MSOE
UNIVERSITY

CULMINATION

SENIOR PROJECT
SHOWCASE 2022–23

DESIGN PROJECTS | INTERNSHIPS | THESIS PROJECTS

Friends of MSOE:

Senior projects at MSOE are a long-standing tradition. The showcase is in large part a celebration: an opportunity for friends and family, faculty and staff, and community partners and corporate sponsors, to bear witness to the bodies of work that define the graduating class.

Every fall, MSOE seniors across program areas put the knowledge they've gained and skills they've honed over their academic career to the test. Working with faculty advisors and industry partners, they form teams—or work individually—to solve a problem, improve a product or process, or create something entirely new. After months of learning and discovery, building and deconstructing, successes and failures, the culmination of these efforts are put on display during the Senior Project Showcase.

The showcase is filled with great optimism and inspiration. Navigating the mazes of student excellence on display, we can only imagine where they will go next and what they will accomplish, knowing only—and with great certainty—that it will be extraordinary.

Have a project idea?

Send your suggestion to Angela Rome, executive administrative assistant, by Aug. 4 to be considered for the 2023-24 academic year. Include a brief description of any senior design project, class project or internship position along with the name, address, email address and telephone number of the project contact person. Project ideas submitted for engineering courses must have a significant design component. Submit ideas to:

VP of Academics Office
1025 N. Broadway
Milwaukee, WI 53202-3109
(414) 277-7190
rome@msoe.edu
msoe.edu/senior-projects

Senior Design

The following list of senior design projects, class projects and internships, compiled with the help of the academic department chairpersons and program directors, represents an important segment of student academic activities conducted during the 2022–2023 year. A variety of projects were completed, some for outside organizations and some for the benefit of the university.

MSOE has a very strong relationship with industry, and many senior design projects often originate in companies where students work as interns. Senior engineering students work in teams on senior design projects, which most students begin planning in the spring of their junior year.

Most engineering senior design projects run through the Fall, Winter and Spring Quarters. In the fall, design teams define a design problem, identify several alternative solutions and develop a project plan for evaluating the possible solutions and solving the problem.

Students develop a thorough project proposal, often working with the MSOE Institutional Review Board. The Winter and/or Spring Quarters emphasize design, where students draw from their specialty courses. At the end of the design project, students are expected to have produced complete project documentation and written reports and oral presentations are required.

Business and user experience and communication design students must complete an internship in the area of their intended career as part of their curriculum. Internships allow students to apply the skills that they have learned in the classroom in a work setting.

Nursing students complete senior research projects. Collaborating with staff nurses, nurse administrators and physicians, they work to implement a change in some aspect of the health care process.

Actuarial science students conduct research projects and case studies that examine data, variables, risk factors and more to provide analyses and insights on varying scenarios. They may offer solutions or present their findings at competitions.

Table of Contents

Guests may park in the State Street A Lot, 501 E. State Street; State Street C Lot, 429 E. State Street.

Civil and Architectural Engineering and Construction Management Department

The Civil and Architectural Engineering and Construction Management Department senior design project is a pseudo-design/build or design/bid/build project involving a client, faculty team and industry mentors.

The project teams are composed of students from the architectural engineering (with design specialties in structural, mechanical, and electrical), civil engineering (with specialties in structural, environmental and water resources, transportation, and construction) and construction management programs. The multi-term project starts with programming and includes the design concept through development, working drawings and construction management. The design process includes engineering systems selection and analysis.

Construction management includes construction methods, project feasibility, estimating and cost analysis, and project scheduling. Presentation and communication skills are reinforced by the formal presentations to a jury consisting of the client and construction industry representatives.

Civil and Architectural Engineering and Construction Management Senior Design Student Projects

TEAM MEMBERS
Erika Burks
Joanna Ekiert
Mitchell Fuller
Ian Leather
Jakob Sherry

Project: Third Coast: STH 181 (N. Wauwatosa Ave.) & W. North Ave. Intersection Redesign
Faculty Advisors: Dr. Mitzi Dobersek

The intersection of STH 181 (N. Wauwatosa Ave.) and W. North Ave. in Wauwatosa, WI has been in existence in its current configuration for almost six decades. The current intersection is problematic for both safety and efficiency for all road users due to cracked pavement, uneven walking surfaces and high travel speeds. Longfellow Middle School is located in the intersection, causing a high volume of students crossing during peak traffic hours. Cyclists, who use the roadway regularly, face challenges due to insufficient facilities. In an effort to create an inclusive environment for all road users, the city of Wauwatosa places a high value on pedestrian and bicycle facilities during this redesign. The implementation of the innovative Dutch intersection design, along with upgrading pedestrian and motorist facilities, will cause the intersection to better accommodate all types of road users while reducing the risks posed by the current condition of the roadway.

TEAM MEMBERS
Maxine Miller
Daniel Nate
Henry Uthmeier
Andrew Veum

Project: Rockstar Engineering: STH 181 (N. Wauwatosa Ave.) & W. North Ave. Intersection Redesign
Faculty Advisor: Dr. Mitzi Dobersek

The intersection of STH 181 (N. Wauwatosa Ave.) and W. North Ave. in Wauwatosa, WI has been in existence in its current configuration for almost six decades. The current intersection is problematic for both safety and efficiency for all road users due to cracked pavement, uneven walking surfaces and high travel speeds. Longfellow Middle School is located in the intersection, causing a high volume of students crossing during peak traffic hours. Cyclists use the roadway regularly and face challenges due to insufficient facilities. In an effort to create an inclusive environment for all road users, the city of Wauwatosa places a high value on pedestrian and bicycle facilities during this redesign. The implementation of the innovative Dutch intersection design, along with upgrading pedestrian and motorist facilities, will cause the intersection to better accommodate all types of road users while reducing the risks posed by the current condition of the roadway.

TEAM MEMBERS
Nicole Harris
Riley Hornilla
Mathew Hughes
Stasia Konsoer
Morgan Long
Isaac Rhodes
Casey Scholz

Project: Marquette Interchange Bike Park
Faculty Advisors: Dr. Belan, Dr. Dobersek, Prof. Nelson

Our team was tasked with the design of a bike park beneath the Marquette Interchange for the Underpass LLC. The bike park includes a pump track, skills park, and a community gathering area. Our team has also taken on the task of developing a trail connectivity plan, site utilities plan, site grading plan, detailed cost estimate as well as a long-term maintenance plan.

TEAM MEMBERS
Grace BeBeau
Samuel Borup
Chase Dulmes
Sean Kennedy
Molly Stewart

Project: Milwaukee Metropolitan Sewerage District Dewatering and Drying Expansion
Faculty Advisors: William Krill, Douglas Nelson, Adam Roder

Students have been asked to address the addition of biosolids dewatering and drying at one of Milwaukee Metropolitan Sewerage District's (MMSD) water reclamation facilities, South Shore Water Reclamation Facility (SSWRF). This group has been tasked with looking at a design alternative that would utilize existing buildings at SSWRF along with designing a new building to hold the new drying equipment. The focus of this project is creating an equipment layout that is efficient and integrates into the existing operations at SSWRF. Furthermore, students need to consider and design structural elements of the expansion to safely hold the loadings of the new equipment.

TEAM MEMBERS
Fabian Calvillo
Brigid Doyle
Charles-Kemil Koffi
Weston Lema
Ben Schleh
Lily Swanson (team lead)

Project: Milwaukee Metropolitan Sewerage District South Shore Water Reclamation Facility Expansion
Faculty Advisors: William Krill, Adam Roder

The primary goal of this project is to provide the Milwaukee Metropolitan Sewerage District (MMSD) South Shore Water Reclamation Facility (SSWRF) with a workable, and constructible dewatering and drying facility design. This project is the next step in MMSD's Biosolids Advanced Facilities Plan which involves the design and implementation of a biosolids processing system at SSWRF to produce Milorganite for resale. Rather than achieving this by constructing new buildings, this project aims to utilize existing buildings for new dryer systems and dewatering centrifuges.

TEAM MEMBERS
Drew Esson
Alex Schmidt
Arjun Vorster
Riley Whitted
Damian Williams

Project: Creo Consultants
Faculty Advisors: William Krill, Douglas Nelson, Adam Roder

The primary goal of the Milwaukee Metropolitan Sewerage District (MMSD) project is developing the maximum amount of solar drying or composting production. This project's scope includes the evaluation of biosolids solar drying versus biosolids composting using the available buildings in the surrounding area as well as the available acreage at MMSD's South Shore plant. The final outcome is to produce a design with the most efficient building layout for processing biosolids into a marketable material.

TEAM A
(Midwest Design Studios):
Dylan Blum (ST)
Chriss Tshibangu (ST)
Hope Huenecke (ME)
Justin Villareal (EE)
Christopher Hansen (EE)
Matt Hanewall (CM)
Daniel Folos (CM)
Riley Rathman (CM)

TEAM B
(Ninth Element)
Maria Renier (ST)
Jenna Roth (ST)
Violet Putz (ST)
Carley Bazan (ME)
Anna Halloran (ME)
Erika Garcia (CM)
Chelsea Vu (CM)
Gisselle Vasquez (CM)

TEAM C
(ConVision):
Noah Quartaroli (ST)
Deepansh Agarwal (ST)
Mackenzie Beck (ME)
Ian Wright (EE)
Mitchell Weyker (EE)
Ayush Patel (CM)
Carson Barwick (CM)

Project: Good City Brewing Company – Menomonee Valley
Faculty Advisors: Christine Brotz (EE), Adam Friedman (ST), David Grassl (ME), Cory Powers (ME), Jayme Radomski (ME), Mark Rounds (CM), Kurt Zimmerman (AR)

This year the Senior Project teams look at a brownfield site along the Menomonee River under the Marquette Interchange that poses some difficult challenges. The Redevelopment Authority of the City of Milwaukee and Menomonee Valley Partners have identified this site for development as a Food and Beverage (FaB) industrial user, in alignment with their Menomonee Valley 2.0 Master Plan. The student teams are subject to additional zoning ordinances and covenants related to development in the Menomonee Valley, namely sustainable guidelines and Riverwalk expectations.

The three interdisciplinary design teams have been working closely with Dan Katt, Founder of Good City Brewing Company. Each team is taking a unique approach to the development of an expanded operation for the Good City Brewing Company along with hospitality services such as a restaurant, ballroom and tasting rooms. The teams are exploring efficiencies in streamlining operations and distribution along with energy usage within the buildings.

The tri-partite site layout includes areas under the freeway interchange along with easements for utilities and access. All the design teams utilize this area under the overpass for their guest parking and truck maneuvering, along with aggressive stormwater management efforts.

The Midwest Design Studios team takes advantage of the entire site with operation west of the freeway and hospitality following a curve in the river. The Ninth Element team condensed their operations and hospitality into a single structure west of the interchange, with plenty of room for expansion. The east end of the site is developed as an amphitheater with skyline views beyond. The ConVision team proposes a vertical concept by condensing their footprint and stacking functions on the east side of the site, allowing the west portion of the site to be sold to fund the initial construction costs.

All the teams investigate best practices in planning, sustainable construction and management and the resulting concepts demonstrate a strong understanding of these principles.

TEAM D

Cobey Alderden
Burhan Alka
Stephen Dillard
Sawyer LaChance
Nicolas Romano
Anthony Schultz

TEAM E

Anne Blejwas
Faith Hardy
Isaac Hunter
Joseph Kalata
Kayhan Khandan
Zachary Krysztopik
Edward Nelson

TEAM F

John Cunningham
Kyle Herbster
Christian Knisley
Gonzalo Palacios
Gabriel Vikse

Project: Bancroft Luxury Apartments for Racine, WI
Faculty Advisors: David Grassl (HVAC), Michael McGeen
(Architecture), Cory Powers (Plumbing)
Jayme Radomski (Fire Protection), Bob Schumacher
(Structural), Kristy Wolf (Construction Management)

The challenge this year is to design a mixed-use development that includes 12 floors of luxury apartments (144 units), two floors of leasable commercial space, and adequate off-street parking that will set a new standard for Racine. The client requested that projects should qualify for LEED Platinum, be ADA accessible and apartments should maximize lakefront views. The project will replace an aging YMCA facility on a sloping site that overlooks Lake Michigan. Numerous amenities are within easy walking distance including downtown Racine, the marina, and a soccer field. Our client is Bancroft Architects and Engineers and our budget for the project is $92 million.

Key to specialties:

(A) Architecture
(CM) Construction Management
(CM/PM) Team Project Manager
(E) Electrical
(EE) Building Electrical Systems
(Env) Environmental
(F) Fire Protection
(H) HVAC
(ME) Building Mechanical Systems
(P) Plumbing
(PL) Project Lead
(S) Structural
(ST) Building Structural Systems
(T) Transportation
(WR) Water Resource

Rader School of Business

Rader School of Business Senior Projects

Student:	**Dag Barkow**
Faculty Advisors:	**Dr. Rainer Lehmann, Dr. Katrina Moskalik, Dr. David Rollins**
Organization:	**The Angelus Corporation**
Project:	**Increasing efficiency of a work cell**

The COVID-19 pandemic has disrupted markets and thrown entire supply chains off balance. Many companies have struggled with supply shortages. As a result, many companies are fulfilling backorders and ordering significantly more than they currently need out of fear of further supply shortages in the future. This poses a challenge for the Angelus Corporation to meet current demand while assuring customers that there is no supply shortage, and to maintain a steady flow of orders. My project focuses on optimizing the material flow and making layout changes to streamline processes and identify redundancies or unnecessary steps. I conducted interviews with employees, analyzed processes, and discussed results with all stakeholders to make adjustments and design a material flow and layout that helps the Angelus Corporation reduce the processing time for the Kitting Area, cope with the current order volume, and ultimately achieve a shorter lead time.

Student:	**Chris Barnes**
Faculty Advisor:	**Carol Mannino**
Organization:	**Hoptein**
Project:	**Creating a Protein Beer**

For my capstone project, I'm working on making a protein beer called Hoptein with a partner, Luke Schraufnagel. I've been working specifically on product development, along with all the legal aspects including regulations, licenses, and permits. Because our project is starting from scratch, we've had to gather more secondary research, along with doing more hands-on work, than the normal project. Secondary research included figuring out how to get this product to work, analyzing our potential competitors, legal work, and how to expand in the future. During capstone I, I made a problem description and objective, project scope, stakeholder analysis, and theoretical tools. Project scope was about deliverables, exclusions, working assumptions, constraints, and biases for Hoptein's product development. Stakeholder analysis goes in depth into who is currently important for the project. Theoretical tools focus specifically on our research. This includes studies, facts, and other necessary information. A big accomplishment was a Hoptein taste test with some people (all were 21+ years of age). I created a survey to gather their thoughts, and I plan on analyzing the responses with the results being put into a written paper.

Student:	**Carmine Cappuccio**
Faculty Advisor:	**Dr. Michael Payne**
Organization:	**Res Manufacturing**
Project:	**Expansion into Clean Technology Markets**

`

I worked as a marketing intern for RES Manufacturing, a well-established metal-stamping company in Milwaukee. The project explored opportunities to expand Res Manufacturing into the clean technology markets beyond electric vehicle components. The project began with a comprehensive analysis of the competitive landscape using Porter's Five Forces Model, followed by market segmentation and SWOT analysis. Primary and secondary research methods were utilized, including field research and stakeholder interviews, company and trade association website analyses, and industry report reviews. Through these efforts, valuable insights were identified into the market dynamics, trends and key players, which informed the development of a comprehensive strategy. The value proposition concept was used to identify unique value offerings that Res Manufacturing could provide to customers in these markets. Key performance indicators were established and tracked to monitor progress throughout the project. The results of this project provided Res Manufacturing with a strong foundation to expand into these important and rapidly growing markets and contribute to a more sustainable future.

Student:	**Finn Dreyer**
Faculty Advisors:	**Dr. Rainer Lehmann and Dr. Katrina Moskalik**
Organization:	**Eaton Corporation**
Project:	**Improving inventory control in the receiving area through the Implementation of Standardized Processes and the Change of Layout**

The improvement project is carried out in Eaton Corporation during the capstone thesis coursework. The aim of the project is to identify and eliminate the causes in the receiving area that lead to systematic problems caused by the receiving department. This includes the use of warehouse aisles as storage areas that affect the material flow and lead to late deliveries to the production lines. Furthermore, inaccurate labeling of receiving goods leads to tracking problems throughout the company. Lastly, high turnover times of discrepancy inventories lead to late deliveries in production and increased storage space requirements for semi-finished products. As a result of the root cause analysis identified, a Kaizen Blitz event will be conducted using 5S tools, a new layout for the receiving area will be designed and implemented, and the current processes will be standardized and written down in operators' instructions and trained with the receiving employees.

