is my commitment?

Work with faculty to define appropriate project scope. Assign a project manager for each project and ensure that this manager has the time, ability, and resources to provide the students with access to data and facilities in a timely manner. Students and faculty are able to sign NDA and IP agreements. Payment, subject to your satisfaction, is $5,000 per project (covers travel and up to $500 in materials). As this is a fee-for-service project, the fee is not a tax-deductible expense.

How do I get started?

Dave Sly (Course Lead) - 515-450-2335, *davesly@iastate.edu*
Sarah Ryan (Analytics Lead) - 515-294-4347, *smryan@iastate.edu*
Rick Stone (Human Factors Lead) - 515-294-3644, *rstone@iastate.edu*

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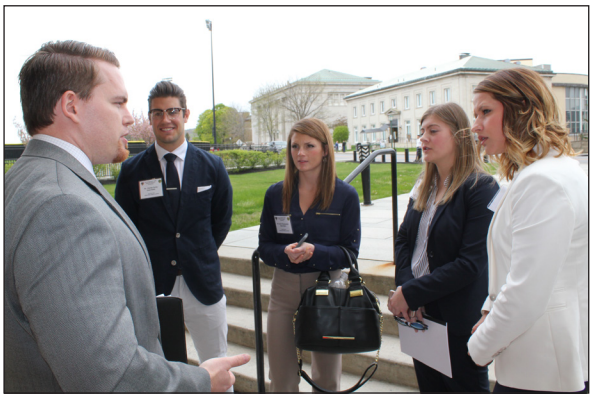

One of the competition judges told the ISU team that he felt the project could be used as a basis for Six Sigma Green Belt certification and he was very impressed with the project.

IE 441 team chosen to participate in national capstone competition

In April 2016, the IMSE Department selected a team of students to travel to the United States Military Academy at West Point, New York, to compete in the General Donald R. Keith Memorial Capstone Conference Competition. Students from various universities and military academies presented their capstone project results in one of nearly a dozen different tracks formats (including Decision Analysis, Process Optimization, Systems Design, and other tracks that are closely related to systems engineering).

Eight student teams from IE 441 competed for the opportunity to go to New York, and after much deliberation, a team was chosen to represent the IMSE Department. The students in the group were Nicole Kittleson, AG Fleckenstein, Madison Bishop, and Charlie Forey. The team's capstone project focused on efficiencies and process improvements for Mary Greeley Medical Center in Ames, Iowa, and was considered outstanding in its content.

The students had a wonderful and rewarding trip while representing Iowa State University.