Student:	**Alissa Evans**
Faculty Advisor:	**Dr. Katrina Moskalik**
Organization:	**Regional community-based residential facility (CBRF) for senior citizens**
Project:	**Bottom-Up CI Communication Improvement Plan**

Investigation of complaints made in the facility to identify root causes and potential solutions for these complaints. It was a bottom-up project, meaning the work was led by care givers working with the residents to share with the management of the facility, who is offsite. Research included many continuous improvement tools and levels of analysis. A few main root causes were identified, and all aligned with poor communication as the primary cause of most of the problems. New procedures were created for shift changes between caregivers, communication between families and caregivers, and finally a new process for overall record keeping and storage was created. These findings were shared with management and some of the new forms and procedures will be implemented. This should reduce the number of internal and external complaints and increase the quality of care for residents.

Student:	**Jan Helge Gevekoth**
Faculty Advisors:	**Ramon Balisnomo, Dr. Rainer Lehmann, Dr. Katrina Moskalik**
Organization:	**Arandell Corporation**
Project:	**Streamlining Warehouse Management and Plant Layout: A Business Process Simulation Approach**

Business Process Simulation is a powerful tool for modeling and simulating complex processes to analyze their performance and efficiency. This approach offers a safe environment for testing and optimizing processes and identifying areas for improvement. Simulation also enables the generation of key metrics, which can help to quantify and measure improvements.

The company faced challenges related to the reliable supply of raw materials for their main processes. To address this issue, the receiving, storing, and retrieving processes from the warehouse to the workstation were modeled using simulation. The accuracy of the model was validated using real process data and time studies. The simulation revealed bottlenecks in the processes, which were then scrutinized and brainstormed for potential improvements. Various future states were simulated and compared, with important key figures including the utilization of forklifts and employees, travel distance, and associated time savings due to shorter routes. Hypothesis testing was used to validate the results, ensuring their accuracy and reliability.

As a result of the project, a plan for a streamlined process and optimized plant layout with a lean flow was developed. This plan provides a clear roadmap for improving the efficiency and reliability of the company's warehouse management and plant layout.

Student:	**Mika Hansen**
Faculty Advisors:	**Ramon Balisnomo, Dr. Rainer Lehmann, Dr. Katrina Moskalik**
Organization:	**ER Wagner**
Project:	**Improving Inventory Accuracy by Applying Six Sigma Methodologies**

This project aims for the improvement of inventory accuracy in the ER Wagner manufacturing plant in Menomonee Falls, Wisconsin. Inventory accuracy is achieved when the recorded (or electronic) inventory aligns with the actual (or physical) inventory. It is desirable as inaccurate inventory regularly leads to write-offs that ultimately impact a company's financial statement. In addition, unexpected out-of-stock situations caused by inaccurate inventory records may result in customer orders not being fulfilled as contractually agreed. With the intention of developing concepts for an improved inventory management in the future, the current state is first recorded and analyzed. For this purpose, Six Sigma tools such as the cause-and-effect diagram and the failure mode and effects analysis (FMEA) are deployed. In addition, the inventory is categorized by its forecasted value in a 14-week-horizon using an ABC analysis. Based on these analyses, concepts that address the issues identified are developed which allow for an improved inventory accuracy once implemented. To give an example, the proposed solution includes designated racking for valuable A parts.

Student:	**Gregory Iverson**
Faculty Advisor:	**Dr. Katrina Moskalik**
Organization:	**Milwaukee Brewers Baseball Club**
Project:	**Milwaukee Brewers Team Store Jersey Customization Project**

My project is focused on finding a way to customize jerseys at an increased rate while creating less damaged material for the Milwaukee Brewers Team Store. During the 2022 MLB season, the store made $1.3 million in revenue from customized jerseys, making customized jerseys the number one revenue stream for the Brewers Retail Department. Because of an unreliable heat press and letters that curl because of their adhesive backing, the time it takes to customize a jersey at the Brewers Team Store was averaging 10–15 minutes per jersey, with a success rate of 90-95%. As a result, the Milwaukee Brewers Retail Department has had to turn away customers due to the inability to meet jersey customization demand on game days while damaging between $65,000–$130,000 worth of jersey material in revenue. By using tools I've learned at MSOE like time studies, process mapping, fishbone/Ishikawa diagrams, identifying eight wastes, cost analysis, and introducing a new way to press jerseys, I will reduce the average time it takes to customize a jersey from 10-15 minutes to 7 minutes and increase jersey customization success rate from 90-95% to 98% by April 1, saving the company between $39,000 and $104,000 in revenue.

Student:	**Simon Jahnke**
Faculty Advisors:	**Dr. Rainer Lehmann, Dr. Katrina Moskalik, Gene Wright**
Organization:	**LEMAN USA**
Project:	**Implementing Lean Methodologies**

LEMAN USA is a third-party logistics provider. The company provides services that include transporting, storing, repacking, and shipping its customers' products to their customers. My project focuses on improving the receiving area of the warehouse location in Sturtevant, WI. The department processes incoming products and prepares those items to be stored in the warehouse. This capacity of incoming containers has increased greatly over the last two years and affected the processes and organization in the area. My task is to analyze the current process, identify improvements, and implement techniques to improve the current state as well as creating a basis for further refinement of organization and processes in the future. The tools I use to analyze the current state are process maps, spaghetti diagrams, fishbone diagrams (finding root causes), and pareto charts (visualizing impact of root causes). My implemented techniques concentrate on the idea of lean management. This approach is based on creating standardized processes, workflows, and "continuous improvement". Therefore, the focus of my implementation phase is on 5S, a tool that establishes a foundation of organization and standardization on which the company can continue to build.

Student:	**Timo Knueppel**
Faculty Advisors:	**Dr. Rainer Lehmann, Dr. Katrina Moskalik, Dr. Michael Payne**
Organization:	**KHS, Inc.**
Project:	**Realization of Warehouse Optimization through Lean Management in the Inventory Control Department**

Since the implementation of a completely new Enterprise-Resource-System (ERP) in the warehouse of a leading manufacturer of innovative filling and packaging systems, all the processes have changed significantly. They have become completely digital and should provide scheduled and efficient processing of all logistic processes. A system change can often create new problems, which in this case led to a high backlog of orders and the existence of defects and waste. As the company is striving to be a reliable partner, customer dissatisfaction can lead to reorientation of customers to new or other suppliers. In addition, inefficient processes lead to higher costs and demoralization of employees. The objective of this project is to identify waste, make recommendations, make changes and improve processes to achieve the goal of reducing backlog orders and increasing customer satisfaction. To this purpose, the processes are mapped, and time and motion studies are examined. This is followed by an analysis of occurring wastes. Then an implementation plan is carried out to eliminate the waste and improve the processes. In this way, the efficiency of the processes can be ensured, and the general backlog reduced.

Student:	**Alex Kuriatnyk**
Faculty Advisor:	**Carol Mannino**
Organization:	**Khloe Kuriatnyk, LLC. DBA: Momsitivity**
Project:	**Implementing an Accounting System for a Small Business**

This project consisted of the selection and implementation of an accounting system for a small business. This included training on how to use the new system. It was necessary to complete this project because of several issues regarding the business's previous accounting system. Under the old system, it was difficult for the owner to track key financial information. This system was also inefficient, time-consuming, and inaccurate. Much of the research conducted for this project was in regard to best practices for selecting, implementing, and executing an accounting system in a way that benefits a small business. Before selecting a new accounting system, I made sure to fully understand the current business processes and accounting system. Then I identified concerns and issues with the current processes and system. This was done mainly through primary research, which consisted of meetings with the business owner and analyzing the current accounting systems and processes. Based on this research, I developed a needs analysis which provided guidance for criteria to look for in a new accounting system. I then worked with the business owner to select and implement an accounting system that best fit the needs of this business.

Student:	**Lucas Muench**
Faculty Advisors:	**Dr. Rainer Lehmann, Dr. Katrina Moskalik, Beth Slayman**
Organization:	**Hydro-Thermal Corporation**
Project:	**Business Process Management: Developing a Consolidated Process Documentation System**

Hydro-Thermal Corporation has varying forms of process documentation tools, which are difficult to understand and not part of the daily routine of employees. The lack of oversight results in longer training periods for existing and new employees, and it impedes the implementation of a new ERP system. The corporation seeks an overall business process documentation. Through research, a standard method for mapping business processes has been identified, referred to as BPMN 2.0. Existing procedures shall be consolidated in a document and missing processes will be identified during interviews with department managers. The overall business process map shall have cross-references between departments and shall be easily accessible for every employee. The process map starts by identifying an opportunity for selling a solution, continuing with the proposal and order definition, purchasing, receiving, manufacturing, shipping, as well as providing services to the customer. The documentation shows data exchanges, and work steps within and between departments, as well as with customers and suppliers. This overall process map is the baseline for future improvements as it uncovers opportunities and can be used for training purposes as well as for implementing a new IT system.

Student:	**Kilian Oelrich**
Faculty Advisors:	**Dr. Rainer Lehmann, Dr. Katrina Moskalik, Dr. David Rollins**
Organization:	**Hellermann Tyton**
Project:	**Reduction of Stock Keeping Units on Standard Products**

The project, which is taking place in the Product Management Department, needs 6 months to be completed. The main problem is that there are too many unnecessary Stock Keeping Units (SKUs). A SKU is a unique part number used by the business to keep track of inventory and sales. When a new customer-specific order is placed, there is no process to check if a similar SKU already exists and can be recommended. Over the last few decades, an overload of SKUs has built up with consequences such as massive workloads, lack of production efficiency, higher inventory levels, longer change over periods at the plants and different pricing of the different SKUs. The project ensures SKU obsolescence based on an analysis that considers various factors such as the date of the last sale or the overall margin. In addition, the project helps the department consider important factors when creating new SKUs to avoid the problem in the future, save money, and generally work more efficiently and productively. This is ensured by a newly developed review process, which is based on the experience gained from the analysis.

Project:	**Hoptein Company Business Plan**
Student:	**Luke Schraufnagel**
Faculty Advisor:	**Carol Mannino**
Organization:	**Hoptein**

Hoptein is a protein infused beer in the early developmental stages. We believe that there is a market for this type of product because results from a study published in the National Library of Medicine (2015) stated that "Results elaborated previous cross-sectional findings that recent physical activity and alcohol use are positively associated... People drank more than usual on the same days that they engaged in more physical activity than usual." Currently there are insufficient options in the market for people who want to enjoy a beer without sacrificing the progress they have made on their fitness journey. My project is to create a business plan to work in conjunction with the product development activities of my counterpart, Chris Barnes, that outlines how we can take this concept beer from just an idea to a fully functioning business. This business plan outlines our company description, industry analysis, customer analysis, marketing plan, and financial plan to determine how we will start this company. It provides an in-depth look into each of these areas to make it clear how we can differentiate ourselves to the point where a small business loan could be acquired.

Student: **Gabriel Smith**

Faculty Advisor: **Beth Slayman**

Organization: **Community Water Services**

Project: **Database Project for Community Water Services**

Community Water Services is a 501(c)3 nonprofit organization dedicated to providing clean, safe drinking water for the vulnerable population of Milwaukee County. With more than 70,000 homes in Milwaukee having lead pipes, they are all in dire need of replacement. Thousands of Wisconsin children are diagnosed with elevated levels of lead in their blood each year, which can cause permanent brain damage. As part of a water collection project, the organization is collecting periodic water samples over an 8-week span from 150 homes to test the quality and lead-content. Subsequently, these homes will receive free installation of a whole-house WaterPod Filtration Device. The organization's original method of inputting and storing lead-content data on Google Sheets is inadequate and primitive, leading them to find an alternative. This capstone project is focused on the requirements specification, identification and implementation, and the database design for a lead-content data system. The project entails research and application of the Software Development Lifecycle (SDLC), local and cloud-based database implementation options available, and practical application of MySQL, an open-source relational database management system.

Student:	**Sam Witt**
Faculty Advisor:	**Carol Mannino**
Organization:	**Field Services Company**
Project:	**Profitability Analysis**

The project consists of a profitability analysis for all the top clients for a field services company to help increase profitability for the future. The analysis will ensure that the company is maximizing profit where they can and learn how to maximize it in clients that it currently isn't. The analysis will help with future negotiations with clients by having useful ratios to work off and have facts to back the rates they are charging. The project will leave a clear outline so future employees will be able to complete this analysis annually to ensure there is peak profitability from clients. I calculated various sales and profitability ratios for the top clients and the company including Gross Profit Margin, Net Profit Margin, and others. A current state analysis along with a post-state analysis was completed the show the change. A plan with recommendations for how to increase profitability with the top clients who were analyzed along with the smaller clients will be given to the company to help with their plan going forward.

Student:	**Kathinka Zorn**
Faculty Advisors:	**Dr. Rainer Lehmann, Dr. Katrina Moskalik, Beth Slayman**
Organization:	**Leman Inc.**
Project:	**Return process improvement project**

Leman Inc. is a third-party logistics provider that offers its service to over 20 clients. The client service representatives (CSR) are responsible for managing the clients' returns. The returns process, however, was not operating efficiently. As the volume of returns from some clients increased, the CSRs were no longer able to handle the volume of returns on an ongoing basis. As a result, there was not enough space for the returns to be placed in their designated location, and many packages ended up lying around in the warehouse for several weeks until their processing was completed. The purpose of this project was to create a more efficient process flow and to avoid packages lying around in the warehouse. For this reason, a return handling workstation was created with the help of the Lean Tool 5S, so that return packages can be organized and processed according to client affiliation. In addition, responsibilities for handling returns were introduced in the receiving and put-away teams to achieve faster handling. Finally, a job analysis was performed to hire a new return manager who will be responsible for the regular processing of returns in the future.

Humanities, Social Science and Communication Department

User Experience Senior Projects

Students:	**Sarah Cianciola, Alyssa Escanio**
Faculty Advisor:	**Dr. Katie Panciera**
Project:	**Discovery World Early Learners Exhibit**

The goal of this project was to identify whether there was a need for an early learners exhibit at Discovery World and then to create ideas for that exhibit if it was needed. The team conducted multiple rounds of research at Discovery World as well as other related museums in order to understand the competitive landscape and worked with psychologists and educators to better serve the developmental needs of specific ages of children. Through survey and census data and multiple infographics, the team determined that the need did exist and proposed a divided exhibit that would have separate areas for the two developmental stages of child psychology being targeted.

Students:	**Evan Jackson, Ethan Latham, Caitlin Rodriguez**
Faculty Advisor:	**Dr. Katie Panciera**
Project:	**Discovery World Nature Exhibit**

The goal of this project was to identify whether there was a need for an early learners exhibit at Discovery World and then to create ideas for that exhibit if it was needed. The team conducted multiple rounds of research at Discovery World as well as other related museums in order to understand the competitive landscape and had children participate in design thinking experiences to better understand what kids of the goal age range wanted out of a museum. Through survey work and observation, they determined that the need exists and proposes an in-depth nature themed play and learn space for Discovery World. The interactive exhibit will utilize buttons, binoculars, tree bark, floral scents, and more to engage children with Wisconsin nature inside the museum.

Students:	**Arsenius Adogamhe, Elaine Zamudio**
Faculty Advisor:	**Dr. Katie Panciera**
Project:	**Entrepreneurial Ecosystem Development**

This project began as a project working with Walnut Way, a local nonprofit, to support Lindsay Heights entrepreneurs in moving their businesses online and broadening their user base. Lindsay Heights is a historic Black neighborhood roughly two miles from MSOE. Due to a variety of factors, the team pivoted and is now presenting a project to build trust and communication both between Lindsay Heights and the downtown communities and between Lindsay Heights entrepreneurs and their customers. The team completed field research, interviews, and a survey as well as a literature review on building trust and entrepreneurship.

Electrical Engineering and Computer Science Department

Computer Science and Software Engineering Projects– Presented in Diercks Hall

TEAM MEMBERS
Mitch Allen (CS)
Nicolas Anderson (CS)
Juan Jimenez (CS)
Parker McMahon (SE)
Matthew Parrish (CS)

FACULTY ADVISOR
Dr. Derek Riley

TEAM MEMBERS
Nicholas Dang (CS)
Grace Hughes (CS)
Garin Jankowski (CS)
Andrew Ruswick (CS)
Laura Weinschrott (CS)

FACULTY ADVISOR
Dr. Sohum Sohoni

SPONSOR
Rockwell Automation,
Discovery World

AI Cybersecurity

The goal of this project is to develop an application which focuses on anomaly detection on Rosie, MSOE's supercomputer. The tool gives administrators the ability to investigate potential issues and respond if necessary. Due to the complexity of jobs that run on Rosie, it can be difficult to understand the landscape of operational conditions, and many details are hidden in voluminous log files. The goal of this tool is to expose everything from simple syntax errors in code to more complex, multifaceted problems. The tool uses anomaly detection, a strategy for detecting out-of-place data in a sea of information.

Discovery World Pong Exhibit

Discovery World, in collaboration with Rockwell Automation, plans to have an exhibit in which visitors will be able to play pong against an AI opponent. The purpose of the exhibit is to provide a real-world example of artificial intelligence and demonstrate how AI improves over time. Contactless input from the user is taken in through a depth camera. The exhibit will include a screen that shows the neural network as it makes decisions, highlighting the connections made during each inference. It is a good exercise in machine learning visualization and would help in introducing basic ML concepts to those unfamiliar with the field. The project has already been developed but would benefit from a reintegration into a professional level game engine rather than the custom system it is currently running on. This would allow for better scalability and maintainability for others to work on this project in the future..

TEAM MEMBERS
Tiffany Dabrowski (SE)
Bart Gebka (SE)
Matej Koncos (SE)
Jake Strasler (SE)
Nathan Wagenknecht (SE)

FACULTY ADVISORS
Dr. Walter Schilling and
Dr. Sohum Sohoni

SPONSOR
TRT Speech (Benjamin Taft,
Joseph Tenuta)

Hello Audrey

The Hello Audrey platform is a web application that aims to supplement the work of existing speech pathologists by providing an easy-to-use portal for clients to record their speech and have clinicians review it. The platform has a user-friendly interface that greets visitors with a login page where, upon signing in, they are directed to the appropriate page based on their role within the organization. The three main roles are Patients, Auditors, and Organizations. Patients are users who record their speech, Auditors evaluate the uploaded speech recordings, and Organizations manage both types of users. The platform is designed to be easily accessible and understandable for patients and, if applicable, their parents, providing a clear picture of progress in speech therapy through progress tracking metrics. The use of Firebase, Firestore, FastAPI, and GCP ensures that the website is secure, scalable, and efficient, thus speeding up the process of speech therapy evaluations and assessments.

TEAM MEMBERS
Bailey Franklin (SE)
Mahmadkaif Sindhi (SE)
Hunter Turcin (SE)
Gavin Vaubel (SE)
Amish Verma (SE)

FACULTY ADVISOR
Dr. Angela Wiedenhoeft

Insight Configurator

Insight Configurator will be an in-house web portal to be used by New World to maintain their clients' website configuration. It is built on a C# .Net backend and uses an Angular frontend. The tool incorporates several important capabilities involving staging and batching of configuration changes. New World's support team can update customer websites via a web user interface without writing SQL commands. Users can also audit previous changes, undo bad changes, and move changes through multiple production levels.

TEAM MEMBERS
Ryan Emerich (SE)
Gage Franklin (SE)
Ian Gresser (SE)
Joshua Rist (SE)
Dylan Schultz (SE)

FACULTY ADVISOR
Dr. Sohum Sohoni

Into the Inferno

The team is making a rogue-like video game inspired by "The Divine Comedy." As a rogue-like, our game generates a randomized level for the player to navigate through. As the player moves through different levels, the player will find items and weapons to become stronger. At the end of every level, the player fights a boss. If the player dies, the game randomly regenerates the level, and the player must start over with no items. The game is developed using the Unity Game engine as a starting point and the 3D modeling software Blender is

utilized to create unique artwork and assets for the game. Assets are made in Blender, placed in Unity, and scripted using the C# programming language. The C# scripts control asset animations, and other functional logic for the game. Audio is created in a digital audio workstation (DAW) known as Ableton Lite.

TEAM MEMBERS
Joel Frank (CE)
Thy Le (SE)
John Peters (SE)
Bilal Syed (SE)
Mike Zabrowski (SE)

FACULTY ADVISORS
Dr. Walter Schilling
Dr. Sohum Sohoni

Modem-Activated Warning System

The modem activated warning system is a research and development project to improve the communication between TAPCO traffic devices (e.g., road signs and sensors) by allowing messages to be sent over a cellular network. Implemented with off the shelf microcontrollers and modems, the modem activated warning system is a cost-effective way to allow for communication within areas too dense for radio communication and over longer distances than the current radio systems can manage. Integrating the components chosen in an environment without an operating system has been a great challenge that the team has worked hard to overcome. To overcome this challenge, the team assigned work based on existing skill and the desire to learn more about certain facets of the project. This maximized the team's performance while also allowing for team members to learn from each other in areas they are passionate about. The data gathered from developing this product will help TAPCO design safer and more reliable systems that work in previously inaccessible environments.

TEAM MEMBERS
Derek Gauger (SE)
Kyle Krueger (CS)
Kenneth McDonough (SE)
Alan Van Dyke (SE)
Riley Woytas (SE)

FACULTY ADVISOR
Dr. Derek Riley

SPONSOR
Molson Coors
Beverage Company

Molson Coors Keg Traceability System

Molson Coors Beverage Company is sponsoring this project to explore the feasibility of using blockchain to increase the visibility of kegs along the supply chain. Our solution utilizes RFID tags and scanners at various supply chain locations uploading individual keg information to a blockchain ledger. This blockchain ledger provides an immutable, tamper-proof storage solution that can be scaled to handle Molson Coors' keg fleet. This data is aggregated and displayed on an interactive dashboard. The dashboard will be used by Molson Coors' Logistics team to perform accurate asset counts, provide accountability for third party partners who transport kegs, and inform other supply chain logistics decisions. This project is intended to be a proof-of-concept to give Molson Coors' data to further develop a scaled-up solution.

TEAM MEMBERS
Hayden Dalton (CE)
Collin Quinn (CS)
Keegan Rhodes (CS)
Christian Sabin (EE)
Maxwell Udell (EE)

FACULTY ADVISOR
Dr. Sohum Sohoni

SPONSOR
Molson Coors
Brewing Company

Molson Coors Line Status View (LMS)/Maintenance Improvement Tool

Molson Coors Brewing Team has limited visibility to past and current equipment status for specific brewing systems. Currently, the Brewing Team primarily relies on operator feedback while on shift or at the end of shift. By creating a tool which displays equipment status and relevant brewing information, Molson Coors will be able to reduce reaction time to potential issues caused by various process dependencies, increase process and equipment awareness. Additionally, we aim to create an alert system to prompt key Molson Coors employees if certain machines have lower than a tolerated level of availability.

TEAM MEMBERS
Ryan Alexander (SE)
Austin Boley (SE)
Patrick Hayes (SE)
Courbin Kettenhofen (SE)
Sam Kluck (SE)

FACULTY ADVISORS
Dr. Chris Taylor
Dr. Angela Wiedenhoeft

Nail Art Creator Software

Our website allows artists to template a work of nail art from a digital picture. Nail art is created by hammering nails into a wooden board in a pattern which, when viewed as a whole, looks like the original picture. Our website generates two ways to assist with nail art creation – a printout which can be laid over a wooden board showing where the nails should be placed, or a Gcode file which can be sent to a Haas VF-1 CNC machine to drill pilot holes for the nails.

TEAM MEMBERS
Christian Doughty (SE)
Zach Kangas (CS)
Muize Rahman (EE)
Jaden Rogel (CE)
Noah Stiemke (SE)

FACULTY ADVISORS
Dr. Walter Schilling
Dr. Sohum Sohoni

SPONSOR
Erik Krippaehne, Sales and
Operation Manager at Pac-land

OLED Keyboard

This project is to create a custom keyboard number pad where each individual keycap is a small OLED screen. A program on the user's computer can be used to change the image displayed on each key, as well as customize different image layouts to display when certain applications are running. This allows for a user to select which images are displayed when an application (a video game, for example) is opened. This project aims to provide new customization to aspects of a computer setup which previously could not be done. The project involves a C# computer application with a C++ hardware backend.

TEAM MEMBERS
Luke Altschwager (SE)
Tyler Daehn (SE)
Aiden McCrea (SE
Ben Mueller (SE)
Riley Sullivan (SE)

FACULTY ADVISORS
Dr. Chris Taylor
Dr. Walter Schilling
Dr. Angela Wiedenhoeft
Dr. Josiah Yoder

One Source Quality Culinary Solutions

OneSource aimed to provide a comprehensive training solution for senior care staff, particularly cooks, servers, and kitchen directors. It involved developing an LMS (Learning Management Software) that is hosted by WordPress, providing an easy-to-use and accessible platform for training. The LMS software is designed to be user-friendly, with features such as interactive courses, quizzes, and progress tracking. It provides a wide range of training materials, including videos, images, and documents, that cover essential topics such as food safety, nutrition, and dietary restrictions. This platform also offers certification upon completion of the training program. The project is expected to enhance the knowledge and skills of senior care staff, ensuring that they are well-equipped to provide high-quality services to the elderly.

TEAM MEMBERS
Ryan Becker (CS)
Ryan Burleson (CS)
Simon Erickson (SE)
Samuel Goedert (CS)
Noah Villanueva (CS)

FACULTY ADVISOR
Dr. Gerald Thomas

Rare Coin Detector

This project is a mobile application that helps streamline coin collecting by quickly identifying a coin, and saving its information to a digital collection. This saves time for experienced collectors when they are sorting through large batches of coins. Additionally, Rare Coin Detector also assists new collectors by identifying their coins and providing information on scanned coins quickly. Our app uses a combination of machine learning models to make the coin identification possible.

TEAM MEMBERS
Roberto Garcia (SE)
Jonathan Her (SE)
Miriam John (SE)
Claudia Poptile (SE)
Chloe Wallach (SE)

FACULTY ADVISORS
Dr. Walter Schilling
Dr. Sohum Sohoni

SPONSOR
Innovent Center

RESLock

This project is a mail management system that semi-automates the processing of mail pieces. It also ensures the security of mail pieces for residents of universities. This system is a mobile application that uses optical character recognition (OCR) to scan the label of a mail piece, and the receiving user is sent a notification along with a QR code. A worker must scan this QR code in order to retrieve the correct mail piece for the resident and the resident can only pick up the mail piece associated with that QR code. Owners and administrators of organizations will be provided with access to a complementary web application to manage and oversee operations. This system will be marketed primarily towards university dorms that process mail and notify residents manually. With our product, mail room workers will be able to scan in, scan out, and keep track of mail pieces more efficiently.

TEAM MEMBERS
Neel Desai (CS)
Tyler Faulkner (CS)
David Jin (CS)
Michael Salgado (CS)
Emma Straszewski (CS)

FACULTY ADVISOR
Dr. Derek Riley

SENIOR DESIGN SCHOLARS*
Ashley Hernandez Caballero
(Ronald Reagan High School)
Jude Restrepo (Heritage
Christian Schools)

SPONSOR
American Family Insurance

Rosie Education Dashboard

As a relatively new addition to MSOE, the Rosie supercomputer currently does not have many observable resources available that showcase its capabilities and potential. Our project, Rosie Educational Dashboard, aims to create an interactive application that enables visitors and members of the MSOE community to learn more about computer science and machine learning in an engaging and accessible way. The application, built using Python and Javascript, will offer a range of interactive demos, including art generation using Stable Diffusion, an emotion recognition photobooth, and games featuring AI opponents. Running on Rosie itself, the application utilizes hand tracking navigation and voice navigation through a camera and microphone providing a unique interactive experience for users. The project's goal is to not only showcase the capabilities of the Rosie supercomputer but also to educate and inspire the MSOE community and visitors about the potential of computer science and machine learning.

TEAM MEMBERS
Kian Dettlaff (CS)
William Lauer (CS)
Austin Patterson (SE)
Jayden Shaw (CS)
Parker Splitt (CS)

FACULTY ADVISOR
Dr. Derek Riley

SPONSOR
Dr. John Bukowy

TippyTap (Smart Tap Handle System)

Bar owners and homebrewers alike have few options for measuring how much draft remains in their kegs. Most just shake the keg or try to heft it, which leads to unreliable inventory management for bars, and disappointment for homebrewers. Dr. Bukowy came to us with a smart tap handle prototype and barrels of potential. Our team has worked year-round to draft an enhanced prototype adding wireless capability, a base station that connects and manages multiple taps, and a mobile-friendly web app for monitoring and control. TippyTap allows businesses and homebrewers alike to start tracking keg fill-level and pours over time by adding one or more tap handles to their existing setup. TippyTap provides data visualizations and predictions to help plan when to order more kegs or ingredients.

Senior design scholars are high school students that are admitted to MSOE and participate on senior design teams. The Senior Design Scholars Program provides participants with mentoring experiences and opportunities to enhance leadership, team building, cross-cultural communication and analytical skills in science, technology, engineering and math (STEM). Scholar participation is by application. American Family Insurance sponsors the Senior Design Scholars Program.

TEAM MEMBERS
Angela Christie (CE)
Grant Fass (CS)
Nicholas Kaja (CS)
Alexander Karpov (CE)
Teresa Toohill (SE)

FACULTY ADVISOR
Dr. Sohum Sohoni

Transcription Study Assistant

The Transcript Study Assistant provides aid to both instructors and students during the learning process. This project provides a more affordable option for presentation-focused recording devices than what is currently offered in the market. Using machine learning, the study assistant helps break down large amounts of information into manageable pieces to help students understand key concepts. This tool also helps educators identify the key concepts they are teaching. Overall, the Study Assistant makes it easier for students to learn and for educators to communicate their ideas effectively. A custom, all-in-one device has been developed and tailored to the classroom environment. It utilizes a custom PCB to control the onboard camera, motor, and microphones. Files can be uploaded through our frontend, written in Angular, to our backend, written in Flask. The backend utilizes HuggingFace transformers and Latent Dirichlet Allocation to perform transcription, create summaries, extract keywords, and answer questions.

TEAM MEMBERS
Autumn Beyer (CS)
Michael Connor (CS)
Malcolm Johnson (SE)
Luka Malovic (SE)
Alex Moran (CS)

FACULTY ADVISOR
Dr. Angela Wiedenhoeft

TREN (Transformers Using Reinforcement with Emulation and Networks)

This project seeks to make use of state-of-the-art AI technologies, namely transformers, to train a model to be able to play select games from the platforming video game franchise, Super Mario Bros. To that end, the model is being trained on Super Mario Maker 2, a game that allows for a high degree of customization both in the content of the levels, as well as the visual style in which they are presented; this includes the styles of Super Mario Bros., Super Mario Bros. 3, Super Mario World, and Super Mario Bros. U. This allowed us to curate a highly iterative training process for the model, in which it will gradually learn how to overcome a variety of obstacles in each of the aforementioned styles.

Computer Engineering, Electrical Engineering and Biomedical Engineering Projects – Presented in the Walter Schroeder Library

TEAM MEMBERS

Natalia Bukowski (BME)
Dimitri Jifas (BME)
Grey Tubutis (BME)
Nathan Walla (BME)

FACULTY ADVISOR

Dr. Jeffrey LaMack

AI-Enabled TENS Device for Regimen Optimization

The TENS, or transcutaneous electrical nerve stimulation unit, is a small handheld device that sends electrical pulses through the skin via connecting electrodes. Currently, the TENS operates by having the user manually adjust electrical pulse settings through trial and error to find the best combination that helps reduce their pain. These manual adjustments and guesswork of parameters can cause a lot of confusion to first-time users. Additionally, when a user does find their optimal parameter combination, they could be at risk of becoming desensitized from repetitive overuse. Our proposed project would alleviate user confusion by implementing an algorithm that learns the user's preferences for possible pulse settings and automatically recommends ideal combinations. This AI-enabled capability is conveniently stored within a mobile app for easy access and is a helpful tool for those struggling to get effective treatments from their manual adjusting.

TEAM MEMBERS

Adrian Degenhardt (BME)
James Mills (BME)
Gabrial Neff (BME)
Madeline Powers (BME)

FACULTY ADVISOR

Dr. Icaro dos Santos

SPONSOR

VA Hospital
Dr. Katie Schultz
Dr. Katie Powell

Air Mattress Modifications for Patients with Tetraplegia

Tetraplegia is partial or total loss of use of all four limbs that is caused by injury or illness. Patients with this condition spend extended periods of time on air mattresses which puts them at risk for developing bed sores. Modern alternating air pressure mattresses redistribute pressure via air cells that slowly inflate and deflate to stimulate blood flow and prevent bed sores from developing. The current control system is manually operated and located at the foot of the bed, making it inaccessible to the patient and inconvenient for caregivers. Our project aims to develop a control system which allows tetraplegic patients, without speech impediments, to independently adjust the air pressure via voice control interfaced with Alexa.

TEAM MEMBERS
Mitchell Bath (CE)
Tommy Donahoe (CS)
Joshua Goldshteyn (CS)
Alexander Knepprath (SE)
Zachary Stoffel (SE)

FACULTY ADVISOR
Dr. Eric Durant

Amplisampler

The Amplisampler is a game-changing device for musicians who want to capture their rig's sound signature and transport it with ease. This portable and compact device can capture a guitarist's complete rig, including pedals, amplifiers, speaker cabinets, microphones, and non-time-based effects processors. It uses a neural network to learn how a given rig modifies an incoming signal, then it uses the generated model to recreate the rig's sound signature. The Amplisampler can then be substituted for the actual rig for the musician to play with. The innovative technology is packed into a small device that fits neatly within a 2U rack space, making it much easier to transport than the heavy equipment that makes up the rig.

TEAM MEMBERS
Devin Baumgartner (EE)
Christian Estrella (EE)
Kaleb Kendziora (EE)
Matthew Miller (EE)
Peter Zambo (EE)

FACULTY ADVISOR
Dr. Edward Chandler

Automated Universal Piano Player

In recent years, fewer households include a person who can play a piano. Thus, the door has opened for piano automation. Currently, there are no commercial methods of piano automation that convert a piano to provide self-playing jukebox functionality while also fitting a wide range of keyboard sizes and not being destructive to the piano. Our solution is intended to be a low-cost, highly functional, and nondestructive alternative when compared to existing automated mechanical and electrical player pianos. The solution allows users to select any piano MIDI file, which the solution will convert into musical notes played on a piano that can be enjoyed by the listeners without having to alter the piano in any way. It will also give the user peace of mind knowing that they can install the Automated Universal Piano Player in minutes, knowing that the piano underneath is still in the same condition as before the installation.

TEAM MEMBERS
Patrick Christianson (CE)
Nathan Roth (CE)
Sean Ryman (CE)
Oliver Sawyer (CE)
Michael Scatena (CE)

FACULTY ADVISOR
Dr. Eric Durant

DSP-FPU

Smaller microcontrollers, which are utilized by prototypers and hobbyists due to their affordability and accessibility, lack floating-point calculation capabilities often used for DSP (Digital Signal Processing) applications. To perform floating-point calculations, a microcontroller needs a FPU (Floating-Point Unit) to offload more complex mathematical operations that the microcontroller cannot handle on its own. Currently, only larger, more expensive microcontrollers have built-in FPUs to allow for floating-point arithmetic functionality needed for DSP. Contrastingly, smaller microcontrollers

such as Arduino Nano or Uno only have basic arithmetic functionality but are much more inexpensive to purchase. Our project is designed to be a dedicated FPU that will enable smaller microcontrollers to utilize floating-point arithmetic. Furthermore, this dedicated FPU will also be integrated into an attachable PCB with a custom-made C++ library to allow for a simplistic set up process and streamlined execution of DSP filters.

TEAM MEMBERS
Vishnu Appalaraju (CS)
Daniel Leskiewicz (CS)
Vaughan Neidert (CS)
Jonathan Paulick (CS)
Tyler Tran (CS)

FACULTY ADVISOR
Dr. Eric Durant

SPONSOR
Dr. Kevin Cohoon
Medical College of Wisconsin

MEDICAL COLLEGE OF WISCONSIN

EKG Illness Classifier

An electrocardiogram (EKG) supports a medical diagnosis of a patient's heart by providing a recording of the electrical signal that the heart produces during several cardiac cycles. The EKG is recorded as a waveform with three distinct components from several different channels. These waveforms can potentially be used to detect specific conditions that a patient may have. Our team developed various machine learning and deep learning models to determine if it is possible to differentiate patients that have a condition, such as pulmonary embolism or myocarditis, from those that have the same condition with COVID-19 by using their electrocardiogram. This approach aims to show that a successful diagnosis can be made even in the presence of multiple conditions that affect the EKG. This technology could be used to aid medical professionals in diagnosing patients to a higher degree of accuracy as well as limiting the number of invasive tests that a patient has to experience.

TEAM MEMBERS
Giovanni D'Addabbo (EE)
Andrew Eder (EE)
Jorge Jurado-Garcia (EE)
Daniel Ruppert (EE)

FACULTY ADVISOR
Dr. Cory Prust

SPONSOR
Milwaukee Tool

Milwaukee

E-Paper Display Implementation on Milwaukee Tool Products

In recent years visual display and performance indicators for construction tools have steadily increased in demand. High battery usage and inconsistent visibility of current solutions such as LCD displays have undesired tradeoffs, limiting tools with visual indicators. Advancements in display technology, such as electronic paper (e-paper), have made it possible to explore if a digital display can be used without sacrificing battery life. Our design implements a modular adapter that integrates e-paper displays onto Milwaukee Tool products to meet current market demands of visual performance verifications and indications.

TEAM MEMBERS
Justice Escamilla (EE)
Samuel Hiller (EE)
Salvatore Rouse (EE)
Aidan Showalter (EE)
Marques Washington (EE)

FACULTY ADVISOR
Dr. Cory Prust

SPONSOR
Fluid Power Institute

Gas to Electric: FPI Tractor Upgrade

The goal of this project was to update the existing tractor owned by the MSOE Fluid Power Institute (FPI), which was previously created by mechanical engineering senior design students. Upon assessing the tractor's shortcomings, the team decided to improve the tractor without making any changes to the hydrostatics currently in place. The FPI decided that by doing this, the tractor could be used to demonstrate fluid power concepts and be left for potential improvements in future projects. In addition to these ideas, the potential of hydraulic systems being powered electrically is being explored. These improvements were made by swapping the gas engine and improving the electrical controls. The main task involved swapping the engine for an electric motor. Implementation of the motor required finding a motor controller, battery, and a battery management system.

TEAM MEMBERS
Michael Beseler (EE)
Elijah Ruplinger (EE)
Alexander Stein (EE)
Tanner Whipps (EE)

FACULTY ADVISOR
Dr. Cory Prust

Lego Men

Sorting Legos is a time consuming and tedious task that can be improved with automation. We set out to create a Lego sorting device that can sort by size and color while keeping it as simple and inexpensive as possible. Our goal is for this device to appeal to various stakeholders such as Lego enthusiasts and parents. The device utilizes five different subsystems that work together to move Legos through the system. We designed the sorter to use an Arduino controller, coded in C++, that controls various motors and sensors. The Legos flow through an initial hopper and travel via converter belts until servo motors knock off the Legos into the correct corresponding bin.

Lego is a copyright of The Lego Group. All rights reserved.

TEAM MEMBERS
Kyle Labedz (EE)
Emerson Miller (EE)
Grace Salaja (EE)
Mariah Trevino (EE)
Reza Usmani (CE)

FACULTY ADVISOR
Dr. Steven Holland

Line Dancer

Lining fields with chalk is a time-consuming process that requires trained individuals and multiple tools to complete. The Liner Dancer project addresses these problems by automating the field lining process. The device begins by setting a reference point which pairs with the outputs from other sensors of the device's Location subsystem in ensuring the proper path is followed. Safety features of tipping and object detection are incorporated into the device to prevent any harm from occurring to the device or its surroundings. There is also a touchscreen display used to inform the

operator of the device's status. The result of combining these components with the Motion, Power, and Chalk Dispensing subsystems of the device is an alternative to lining fields that is as simple as placing the device down and letting it go.

TEAM MEMBERS
Ted Colwell (BME)
Rin Heidingsfelder (BME)
Josie Kunz (BME)
Raven Pan (BME)

FACULTY ADVISOR
Dr. Icaro dos Santos

SPONSORS
Benjamin Kessel
PA-C
Froedtert South

Medium-Fidelity Cricothyrotomy Training Device

The Cricothyrotomy procedure is an emergency procedure often performed to establish an airway when intubation is not possible. This lifesaving, high-risk procedure frequently occurs in high-stress environments so it's important that professionals have adequate and realistic training. Current trainers offer limited fidelity in both the simulation of human tissues and ventilation mechanics. To resolve these shortcomings, we have developed a medium-fidelity Cricothyrotomy training device that provides a high-quality training experience. Our device is wearable and uses realistic anatomy, textures, and qualitative feedback so that the trainee is provided with a better experience than given by current trainers.

TEAM MEMBERS
Jairo Lezama (EE)
Joshua Roets (EE)
Skylar Sobczak (EE)
Alex Stuebe (EE)

FACULTY ADVISOR
Dr. Edward Chandler

Milwaukee Riverkeeper Dissolved Oxygen Sensor

Milwaukee Riverkeeper needs to measure and retrieve dissolved oxygen data from the rivers and streams surrounding Milwaukee. Currently they rely on volunteers traveling to remote sites to manually measure and report data. Individual automatic water quality sensors of professional grade are too expensive and require frequent human interaction to be used and maintained. This project is a self-sustaining, remote, dissolved oxygen sensor. The device will wirelessly send the data it collects automatically to a remote data-collection location on an hourly interval or per the end user's desire.

TEAM MEMBERS
Crystal Anderson (BME)
Morgan Coirier (BME)
Tyler Gildemeister (BME)
Desiree Martin (BME)
Nicole Robb (BME)

FACULTY ADVISOR
Dr. Icaro dos Santos

SPONSOR
Dr. Eric Paulson
Medical College of Wisconsin

MEDICAL
COLLEGE
OF WISCONSIN

MRI Compatible Augmented Reality System for MRI Guided Interstitial Brachytherapy

The mission of this project is to modify an existing model of the Epson Moverio BT-35E smart glasses worn by physicians, currently used for MRI-Guided Interstitial Brachytherapy to treat cervical cancer. The current model of smart glasses is being used at the Medical College of Wisconsin. The primary objective of this project is to eliminate the need for the glasses to be tethered to a power source for data transmission so full mobility within the operating room can be achieved by the physician. The secondary objective of this project is to improve adjustability and comfortability, while maintaining a lightweight design, of the smart glasses to provide security for the duration of the procedure. The final objective of this project is to modify the smart glasses to be MRI-compatible to ensure there is no magnetic interference between the smart glasses and MRI machine.

TEAM MEMBERS
Robert Hinner (CE)
Jonathan Watson (CE)

FACULTY ADVISOR
Dr. Gerald Thomas

PERSONAL 911

Personal 911

The Personal 911 is a device intended to help students who are in a dangerous situation. It is designed to discreetly contact a phone number you set in case of an emergency. This is in case you cannot reach your phone or if you don't want to be seen contacting help on your phone. It is designed to contact campus security on a college campus as it is intended for college age students, but any phone number can be programmed. It connects to the user's cell phone through a mobile application. It can either call or send a text message with the user's coordinates to the chosen number.

TEAM MEMBERS
Braeden Al-Angary (CE)
Andrew Budreck (CS)
David Catena (CE)
Olivia Garces (EE)
David Lonski (SE)
FACULTY ADVISOR
Dr. Gerald Thomas

SPONSOR
Plexus

PLEXUS.

PETTALS

PETtals is an intelligent pet door that is aimed at increasing security and safety around conventional pet doors. The primary goal of PETtals is to prevent unwanted animals and intruders from accessing a house through a pet door. For pet owners who have indoor-outdoor pets, this can be a real problem. Additionally, PETtals allows pet owners to monitor the basic activity of their pets as well as set scheduled restrictions on the times they are allowed outside. The locking door can be controlled through a mobile application and can be locked and unlocked by a Radio Frequency Identification (RFID) tag worn by the pet on their collar. The RFID tag

communicates with a reader that is installed in the door, effectively preserving the pet's freedom while also increasing the security of the home.

Plant Manager

TEAM MEMBERS
Jacob Dial (EE)
Nicole Sedmak (EE)
Sydney Thomas (EE)
Christian Trujillo (EE)

FACULTY ADVISOR
Dr. Richard Kelnhofer

Many people enjoy plants, and all the benefits plants have to offer. However, tending to your plants can be time-consuming and sometimes difficult. It is easy to make mistakes that damage your plants if you are not knowledgeable on how to take care of them properly. The Plant Manager is designed to save time and save your plants. The Plant Manager is a user-friendly plant management system that monitors the plant's environment and provides precise watering to meet the specific needs of the plant. The Plant Manager utilizes Bluetooth® Low Energy (BLE) for a wireless user interface that is simple and easy to use. Solar power with battery back-up makes it possible to locate the Plant Manager in any part of your garden, and the durable and waterproof construction will keep the Plant Manager operating in all environments.

Portable Insulin Cooling Case

TEAM MEMBERS
Jonathan Gonzalez (EE)
Kenneth Grieger (EE)
Mayada Issa (EE),
Thomas Nord (EE)

FACULTY ADVISOR
Dr. Richard Kelnhofer

People with diabetes may require insulin injections as part of their regular treatment. Insulin is a very expensive medication that can run up to around $170 per injection pen, with some people taking up to 20 pens per month, and must be stored in a controlled refrigerated environment. This makes long distance travel challenging as keeping the insulin cold is essential. People with diabetes must consider medicinal storage solutions when traveling. Medications such as insulin that need to be kept within a specific temperature range are not easily transported on extended flights due to a lack of available storage options. The Portable Insulin Cooling Case (PICC) is a device with active cooling. It is designed to keep an abundant amount of injection pens cooled for at least 24 hours even with outside temperatures as great as 90°F. The PICC is powered using portable battery packs with USB-C Power Delivery. The PICC is designed to meet all TSA travel requirements and is more user friendly than other options available on the market.

TEAM MEMBERS
Grace Brown (BME)
Sarah Grossman (BME/EE)
Carly Paveglio (BME)
Kayla Serio (BME)
Lauren Stefanczyk (BME/EE)

FACULTY ADVISOR
Dr. Icaro dos Santos

SPONSOR
Milwaukee Tool

Power Tool Handle Dynamics

We, alongside Milwaukee Tool, will implement mechanisms to detect kickback in drills. A system needs to be developed that measures the mechanical parameters of a given user's arm such that a mathematical model can be derived to inform the system response of a human arm and drill interface. The model will then interface with a sensor and train the sensor to detect kickback. The end goal is for the sensor to be placed in a variety of Milwaukee Tool tools.

TEAM MEMBERS
Jose Beltran-Gonzalez (CE),
Mary Hodal (CE)
Benjamin Kraft (CE),
Thomas Peachey (EE)
Joseph Teschke (CE)

FACULTY ADVISOR
Dr. Gerald Thomas

S.A.T. Monitor

In the U.S. alone there are over one million jobsites where workers are potentially exposed to harmful air pollutants, loud noises over extended periods of time, and extreme temperatures. Many of these jobsites today require the use of different monitors that only specialize in measuring one kind of contaminant. The Sound, Air and Temperature (S.A.T) Monitor provides a comprehensive solution capable of simultaneous monitoring of pollutants commonly present in construction sites. The monitor can be hung onto a wall or fixed to an I-Beam for hands-off sampling. The monitor also provides auditory and visual cues through an LCD screen, an LED bar, and a speaker to alert the user of any contaminant that exceeds standards set by OSHA, HHS, NIOSH, and the CDC. Moreover, the monitor can export any session data via USB so measurements can easily be saved for future uses.

TEAM MEMBERS
Jordan Dudek (EE)
Steven Earley (EE)
Jessica Hernandez (EE)
Eric Vana (EE)

FACULTY ADVISOR
Dr. Edward Chandler

Soil Moisture Monitoring System

The Soil Moisture Monitoring System helps keep a garden green. Our product addresses a void in the market by offering an easy-to-use and affordable kit in the form of wireless moisture sensors and an interactive display. Placed around the garden, the sensors are equipped with a solar panel and battery, so that each can report the moisture level to the central hub using a Bluetooth Low Energy signal. A central hub mounted in the user's home receives and displays sensor data in an easy-to-read historical chart. The hub also connects to the user's wi-fi and receives the weather, allowing the user to make an informed decision to water the garden

or let the rain do its job, saving time and conserving water. Our system was carefully designed to be safe, simple, and unobtrusive — a helpful tool in any gardener's toolkit.

TEAM MEMBERS
Cedric Carreon (EE)
Jordan Gale (EE)
Noah Gregor (EE)
Zhengyu 'Jason' Ke (CE)
Tanner Nierenhausen (EE)

FACULTY ADVISOR
Dr. Edward Chandler

Solar Tracking Stand

Solar power is good for easily producing renewable energy; however, it can be massively inefficient. Using a solar panel stand that tracks the sun can help raise the efficiency of a solar panel by around 30%. Many current solar tracking solutions are geared to solar farms that use multiple rows of solar panels, and the heights of the stands are around 10 feet. The Solar Tracking Stand is geared towards smaller panels such as for hobbyists that want more efficient solar power for their projects. The height of the stand is 2-feet tall, and two linear actuators are used in conjunction with a gyroscope and light sensor to move a solar panel towards the sun. This movement is done incrementally every 15 minutes throughout the day to conserve energy. The Solar Tracking Stand aims to increase the efficiency of a solar panel beyond that of a simple stationary solar panel.

TEAM MEMBERS
Joshua Fay (BME)
Julianna Getka (BME)
Micah Overley (BME)
Stephen Scripp (BME)
Kyler Tanis (BME)

FACULTY ADVISOR
Dr. Jeffrey LaMack

Squat Form Tracker (Overuse Injury Monitoring and Rehab)

The goal of this project is to create a wearable device to aid in monitoring overuse or repetitive strain injuries. These injuries happen during repeated muscle movements and can be made worse through a lack of proper training or technique. This project will help create a new way to track squat form during a workout, monitor recovery, and use the information to adjust future workout plans. The device will be used alongside the athletic trainers' professional guidance to ensure each athlete is using proper form and understands necessary recovery metrics from their workout. There is a need on the market for a more affordable device that allows college athletes to focus on necessary metrics to aid in workouts and recovery.

TEAM MEMBERS
Austin Breit (EE)
Aleksa Pjanic (EE)
Chad Goplen (EE)
Eric Lehman (EE)
Nicolas Rosenwald (EE)

FACULTY ADVISOR
Dr. Cory Prust

SPONSOR
Dynamic Ratings™

Sulfur Hexafluoride (SF$_6$) Monitoring System

This project is a Sulfur Hexafluoride (SF$_6$) monitoring system that will record measurements of SF$_6$ in high voltage applications and send this information to their respective company. SF$_6$ is a powerful greenhouse gas used in high voltage applications as an insulator due to its high resistance. Due to the environmental concerns with SF$_6$, usage of this gas must be reported to the Environmental Protection Agency (EPA). When switching occurs in high voltage breakers, this will cause arcs to form that are extinguished by SF$_6$ preventing possible explosions. A solution is needed to constantly monitor and inform companies of potential SF$_6$ leaks. This solution will utilize a camera attached to SF$_6$ gauges to take a picture once per day and send the picture along with an algorithm recorded measurement to the company's emails. This will allow companies to efficiently document SF$_6$ levels while also allowing them to confirm the measurement themselves.

TEAM MEMBERS
Caleb Colbert (EE)
Rees Graves (EE)
Hans Hoelzer (EE)
Daniel Rykowski (EE)
Xianghong (Shawn) Tang (EE)

FACULTY ADVISOR
Dr. Richard Kelnhofer

SPONSOR
MSOE Supermileage Org

Supermileage Motor Control

MSOE Supermileage is a student design team that develops fuel-efficient vehicles for the annual Shell Eco-Marathon (SEM) collegiate competition. There are three different energy categories, one being the battery-electric category. A requirement for battery-electric powered vehicles is for the motor controller to be purpose designed and built by the team. This project is the design, development, and verification of the controller for a brushless DC (BLDC) motor that will be used for future competition vehicles. The motor controller can drive up to 1.5kW at 48Vdc nominal voltage and utilizes six-step commutation, which is standard for most BLDCs. The controller is also designed to implement Field Oriented Control (FOC) of the motor for future applications. Safety features in the controller included system status checks, safety-shutdown procedures when faults are identified, battery protection, and overall circuit protection. A sensor system is included to capture motor performance data for post competition analysis.

TEAM MEMBERS
Lauren Campbell (BME)
Jonelle Faith Fabian (BME)
Julia Kalish (BME)
Dyllan Price (BME)

FACULTY ADVISOR
Dr. Jeffrey LaMack

SPONSOR
Dr. Xue-Cheng Liu
Mafer Larraga

Twister Cables with Biomechanical Performance Measurement

Intoeing is a very common condition that describes the feet pointing inwards during movement, it can occur from birth or develop at a young age. As most children grow, their intoeing will correct itself with no external intervention, although in certain situations it will not self-correct. If left untreated, intoeing can lead to further complications and excess strain on the legs and feet. Treatment for intoeing varies depending on the severity, but a common treatment is the use of twister (torsion) cables. These devices contain a pelvic belt, bilateral cables and an ankle-foot orthosis or shoes to resist against the intoeing. Current twister cables available do not have a quantitative way for physicians and patients to measure or track biomechanical progress associated with device use. Our device, GaitBox, adds sensors to collect biomechanical data from the twister cables.

TEAM MEMBERS
Trevor Barnes (CE)
Terry Carney (EE)
Zeshawn Kahloon (EE)
Benjamin Klemp (CE)

FACULTY ADVISOR
Dr. Eric Durant

Unmanned Aircraft System Remote Identification Module for Federal Aviation Administration

On September 16, 2023, per FAA regulations, all drone pilots, whether hobbyist or commercial, must register their drone. This requirement can be met in any of three ways: flying a Standard Remote ID drone, installing a broadcast module onto the drone, or flying at a FAA-Recognized Identification Area (FRIA). This project creates a broadcast module (Remote ID) to meet the ruling and operating requirement of the FAA. The module will acquire data from the aircraft. Broadcasted data will include Altitude, Location, Velocity, and Start (liftoff) and Stop (landing) time stamps. This information will then be sent to a simulated control station (console). The purpose of broadcasting drone data is for the FAA to analyze, in real-time, the use of the drone for federal and state agencies pertaining to security and safety.

TEAM MEMBERS
Theresa Larson (BME)
Justin Louey (BME)
Elizabeth Mikkelson (BME)
Amber Rothe (BME/CE)
Benjamin Steves (BME)

FACULTY ADVISOR
Dr. Jeffrey LaMack

Virtual Visit Auscultation Device

Stethoscopes have been helping physicians auscultate body sounds since Rene Laënnec invented the device in 1816. Auscultation is an integral part of a physical examination, where physicians may listen for irregular heartbeats, heart murmurs, raspy or wet breathing, or other upper respiratory problems. However, there is currently no widely available method for physicians to auscultate heart and lung sounds during a virtual doctor visit. The Virtual Visit Auscultation Device aims to address this shortcoming. The device takes in heart or lung sounds, applies analog and digital filtering, and provides telephone quality digital audio data over USB. A computer recognizes the device as a USB microphone, allowing the audio to be sent to the distant healthcare professional over a variety of telehealth software platforms. The device is intended for in-home use by the patient and is designed to be durable, easy to use, and inexpensive.

TEAM MEMBERS
John Bilkey (EE)
John Martin (EE)
Marshall Mohror (CE)
David "Dee" Sorin (EE)
Ben Tanneberger (EE)

FACULTY ADVISOR
Dr. Richard Kelnhofer

SPONSOR
American Pinball Inc.

WiSE Guys (Network of Interconnected Radio Modules for Arcade Logic (NIRMAL)

It is estimated that a pinball machine contains around half a mile of wiring. Many pinball machines utilize Integrated-Integrated-Circuit (I2C) serial data protocol for communication between the machine controllers and the peripherals in the play field. These peripherals include lights, actuators, and other game components. I2C utilizes two conductors for bi-directional communications and supports up to 400kbit/sec in fast-mode operation. This project reduces the wiring by using a standardized wireless protocol and commercially available wireless interfaces. Wireless communications will be implemented using the STMicro BlueNRG-LPS System on Chip (SoC) wireless controller with an antenna trace on a specialty designed Printed Circuit Board (PCB), aka the NIRMAL board. The wireless SoC supports I2C serial data transfer at up to 400kbit/sec over 2.4 GHz wireless using the Bluetooth® standard protocol. The NIRMAL board will be FCC certified as a unit. Power efficiency and low current requirements were a high consideration in the design as well as system reliability. In addition, each NIRMAL board is configurable over a serial connection with a PC running Windows 10.

Mathematics Department

Actuarial Science Senior Projects

STUDENTS
Nicholas Camacho
Joshua Geisel
Karolina Karaban
Joshua Zess

FACULTY ADVISOR
Dr. William Brummond

Corn Futures Pricing

Price forecasting of crops is an essential need utilized by farmers, traders, and consumers to analyze changes that could be made to contribute to greater financial success, but it also plays a role in ensuring there is enough food and stability in the agricultural sector. By predicting crop prices, farmers can make informed decisions about what crops to grow and when to sell them, which can help optimize their profits and reduce risk. Traders can use price forecasts to profit based on inconsistencies in futures prices and increase the liquidity in the financial markets.

STUDENTS
David Hunger
Joshua Rossy

OUTSIDE ADVISORS:
Adam Majewski
Tyler Tran (Pinnacle Actuarial Resources)

FACULTY ADVISOR:
Dr. William Brummond

A Forest of Possibilities: Supervised vs. Unsupervised Machine Learning Techniques in Actuarial Science

We analyzed a sample of 50,000 auto insurance policies using random forest and hierarchical clustering in R to demonstrate how these techniques could be applied in an actuarial setting to predict pure premium and segment policies with incurred losses based on severity.

STUDENTS
Michael Emmerich
Cole Ninmman

FACULTY ADVISOR
Dr. William Brummond

Movie Revenue and Profitability Modeling

We analyzed a movie dataset and attempted to predict revenue and profitability of movies. Starting off, a model was created to determine whether a movie would generate profit. Then a model was created to determine how much revenue a movie would bring in. We go into an in-depth analysis on variable transformation and modification in order to produce the best model. At the end, the models are used on two recent movies to test the accuracy and reliability of the prediction.

STUDENTS
Benjamin Brogan
Connor Dugre
Sean Lange
Nicholas Stachura

FACULTY ADVISOR
Dr. William Brummond

Retirement Portfolio Forecasting

Our project aims to identify optimal investment strategies for investors of different retirement ages. We use historical returns of four different investments: gold, treasury bills, S&P 500, and the Russell 2000 index to create two stochastic models—an ARIMA (AutoRegressive Integrated Moving Average) model and a Monte Carlo simulation. Both models enable us to predict future returns of the four investments and construct portfolios based on the expected performance. We also project historical inflation data from the CPI (Consumer Price Index) into the future using the same stochastic models, to compare portfolio returns with predicted inflation rates.

Mechanical Engineering Department

Mechanical Engineering Projects

TEAM MEMBERS
Jack Hoeffel
Ken'Triana McDade
Anthony Whylie

FACULTY ADVISOR
Dr. Subha Kumpaty

Self-Regulating Small Animal Enclosure

When people think about outdoor play for animals, what comes to mind are typically dogs playing at parks. However, there are also smaller animals who enjoy nature just as much. Poe is the pet of one of the team members and loves playing and grazing at the park. Milwaukee weather conditions can be quite harsh during the summer and winter months for a pet such as Poe which poses the risk of hyper- and hypothermia. In order to solve this issue, the team designed an outdoor enclosure suited for use by small animals, specifically rabbits. The enclosure is capable of regulating its interior climate to maintain a healthy environment for the inhabitant regardless of the outdoor weather conditions. This is realized by a small HVAC system integrated into the roof of an insulated structure from which the rabbit can freely enter and exit as he pleases.

TEAM MEMBERS
Addison Kopplin
Francisco Salazar
Ben Turner
Jack Van Dyke
Matt Zagorski

FACULTY ADVISOR
Dr. Mohammad Mahinfalah

ASME Student Design Competition

The 2023 ASME Design Competition involves building a renewable-energy-powered robot that carries weights from a charging area to an unloading area via an incline. The robot's propulsion must be powered by a rechargeable AAA battery using energy from solar and wind sources. The device's controls may run on a separate battery. Teams may not use stored mechanical or chemical energy, but the use of mechanical energy generated by the solar/wind energy collected is allowed. Scoring is measured by weight carried in 15-minute rounds—multipliers are applied for minimizing size and unloading weights automatically. Team Coercive Force prioritized the size multiplier, designing a 6" x 6" x 3" robot that carries 1.25-pound weights with an electromagnet. The battery is charged using 9 solar panels and a turbine; it powers a 3V motor through a boost converter and capacitors. The robot is a 3D-printed, 3-wheel design utilizing a mechanical steering linkage.

TEAM MEMBERS
Kathryn Carrol
Alyssa Cazares
Wendy Guan,
Kimberly Weber

FACULTY ADVISOR
Dr. Valerie Troutman

The Pro Lane: Stance Team

The Pro Lane is an indoor basketball skill development training facility for players ranging from the middle school to professional level. The task was to develop a device that measures the distance between a basketball player's feet before and after they make a jump shot. Drew Dunlop, a basketball skills trainer at The Pro Lane noticed in training there are inconsistencies in the stance width of some players while they take a jump shot. A player's initial and final landing stance are the start and end of a shooting motion. Being able to measure and quantify those distances will allow players to receive feedback on their jumping consistency. The feedback system can allow a player to adjust during training sessions to improve the consistency of their stance.

TEAM MEMBERS
Rejoice Alibio
Nathan Johnson
James Santy
George Schille
Kenzie Swinford

FACULTY ADVISOR
Michael Swedish

Autonomous Microgravity Water Supply to Plant Roots

Aboard the International Space Station, astronauts spend an unjustifiable amount of time watering plants. AQUA was tasked with developing a method for autonomously delivering water to keep the plants healthy in microgravity. With a power constraint of 35 Watts, AQUA designed a prototype with the use of electrically driven pumps and microcontrollers. AQUA also investigated ways to simulate the effects of microgravity on plant roots here on earth.

TEAM MEMBERS
Jackson Kohley
Donya Mui-Wright
Edward Rabideaux
Charlie Westlund

FACULTY ADVISOR
Dr. Mohammad Mahinfalah

ProEx Modular Produce Washer

ProEx Food is a post-harvest automation company that delivers integrated automation solutions for fruit and vegetable processing and packaging. One of the key components of the process assembly is washing the various fruits and vegetables as soon as they are harvested. Currently ProEx Food washers are specifically designed to clean one type of fruit or vegetable for each client; to help expand the catalog that produce processors can wash, the MSOEx senior design team was tasked to create a standardized modular produce washer that can process one metric ton of produce an hour. The designed model consists of a standard base that supports a customizable loadout of stacked frames called cartridges. The cartridges allow for full customizability for the end user while using pre-designed components like brush rollers, sprayers, conveyance, bug catcher drums, and paddle wheels.

TEAM MEMBERS
Brandon Hirschmann
Nikola Kresovic
Christian Losurdo
Ian Rybarik
Joshua Schumacher

FACULTY ADVISOR
Dr. Kevin Hart

Cornerstone Composites' Auto-Deflashing Device

Cornerstone Composites is a plastics manufacturing company located in Milwaukee, WI. They currently manufacture IconXusa wall connectors that are used in the construction industry to provide reinforcement in concrete walls. These parts are compression molded under high amounts of heat and pressure to create a finished part. Each part that is molded comes out of the molding process with "flashing," which is an excess amount of material around the part that needs to be removed. Cornerstone Composites' current method of deflashing their Icon wall connectors by hand is too slow and expensive. The company desires a way to speed up the deflashing process while mitigating cost. The Deflashinator 5000 is our group's solution to the problem and consists of a conveyor system that uses brushes to remove and separate the flashing from the Icon parts in an efficient manner, all while using the same worker who molded the parts.

TEAM MEMBERS
Tyler Bartz
Ryan Kamin
Aaron Saef
Evan Williams

FACULTY ADVISOR
Dr. Mohammad Mahinfalah

Milwaukee Tool Pneumatic Pipe Clearing Tool Test Fixture

Milwaukee Tool currently has a completely electric platform of industrial clog clearing devices. However, this platform is not without its dangers. A coil spring is run through the pipe and torque is applied to the machine end of the spring which is transferred to the cutter head on the other end. This can create a state of stored energy and kickback when the machine is turned off. The spring can also "rats' nest" when placed under high enough torques. Developing a pneumatic alternative addresses these issues as it will instead enter a blow-by mode instead of transferring the torque up the line. This motor must be capable of sustained operation at 120 PSI and five CFM. Additionally, it must include a torque arresting method and effectively traverse through a four-inch diameter pipe.

TEAM MEMBERS
Dawson Deheck
Zachary Hart
Daniil Larin
Samuel Macgregor
Peter Meier
Eric Oberstar

FACULTY ADVISOR
Dr. Mark Fleming

Project Nightfall

The 2022-2023 AIAA Design/Build/Fly (DBF) Competition is seeking designs for a prototype electronic warfare UAV. The aircraft must be an unmanned radio-controlled vehicle capable of achieving 3 specific flight missions and will be scored based on mission performance. The 3 flight missions are a flight with no payload, a flight while carrying a heavy internal package, and a flight with a PVC pipe mounted vertically above the wing on the tips of the wing to simulate a jamming antenna. Additionally, the aircraft must fit, disassembled, within an airline approved shipping box, to be assembled and ready to fly within 5 minutes. Under supervision of Dr. Mark Fleming and managed by the two project managers, the team had followed the engineering design process over the course of their senior year to research, design, simulate, and prototype a UAV to undergo flight trials and be evaluated on each of the mission criteria.

TEAM MEMBERS
Luke Kiecker
Radhakrishna Kothapalli
Israel Ngoy
Guilherme Rodrigues Gorescu

FACULTY ADVISOR
Dr. Valerie Troutman

"Pull Up" Shoulder Rotation Guide

The Pro Lane is an indoor professional basketball training center that trains players from the middle school to the professional level. The training center requests a device that enables athletes of varying skill levels to improve their shooting form in relation to shoulder and guide hand rotation. The goal of the device is to enable athletes to improve their true shooting percentage and to make shots more consistently. This stage of the project focused on development of a prototype which can be used by The Pro Lane to investigate the impact of the guide hand, the non-shooting hand that supports the basketball and helps with aim and trajectory.

TEAM MEMBERS
Cade Beekman
Izaiah Dietrich
Michael Gavin
Devon Lallensack
Davis Mattingly

FACULTY ADVISOR
Dr. Prabhakar Venkateswaran

2023 AIAA Undergraduate Engine Design Competition

The AIAA 2023 Engine Design Competition requests a proposal for the design of a hybrid-electric propulsion system utilizing boundary layer ingestion for a single-aisle commercial aircraft. Boundary layer ingestion propulsion systems are the expected future for aircraft propulsion because of their reduced fuel consumption and lower emissions over a typical flight profile. The final design consists of two conventional turbofan engines mounted beneath the wings of the aircraft, and an additional electric fan at the rear of the fuselage which also produces thrust by capturing the low velocity flow in the fuselage boundary layer. This technology is expected to be used commercially in about 15 years and shows great promise for increasing the sustainability of air travel.

TEAM MEMBERS
Kevin Campos Botell
Thomas Cullen
Marya Kour
John Olson
Samuel Thompson

FACULTY ADVISOR
Dr. Mark Fleming

AIAA Design Build Fly Competition: Surveillance Vehicle

The goal of the competition is to design, build, and test an aircraft that can execute electronic warfare missions. Three main missions need to be accomplished. The first mission is to fly the course with the aircraft as is. The second mission is to add a payload that has a weight of at least 30% of the empty aircraft weight and then fly the course. The third mission is to add a jamming antenna to either wing and then fly the course. This presentation will start with the first design concepts presented with a build-up to the final CAD model displayed at the end. Along the way, material selection, background equations, and design decisions will be explained. The team will talk about the budget and costs associated with the building of the aircraft. Finally, the team will discuss plans for the building process and goals for the final quarter of the project.

TEAM MEMBERS
Warren Burton
Ben Greenberg
Michael McDonald
Nicholas Migliaccio
Wesley Salverson

SENIOR DESIGN SCHOLARS*
Alonso Munoz
(Brookfield East High School)
Enrique Ramirez
(Sun Prairie East High School)
Simon Restrepo
(Heritage Christian Schools)

FACULTY ADVISOR
Dr. Michael Cook

SPONSOR
American Family Insurance

Rockwell LVMCC Autonomous Guided Vehicle

Rockwell Automation produces low voltage motor control cabinets (LVMCCs) to control complicated systems through a centralized processing unit. These systems have large currents running through them, making arc flash events possible. Arc flash events involve the violent release of energy from the system, these events are a grave threat to employees performing maintenance on the LVMCC. When servicing the LVMCC's, significant Personal Protective Equipment (PPE) is required to adequately protect employees from the arc flash events. This PPE increases the time spent repairing the module, reducing the employees' efficiency, and leaving them in potential danger for longer. To reduce the risk of injury and improve maintenance efficiency, Rockwell Automation has teamed up with the MSOE Senior Design team to create an autonomous unit capable of extracting and returning electrical pods from the LVMCC. The functions that this year's Senior Design team will implement are the extraction, return, and door manipulation of the LVMCC.

TEAM MEMBERS
Isaac Grahl
Elise Lettiere
Caleb Rife
Olivia Torrey

SENIOR DESIGN SCHOLAR*
Laura Obasi
(Rufus King IB high School)

FACULTY ADVISOR
Dr. Michael Sevier

SPONSOR
American Family Insurance

Intake Air Control of Retrofit Cardamom Dryers

The main export of Guatemala is cardamom, a gourmet spice that needs to be dried quickly after harvesting so that it does not rot. Wood is burned to dry the cardamom. Increasing efficiency of the dryers will decrease deforestation and increase the profitability of cardamom farming in Guatemala. The scope of this project was to design a mechanism to control the air intake into the wood burning fire. This allowed the temperature of the air leaving the fire to be controlled directly and without heat loss, therefore increasing efficiency. Three concepts were tested on a test stand that represents the fire box of the dryers. The most effective design was then recommended for use on the dryers in Guatemala. The final design was presented along with a set of simple instructions for best practice to EWB Guatemala.

*Senior design scholars are high school students that are admitted to MSOE and participate on senior design teams. The Senior Design Scholars Program provides participants with mentoring experiences and opportunities to enhance leadership, team building, cross-cultural communication and analytical skills in science, technology, engineering and math (STEM). Scholar participation is by application. American Family Insurance sponsors the Senior Design Scholars Program.

TEAM MEMBERS
William Blan
Laurie Paul

FACULTY ADVISOR
Dr. Kevin Hart

Design of a New Device to Evaluate Buckling of Slender Members

A buckling lab is executed in Mechanics of Materials II and the machinery currently is not optimal. The objective of the buckling lab is to measure the buckling load of the columns made of different materials, to determine the stress applied and compare the Eulerian buckling stress to the experimental stress. The current weight of the machine in the lab is extremely heavy and is not easily movable as well as takes up a great volume in the lab due to the height. Then the load readings and the fixations on the machine give inaccurate readings. The objective of the project is to have a smaller machine, a more mobile machine, and a continuous load reading for more precise measurements.

TEAM MEMBERS
Robert Marcenko
Dorian Sielaff
Jan Sonnenschein
Isaiah Vang

FACULTY ADVISOR
Dr. Kevin Hart

Development of a Mars Ascent Vehicle

NASA plans to land humans on Mars by 2040. To successfully achieve this goal and bring them back safely, a Mars Ascent Vehicle (MAV) is required. The goal is to design a concept MAV according to guidelines set by the American Institute of Aeronautics and Astronautics (AIAA) design competition. The MAV must land on Mars, refuel, ascend, and dock with the Deep Space Transit (DST). The subsystems of this concept vehicle are divided into life support, structure, power supply, guidance, navigation, and control systems (GNC). Each category was defined and classified into multiple sub-functions for which the objectives and constraints were defined. Based on this definition, research was conducted on historical and current space missions and related concepts and innovations. From there a design was developed.

TEAM MEMBERS
Florian Kleis
Emma Knutson
Dennis Niemeyer
Rieke Wittorf

FACULTY ADVISOR
Dr. Robert Rizza

Design of a Lattice Structure for an Additively Manufactured Scoliosis Brace

Scoliosis is the medical condition of an abnormal sideways curvature to the spine in a 'c' or 's' shape, often corrected by a brace. To make braces more comfortable for the patient to wear, the goal of this project is to decrease the weight and increase the airflow through the brace by implementing a lattice structure. A lattice structure is a three-dimensional structure comprised of repeating patterns of interconnected geometric shapes. Specimens with different variations of lattice structures are analyzed in their ability to achieve a high stiffness-to-weight ratio and will be implemented in a brace. Additionally, fatigue failure is an issue that has been reported from previous additively manufactured lightweight brace attempts. Therefore, a flexural fatigue testing device is developed to gain knowledge about the fatigue properties of the two 3D printable materials, 3D SYSTEMS Nylon-12 and BASF Polypropylene, as well as lattice structure variations.

TEAM MEMBERS
Jack Stewart
Grayson Vandenbush
Mitchell Van Gompe
Jackson Wellner

FACULTY ADVISOR
Dr. Mathew Schaefer

Baja SAE Rear Suspension Redesign

The SAE Baja Club at MSOE is building a new car this year that requires a new design for the rear suspension. The suspension system must comply with the SAE Baja standards, use nominal material sizes, seamlessly integrate into the existing frame, and be manufactured with accessible equipment at MSOE. Possible design concepts, while considering cost and weight, focused on maximizing stability, responsiveness, serviceability, and ease of manufacturing. The semi-trailing arm design concept met the constraints and obtained the best score when compared to other designs in a decision matrix. Force analysis, kinematic analysis, dynamic analysis, and finite element analysis were used to develop the final design. When manufacturing is complete, testing will be conducted to evaluate the performance characteristics of the suspension system. The new Baja vehicle was used at the national competition on May 4, 2023.

TEAM MEMBERS
Peter Blanchard
Collin Fayas
Tyler Kalies
Andy Maye

FACULTY ADVISOR
Richard Dykowski

SAE Baja Drivetrain Design

The SAE Baja competition now requires a significantly more powerful engine, and the new vehicle chassis is more compact than the previous generation. A more compact coupling mechanism between the gearbox and rear differential was therefore designed to withstand the higher performance engine, and all previous drivetrain components were analyzed to confirm their compatibility with the new engine. Mounting assemblies were then created for the differentials and engine. Additionally, new CV axles were specified to accommodate the changes to the vehicle chassis and drivetrain placement. The group was responsible for assisting the SAE Baja Club team in assembling each of the drivetrain components. Completion of the project included testing, routine maintenance leading up to the spring competition, and publication of a comprehensive assembly manual for the drivetrain components.

Industrial Engineering Projects

TEAM MEMBERS
Alexandra Ballwanz
Paige Michael

PROJECT ADVISOR
Dr. Leah Newman

Velvac ECN

The senior design team of Alex Ballwanz and Paige Michael was retained to improve and automate Velvac's engineering change notice (ECN) process. The team observed how long the ECN process took as a whole, as well as how long the sections within the process took to complete. The results indicated the process took 373 days, on average, to complete, with lots of variance and defects. The main tools used in identifying problems with the process were time studies, fishbone diagrams, and swim lane diagrams; this helped to determine preliminary solutions to improve the process. The future state of the process addresses issues such as the isolation of departments in order to create a process which allows all departments to work together to prevent defects and long lead times. In spring, the team will oversee the automation of the ECN process through a software system. Simulations will be made with collected data to provide additional recommendations for improvements to the process.

TEAM MEMBERS
Robert Anderson
Jacob Krim
Gustas Valentukaitis

PROJECT ADVISOR
Dr. Aaron Armstrong

SPX FLOW

SPX FLOW is a food and beverage pump manufacturer with a location in Delavan, Wisconsin. Their small positive displacement pumps utilize tight tolerances to efficiently pump a variety of substances. One factor in maintaining the tight tolerances is the use of a cutoff process during assembly. SPX FLOW identified that this cutoff is a bottleneck and asked the team to alleviate the bottleneck by reducing the manufacturing critical path time of the cell. A process capability analysis was used to identify where tolerances were out of specification and recommendations were created to reduce the amount of labor required to assemble a pump. In addition, a queuing-based process model was created to analyze the process and developed to reduce the critical path time and increase the capacity of the process.

TEAM MEMBERS
Megan Lee
Luke Meyer
Nathan Roelse

PROJECT ADVISOR
Dr. Leah Newman

Dakonte Product Group (DPG)

This project was completed in collaboration with Dakonte Product Group Incorporated (DPG) located in Milwaukee, Wisconsin. The Wisconsin Manufacturing Extension Partnership completed an automation assessment that identified ten automation opportunities for DPG. The throughput of ticket holders is 50% lower than what is required to begin implementing the findings of the assessment. The throughput had to be increased from 50 to 75 products per hour. The project team prepared tiered recommendations to improve production capability of the ticket holder. Recommendations that could be implemented immediately included a work cell layout and a plastic sheet counting tool. The first tier could increase throughput to 67.5 products per hour. A second tier of recommendations included anti-static cling mats and an automatic bobbin winder. These improvements could further increase throughput to 80.6 products per hour. Finally, a laser sintering machine and automated sewing stations could fully prepare DPG to take on automation implementations.

TEAM MEMBERS
Allan Brickl
Cameron de Boer

PROJECT ADVISOR
Professor Patrick Gathof

Velvac Warehouse

Velvac Inc. is a North American commercial vision system supplier with its headquarters and aftermarket distribution center located in New Berlin, Wisconsin. Due to a 23% increase in demand over the last two years and a change in product mix, Velvac's storage racks in the aftermarket distribution center have become overutilized resulting in pallets on the floor, and operators are falling short of their pick rate goal in the distribution center. To decrease rack utilization to no pallets on the floor and to increase operators' pick rate, the team used Excel, spaghetti diagrams, fishbone diagrams, and standard work instructions to produce three recommendations to the client. The first recommendation was a new inventory layout in the distribution center to decrease travel distance on the pick path. The second was a full pallet purchasing list to decrease the number of partial pallets on the racks. Lastly, the team created a consolidation tool using Excel to combine partial pallets in the racking. With implementation, Velvac can expect an 11.3% reduction in rack utilization, and a 3.3 line per hour increase in picking throughput.

TEAM MEMBERS
Jillian (JC) Silva
Mark Swanson

PROJECT ADVISOR
Dr. Doug Grabenstetter

Luxium Solutions

Process capability can be affected by task difficulty, lack of resources, or lack of prior experience. Luxium Solutions' base compensation process (i.e., a process that involves cutting, roughening, and packaging of the crystals) is highly difficult, which has negatively impacted their process capability. To solve this problem, six sigma tools and lean concepts were used to understand the current process and develop solutions. Specifically, the Define, Measure, Analyze, Improve, and Control (DMAIC) process, and a fishbone diagram were used, a Failure Modes and Effects Analysis (FMEA) was conducted, and a capability study performed. The capability study confirmed that the process was underperforming with a Cpk value of 0.423. This causes many of the crystals to be reprocessed and adds an unnecessary extra step in the process. The suggested solutions target a Cpk value of 1.05 and use current technology to simplify the current process and reduce its difficulty.

TEAM MEMBERS
Lydia Fische
Avery Tiegs

PROJECT ADVISOR
Professor Patrick Gathof

Advocate Aurora Health

Advocate Aurora Health is a not-for-profit health system that aims to provide expert health care in the Midwest. This project focused on the West Allis, Wisconsin facility. This location receives its deliveries through its receiving dock and distributes products to the stockrooms in individual hospital departments. Within the receiving dock, a lack of organization, efficient processing of product, and prompt delivery of materials is contributing to 14.5 necessary materials going out of stock in stockrooms each day, known as stockouts. This project aimed to reduce the presence of stockouts by 25%. After analysis, the team found that an improved layout, visual management tools, and updated work instructions would provide significant improvements to the receiving dock by reducing the time needed to stock a delivery cart by 52%. With the implementation of these recommendations, stockouts will decrease, reducing the strain on the healthcare system and leading to improved patient care.

TEAM MEMBER
Benjamin Geoffroy
Abigail Ranalli
Jennifer Rivas

PROJECT ADVISOR
Dr. Doug Grabenstetter

Tecomet

This project involved coordination between a team of students and the Kenosha branch of Tecomet Incorporated, a supplier for medical instruments, to develop recommendations which aim to increase throughput from the current state of 38.8 parts per day. This was accomplished by (1) identifying top volume products, (2) collecting process data via time studies, (3) creating a discrete event simulation to test the elimination of process waste, (4) running hypothesis tests to validate results and show significant change to throughput, and (5) consulting operators and engineering to analyze the assembly floor layout. The team generated three improved layouts and recommended changes regarding set-up time reductions, assembly fixtures, testing station spacing, assembly greasing process, and product batch sizes that, in conjunction, should provide Tecomet with up to a 16.3% increase in throughput. Other qualitative recommendations included: material storage at assembly workbenches, swivel computer mounts, and under the desk sliding keyboard trays.

TEAM MEMBERS
Benjamin Grambsch
Sebastian Ishman
Grant Oberfoell

PROJECT ADVISOR
Dr. Aaron Armstrong

FORCE America

FORCE America is a hydraulic controller manufacturing company located in Waukesha, Wisconsin. The main goal of this project was to reduce Manufacturing Critical-path Time (MCT) for their controller manufacturing process. Using process mapping and MPX modeling to analyze their assembly process, the team was able to provide recommendations for reducing their critical path time and work-in-process inventory accumulation as well as increasing the capacity of the process. The team used a meta-heuristic genetic optimization engine to design new layouts for both their current and future manufacturing facilities which minimized transportation distances and yielded a 46% reduction in part movement. Other recommendations include cross-training workers, adding a second test station, instituting in-line packaging, and increasing the planning cycle frequency. If implemented, the team projected a 14% increase in throughput and a 97% reduction in Manufacturing Critical-path Time.

School of Nursing

Summer 2022 Senior Projects

STUDENT
Alex Dyszelski
Ashok Manoranjan

FACULTY ADVISOR
Dr. Jennifer Klug

Enhancing Integration of Mental Health Concepts into the Undergraduate Nursing Curriculum

Nursing students and new graduate nurses often feel they lack in knowledge and confidence when working with patients who have mental health needs in a general medical-surgical setting. Individuals diagnosed with mental health conditions are on the rise, with The National Alliance on Medical Illness reporting that in 2020, 21% of U.S. adults (52.9 million people) experienced mental illness (NAMI, 2020). However, negative stigma towards this population persists. Additionally, non-psychiatric nurses, who have limited or no experience or skills working with these patients, can often yield inadequate outcomes for them in the medical-surgical setting. To address these issues, we have identified a need for better mental health nursing education for undergraduate level nursing students. The literature identifies that nursing students' confidence in working with mental health patients is improved after having engaged in simulation exercises. Our change project, therefore, involves integrating mental health nursing content into current courses and simulations of the undergraduate nursing program to help BSN students become better prepared to meet the needs of these patients when encountering them in a general medical-surgical setting. Success of the updated program will be measured by comparing the feelings of students in the current program to those of the pilot class who graduate from the updated curriculum. Patients with mental health conditions have long been identified as a stigmatized and undervalued patient population. This project seeks to set the groundwork for developing student nurses who can adequately advocate for and confidently work with this patient population in any healthcare setting.

STUDENTS

Kacie Gresenz

Sara Kalassina

Jaquelynn Nguyen

FACULTY ADVISOR

Dr. Jennifer Klug

Reducing the Primary Cesarean Section Rate

Primary cesarean section rates in the United States remain high and emphasizes the need for review of current practices. Various complications associated with cesarean sections include infection, hemorrhage, extended recovery time, an increased risk of repeat cesarean sections, and mortality. Active labor support has been shown to reduce the need for obstetric interventions and promote safe vaginal delivery through supportive care, pain management/coping, and movement. An active labor support (ALS) bundle consisting of evidence-based interventions can be introduced as a new standard of care to promote safe vaginal delivery for low-risk pregnant women in labor. Units can prepare for the implementation of the ALS bundle through a staff meeting covering key information related to the necessity of reducing the primary cesarean section rate and the plan for change. Nursing staff will be oriented to the ALS bundle and receive training via eLearning modules. Unit management and an "ALS Bundle Committee" will be responsible for staff compliance, questions and concerns, interdisciplinary communication, and facilitating unit culture. The project's success will be evaluated through nursing chart audits, team meetings, anonymous staff surveys, and tracking of the primary cesarean section rate over the first year of implementation. By reducing the primary cesarean section rate, patient outcomes are improved, and complications are prevented.

STUDENTS

Melissa Hickey

Balpreet Kaur

Saira Talwar

FACULTY ADVISOR

Dr. Jennifer Klug

Mitigating Workplace Bullying

Bullying is often identified in school-aged children navigating the difficult terrain of new friends and new experiences. However, as the school-yard bully grows, so does the environment in which they control and, unfortunately, nursing is an environment in which bullying has notoriously bred. The purpose of this change project is to provide a mandatory standardized protocol to enhance workplace culture through zero tolerance for bullying. Among registered nurses working in the intensive care unit setting (P), does implementation of a validated mandatory educational session (I) versus absence of a validated mandatory educational session (C) result in decrease in incidence of bullying behavior (O)? The standardized protocol includes a pre-implementation survey, compensated mandatory educational workshops for all employees starting at their new-hire orientation, post-implementation survey, and translation into the workplace.

Workshops will include reflection, simulation, discussion, a guest speaker, and end with reflection. Changes will be evaluated through analysis of pre- and post-implementation survey results, analysis of attrition rates, medication errors, delays in patient care associated with bullying in the workplace, and incident of employee report to leadership. This data will be displayed explained during each quarterly workshop and 6 months after the sessions. Through this change project, the goal is to decrease attrition rates, improve patient and staff satisfaction and ultimately decrease the prevalence of bullying amongst nurses in the intensive care unit. This is a goal best achieved first through united and compassionate care for one another.

STUDENTS
Cassandra Lyles
Amanda Mapes
Sarah Marsh

FACULTY ADVISOR
Dr. Kathleen Mussatto

Reducing Central Line-Associated Bloodstream Infections Through Mandatory Use of Antimicrobial Impregnated Caps and Transparent Dressings

The motivation for initiating this project is to reduce central line bloodstream infection rates in critical care settings. For adults that are in the critical care setting with central lines placed, will the mandatory additions of capping every luerlock with an additional antimicrobial impregnated cap and using transparent dressings reduce the incidence of CLABSIs compared to not using the proposed additions to currently existing bundles? The plan for this project is to implement the mandatory use of antimicrobial caps and transparent dressings. The evaluation plan will include follow-ups with infectious disease, gathering data on culture-positive bloodstream infectious pre-change and post-change, and checking for proper documentation and monthly infection reports with current CLABSI rates. If the implementation of this change is effective, the expectation is for this project to evolve over one year's time and will show a significant reduction rate in CLABSIs. Keywords that can be used to facilitate a search for this abstract include infection, CLABSI, antimicrobial, central lines, and critical care.

Fall 2022 Senior Projects

STUDENTS
Hannah Abbott-LaPayne
Dinara Beth
Jasmine Williams

FACULTY ADVISOR
Dr. Jennifer Klug

Building Confidence as Frontline Leaders

Regarding the professional program project, the motivation for initiating this project stems from the need for well-developed, well-trained nurse leaders within the acute-care setting. While the hierarchy of nursing leadership has seen its many changing faces of progression over the decades, an organization's best efforts to develop transformational leaders, frontline nurse managers; charge nurse leaders may often lack the transformational leadership qualities necessary to adequately function within the acute-care setting. Thus, the need for further charge nurse leadership development arises. Furthermore, the problem statement is as follows: among charge nurses with 5-years or less of experience in a med-surg unit at an acute care hospital in the upper Midwest, will the implementation of a formal charge nurse educational program increase charge nurse confidence in their new role compared to charge nurses who do not receive charge nurse educational programming? The prospective implementation plan will address the problem by way of a 3-day, 9-hour, in-person program followed by competency evaluations with the assistance of charge nurse stakeholders. Henceforth, the evaluation plan will determine whether the project's program was successful at reaching the intended target population of future charge nurse leaders as well as include an electronic monitoring system to track the progress of the course. Additionally, a comparison of nurse leader competency rates prior to and postimplementation of the program may highlight positive strides in the direction of greater leadership confidence and positive program outcomes.

STUDENTS
Hanna Belk
Lolita Obolenskaya
Jennifer Ortiz
Madeline Wegner

FACULTY ADVISOR
Dr. Laura Kollatz

Increasing Self-Esteem in Middle School Adolescents

Middle school is a difficult time and full of changes for the average middle schooler. Self-esteem is considered one of the most important factors in how middle school adolescents handle changes. The problem identified is among middle school adolescents, does a school-based self-esteem building program, compared to no self-esteem building, increase self-esteem? The issue addressed was found by researching and reviewing literature that determined that without high self-esteem, adolescents are at higher risk for

anxiety, depression, self-harm and suicidal ideation. The goal of research in this implementation project is to create a committee tasked with determining one effective program to implement in a middle school setting, meant to increase self-esteem in adolescents. The Rosenberg Self-Esteem Scale will be used to determine the success of this program by comparing the first survey to the last survey completed (Rosenberg, 1965). This program will be implemented to increase middle school adolescents' self-esteem in their day-to-day lives.

STUDENTS
Madalynn Fuchs
Rebecca Stapleton

FACULTY ADVISOR
Dr. Aruna Lal

Reducing Emergency Department Visits by Utilizing Individual Emergency Department Care Plans for Frequent Utilizers

The purpose of this project is to implement individualized care plans for identified frequent utilizers. Frequent utilizers can account for 21%-28% of patients presented to an Emergency Department (ED). Frequent utilizers may lack access to other care, unsatisfied with care, or looking for more resources. Using a multidisciplinary team to create and implement individualized care plans will help ED nurses provide safe and high-quality care for these identified patients. The individualized care plans will consist of frequent chief complaints, frequent presentations, medications that work well for these patients, who to involve in the patients' care, and other behavioral or clinical recommendations. The multidisciplinary team will meet monthly to discuss how individualized care plans are working in the ED. We are using a pre-post intervention study by comparing statistics from before the intervention and after the intervention. The team will look at statistics of how many visits the identified utilizers have had within the past month. They will also look at the chief complaints and treatments that were provided to the patient. After one year of implementation, the multidisciplinary team will meet and review statistics gathered throughout the year to see if the intervention was effective. The team will then compare the statistics from before the invention and after the intervention. Overall, this project will aim to reduce frequent utilizers from visiting the emergency department by providing resources, behavioral and clinical recommendations, and referrals to get the patient access to other care to manage their health.

STUDENTS
Claire Brzenk
Christopher Farruggia
Taryn Kilgore

FACULTY ADVISOR
Dr. Jennifer Klug

Implementing a Sleep Hygiene Protocol for the Surgical Intensive Care Unit

Intensive Care Unit (ICU) patients experience markedly low-quality sleep due to the nature of the critical care setting. ICU patients experience frequent disruptions from the interdisciplinary team, increased noise and light exposure, and altered circadian rhythms which contribute to disrupted sleep. Sleep disruptions are correlated with increased incidents of ICU delirium, decreased immune functioning, delayed wound healing, reduced cognitive performance, decreased patient participation in care, altered pain thresholds, and increased stress. These factors are linked to increased length of stay (LOS). With increased LOS, patients are vulnerable to further financial burden and negative outcomes. A sleep hygiene protocol can promote sleep quality and mitigate the risk, incidence, and severity of complications as well as reduce LOS. The sleep hygiene protocol is focused on nonpharmacological interventions. It has two parts: (1) a standard component detailing environmental modification to be implemented for non-sedated, non-intubated patients in the surgical ICU (SICU) and (2) optional interventions per patient preference. The standard component includes a dedicated rest period from 2:00 a.m.–3:30 a.m., unit and room noise reduction, light reduction, and restricted room entry with care clustered outside of the rest period. The optional component includes the possible use of earplugs, eye masks, white noise, calming music, and lavender essential oil. Reduction in LOS will determine the success of the protocol as evaluated by the interdisciplinary team.

STUDENTS
Danielle Burr
Xandra Slowley

FACULTY ADVISOR
Dr. Jennifer Klug

Nurse Bias in the Care of Patients Post-Opioid Overdose in the Emergency Department

Milwaukee County mirrors the opioid crisis that has been plaguing the United States since the 1990s. Recent data shows that approximately 70% of all deaths in Wisconsin due to drug overdoses are due to opioids, with the majority of opioid-involved overdoses occurring in Milwaukee County. People who overdose on opioids and receive medical attention will find themselves patients of an emergency department. Oftentimes these patients feel judged by nursing staff. Studies have shown that many nurses have negative views of those who suffer from opioid addiction. This belief, held by many nurses, is due to an implicit bias formed from a lack of understanding of what can lead someone to abuse

opioids. The primary purpose of this project is to reduce emergency department nurses' implicit biases about patients suffering from opioid addiction through education. This project will be implemented in a community hospital in Milwaukee County and will utilize an annual online educational module to bring awareness surrounding opioid addiction. The module will include definitions, personal testimonies from those recovered from opioid addiction, and social theories identified as facilitators of opioid addiction. The evaluation of this project will be completed via statistical analysis comparing the pre- and post-test scores of an Implicit Association Test (IAT) designed specifically for this project to assess opioid addiction biases. This project aims to reduce those implicit biases by 30% between the pre-test and post-test following completion of the online educational module.

STUDENTS
Ciara Ceballos
Ana Lopez-Silva

FACULTY ADVISORS
Dr. Jennifer Klug

Providing Culturally Tailored Mental Health Resource Information to Latinx Patients Seen in the Emergency Department

Across the United States, there is an increasing number of adults diagnosed with mental illness with a disproportionate number of them being Latinx individuals (Rogers et al., 2018). This essay highlights the sociodemographic factors that prevent this population from obtaining culturally appropriate mental health resources and how emergency department (ED) nurses can help make a difference. Research shows that the first encounter a Latinx patient receives mental health care is in the ED after a major psychological episode (Ford-Paz et al., 2013). ED nurses can bridge the gap between the Latinx community and mental health care they need. The correlation between culturally competent resources and good patient outcomes will be taught to ED nurses via a module, which will be followed by collectively providing all identified non-white Hispanic with the culturally appropriate mental health resources available in their community. The use of electronics will allow for the monitoring of ED nurses completing the educational module and track that they provide the culturally appropriate mental health resources at time of discharge. This will be monitored every four months with the goal of having 100% participation within one year. Creating and implementing this strategic plan to better serve the Latinx community and will pave the way for this population to receive individualized culturally appropriate mental health care and ultimately result in good patient outcomes.

STUDENTS
Erin Kinney
Talya Lattanzio
Genesis Santana

FACULTY ADVISOR
Dr. Jennifer Klug

Individualized Diet Education for the Client with Non-Insulin Dependent Diabetes

Millions of adults in the United States suffer from non-insulin dependent diabetes. There is a correlation between low socioeconomic status and clients diagnosed with non-insulin dependent diabetes. Clients within the free clinic setting are more likely to suffer from poor diabetes management. HbA1c levels are efficient indicators of a diabetic client's diabetes management. Diet control has been found to directly reduce HbA1c levels in clients with diabetes. However, clients who receive care at free clinics may encounter difficulties adhering to diet programs due to food insecurity and financial disparities. It's important to account for these disparities when creating a treatment plan. Free-clinic providers must be willing to implement client-centered care to achieve better glycemic control in clients with non-insulin dependent diabetes. The use of surveys administered before appointments can help identify areas in which the provider can individualize client education. Evaluation of improved diabetes management through diet control can be measured via seeing a decrease in HbA1c levels. Diabetes mismanagement can cause complications with physical health, quality of life, and increase the financial strain for the client and the healthcare system. By providing individualized education on diet management for clients with non-insulin dependent diabetes, disease management can be improved, and adverse outcomes can be avoided.

STUDENTS
Melanie Koch
Mary Beth Tyson
Victoria Westman

FACULTY ADVISOR
Dr. Jennifer Klug

Implementation of Delirium Prevention Education for Nurses to Reduce the Incidence of ICU Delirium

In the Intensive Care Unit (ICU), the effects of delirium negatively impact patient outcomes. Patients with delirium experience increased length of stay and increased mortality and morbidity rates. The use of nonpharmacological primary prevention skills by ICU registered nurses (RNs) results in reduced incidence of delirium. Therefore, this project proposes implementation of a mandatory delirium prevention educational module for bedside ICU RNs. This module addresses the basic components and primary prevention methods of delirium as well as a brief review of the Confusion Assessment Method for the ICU (CAM-ICU). RNs independently complete the online module as a continuing education course. The module educates the bedside ICU RNs to use non-pharmacological methods to prevent delirium. Each bedside RN needs to document their CAM-ICU shift assessment in the electronic health record (EHR). The

outcome of the prevention methods will be measured using the CAM-ICU in the EHR. The hospital medical records department will analyze both pre- and post-intervention CAM-ICU results from the EHR. A comparison will be made using the incidence of delirium as a percentage of total ICU population. Patients that will be disqualified from the project will be those with a positive delirium screen upon admission, dementia, and pre-existing cognitive impairment. The success of the project is based upon reduction of delirium by 20% one year from implementation. The implementation of a delirium prevention educational module will empower bedside ICU RNs to use primary prevention techniques to reduce the incidence of delirium in the ICU.

Winter 2022-23 Senior Projects

STUDENTS
Christabel Adu
Lenny Guerrero-Bae
Maggie Loehr

FACULTY ADVISOR
Dr. Jane Paige

The Effectiveness of a Preoperative Screening and Education to Decrease the Incidence of Prosthetic Joint Infections

Despite the improvements in surgical technology and techniques, prosthetic joint infections (PJI) remain a challenging and costly complication following a total joint arthroplasty (TJA). PJIs occur in 2.0–2.7% of TJAs annually performed in the US (Kim et al., 2020). The annual incidence of PJI is projected to triple by 2030 and cost over $57 million (Kim et al., 2020). The purpose of this project is to implement solutions preoperatively to decrease prevalence of PJI in patients undergoing TJA. The implementation plan focuses on improving patient outcomes and lowering the financial strains on the patients and their families. A preoperative screening tool will be implemented to identify modifiable pre-operative risk factors, including smoking history, obesity metrics, tests to assess for malnutrition, anemia, presence or management of diabetes, and MRSA colonization. A clinical nurse specialist (CNS) will follow the patient throughout the continuum of care and develop an educational plan based on their individualized screening results. Follow-up appointments will be conducted in-person or via telehealth at two weeks, three months, six months, and one year postoperatively. Data will be documented through the assessed risk factors, pre-operative educational and management plans used, and the number of PJI readmissions. The data will be used to evaluate the effectiveness of our implementation and the need for adjustments. Prospective

studies have supported the implementation and compliance with pre-operative screening tools, education, and treatment plan to improve the overall TJA outcomes. This project incorporates evidence-based pre-operative protocols that support improving surgical outcomes.

STUDENTS
Aliana Alanguilan
Eva Gretz
Shelby Matthews

FACULTY ADVISOR
Dr. Jane Paige

Reinventing a Standardized, Cohesive Handoff Process: Impact on Adverse Health Outcomes and ICU Readmission Rates

The transition of care process is a vulnerable phase of healthcare delivery for patients. Suboptimal transition of care processes pose substantial risks for adverse health outcomes and medical errors, increasing the stress of nurses and draining facility resources. Ineffective communication during handoff reports is associated with substandard care, increased patient anxiety, longer length of stay, and higher in-hospital mortality rates. The purpose of this project is to develop a standardized, cohesive handoff process between the neurological ICU nurse and the respective step-down unit nurse to decrease adverse health outcomes and ICU readmission rates. A review of the literature provided a better understanding of the factors that can positively influence the transition of care process, which include the use of a standardized handoff report tool, providing report at the patient's bedside with both transferring and receiving nurses, and negotiating a time that would work best to minimize interruptions. To incorporate best evidence into daily practice, an educational and interactive training video will be developed for nurses to apply during the two-year implementation of the project. Baseline, midway, and final quantitative and qualitative data will be gathered and analyzed to determine if there is a decrease in ICU readmission rates and adverse health outcomes. Surveys will be sent out to nurses and patients/families to determine satisfaction of the new changes. By addressing the barriers associated with suboptimal transition of care processes and changing the practice to become more cohesive and standardized, more effective care can be delivered to patients overcoming critical illnesses.

STUDENTS

Mariam Bader

Claire Butkus

Madeleine Carpenter

Chelsea Ortuno Miller

FACULTY ADVISOR

Dr. Jane Paige

Holistic Practices to Mitigate & Limit Compassion Fatigue, Burnout Rates, and Potential Turnover of Nurses Working in Stressful & Traumatic Environments

In the Intensive Care Unit (ICU), the effects of delirium negatively impact patient outcomes. Patients with delirium experience increased length of stay and increased mortality and morbidity rates. The use of nonpharmacological primary prevention skills by ICU registered nurses (RNs) results in reduced incidence of delirium. Therefore, this project proposes implementation of a mandatory delirium prevention educational module for bedside ICU RNs. This module addresses the basic components and primary prevention methods of delirium as well as a brief review of the Confusion Assessment Method for the ICU (CAM-ICU). RNs independently complete the online module as a continuing education course. The module educates the bedside ICU RNs to use non-pharmacological methods to prevent delirium. Each bedside RN needs to document their CAM-ICU shift assessment in the electronic health record (EHR). The outcome of the prevention methods will be measured using the CAM-ICU in the EHR. The hospital medical records department will analyze both pre- and post-intervention CAM-ICU results from the EHR. A comparison will be made using the incidence of delirium as a percentage of total ICU population. Patients that will be disqualified from the project will be those with a positive delirium screen upon admission, dementia, and pre-existing cognitive impairment. The success of the project is based upon reduction of delirium by 20% one year from implementation. The implementation of a delirium prevention educational module will empower bedside ICU RNs to use primary prevention techniques to reduce the incidence of delirium in the ICU.

STUDENTS

Rochelle Bartley

Danielle Fox

Madisen Penna

FACULTY ADVISORS

Dr. Jennifer Klug

Dr. Kathleen Mussatto

Integrating Self-Care Education and Activities into the Baccalaureate Nursing Curriculum

The utilization of self-care practices is beneficial in helping individuals in managing stress and living healthier lives. Strategies such as meditation, mindful breathing exercises, yoga, guided imagery, and journaling have been found to improve stress management or reduce stress levels. Poor stressor management has increased the incidence of illness and disease. Undergraduate nursing students endure excessive amounts of stress related to their demanding academic and clinical requirements but are often ill-prepared to effectively cope and therefore are at risk for deteriorating health. Incorporating self-care activities and

learning materials within the nursing curriculum will ensure that students are exposed to strategies which improve stress management and promote healthy living. A survey including the Perceived Stress Questionnaire (PSQ) will be distributed to students periodically throughout their schooling to measure changes in the students' stress levels both prior to and after completing the self-care interventions. Trends in the PSQ index will indicate if the project interventions are effective in teaching the students self-care modalities and consequently reducing their stress. Inclusion of self-care education into nursing curriculum can be a powerful tool in helping students mitigate their stress and learn lasting methods of self-care they can take into their future nursing careers.

STUDENTS
Leah C. Busse
Makayla R. Grimm
Mimi L. Hein

FACULTY ADVISOR
Dr. Jennifer Klug
Dr. Kathleen Mussatto

Facilitation of Sleep in the Neurological Intensive Care Unit

Decreased quality of sleep has major consequences on hospitalized patients. Adverse effects of poor sleep include anxiety, delirium, impaired wound healing, and post-traumatic stress disorder. Benefits of high-quality sleep include improved patient satisfaction scores and higher Medicaid reimbursements. A patient's sleep in a neurological intensive care unit is significantly impacted by lights, noises, and constant interruptions from medical providers. The purpose of this project is to evaluate measures aimed at reducing noise, light, and promoting mandatory no-contact hours to improve the quality of sleep for patients in the neurological intensive care unit. Ear plugs, eye masks, and predetermined no-contact hours will be employed as nonpharmacological interventions to address these concerns. Quality of sleep will be measured with the Richard Campbell Sleep Questionnaire, a visual analog scale, over 9-12 months in a local tertiary care center's neurological intensive care unit. These scores will be evaluated and extrapolated to create continued buy-in from key stakeholders. High quality sleep is vital for this critical population and through this project, nonpharmacological interventions can become a mainstay improvement measure for patient sleep in other intensive care units.

STUDENTS

Sariah Lafourche

Stephanie Rattle

Heath A. Wright

FACULTY ADVISOR

Dr. Jennifer Klug

Enhancing Engagement in Prenatal Care

Mothers' engagement in prenatal care and their own health is a critical aspect of fetal outcomes. Twenty-five percent of pregnant clients do not attend prenatal appointments, of which a majority come from underserved, low-income, and at-risk populations. Internal stakeholders within organizations focus on promoting programs and identifying community partners that can assist in barrier reduction. Partnering with key stakeholders within the community provides the greatest opportunities to reduce barriers to at-risk clients by reducing financial obligations felt by one organization and can increase the overall community exposure needed to engage clients' interest in the promotions and incentives offered to them. By defining barriers to help explain why at-risk pregnant clients fail to make their prenatal appointments, it also highlights opportunities for encouraging patient engagement. Furthermore, activating patients to become partners in their own healthcare can be accomplished through internal and external factors geared toward alleviating identified barriers. Several methods have been identified to increase engagement that include use of social media, mobile applications, group prenatal sessions, incentivizing care that specifically targets reducing barriers to accessing healthcare, advertising and marketing methods, and patient activation strategies to increase the likelihood of attending prenatal appointments. Using patient surveys, appointment data collected on attendance, and social media data analytics, the level of patient engagement can be monitored and assessed. The research reveals various ways to engage mothers but there is a need for proceeding analysis on how to best involve this at-risk pregnant population.

STUDENTS

Macy Matyjas

Jeremy Sasser

Annabella Scarano

FACULTY ADVISORS

Dr. Jennifer Klug

Dr. Kathleen Mussatto

Universal Suicide Ideation and Risk Screening in Adolescent Clients at Emergency Departments

Adolescent suicide has been a leading cause of death for those 12-18 years old and is considered a public health crisis in the United States. The current mental health crisis in the United States has led to an increased number of adolescents presenting to the Emergency Department (ED), and many adolescents presenting to the ED found to have a high risk of suicide do not present with suicide-related complaints. The goal of this project is to implement universal suicide screening in the ED to increase identification of adolescents with suicidal ideation, and decrease the number

of subsequent adolescent patients presenting to the ED. The ED nurses will be educated on the ASQ questionnaire and use it for every 12- to 18-year-old that has completed initial triaging in the ED. Further assessments will be completed for the adolescent if they screen positive for suicidal ideation. Data will be collected monthly on the number of patients seen, nurse compliance rates of ASQ screenings administered, the number of patients receiving psychiatry consults, the number of patients receiving outpatient referrals, and the number of patients who return to the ED. The data will be compared to statistics from the prior year to assess for increased screening and decreased rates of readmissions. This project will utilize Kotter's 8 Step Change Model to establish a sense of urgency for the key stakeholders and encourage ED staff compliance. The hope for this project is that it identifies more adolescents with suicide ideations and provides a foundation for future research when implementing trauma informed care.

STUDENTS
Chrystal Sterling
Yan Thero
Krista Vidana

FACULTY ADVISOR
Dr. Jennifer Klug

Increasing Health Screening and Health Education Related to Hypertension to Decrease the Rate of Premature Births in Pregnant Black Women

The Black infant mortality rate in the United States is over two times as high as that of White infants. Previous literature identifies preterm birth secondary to maternal hypertension as a significant contributing factor to this marked disparity. The purpose of this project is to reduce the prevalence of preterm birth by decreasing the rate of perinatal hypertension in Black women living in the urban upper Midwest. To address this issue, the involvement of multiple disciplines is necessary, including direct care providers, social workers, and public health leaders. Interventions to enhance patient health literacy/education, implement lifestyle changes including modifying diet and exercise, mitigating stress, and adherence to medications and regular blood pressure monitoring have been shown to be effective in decreasing perinatal hypertension. Evaluation of the efficacy of such interventions will be implemented through regular follow-up monitoring and data collection and analysis by medical records technicians and health care providers. The incidence of preterm births will be assessed in response to the interventions targeted toward reducing perinatal hypertension. The interventions proposed do not address all social, political, and cultural facets of the problem, and thus supplemental interventions within these areas will be imperative to further address this issue comprehensively.

Physics and Chemistry Department

BioMolecular Engineering Senior Projects

TEAM MEMBERS
Samantha Brown
Derek Schaper
Ted Simpson
Simon Uecker

FACULTY ADVISORS
Dr. Eryn Hassemer

EXTERNAL ADVISORS
Bekah Bartels
BioE SD Team Argus
 (AY 2021-22)

SPONSORS
Rader School of Business

A Dual Lateral Flow Immunoassay to Differentiate Between COVID-19 and Influenza

Team Aurum has designed a lateral flow immunoassay (LFIA) rapid test that detects and differentiates the presence of SARS-CoV-2 and influenza from a saliva sample. SARS-CoV-2 is the virus responsible for the COVID-19 pandemic, which has killed 1,110,364 people in the US (CDC) and 6,836,825 people worldwide (WHO) since February 2023. Influenza and COVID-19 are prevalent diseases today and have similar symptoms, making it difficult to differentiate the etiology. To further complicate the matter, these two diseases are active around the same time of year. This creates a need to quickly, efficiently, and cost effectively differentiate between these two diseases. The goal for Team Aurum is to assemble a prototype that features a simultaneous COVID-19 and influenza detection system via a user's saliva sample.

TEAM MEMBERS
Anna DeBruine
Ian Knudson
Emma Kroll
Keoni Young

FACULTY ADVISORS
Dr. Jung Lee,
Dr. Wujie Zhang

SPONSORS
Innovent Center Seed Grant

Validation of Passive Solar Dehydration for Food Drying

Agricycle® passive solar dehydrator systems show great potential for preserving fruits and vegetables before they go to waste, a significant contributor to food loss. These systems do not require electricity and are a simple and accessible solution for sub-Saharan African communities. Pineapples were studied due to consumer demand and lack of safe and effective drying methods. Standard industrial drying methods are associated with nutrient loss and need for specialized, energy-intensive equipment such as freeze dryers that involve costly, standardized facilities requiring expensive and technical routine maintenance and cleaning. This study served to design a controlled laboratory environment, with special focus on humidity, that mimics sub-Saharan Africa to validate Agricycle® dehydrators and investigate the quality of produce that undergoes passive solar dehydration while meeting engineering standards. Water content, microbial load, and nutrient viability tests all validated the use of these dehydration trays to produce a safe and viable dried pineapple product.

TEAM MEMBERS
Nicholas Heide
Amber Roels
Jack Schoepke
Amanda Yackley

FACULTY ADVISORS
Dr. Serdar Ozturk
Dr. Faisal Shaikh

EXTERNAL ADVISOR
Dr. Mahmoud El-Halwag
Texas A&M University

PROJECT SPONSORS
MSOE Physics and
Chemistry Department
Biomolecular Engineering
Program

TEAM MEMBERS
Jared Burks
Grace Kringle
Behrgen Smith
McKayla Zastrow

FACULTY ADVISORS
Dr. Jung Lee
Dr. Wujie Zhang

EXTERNAL ADVISORS
MSOE BioMolecular
Engineering

Chemicals From Biomass – The Design of a Production Facility

The goal of this project is to design a facility to produce bio-based succinic acid from crude glycerol and complete a preliminary feasibility study for this process. Bioproduction is currently being explored as an alternative to current and widely used petroleum production methods, being more sustainable and releasing significantly less carbon-dioxide. Raw materials comprise 75% of the production cost of petro-based succinic acid, which causes it to be greatly affected when petroleum prices fluctuate. Therefore, a less volatile price of production can be obtained using a bioprocess from a sustainably sourced waste stream. This design uses crude glycerol obtained from the biodiesel industry as a feedstock, which is fermented by the organism Actinobacillus succinogenes to produce succinic acid. This is ultimately isolated and crystallized into a dry bulk solid for sale. The final process model results yield 30 kilotons of crude glycerol processed into 15 kilotons of succinic acid crystals per year at a purity of 99.5%. The bioprocess design model was drafted in SuperPro Designer.

Identification of an Alternative COVID-19 Vaccine Target and Antibody Optimization

COVID-19 is an infectious respiratory disease that is contracted by a host through a novel RNA virus known as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Since the novel virus' initial outbreak in December 2019, its containment was unable to be achieved and the illness started to rapidly spread across the entire globe, having left the entire world population faced with a pandemic. The current available mRNA-based COVID-19 vaccines, targeting the spike (S) protein of the virus, have played a crucial role in combatting the spread of the virus. With the emergence of new SARS-CoV-2 variants, however, the need for improvement in vaccine effectiveness is in dire need. This study aims to identify an alternative vaccine target to improve effectiveness in providing immunity for all known variants and to investigate an antibody therapy that could be used to treat COVID-19 infection through computational modeling studies of antibody-protein binding interactions.

Notes:

Notes: