



CULMINATION

**SENIOR PROJECT
SHOWCASE 2020-21**

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.

While the COVID-19 pandemic situation prevented us from holding a Senior Project Showcase in 2021, we are proud to share this compilation of the students' projects and commend them for their hard work and dedication. 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. 6 to be considered for the 2021–2022 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 2020–2021 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.

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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 project involving a client, faculty team and professional construction mentors.

The project teams are composed of students from the architectural engineering (with design specialties in structural, mechanical, and electrical) and construction management programs. The one-year project starts with programming and includes the design concept through development, working drawings and construction management. The design process includes architectural 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.

TEAM A

Feda Alabduljabar (ST)
Tanner Hansen (ME)
Cody Ingwell (CM)
Yavori Luenig (E)
Laura Pizano (ME)
Cara Schlagel (CM)

TEAM B

Jinan Bahzad (ST)
Lucas Grohmann (CM)
Stian Owens (CM)
Amy Reiser (E)
Johannah Starr (ST)
Megan Weidner (ME)
Randall Witzel (CM)

TEAM C

Kathryn Ashley (ME)
Jasmine Avalos (ST)
Tyler Mortensen (CM)
Zak Skumatz (ST)
Gohan Velazquez (E)
Maxwell Walsh (ME)

Civil and Architectural Engineering and Construction Management Senior Design Student Projects

Project: Brady & Water

Student Teams: A, B, C

Faculty Advisors: Shauna Boyer, Adam Friedman, David Grassl, John Hudock, Cory Powers, Jayme Radomski, Kurt Zimmerman

The proposed development on the Milwaukee River at Brady and Water Streets presents an exciting challenge. The proposed mixed-use development will act as a connection between these neighborhoods along both the street and Riverwalk.

Three proposals are being developed by interdisciplinary teams of MSOE seniors under the guidance of Mark Lake of Wangard Partners. Each proposal has a unique approach, but they do explore some common trends. Most projects include 130-150 condominium living units that range from studios to two- and three-bedroom units in a series of multi-story towers arranged perpendicular to the river in order to share views. A couple teams are exploring townhouses built into the hillside along the Riverwalk. Each scheme looks at underground parking decks interconnecting with multiple elevator lobbies leading to the structures above.

Site amenities and shared spaces include retail opportunities, including a stand-alone restaurant site, on the smaller parcel opposite the Brady Street easement, with a presence along Water Street and access to the river. Schemes exploring underground parking take advantage of the roof terraces overlooking the river to create landscaped public plazas with pools and exercise and community rooms on the ground floor surrounding.

This waterfront property is expected to continue the Riverwalk that provides pedestrian access along the entire Milwaukee River. Each scheme includes private boat slips for individual use and considers the concept of a shared boat for the home-owner association. Other amenities include storage for kayaks and canoes, a fish-cleaning station, fire-pits, grills and picnic patios all provided to take full advantage of dynamic views of downtown and riverfront living.

TEAM D

Katie Augustine (ST)
Nicholas Beck (E)
Ryan Marcangelo (CM)
James Rodell (CM)
Sam Swan (CM)
Michael Teeter (ME)
James Warren (ME)

TEAM E

Ricardo Flores (ST)
Lucas Levenhagen (CM)
Zaiba Malik (CM)
Calvin Schelfhout (ME)
Alessandro Storniolo (CM)
Anne-Marie Warren (ME)

TEAM F

Sarah Ceurvorst (ME)
Morgan Duffus (ME)
Dylan Hamlin (CM)
Brian Jimenez (CM)
Jack Kemp (E)
Troy Simonides (CM)
Owen Stoppleworth (ST)

Project: River Vista

Student Teams: D, E, F

Faculty Advisors: Sarah Kannass, Kathleen Knutson, Michael McGeen, Cory Powers, Jayme Radomski, Bob Schumacher, Kristy Wolfe

As Wisconsin's largest senior care provider with over 22 senior communities and 2,000 units, Capri Communities plans to expand their footprint into the Sheboygan market.

The development will be a combination of two campus buildings—one designed for active independent living and the other for assisted living/memory care. The buildings should be disconnected yet feel like a cohesive campus. Surface parking can be shared between both buildings. Each building shall also have its own outdoor riverside patio and active space for residents to enjoy. It would also be the intention to have boat slips and/or private access for Capri Communities and its residents to have river access as an amenity and rent-enhancing feature.

In early discussions with the City, they see this property as a continuation of the pedestrian bridge that extends over the river and would like to see pedestrian access extended along the river. Ideally, a public boat launch could be provided at a junction of the property to allow kayaks and other small watercraft easy access into the river.

TEAM MEMBERS

Ethan Buechel (CM)
Willem Gauthier (CM)
Maxwell Jenney (CM)
Jeff Makowski (CM)
Justin Meseberg (CM)

Project: Blue Lotus Farms**Faculty Advisors: Mark Rounds**

With the assistance of the CREATE Institute, the team took on a project to design and build a bath house for Blue Lotus Farms. In early fall, the team met with Blue Lotus leadership to learn about the concept of the bath house. With the assistance of Ramlow-Stein Architects, the team designed the bath house to the owner's requirements. Upon approval of the owner, the team with R-S submitted the drawings to the Town of Trenton for zoning approval in March 2021. They also created a budget and schedule for the building. The building was approved by Trenton and a building permit secured.

The team is working with industry partners to assist with the construction of the facility. After a site visit to layout the building, Scott's Landscaping built the gravel pad for the structure. With the help of VJS Construction, the team formed the concrete foundation. The building materials were donated by Bliffert Lumber, and with the assistance of Findorff Construction, the team built and erected the wall panels and roofing deck. Langer Roofing will complete the roof system and Steiner Electric is providing the electrical installation. The team will complete the finished interior walls and apply the flooring paint system in May.

TEAM MEMBERS

Andrew Apenteng (S)
William Berger (S)
Steffan Demetropoulos (CM)
Rachel Dudley (S)
Geoffrey Golly (S)
Cierra Smith (T)
Emily Wiederholt (T)

Project: Oak Leaf Trail–Bridges**Faculty Advisors: Kristen Belan, Dr. Philip Ciha**

The current crossing of Oak Leaf Trail at STH 100 is at grade with no traffic controls. STH 100 is a six-lane divided highway (three lanes each direction) with traffic speeds of 40-mph. The client has heard many concerns from the public associated with the safety of the crossing. The project team is tasked with developing potential solutions to improve the safety of the crossing. Potential solutions will be discussed and designed to improve pedestrian crossing.

TEAM MEMBERS

Anthony Di Padova (S)
Rachel Herb (Env)
Samuel Linn (S)
Matthew Oldendorf (Env)

Project: Point Beach Bridges

**Faculty Advisors: Dr. Philip Ciha, Dr. Todd Davis,
Dr. William Gonwa**

Along the Rawley Point Trail located in Point Beach State Forest lies five existing wooden pedestrian bridges. The existing bridges are beginning to fail due to differential settling in the wetlands and must be entirely replaced. The new bridges will need to be designed to handle an H5 (10,000 lb.) vehicle load in addition to pedestrian loads. The bridge design needs to be possible to be installed with very minimal wetland disturbance. Additionally, the new bridges should be designed to last 50 years or longer with minimum maintenance needed.

TEAM MEMBERS

Miranda Durbin (Env/T)
Samuel Gianakos (S)
Max Hakanen (CM)
Ben Hoppe (S)
Lauren Kirsch (S)
Benjamin Mason (S)
Bobby Rogers (S)
Devin Standley (S)
George Sterner (S)
Jacob Zietlow (S)

Project: Oak Leaf Trail–Intersections

**Faculty Advisors: Kristen Belan, Dr. Philip Ciha,
Dr. Todd Davis**

Two bridges located approximately 400 feet apart. The first is a 65-foot bridge spanning over Milwaukee River Parkway and the other is a 250-foot bridge spanning the Milwaukee River. The Milwaukee River Parkway goal is to raise the bridge in order to reduce the amount of vehicle collisions on the underside of the bridge. The Milwaukee River goal is to make a single span bridge across the river to have an uninterrupted flow.

TEAM MEMBERS

Logan Halladay (T)
Paraskeva Hasapis (Env)
Anthony Lukowitz (T)
Ashley Manske (T)
Benjamin Quintero (T)
Sydney Shaffer (Env)
Diya Singh (CM)
Yeechue Thao (Env)
Jasmine Thevarajoo (Env)

Project: Monarch Subdivision

**Faculty Advisors: Kristen Belan, Dr. Philip Ciha,
William Krill, Dr. Jera Sullivan**

Monarch subdivision is a single-family subdivision development in the City of Waukesha being developed by Siepmann Realty. Extremely challenging topography is a large constraint on the number of lots, utility design, and road design. Close coordination through various City of Waukesha personnel and the client established the desired goal of the project to be client profit of 18-20% with the development of plan sets including site grading, stormwater management and conveyance, sanitary sewer, water main, erosion and sediment control, traffic control and utilities.

Key:

(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
(S) Structural
(ST) Building Structural Systems
(T) Transportation
(WR) Water Resource

Rader School of Business

Rader School of Business Senior Projects

Student: Adem Arifi, Calvin Fellows, Jillian Ruark,
Brandon Stoller, Kyle Zacher

Faculty Advisors: Carol Mannino

Project: Buy Side Financial Report of Marten Transportation
Limited Corporation for the CFA Global Research Challenge

The CFA Institute Research Challenge is a competition between university-sponsored teams that research a designated publicly traded company (Marten Transport), prepare a written report on that selected company, and then present their findings to a panel of judges. The team worked with their faculty advisor and an industry mentor to prepare the report and presentation.

Team Members: Chanté Edwards, Claire Fagan

Faculty Advisor: Dr. Katrina Moskalik

Project: #MSOE4ME=#HERE4U

This project consists of two sections that have equal correlation with each other. The first section is a training manual for MSOE faculty and staff which details the importance of mental health on campus and how they can impact it. This also includes details on common mental illnesses and guides the faculty or staff member on how to start conversations with students and what the next steps can entail for everyone involved.

The second section of the project is a communication plan that will expand on the best ways to let the MSOE students know about the resources at their hands and which of the current best practices will work best on the MSOE campus. The communication plan will also consist of the current best practices of communicating about mental health programs and communicating on college campuses. There will also be communication materials that will align with the current best practices mentioned.

Student: James Erich Roth

Faculty Advisor: Dr. Katrina Moskalik

The objective of my capstone project is to use Lean, Supply Chain, and Project Management tools and methodologies to improve the Credit Transfer Process at Milwaukee School of Engineering (MSOE). The Credit Transfer Process is the process whereby incoming and existing students petition MSOE to apply credits received at other colleges and universities towards a degree at MSOE. This project required me to conduct in-person interviews to gather primarily qualitative data and further obtain any quantitative data pertinent to the existing process. Using this data, I applied analytical tools to identify the root cause of any of the primary inefficiencies of the process and identify ways in which the process could be improved, culminating in a list of feasible recommendations.

Student: Aaron Trattner

Faculty Advisor: Dr. Michael Payne

Looking to develop a marketing plan to increase viewership of NFL games through viewer participation and involvement in Daily Fantasy Company (Draftkings/FanDuel).

Student: Jake Lyon

Faculty Advisor: Dr. Michael Payne

Creating a social media marketing plan to help a local company with expansion and customer acquisition.

Student: Joey Hoffman

Faculty Advisor: Dr. Michael Payne

Developing a marketing plan for RSOB to support the launch of an online academic program within RSOB.

Student: **Travis Duffy**

Faculty Advisors: **Beth Slayman**

Project: **SharePoint 2013 Decommission Phase 2 Planning**

SharePoint, a content management system developed by Microsoft, is a tool that is currently in use for document and workflow management at Artisan Partners. The version of SharePoint we have installed is SharePoint 2013. In addition to becoming increasingly unstable, SharePoint 2013 will be out of support by Microsoft in May 2023, meaning security patches will no longer be available for the system.

SharePoint is a costly system to maintain and being that there is an organization-wide drive to consolidate content management systems at Artisan Partners, it was decided to retire the platform.

In this preliminary project, planning was done in preparation for the 2021 project in order to determine which platform's specific sites they will be moving to and to develop rough budgets, allocations and timelines for each site. Throughout this planning project, I worked with several business teams to identify requirements and determine current pain points in addition to working with off-site consultants to obtain quotes on solutions that must be custom developed as a part of this migration.

Student: **Celine Visalda**

Faculty Advisors: **Beth Slayman**

Project: **Development Lifecycle as a Business Analyst (BA) – Integrating 360 Wealth Data into CRM**

My company's CRM system does not currently contain data known as "360-degree Wealth." This information is necessary for Financial Advisors and Client Specialists to develop financial plans for their clients. Currently, the information is held in a separate system from the CRM, in an unorganized state, causing significant difficulty in locating and accessing the information. The purpose of my project is to develop the technical specifications necessary to move 360-degree Wealth data into the CRM system. This feature development is conducted using an Agile framework for software development.

As a business analyst, I must collaborate with various stakeholders to fully understand the needs of financial advisors and client specialists to develop feature requirement specifications for the CRM system. Additionally, I must work with the development team to translate those needs into technical specifications and act as the “functional expert” throughout the entire feature development lifecycle.

Student: **Toua Xiong**

Faculty Advisors: **Beth Slayman**

Project: **Secure File Sharing and Storage for Alternative Family Services**

Alternative Family Services is facing a security issue in the storing and usage of confidential patient records among its team. With limited IT knowledge and support, all patient records are currently stored in multiple folders on personal desktops or laptops and are reaching maximum storage capacity. Security is of importance to ensure patient records are not lost, allow team members to only view the records assigned to them and, most importantly, to meet HIPAA standards. Alternative Family Services is seeking a secure data storage and sharing solution to its problem. The objective of my project is to recommend a cloud storage solution within my client's budget of \$100 per month that will provide enhanced level of security in the storing and sharing of confidential patient records among team members. In addition to providing data security and meeting HIPAA standard, the improvements of the project will achieve file sharing, team collaboration, ability for large files to be received and shared, and server cloud backup.

Student: Yuti Modi

Faculty Advisors: Beth Slayman

Project: Process development and Software Inventory for MSOE

Just like any other university with engineering, nursing and business programs, MSOE provides a lot of software for students, professors and other staff to work with. There is an IT Department at MSOE that keeps a record of the software and there is also a committee formed by people from different academic and administrative departments that records the technological usage and requirements of the departments. This committee, called the Computer Users Committee (CUC), serves as a bridge between the IT Department and the other departments. Through the CUC, the IT Department is made aware of various technological requirements and usage. However, it has been observed that there is no defined process or procedure for communicating the software usage by different departments, making it difficult for IT to manage not only the software inventory, but also the costs of the software. To address this challenge, I am working on process improvement as my capstone project so that the CUC can collect necessary software usage data from different departments and the IT department can easily access details from the CUC to manage the software costs.

Humanities, Social Science and Communication Department

User Experience Senior Projects

Student: **Madison Howell**

Faculty Advisor: **Dr. Katherine Panciera**

Project: **UX Brand Strategist Intern at 3Data**

Madison started this practicum in order to work on a brand refresh at 3Data and help them build out a style guide. This involved user research (to understand what the organization wanted as well as how it was received by outsiders) and starting to build a style guide. The initial brand refresh work that Madison did work on was really helpful and was something that hadn't been done or thought of before. Madison also worked on wireframes of a new user interface within the 3Data product that combined aspects of two existing but separate UIs.

Student: **Damien Langer**

Faculty Advisor: **Dr. Katherine Wikoff**

Project: **User Experience (UX) Designer for Bella Luce Skin Care, Mount Vernon, WA**

As a user experience (UX) design intern for Bella Luce Skin Care, a small skin care company offering a variety of skin care services and products, Damien worked remotely with the owner of the company, Nicole Kawashima, to improve the company's online store front. Damien conducted UX research to inform site improvements and to understand the current state of the online ordering process. Additionally, Damien worked to clean up the digital product inventory, which lead to improved product inventory processes making it easier and more efficient for the company to maintain their physical product offerings.

Student: Alexandre Nelson

Faculty Advisor: Dr. Katherine Wikoff

Project: UX Internship at Petersen Products

Alex did his UX internship at Petersen Products, a plumbing and industrial pipeline product manufacturer located in Fredonia, Wisconsin (Sheboygan County). Alex's internship focused on a product called an "inflation controller" and its accessories. This product is used to inflate plugs (similar to inflating balloons) at a job site and must be able to control the inflation precisely in order to avoid damaging the plug and the pipeline. Alex's position involved him in research and development type projects, as the product needed remote pressuring monitoring. Alex was specifically involved in quality documentation and testing. Alex helped to make the device smaller and more finished. Working with other engineers on a project to optimize an upgrade to the product via 3D printing of a prototype, Alex and his team were able to reduce the cost of the regulator's (the "inflation controller's") components while making it more compact and better/easier for the person using it in the field. Additionally, Alex was assigned to work on the corrective action log, which is associated with the company's ISO program to maintain its quality assurance certification. Part of Alex's job involved physical testing of product components. He tested the plugs and kept a log of the test. Alex had good ideas for improvements, was helpful with troubleshooting, and made suggestions for improving the procedure and safety.

Electrical Engineering and Computer Science Department

TEAM MEMBERS

Kyle Ellis
Emily Gehrke
Kegan Hackett
Ryan Soileau
Abby Strand

FACULTY ADVISOR

Dr. Steven Holland



AD2 Inspector

The AD2 Inspector is a device that will aid identification of malfunctions in the Analog Discovery 2 (AD2). Frequently, misbehaving AD2 units are returned to Tech Support. Time and resources are wasted manually determining the cause of the defected AD2. The AD2 Inspector will save many AD2 units and masses of time. Using a Raspberry Pi controller, waveforms are generated and sent to the AD2. The measurements are calculated by the AD2 and the controller reads the outgoing data from the AD2. Since the controller knows what the data should be, the outgoing data is compared to the accurate data, quickly identifying the specific problem area of the AD2. With an easy-to-use user interface platform, anyone can quickly plug in their AD2 and run a test to see what is wrong with their unit. Say goodbye to wasted time and shelves of defected AD2 units!

TEAM MEMBERS

Sara Alsudeer
Ashley Branner
Jaden DeFields
Michael English
Joshua Wankowski

FACULTY ADVISORS

Dr. Derek Riley
Dr. Gerald Thomas

Algae Bloom Detection IoT Buoy

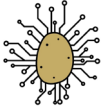
The Algae Bloom Detection IoT Buoy project cooperates with the lake manager on Eagle Spring Lake to monitor Harmful Algae Blooms (HABs). The primary device is a waterproof lake buoy with a microcontroller and two temperature sensors to monitor the lake. The sensor readings are transmitted wirelessly to a proxy server on the shore and then forwarded to the cloud. Temperature readings within 20-35°C can help indicate when HABs form. A cloud-based software service is available to query a database containing the data entries and possibly predict possible algae growth periods. The project serves as a foundation for additional sensors and artificial intelligence prediction capabilities by future teams. Existing solutions are too high cost for smaller lakes like Eagle Spring Lake and our project serves to provide a low-cost solution to an otherwise high barrier to entry market.

TEAM MEMBERS

Justin Bickman
Bartosz Karaban
Preston Makoutz
Noah Schmidt

FACULTY ADVISOR

Dr. Luke Weber

**Autonomous Irrigation System**

The purpose of this project is to improve the current methodology of irrigation for farmers who use outdated irrigation hose reels. Currently, farmers who use this method of hose reel irrigation rely on mechanical linkages for controls that tend to lack repeatability and reliability. This requires the farmer to spend numerous hours every day monitoring the irrigation process to ensure that nothing is broken, and everything is functioning as expected. Our project streamlines and automates this whole process to ensure that the system operates reliably, reduces water waste, and makes the whole irrigation process almost entirely hands-off for the farmer. Our solution is a low-cost, modular addition to the existing irrigation hose reels and water pump that monitors the irrigation process, protects the farm fields from flooding by wirelessly communicating between the water pump and hose reels, and sends the farmer progress updates via text message.

TEAM MEMBERS

Brandon Dunne
Sam Jansen
Than Win

FACULTY ADVISOR

Dr. Gerald Thomas

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TSR Solutions

**BeerBot**

This project is a self-serve beverage system which utilizes a smartphone application using near-field communication to allow users to order, pay, and pour beverages themselves. The system uses a tap controller integrated into a smart tap system to enable users to purchase and serve themselves drinks without the need for a bartender. By doing so, lines are shortened as the system can serve up to eight users simultaneously which reduces costs to serve beverages. The system will be sold as a service and marketed towards temporary or semi-permanent event venues such as Summerfest which are looking to cut costs and lines for beverages.

TEAM MEMBERS

Isaac Ballone
Seth Fenske
Rob Retzlaff
Lucas Stenzel
Joshua Vogt

FACULTY ADVISORS

Dr. Christopher Taylor

Career Pathways Kiosk

The Career Pathways Kiosk is an interactive exhibit that allows children to explore various careers they can pursue in the future. Discovery World visitors answer survey questions via a touch screen. At the end, they are presented with potential careers based on their answers, and they can learn more about each career while exploring different paths. This project involves two different Java applications: the kiosk itself and

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Discovery World

**TEAM MEMBERS**

Daniah Alkhunaizi

Katie Merriman

Catherine Mett

Erin Winter

FACULTY ADVISOR

Dr. Charles Tritt

(with thanks to Drs. Jeffery LaMack
and Ahmed Sayed and the rest of the
biomedical faculty)

SPONSOR

83 Tech Harbor

**TEAM MEMBERS**

Sam Forest

Alex Holt

Vincent Krenz

Lucas Larocco

Blake Masbruch

FACULTY ADVISOR

Angela Wiedenhoef



a survey editing application. To prevent the survey from becoming out of date, Discovery World staff can use the editor to update the content and graphics. The survey is stored as a simple XML file, and it can be loaded back into the kiosk.

Child Gaze Tracker

Our team is working with 83 Tech Harbor to create technology for at home use that will help parents understand and identify possible developmental issues, or detect disorders, such as seizures, earlier and more objectively. Childhood developmental disorders benefit from early diagnosis. However, they are difficult to diagnose, relying on subjective and sometimes unclear criteria, which can increase stress in parents who suspect their child may have a developmental disorder. Based on research showing that tracking eye movement may be useful in the detection of multiple childhood developmental disorders, we intend to develop a prototype for a wearable eye and head tracking device, using infrared (IR) cameras to track the eye gaze and an accelerometer/gyroscope subsystem to track head movement. This will allow gaze direction to be determined without the need for an external facing camera, reducing social and ethical concerns about capturing images of other children around the user.

Drone Link

Drone Link is a full suite of tools and hardware for drone racing management. Features include the planning of heats, finding the best flying frequencies, race day statistics, and the physical timing hardware for each drone on the track. Cost effective and readily available IOT (Internet of Things) technology allows the distribution of more timers on a track to record more accurate metrics, giving the pilots the edge to improve. On race day these metrics can be shared over a local network to spectators and pilots alike to make the day more engaging and informative. This project will be open source, allowing the community to continue developing Drone Link. It will be available for schools and individuals in the hope that drone racing becomes a more popular hobby!

TEAM MEMBERS

Bayan Almarhoon
Will Fredenberg
Deven Jakubowski
Hope Walker

FACULTY ADVISOR

Dr. Charles Tritt

SPONSOR

A portion of the project cost is covered by the Innovent Center grant



TEAM MEMBERS

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Austin Rovge
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Dr. Christopher Taylor

ACKNOWLEDGEMENT

Special thanks to MSOE Public Safety Sgt. Russell and the NVIDIA metropolis engineers and scientists.



Educational Mechanical Right Heart Simulator

Our educational mechanical heart simulator simulates the mechanics of the right heart, demonstrating specific physiological aspects of the right heart in addition to the thermodilution technique that is essential to today's Swan-Ganz catheters. Our device is intended to be highly effective in biomedical engineering education. It can be used to illustrate the performance and function of the right heart in physiology classes and fluid dynamics principles. The design has been completed and documented with open-source principles in mind with the intent to make it available to all interested biomedical engineering faculties and encourage its reuse.

Electronic Parts Vending Machine

The Electronics Parts Vending Machine is an autonomous, always-on vending solution located on the third floor of the Science Building, a location with 24-hour student access. The solution gives students in the Electrical Engineering and Computer Science Department of MSOE the ability to purchase electronics parts on any day and at any time using a Raider Card with pre-loaded funds, a major credit card, Apple Pay, or Google Pay. The machine is stocked with a curated selection of products that both support coursework and encourage extracurricular exploration. The Technical Support Center of the EECS Department has agreed to maintain inventory and accounts and to restock the machine after the project end.

Eye in the Sky: Vision Tracking in Diercks Hall

A software system that will expand on the traditional security camera software suite with modern computer programming technologies. The combination of computer vision, machine learning, and distributed metadata analysis enables the Eye in the Sky to autonomously monitor and record object behavior across campus. This information can be presented, interpreted, and shared with security officers in a dispatch control user application. The current campus security infrastructure consists of a disorganized collection of basic camera video data. MSOE Public Safety has difficulty searching for actors around specific on-campus events. Our solution proposes an individual orientated search pattern for indexing diverse n-point camera systems. MSOE's supercomputer has the compute capacity to simultaneously analyze every high-resolution camera in Diercks Hall and store relevant object information. The rendering engine superimposes guiding boxes on individuals in live campus video to assist Public Safety with human recognition of objects or people.

TEAM MEMBERS

Alexander Blake
Dylan Critz
William Dennis
Shreyesh Patel
Isaiah Zupke

FACULTY ADVISOR

Angela Wiedenhoeff



TEAM MEMBERS

Max Booth
Zachary Krouse
Surya Prakash Madichetti
Rilind Morina

FACULTY ADVISOR

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TEAM MEMBERS

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Arandu Huerta
Leo Madda
Jeremy Pugh

FACULTY ADVISOR

Dr. Eric Durant

First Event Scheduler

FIRST is an education consulting company that hosts professional learning communities every year where educators from school districts can learn a variety of things that they can then employ in their teaching. However, FIRST pays several thousands of dollars to print its agenda on paper for the hundreds of participants. PLC Group will construct an application that allows the stakeholders to enter relevant information for the PLCs, removing the need for printed booklets. The application will run on Android and web browsers. The solution will be safer for the planet and easier to update upon changes to the itinerary.

Flash Charge

E-Bikes have become more popular as an alternative to public transportation in cities all over the world. E-Bikes use batteries to power the array of electronics and motors that make it function. However different brands and models of E-Bikes have different battery voltages. This difference prevents charger cross compatibility. Therefore, a fast and adaptable charger that can adapt to different batteries is needed. This charger removes the need for multiple chargers in a household and charges the battery faster than the included OEM chargers.

FreshBlock

The FreshBlock is a small, rapidly deployable device that acts as a quick reminder of how much time is left before a product expires. The FreshBlock has an eInk display that changes from white, to black, and finally red to indicate the product has expired. This allows the user to quickly estimate the remaining shelf life of the product at a glance. The FreshBlock also displays the expiration date of the product for detailed information when needed. This device will help modernize product freshness solutions and reduce the burden of arduous current date keeping methods. Along with the device, the FreshBlock product utilizes Bluetooth LE to connect with a phone app that will be used for easy set up and its on-board Wi-Fi to connect to a server that provides notifications when a device is low in battery and reminders as the expiration date nears.

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Hobby Hub

When it comes to embedded projects, the sky's the limit and the only obstacle is people's sheer creativity. The Hobby Hub enables hobbyist programmers to create and design unique, multi-faceted solutions to automate their everyday lives. Our system allows users to run multiple independent programs simultaneously from a single piece of hardware. With a straightforward setup process delivered through our custom web interface, the user can set up their device easily and quickly. Following setup, the user can begin managing programs and accessing program development tools to make creating the software they desire a breeze. A custom pin manager tracks I/O pins that are in use while highlighting available pins, thereby saving the programmer time and effort from having to resort to referencing the manual. Motivated individuals can now let their imaginations run wild.

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Kayak Control

Currently there isn't a kayak propulsion system that is easily removable and can be used on a wide variety of kayaks offering the end user a wide range of mobility, control, and enjoyment. Our solution uses a microcontroller system that takes input signals from two user control devices that each control the thrust in the forward/reverse direction on one side (left or right) of the vessel. The magnitude of thrust in each thruster is proportional to the angle-of-throw of its user control. The two thrusters are mounted on a mechanical fixture that can be easily removed from the kayak. The system is powered by a user-supplied marine-grade battery that can be stored in the design-supplied waterproof enclosure. In addition to the battery, the waterproof enclosure also houses the microcontroller system and overcurrent protection devices.

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SPONSOR

Molson Coors Beverage
Company



TEAM MEMBERS

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Milwaukee Tool



MCBC Network Access Control

Molson Coors Beverage Company (MCBC) keeps their breweries in peak operating condition by hiring specialized outside contractors to maintain and update their brewery controls equipment. To perform the needed maintenance and updates, these contractors require access to the brewery network which introduces a security vulnerability. The current way MCBC allows access to the network poses a few problems in monitoring the activity of the contractors along with allowing easy and secure access to the network.

To resolve the issues in monitoring and accessing control, we have designed a two-part solution. The first part of the solution is a Wi-Fi bridge. This device will act as the gateway onto the network by providing an internet connection to the brewery's network and monitors and stores into a database all traffic going onto the network through the bridge. The second part is a hardware key. This USB device will store the credentials of a user and will allow for the contractor to access the network without typing a password. This two-part system will allow for easy, secure access to the MCBC network while offering strong monitoring practices.

Mesh Control of Tools

Milwaukee Tool needs a method to control multiple One-Key lighting devices simultaneously. Currently, Milwaukee Tool's Bluetooth Low Energy (BLE) Module is not capable of mesh control and therefore does not support controlling multiple devices simultaneously. Milwaukee Tool's expectations include: The replacement module needs to forward commands to the lighting device being controlled, the solution must use BLE Mesh communication, all the code is to be in C, the replacement module needs to have lower power-source quiescent current than the current solution, and the replacement module needs to cost under \$10. The developed solution is smaller than 2" by 3"; allows commands sent to multiple devices simultaneously using a smartphone application for control; accommodates commands to turn lights on, turn lights off, adjust light brightness, and sound a buzzer at a light to help locate it; and uses the Milwaukee Tool One-Key application for Android and IOS devices to make commands.

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MSOE Supercomputer Challenge

The MSOE Supercomputer Challenge is a project to develop a web-based application that can analyze a multitude of inputs and requirements to produce an optimized floor plan design using machine learning that can be linked to a cost database. The goal was to determine the best configuration for the project and allow customers more knowledge to let them make more confident decisions. This would be a much faster first step in the design process to make sure the project was feasible for their customer.

NASA Remote Mining Competition

NASA hosts an annual design competition for universities. Teams travel to the Kennedy Space Center in Florida to participate in a robotic mining competition (RMC) and MSOE often participates in this event.

The Mapping, Orientation, and Navigation Kit for Ensuing Years (MONKEY) is designed to provide autonomous navigational support for the MSOE NASA RMC competition team's mining robot. The system is designed around the set of rules and regulations for the NASA RMC, as well as the current MSOE competition team's robot design. The kit is intended for future years' teams.

The MONKEY includes hardware and software systems consisting of power, stereoscopic image processing, inertial measurement units (IMU), communications subsystems, microprocessors, localization and navigational algorithms. The MONKEY will identify the mining robot location and orientation in the field of play. It will then provide the mining robot with commands to autonomously navigate to a mining location using a route that is free of hazards.

POTS Monitor

Our device is designed to improve the quality of life of those with Postural Orthostatic Tachycardia Syndrome (POTS) by providing real-time blood pressure and heart rate monitoring through a non-invasive wearable device. The device will allow wireless BP and HR data transmission via Bluetooth to the patient and their family's Android mobile devices. This will alert users to possible problems and help them manage emergency episodes. The system will also permit users to log their diet and day-to-day activities to aid in the discovery of foods and activities that may trigger episodes.

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PV Panel Eliminator

Green energy has become more prevalent in developing new technologies and energy solutions. Many emerging technologies rely on Photovoltaic (PV) solar panels as their main source of power. This has been seen on larger scales, like assisting in powering homes and communities, and on smaller scales, like personal backpacks that can charge phones and other small devices. As these technologies are developed, they need to be tested either with a full grid of PV panels or DC power supplies. The former can be expensive and the latter does not fully replicate the true electrical characteristics of a PV panel.

The PV Panel Eliminator provides a low-cost power source that accurately and reliably emulates the output I-V characteristics of a solar panel. This device is intended to be used by electronic system designers and will provide a simple power source with the I-V curve of a solar panel to ensure the functionality of their designs. The PV Panel Eliminator can be programmed to emulate different panels and different light/shading scenarios. Multiple Eliminators can be wired in parallel or series to fully emulate a complete PV system.

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PV Sous Vide – The Next Wave of Cooking

Most people are familiar with hearing phrases such as, “Really? You’re pulling them off now?” or even, “I wanted medium-rare, and this is charred!” The common campfire, the culprit behind generations of bickering, is simply too difficult of a cooking method to achieve consistent results.

We introduce the solar powered sous vide cooking system. Our system eliminates the need of a campfire and produces perfectly cooked meals from simple resources such as solar energy, an insulated container, water, and sealable bags. With these few items, the user can effortlessly and safely cook with little to no guesswork involved.

Our team takes great pride in our development of such an ecofriendly, zero-carbon emitting device, as the only non-reusable elements are the sealable bags that the food is placed into.

Clearly, our sous vide is the superior option for a safe, portable, accurate, reliable, and eco-friendly culinary experience.

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Queue Up

Queue-Up is a mobile application providing music playback collaboration across multiple devices through a connected queue management system acting as an extension of one's premium music streaming subscription. This development was triggered by the physical restrictions of connecting to a speaker, whether that be via an auxiliary cord or Bluetooth. These restrictions create inconveniences in music playback management while adapting to the vibes of the listeners. Long silences are inevitable while transferring control of a speaker from one person to another or passing the aux cord to another device. The device connected to the speaker initiates a party session through this app and invites other devices to manage the queue through a contributor code. Similarly, the host and contributors can share listener codes for other people in the scene to view the upcoming songs in the queue and submit song requests.

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Rapid Emergency Monitoring Patch

The rapid monitoring patch is an ECG electrode patch that can be applied to the patient in an emergency situation. It minimizes the number of wires and electrode attachments that need to be applied into a simple and compact package. It has Bluetooth capabilities as the signals from the patch are wirelessly transmitted to existing ECG machines through an adapter.

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with thanks to Dr. Tom Swiontek

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Real-Time Nerve Conduction Velocity Device

Our project involved the design of a nerve conduction velocity (NCV) device that allows collection and display of real-time data for more efficient detection of neuropathies. Nerve conduction velocity devices send small electrical currents through patients' skin to underlying nerves and then detect the resulting neural responses. In our device, this response is displayed on a handheld screen in real-time. Our design integrates a microcontroller for data storage and uses a micro-computer for display of the user interface. It also includes an electrical stimulation circuit as well as filtering and amplification circuitry.

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Rescue Blankets

This past winter has shown us the importance of warmth, not just in Wisconsin, but across the US. There are many car heaters, however, that work either only when the car is on or use propane/non-reusable fuel. Our heater works independent of the car and uses solar and wind energy, as well as home outlets to charge. The product can use up to three heated blankets and has two phone chargers as well. This will help users survive and stay comfortable in the case they are without heat and power.

Sisyphus Table Expansion

Previous to the MSOE Sisyphus Design team's intervention, a combination of robotics, magnetics, a steel ball and a Neopixel LED light strip were employed by Sisyphus Industries to create beautifully illuminated patterns on a kinetic art table. These patterns provide a deep sense of tranquility and meditation for the viewer. The MSOE Sisyphus Design Team has furthered the interactivity of this table through a combination of machine learning algorithms that enable the table's lights to respond in both color and brightness to input audio mood and volume. Additionally, the MSOE Sisyphus Design Team has produced further innovations in the space of R&D for Sisyphus Industries to explore in future attempts to increase the interactivity of the table, including new light patterns and new sand tracks as well as an app to use the table to display phone notifications.

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SPONSOR

Renair Shotgun Sports

Smart Clay Pigeon Thrower

There is currently no smart clay pigeon thrower available on the market that has an extended operating distance and full remote-control capabilities. Additionally, no currently available thrower can save positions and recall them when desired. A satisfactory level of safety and stability is essential to this type of product, and currently available products are unsatisfactory with regards to safety and stability. Our solution involves creating a handheld controller allowing the user to enter commands that are wirelessly communicated to the launcher. This controller can save launch directions for later recall and use. The controller is user friendly and will accommodate future enhancements such as creating a mesh network of multiple launchers. The controller with its capabilities and our safety and stability attributes are the distinguishing features between our product and existing solutions.

TEAM MEMBERS

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Smart for All

Smart for All is our IoT (internet of things) hub, that will connect wirelessly to modular adapters that add smart functionality to legacy devices to easily control them from the comfort of your smartphone. The hub communicates with our custom modular devices using a wide variety of standard IR remote control formats that relay the data to the hub and in turn receive the proper commands to perform the correct functions. Our goal for this project is to create a product which will allow for devices that don't utilize an internet connection to easily connect to the internet and be easily controlled remotely from an app on a smartphone, giving them "smart" functionality.

TEAM MEMBERS

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Smart Sump System

This project is aimed at giving users more information about the condition of their sump pump so they can make informed decisions about replacing their pump. This is done by monitoring the power to the pump and additional sensors to monitor the water level more accurately in the sump basin. It is also designed to be flexible and open source, allowing users to determine the sensor type and the number of sensors that are suitable for their situation. Since this project is open source, it also allows users to further customize the system to their needs.

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Smartwatch to Detect Symptoms of Hypoglycemic Events

Hypoglycemia is a common complication of diabetes treatment. Individuals who suffer from low blood sugar have hypoglycemia. Sudden reductions in glucose levels in the blood systems may cause dizziness, shaking, confusion, and feelings of anxiousness and weakness. When a hypoglycemic event occurs, the individual experiences a drop in temperature and excess perspiration. The project goal was to develop a smartwatch technology based on temperature sensors that detect these sudden changes. Self-heating thermistors measure both the perspiration and temperature using a single temperature sensor. When a hypoglycemic event is detected, or the sensor's threshold conditions are met, the smartwatch will vibrate and sound an alarm through a speaker to notify the user of a potential hypoglycemic episode. Additionally, a Bluetooth application was developed

to alert the user and their emergency contacts on their mobile devices. The intention of the alarm system is to notify the individual before the event occurs so that the user can be better prepared.

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Sympathetic Response Sensing Device

The sympathetic nervous system (SNS) is a necessary component of overall nervous control, helping regulate body functions. During stressful situations, the SNS increases heart rate, blood pressure, and sweat, resulting in its nickname, the “fight-or-flight” response. Individuals with certain mental illnesses, such as anxiety, may have increased sympathetic response, but with the use of biofeedback and therapy they can learn to reduce their symptoms. Our device utilizes three biosensors housed in a glove to continuously monitor physiological signals associated with the SNS (i.e. temperature, heart rate, and galvanic skin resistance) and indicate heightened sympathetic activity through real-time feedback to a mobile application via Bluetooth. The intent is for use in virtual therapy, where the therapist can use the real-time and stored historical data to learn about the patient’s condition, the patient and therapist can recognize trends, and ultimately the patient can learn to control their sympathetic response.

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Templ.D

Templ.D will prioritize the health and welfare of company personnel and university students. Using infrared and contact technology, individuals can monitor their overall surface health. Wearable data provided by the sensors will be available for additional monitoring through the LCD/LED components and through a simple Android application.

Templ.D will adhere to all social distancing policies that are put into effect due to COVID-19 or similar pandemic situations. Close proximity measurements will no longer be necessary as Templ.D will have an IR device embedded for similar temperature accuracy at a safer distance. Both parties (user and health official) can acquire the temperature data and guidance needed through this device without ever needing to come within a six-foot distance.

In addition to safety, improper use of equipment will no longer be a factor for increased wait time as taking temperatures on Templ.D are done instantaneously and periodically.

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Upper Limb Prosthetic for Motorcyclists

Our project was to design a prosthetic that would allow someone with an upper limb impairment to operate and maneuver a motorcycle. This allows the user to utilize an attachment that will enable them to mechanically pull the clutch when shifting gears as well as let them “hold onto” the motorcycle with their impairment. This will allow people with an upper body impairment to ride a manual motorcycle without having to attempt dangerous maneuvers or make significant modifications. The system must work in such a way that the user will be able to pull the clutch on the handlebars without affecting steering. The user must also be able to release themselves quickly from the device in an emergency. The device must also fit onto most common motorcycles to be as universal as possible.

Versiti Autonomous Sample Sorter

Versiti operates blood centers throughout southeastern Wisconsin and the upper Midwest. The Versiti Autonomous Sample Sorter provides an effective solution to a time consuming and inefficient task of sorting and recording the incoming vials of donated blood for disease testing.

Currently, vials containing blood samples are sorted into groups of four, depending on the information scanned on the barcodes attached to the vials. This information is logged and relayed to Versiti’s database of information. Defective vials are automatically detected, set aside, and the technician is alerted of this by a visual indicator. All the current containers and racks that Versiti currently uses are compatible with the Autonomous Sample Sorter. The system is user-friendly and takes less than an hour for new personnel to be trained.

This Autonomous Sample Sorter solution improves the process that Versiti currently uses and will save lab staff technicians time, so their efforts can be directed towards other important projects.

TEAM MEMBERS

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Watermen Adventurer

The goal of Watermen Adventurer is to make it easier for watermen to plan trips both far and close to home. By providing predicted weather data, we can allow watermen to plan their adventures in advance without much worry. We aim to make it easier for surfers, fishermen, divers and sailors to view predicted seasonal weather patterns for the

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Angela Wiedenhoeft



wind, waves and temperature. This is accomplished by using historical aggregations and predictions through a deep learning model. The application displays historical averages of wind, waves, temperature and fish catches over a map. In addition, the prediction model predicts the waves two weeks in the future and displays the wave heights on a map. In the future, we hope our app can correctly and consistently predict weather patterns to allow for a smooth transition from laptop to adventure.

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SPONSORS

Milwaukee Tool



Wireless Run Detection for Dust Extractors

The Milwaukee Electric Tool Corporation currently produces a family of dust extractors utilized to capture airborne debris generated by masonry and cement drilling operations. The “Wireless Run Detection for Dust Extractors” project aims to utilize the M12™ HAMMERVAC™ UDE as a test platform to introduce a method of wirelessly sensing the operation of an attached SDS Rotary Hammer, resulting in a signal used to activate the dust extractor device. The Wireless Run Detection Module—the core of the design project—serves as the interface, capturing the stray magnetic flux emitted from the powerful SDS Rotary Hammer motor and processing the characteristics of the induced voltage waveform. The result is a logic signal which communicates the run state of the rotary hammer to the UDE controller, allowing fully automatic operation of the dust extractor in tandem with the operation of the attached tool.

Mathematics Department

Actuarial Science Senior Projects

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Wildfires: Solutions to a Burning Question

In recent years, large-scale wildfires have been burning across the western United States and in other areas of the world. As different environmental factors shift due to climate change, fires have gotten more unpredictable and severe. The goal of this research project is to look at wildfire trends in California and determine if the insurance industry needs to make changes to account for the increased risk. The possible solutions this project explores are leaving premiums as they are, raising all customers' premiums, and solely raising the premiums of high-risk properties. These solutions are modeled and priced, which provides a better idea as to which option likely offers the highest customer satisfaction while effectively covering the extra risk of worsening wildfires.

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Outsider Investing in MLB Player Salaries

In this project, we explored variables which would contribute to an MLB player's salary in their early career. After compiling large quantities of data, we were able to implement R Studio and Excel to create accurate pricing models based on significant variables from a player's first two years in the league. Using these models, fans and investors could potentially invest in MLB players' careers as easily as buying a share of stock, giving value to both the player and the investors' portfolio. We were able to partner with Pinnacle Actuarial Resources in Bloomington, Illinois for this project and were given the opportunity to present our processes and findings to their actuarial staff during their Pinnacle University presentation day.

TEAM MEMBERS

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Analysis of Telematics in Auto Insurance

This project was an analysis of telematics in the auto insurance industry. The project starts with a broad explanation of what telematics is and why I am taking time talking about it. As I go more in-depth, I talk about my research on the benefits and costs, as well as how new technology and pricing models affect markets. I explain why telematics are important to insurers and how it changes traditional insurance risk modeling. I also cover how a self-selection bias can change a risk group's risk distribution, causing dynamic shifts in adopter vs. non-adopter liability with static expected loss modeling. Overall, my presentation of my analysis provides insight for all levels of knowledge surrounding insurance telematics.

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Corporate Parametric Insurance

In accordance with the guidelines set by the 2021 Society of Actuaries Case Study Competition (in which we advanced to the semifinals), we examine a hypothetical company incorporating parametric insurance into the national healthcare marketplace. The company aims to transition from the standard tradition of paying the insured based on a recorded loss, to paying them based on certain triggering criteria; i.e., our team aims to create a plan in which the insured receives compensation once certain conditions are met. These conditions do not have to stem from physical or mental damage to the insured. Instead, the insured are compensated for the increased future losses revolving around the conditions. Furthermore, our plan aims to insure countries against unforeseen increases to their demographics which could have detrimental future financial consequences.

Mechanical Engineering Department

Industrial Engineering Senior Projects

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Dakonte Product Group

This project was performed for Dakonte Product Group (DPG), a small Milwaukee manufacturer. The manufacturing process examined in this project was the production of clear vinyl partitions, a COVID-19 pivot product. As the demand for these partitions has kept steady, DPG needed immediate improvements to the cycle time. As a result, the main objective was to improve the cycle time of the process from 19 to 6 minutes per unit by the end of February 2021. The first phase of improvement was completed through weekly Kaizen events focused on consolidating the process while implementing 5S methodologies. A value stream map was then created to identify bottlenecks in the production process that were then eliminated through improved equipment, proper tooling and new procedures. Through these improvements, the overall production time of the system was lowered to eight minutes per unit, with six minutes being feasible after implementation of additional recommendations.

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Emerson

Emerson is a manufacturer of garbage disposal components. Emerson recently moved their Pack A: Specialty Cell from another facility to their facility in Racine. The objective of this project was to design a cell layout that can fit the Pack A: Specialty Cell into the Racine facility. To this end, the Row and Column Method was applied with the aim of developing groups of machines and workstations to form an initial layout. Using the generated initial layout, the Pairwise Exchange algorithm was implemented to generate alternatives of layout improvement with the objective of reducing travel distance within the cell. As part of the project outcome, an improved layout was proposed which provides a line balance wherein no more than 35% of throughput is completed in one day, with an overall cell efficiency of 86% and a cell throughput of 5,126 parts per week.

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Empire

Empire Level manufactures rafter squares and framing squares at their facility in Mukwonago, Wisconsin. This project focused on improving one area of their facility, the laser etching department. Empire Level wanted to increase their capacity by 50%, allowing them to accept more orders from their customers. The current state takt time is 63 seconds per part, 1.5 times slower than needed to meet upcoming demand. The objectives for this project included identifying the wastes of the laser etching process and providing recommendations for improvement. Anodizing, milling and washing were taken into consideration to balance the flow of the laser etching process. The team used tools from simulation, lean, six sigma and work methods to develop recommendations for improvement. A discrete event simulation was used to model the improvements. By implementing the recommendations provided in this report, Empire Level can expect a 50% reduction in takt time.

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FORCE America

Over the past few years, FORCE America had been experiencing long lead times on the production of their harness boards. To begin the project, the team gathered historical data and conducted various quantitative and qualitative analyses about the company's process in order to fully understand how it worked and where there may be possible room for improvement. The team decided that with some changes, the process lead time could be reduced by 10% based off of statistical analysis and discussion with the client. From these analyses, the team determined that the main areas of focus for the improvement of their production process were shared tooling amongst workers, reduction of human and material movement, and the method with which the company cuts their terminals for the harness boards. Along with that, the team is offering a suggestion for future data collection for the company's benefit after the project concludes. With these changes the team hopes to reduce the company's lead time by about 10%.

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**Harley-Davidson**

Harley-Davidson produces powertrain assemblies for use in their motorcycles in their Menomonee Falls facility. A crucial step in the process is the manufacturing of engine and transmission gears, starting from a casting and ending in a hardened and polished gear, ready for assembly. The project was intended to standardize the production schedule for the gear finishing department by determining the optimal batch size for each gear and developing a system to generate production schedules. Production floor data was collected, the material flow process was documented to create a schematic model for Harley-Davidson to use, and an optimized production schedule was developed utilizing industrial engineering tools and methods such as value-stream maps, queueing theory, simulation and lean ideologies. The Harley-Davidson Gearing Department should anticipate an elimination of their current 46 hours of weekly overtime which will result in a \$218,592 in total savings and a 91.46% rate of return for the project over a two-year time frame.

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Intelligent Ventilation Energy Control Systems

Intelligent Ventilation Energy Control (IVEC) Systems is a company specializing in ventilation systems and controls for industrial facilities. IVEC Systems is planning to build their own facility in the near future, which will allow them to bring production of their General Ventilation Self Cleaning Dust Collector (GVSC) product line in house. The systems are currently produced by i-TECH, a company owned by Tri Phase Automation, IVEC's electrical supplier and assembly partner. Using preexisting information as well as information collected from site visits, the team provided documentation of the mechanical assembly process' current state along with work instructions, equipment and labor requirements. The team used Failure Modes and Effects Analysis, Value Stream Mapping, facilities design, queueing theory, and simulation to document the current process and identify areas for improvement. Through Failure Modes and Effects Analysis, the team was able to highlight a potential savings of \$22,000 due to notable safety concerns, yielding a 13% Rate of Return on the project.

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**JW Speaker**

J.W. Speaker is a Germantown, Wisconsin based LED headlight manufacturer. Currently, there is not a system in place for scheduling labor for their material handling process which contains both line handler and market handler positions. In response, J.W. Speaker requested the team to address this issue so that the material handling department could be properly staffed. The client desired a task list database to be created that contained the average times of material handling tasks to be organized in a database. These task times were collected and compiled into a single document. Data analyses were performed on the collected data, such as calculations of standard deviation and confidence intervals at 90% and 95%. The group wanted to create a predictive model for labor staffing, although insufficient data made this task impossible. To conclude the project, recommendations on how to continue this material handling labor project were made.

TEAM MEMBERS

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Maglio Farms

Maglio Farms is a collaboration between Maglio Companies, Riverwest Food Pantry, and Groundwork Milwaukee, and they grow and distribute fresh produce to communities in Milwaukee. The farm requested assistance from MSOE to develop an on site produce washing and storage solution. The goals of the project were to reduce the manufacturing critical path time (MCT) by 15% and to provide the client with a viable layout from which to produce a washed plant. A series of time studies were conducted to determine the current state of the process and determine the main source of the problems. To develop the initial station layouts, the team used the Modified Spanning Tree to maximize the flow between stations; the Pairwise Exchange method was then used to reduce the material handling. The effect of these layouts on the MCT of the process was evaluated using MPX models. The team prepared three layouts that fit different budgets.

TEAM MEMBERS

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Planet to Plate

Planet to Plate partnered with Milwaukee School of Engineering's industrial engineering senior design team to help them establish their first indoor vertical hydroponic farm. The objective of the project was to validate their proposed production process, balance labor utilization, maximize their capacity, and achieve maximum throughput from their farming process while minimizing costs. The team obtained process data from both Planet to Plate and their equipment vendors and utilized a variety of tools including queueing network modeling (MPX), simulation (Simio), and optimization to validate their proposed production process as well as provide them with two improved alternatives. If Planet to Plate implements the team's top recommendation, they should expect a constant labor requirement of four farm technicians per day, five days per week, steady production throughput, a 16.67% increase in product yield with over a 10% reduction in cost per unit, allowing for an average 46% increase in revenue over the base plan.

TEAM MEMBERS

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Dave Kohlmann

**Putzmeister**

Putzmeister, a manufacturer of concrete related technologies, currently has an average lead time of 14.2 days for a replacement set of pipes, aiming to reduce it to 10 days. Upon observation, the paint booth was determined to be the process' bottleneck; therefore, improving the utilization of the booth will increase the throughput capacity of the system and decrease lead time. To address the underutilization and the non-value added time, four recommendations have been considered. Having everything pre-staged for loading and unloading of the booth, providing assistance to the painter for changeovers, standardization of the prep process, and better maintenance of the large paint racks is likely to result in a savings of 3.21 days in total, bringing the lead time to 10.98 days. With approximately 2.7 hours per day becoming value added time, the value of the time in and of itself is \$37,240 per year before inflation.

TEAM MEMBERS

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Walnut Way

The Walnut Way Conservation Corporation is currently developing Designaway, a print on-demand apparel business, to foster economic opportunities for the Lindsay Heights neighborhood of Milwaukee. The decision to form Designaway created a need to develop a production system capable of fulfilling the future high demand of local artists, fundraising entities and organizations. The purpose of this project produced results among three areas: (1) the development of standardized operating procedures for production, fulfillment, and shipping activities; (2) the provision of recommendations derived from value stream maps that reduce critical path time for the current process by 31%; (3) the use of a fishbone diagram to identify potential machine maintenance or consumable inventory problems. The team also provided recommendations to ensure proper safety design and to maintain necessary inventory for machine maintenance consumables. The team used information gathered from historical data, direct observations, and employee interviews to provide recommendations for improvement in these three areas.

TEAM MEMBERS

Jacob Egan
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Xylem

Xylem is a water technology company dedicated to creating innovative and smart technology solutions to meet the world's water needs. They manufacture many products including make-to-stock water pumps at their Morton Grove, Illinois facility. Xylem's shipping department has experienced poor performance due to inefficiencies in their ordering and shipping processes. The primary goal of the project was to increase Xylem's profit by reducing the number of non-profitable picks within the shipping department. To achieve this, a minimum order quantity tool was developed to determine the optimal order quantity for the 590 department's make-to-stock products. Outlier analysis was used to verify and validate the ERP system data. Additionally, standardized instructions were provided along with the tool for future use on other products. Four recommendations from the analysis were provided: implement minimum order quantities, multipacks, a combination of minimum order quantities and multipacks, and sales department training.

Mechanical Engineering Senior Projects

TEAM MEMBERS

Matthew Flipp
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Aerial Assault

Millions of dollars are lost each year due to warehouse fires. Aerial Assault attempts to conquer this problem by designing a fire suppression equipped small unmanned aerial system (sUAS). This system would extinguish fires well before the trigger of a conventional sprinkler system which typically floods unimpacted shelving and damages products that weren't near the fire. The system started first with an analysis into different classes of suppressants. These classes vary based on the type of fire; however, all classes of fires have suppressants that can be equipped to our sUAS for the type of product stored within an area. This led to an open-source design from which full analysis of strength and feasibility ensued. The final concept is constructed fully from readily available consumer products and 3D printable components making it dependable, adaptable and highly efficient. Future concepts would include thermal imaging, automated fire detection/suppression, control center incorporating a wireless charging dock, and the ability to contact authorities in the event of use.

TEAM MEMBERS

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ASME Student Design Competition—Harvesting the Sun and Wind

The American Society of Mechanical Engineers (ASME) hosts a student design competition every year, and this year focused on harvesting light and wind energy. This project consisted of creating and designing a robot from scratch that was able to be powered by one AAA battery and could be recharged via wind or solar power. With this robot, we were tasked with navigating a 5-meter by 5-meter course with arrows located throughout. The goal of this competition was to load the robot with up to 5 kilograms of weight (10, 0.5 kg weights) and transport them across the arena. Each arrow successfully crossed along the way would act as a multiplier to the amount of weights transported. Within the course, there were two charging zones where the robot could be recharged if necessary. 72 teams were placed against each other in a bracket style competition with a top prize of \$500.

TEAM MEMBERS

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ASME Design Team Competition—Racing Raiders

Every year the American Society of Mechanical Engineers (ASME) holds various competitions during their E-Fest event. The Student Design Competition is a critical part of every E-Fest as collegiate seniors from schools across the world compete in a new event designed to push their minds and abilities to the limit. This year's Student Design Competition was titled Harvesting the Sun and Wind. In this competition, students were to build a remote-controlled vehicle with the ability to maneuver its way through a given course. The major constraints on the vehicle included the ability to run on one singular AAA rechargeable battery, and the ability to recharge the battery from either wind or solar energy. Points were scored by transporting 0.5 kg weights, up to 10 weights per trip, from one loading area to another. Due to the current COVID restrictions, the teams submitted a pre-recorded video to compete.

TEAM MEMBERS

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NASA ADVISOR

Mike Ewert

Chilling in Space

NASA has requested team "Chilling in Space" to design a passive cold food stowage system for a future manned mission to Mars. The system utilizes the cold of space as a heat sink to passively maintain temperatures of 0°C to +5°C within the food stowage area. After concluding that this idea was possible, our team researched and analyzed three possible approaches for controlling temperature. The three designs were based off the following: Thermal Expansion, Shape Memory Alloy's, and Thermal Transducers. Thermal Expansion was the design chosen to control the system. Using Thermal Expansion allowed for a fully passive, accurate, precise, compact, and long-lasting control system. A sensing rod detects when the temperature changes inside the logistics module. Two pistons connected to the sensing rod moves a working fluid that changes the rotational angle of louvers on the outside of the module. Adjusting the louvers allows the view factor to be altered when the rotational angle is increased or decreased which varies exposure to thermal radiation.

TEAM MEMBERS

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Commercial Zone (CZ)

CZ creates site furnishing solutions to elevate spaces through their line of garbage cans, planters, and benches. They have over 200 products with various materials, finishes, and color options. The goal of the project was to integrate a flipper lid into their product line. The design options were retrofitting a flipper door onto their existing 42-gallon PolyTec Dome lid

and completely redesigning a flipper door dome lid. Six design solutions were evaluated against cost, hardware visibility, user friendliness, and overall weight. Solidworks was utilized to model and finalize both chosen designs. The redesign was 3D printed as a scaled model to verify functionality and fitment. The retrofit design was fully prototyped using 3D printed components. Having completed drawings, prototypes, and spec test results, one of the designs will be chosen to be added to Commercial Zones product line. The decision will also include a cost analysis for both the retrofit and clean sheet cases.

TEAM MEMBERS

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Design Proposal of Cranial Helmet for Plagiocephaly Using Additive Manufacturing

Plagiocephaly is a type of head deformity that is common in infants, where a flat spot develops on a child's skull. Cranial helmets are used to correct this deformity. The current plagiocephaly cranial helmet shave a thick, hard outer shell with an inner foam lining, and contain a Velcro strap on the outside of the helmet to hold it shut. Our goal for this project was to create a cranial helmet that reduces the cost and weight, increases breathability for the patient while the helmet is being worn, and is easier to open and close. Our final design consists of a 3-millimeter hard shell lining and a 7-millimeter inner foam lining. There is a latch on each side of the helmet additively manufactured into the hard outer shell. Our final cranial helmet design effectively reduces weight, cost, material, and increases breathability.

TEAM MEMBERS

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Determine Feasibility of RFID Technology within a Hot-cast Polyurethane Component

Our project's sponsor is Stellana, a manufacturer of polyurethane wheels for forklifts and other load bearing applications. Our group is conducting a feasibility analysis for implementing RFID technology into a hot-cast polyurethane wheel. When one of these forklift tires is subject to prolonged use it experiences hysteresis due to the constant loading and unloading upon the wheel. Due to polyurethane being an excellent insulator, the heat generated in this process is retained within the wheel. If the wheel reaches approximately 175-185 degrees Fahrenheit, the wheel starts to lose its structural stability. By implementing a RFID tag capable of sensing this data into the wheel, a safety mechanism can be developed. This system can reduce environmental risks, increase operator safety, and decrease costly downtime.

TEAM MEMBERS

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TEAM MEMBERS

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**Engine Dynamometer Driveline Coupling**

The Mechanical Engineering Department at MSOE owns a functional diesel engine and water brake dynamometer which has been unused due to the lack of an effective coupler. The driveline coupling was designed to transmit power from the engine to the dynamometer while avoiding resonant frequencies, the cause of the previous design's failure.

A CAD model was developed in SolidWorks and evaluated using ANSYS. The improved design incorporates a flex disc to damp engine vibrations and shaft imbalances. The coupling also features a telescoping assembly to assist installation.

Exhausted: Gas Turbine Engine Project

The purpose of the Exhausted Senior Design Project is to create a thrust generating gas turbine engine that can be used as an educational tool by future MSOE students in thermodynamics courses. The engine will utilize a GT1544 turbocharger, which provides cost effective compressor and turbine components. The final project deliverables include a safe and reliable gas turbine engine, necessary instrumentation to conduct a thermodynamic analysis of the system, a lab procedure with background and methodology, and documentation for proper maintenance and safe use of the system. A large focus of the project was utilizing the previous team's system to reach self-sustaining conditions while also improving upon the instrumentation and safety designs of previous years.

Herrmann Ultrasonics Precision Adapter Plate

The goal of this project was to develop an adapter plate for use by Herrmann Ultrasonics that could precisely align an ultrasonic welding fixture with a high degree of repeatability and indicate the current position with respect to each axis. The scope of this project involved the design, prototyping, testing, and plans for manufacturing a custom adapter plate. Some of the key criteria that needed to be accomplished with the prototype included withstanding a maximum static vertical load of 500 lbf, deflect less than 0.02 mm, generate translation alignment within 0.05 mm, at least 0.01° rotation accuracy in the X, Y, and Z-direction. The final design utilizes five LVDTs to measure X-Y position along with the top plate's roll, pitch, and yaw within the desired tolerances. FEA was used to ensure the deflection and loading conditions could be met. The final prototype allows for fast and accurate alignment.

TEAM MEMBERS

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IVEC Auto Filter

Many industries produce dangerous and or toxic particulate matter into the air. This leads to safety concerns for the workers in these production facilities. To avoid long-term health conditions, many industries are required to remove this matter in a regular continuous fashion and the most effective method for this removal is the standard fabric filter. IVEC Systems is an air filtration company that manufactures cleaning housings for these filters that leverage compressed air as the main method for driving an arm to generate force and knock the particulate from the filter. The team was tasked with creating a new design that performed the same or better than the current method but without using compressed air as it is expensive to install and maintain long term. The new design uses a vibratory gyration motor to shake the particulate-free from the filter pleats and cleans as effectively as the current method.

TEAM MEMBERS

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IVEC GVSC Tradeshow Unit

IVEC Systems, LLC is an engineering firm specializing in intelligent, industrial, filtration systems. One of their forefront products is an ambient air filtration unit focused on filtering industrial dust and oil mist out of a facility. IVEC's full scale GVSC (General Ventilation Self-Cleaning) units are approximately nine feet tall, making it difficult to transport to tradeshow and does not allow the functional capability of the system to be showcased. To facilitate this, a functional scaled model of the GVSC was required. To properly demonstrate the IVEC's filtration system, a mobile tradeshow unit was designed to house three scaled GVSC's. The operation of the system is demonstrated by introducing fog into the upper cabinet, which is comprised of acrylic panels and houses the GVSC's. This provides customers with a visual indication of the functional capability of the system and showcases the logic behind IVEC's filtration systems.

TEAM MEMBERS

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Austin Kour
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Milwaukee Tool Rotary Hammer

Milwaukee Tool is an industry leading manufacturer specializing in heavy-duty and portable electric power tools and continues to innovate smaller tools that deliver more power as thermal energy management becomes increasingly important. The objective was to develop a time-based mathematical model that predicts how a rotary hammer generates thermal energy during operation through

FACULTY ADVISOR

Dr. Mohammad Mahinfalah



pneumatics and friction. The model was developed to predict the changes in heat generation by altering parameters within the tool to aid engineers in designing future tools that are more thermally efficient than the previous models. Equations were derived from the piston-cylinder, gear train, and anvil-striker subsystems that integrated the geometry of the components and the motion of the tool which generate thermal energy. The results of mathematical equations were compared to testing data of the tool under load to verify model accuracy.

TEAM MEMBERS

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NASA Lunabotics Senior Design Team

The MSOE NASA Lunabotics Competition competes at NASA Kennedy Space Center that creates a concept mining robot to collect lunar icy regolith. Their ultimate goal is to implement autonomy, but the problem is they only have the last few months to test and work out the code. Team Space Raiders are the senior design team that helps provide a modular test robot for them, so they have hardware to test code and autonomy with. This robot includes an adjustable drivetrain with motors for steering and drive, LEDs for simulating digging motors, onboard power, and a microcontroller to run code. This test robot will allow the programmers to test and troubleshoot their code and autonomy while the competition robot is being manufactured. This allows more time for the competition team to be able to create fine-tuned code and autonomy for the mining robot.

TEAM MEMBERS

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NFPA Fluid Power Vehicle Challenge

The National Fluid Power Association (NFPA) hosts an annual competition called the Fluid Power Vehicle Challenge. The challenge requires the construction of a human powered vehicle that uses hydraulic components to convert the rider input into vehicle motion. Each competition vehicle is evaluated using multiple criteria, including vehicle weight, efficiency, innovation and speed. The competition teams compete in three events: a sprint, an endurance challenge, and an efficiency test. The competition was held at the Danfoss facility in Ames, Iowa on April 14–16, 2021. The Fluid Power Vehicle Challenge is one of the mechanical engineering senior design projects this year. The team of students, named Premature Cavitation, have started the design process for a fluid powered vehicle. Our team's goal is to design a competitive and safe human powered vehicle that

utilizes hydraulic and pneumatic technology to place third or better in the competition for all challenge events. The vehicle is comprised of four main subsystems that are integral to the creation of a high performing vehicle. The four systems are the frame and gearing, the hydraulic circuit, the pneumatic circuit, and the electronic controls.

TEAM MEMBERS

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Optimization of Pneumatic Manifold Design

The purpose of this project was to design a new and more efficient pneumatic manifold to be utilized in industry. Current manifold design is limited by its process of manufacture. These manifolds do not have a uniform flow distribution and have a good amount of unnecessary material. This project utilized cutting-edge software to best optimize the current industrial manifold design. This software includes ANSYS CFD software to create an internal design that encourages a more uniform outlet distribution and Solidworks' new Topology Optimization software to discard the excess material from the manifold that serves no purpose in design while still holding the integrity of the manifold design. The process of manufacture for the final optimized designs utilized Carbon 3D's additive manufacturing. Additive manufacturing allowed for a greater level of complexity in the final design and permitted a design's traditional manufacturability to be independent of the final design.

TEAM MEMBERS

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Optimal Design of a Pneumatic Manifold for Additive Manufacturing

Pneumadyne currently manufactures nylon manifolds that vary from 2-10 ports using CNC machining on a raw block of nylon. This production method causes an inequality in flow between each of the ports and does not allow for a complex design because of machine restrictions. Such designs are sufficient for general purpose usage but are unsatisfactory for specialized applications requiring high precision air supply to components or lightweight parts. The primary and secondary goals, respectively, for this project were to equalize flow between ports and reduce material usage. To achieve these goals, Carbon3D's additive manufacturing technology and materials were utilized, removing design complexity restrictions.

TEAM MEMBERS

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PneuMan 2.0 Electromechanical Team

The original PneuMan was a senior design project from the turn of the millennium, used to market and showcase MSOE's Mechanical Engineering Department. Having since been salvaged, a new PneuMan will provide these same opportunities, while also showcasing how MSOE has been able to adapt to technological advances. This new PneuMan will be designed by two separate MSOE mechanical engineering teams, Pneumatic and Electromechanical. The portion of PneuMan that will be designed by these teams includes the waist section and above, as future senior design teams will focus on implementing legs into the design. This project will attract attention to the abilities of MSOE's Mechanical Engineering Department and foster interest in MSOE for graduating high school seniors who are deciding on which engineering college to attend. In order to showcase the designed abilities of PneuMan, it will be able to make hand signs, gestures, and manipulate small objects.

TEAM MEMBERS

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Pneuman 2.0 Pneumatics

Pneuman 2.0 is a design project sponsored by MSOE that combines pneumatic and electromechanical subsystems to build a lightweight, engaging humanoid robot that can be used by the university to advertise the technical expertise of its students. Our team designed the pneumatic systems which includes the shoulders, arms, face, and one of the hands. The new robot will have the same basic human-like functionality and shape as the original, while maintaining a weight under 700 pounds, being able to pick up a 5-pound object, and portable design that will allow for ease of transportation. Improvements were made to the pneumatic and electromechanical subsystems to reduce complexity and increase functionality. A prototype of Pneuman 2.0 will be assembled by the conclusion of the project and ready for the addition of advanced control systems to illustrate the functionality of the design.

TEAM MEMBERS

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**Rockwell Automation: LVMCC 2500
Autonomous Maintenance**

The removal of modules from a low voltage motor control center requires significant personal protective equipment and poses a serious threat to employees. Rockwell Automation desires to remove this threat by creating a robot that can autonomously withdraw these modules without any human interaction. Rockwell Automation has partnered with MSOE Senior Design to begin the first steps of this project by designing a system to properly locate and prepare the module for extraction.

The solution was an autonomous mobile platform that will follow a set path using magnetic tape to the location of the cabinet. Using large trapezoidal screw linear actuators, a secondary platform with a UR5 robotic arm attached is raised to the height of the module to be extracted. Lastly, the UR5 will unlock the door, open it, and rotate the module release lever.

TEAM MEMBERS

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Self-Healing Additively Manufactured Polymeric Material

Additively manufactured parts have a weak toughness between their printed layers that makes them more susceptible to fracture. With this as motivation, the goal of the project was to research, design, and optimize an additively manufactured specimen that could autonomously heal fracture damage. Self-healing was accomplished by incorporating solvent filled glass capillaries into vascular channels embedded within the specimens. When a fracture occurs in a self-healing specimen, cracking progresses through the sample and ruptures the glass capillary which then releases the solvent into the crack. A solvent welding reaction between the solvent and the 3D-printed polymer then heals the damage. A healing efficiency was defined to compare the healed fracture toughness to the original fracture toughness and used to evaluate the effectiveness of the various designs. Through testing, it was proved that healing is in fact possible and in many cases, the healed fracture toughness exceeds the original fracture toughness.

TEAM MEMBERS

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Sustainable Community Design Tool

A design tool, usable by the public, to provide guidance on the energy, land, and cost requirements of a rural, self-sustaining community. The tool provides analysis for varying community designs, costs, energy demand, and energy generation requirements. This tool requires little technical knowledge and skill to use, making it accessible by most of the public. The design tool is based in Excel and includes a guide to help the user make decisions about their inputs. The user designs their community defining constraints for the climate, housing, garden, farm, infrastructure, water/waste system, and energy generation. The tool takes in the plethora of information from the user and outputs a breakdown of costs as well as land, water, and energy requirements amongst other information. The project also includes producing a physical model demonstrating what a sustainable community could look like.

Technische Hochschule Lübeck (THL)/ MSOE Bachelor Thesis

STUDENT

Xuhao Chen

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Dr. Nebojsa Sebastijanovic

Designing and Evaluating a Single Cylinder Electromagnetic Cone Crusher

Most mills used in laboratories are rotor mills. One of the main disadvantages of rotor mills is the high requirement for the feeding material size. Cone crushers are widely used in mining industry for crushing objects of larger size. The goal of the project is to study the possibility of applying miniature cone crushing for laboratory or educational purposes to process smaller particles. The main objective is to design and build a single cylinder electromagnetic cone crusher for milling chemical substances for laboratory and educational purpose and evaluating its performance and feasibility.

STUDENT

Matthew Flipp

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Dr. Nebojsa Sebastijanovic

Examination and Suppression of Force Vector Formed From The Fire Suppressant on a sUAS

Among many other applications, a drone (small, unmanned air system (sUAS)) can be used as a fire suppressing device that can contain or suppress a small, localized fire that has started within a warehouse. This would prevent the activation of the entire sprinkler system releasing water and damaging all products within the warehouse. As the small aerosol can attached to the bottom of the drone is activated, it creates a force that can cause the sUAS to become off balance and can result in unwanted rotation. The goal of this study is to design and build a working prototype with a damping system which will be capable of handling the force due to the aerosol can activation.

STUDENT

Mason Hansel

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Dr. Kevin Hart

Design of a Testing Apparatus for Buckling Analysis

The goal of this project is to improve the current apparatus used for buckling experiments in a mechanics lab course. Improvements include creating a smaller size, portable system with proper safety features, as well as having the capability of handling various test specimen sizes. Redesigned apparatus has an adjustable height and different mounting points for the samples, including different cross section sizes. It can fit on a table and be moved easily to allow for use in both experiments as well as for demonstrations in outreach programs.

STUDENT

Eirene Kowal

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Characterizing and Defining Impact and Vibration Properties of a Marimba Bar Using Various Mallet Types

A marimba is a percussive instrument used in bands and orchestras. Different sounds are achieved by using different types of mallets to strike the instrument. The sound achieved by different mallets is defined by musical terms such as warm, full, or bright. It is desired to determine what these musical terms mean for the impact curves and corresponding vibration response of the marimba bar. The goal is to characterize this behavior to give an engineering definition to musical terms that describe the sound achieved by each mallet. Membrane force sensors will be used to capture the input force from the strike of the mallet. Accelerometers will be used to capture the frequency response of the marimba bar.

STUDENT

Henry Neerdaels

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Design and Analysis of a Body Roll Transfer Linkage for Oval Track Racing

One of the most important factors that define performance when driving, and especially racing, is the grip created by the tires. By altering corner weights, body roll, and other components, the grip per tire can be optimized to achieve better performance. In circle track racing, the car experiences large forces when taking sharp corners at the maximum speed. The task for this project is to develop a linkage system that will tie into the front suspension and result in more weight being applied to the left front tire during maximum suspension travel. One of the main goals is to determine the maximum improvement to left front tire load that the linkage can provide and then build a prototype system to test aspects of the design.

School of Nursing

Summer 2020 Senior Projects

STUDENTS

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Mitigating Student Resistance in the Implementation of Active Learning Strategies

The worsening nursing shortage has the medical industry taking a hard look at causes and solutions for this scarcity in order to provide for the growing patient population needing medical care. The rising attrition rates among new nurses can be the result of a variety of variables, including the need for knowledge development in clinical judgment and decision making. The motivation for this project was the report by both nursing students and employers that new graduate nurses lack in their knowledge development, particularly in their clinical judgement and decision-making skills. The primary goal of the project is to identify, mitigate, and evaluate student resistance while implementing active learning strategies to increase critical thinking in baccalaureate nursing students. The school of nursing leadership is recommended to use a pedagogy focused on utilizing active learning strategies based upon the available literature and their suggestions. The School of Nursing faculty are recommended to implement the pedagogy and evaluate the nursing student's perceptions and resistance to the pedagogy. The recommended evaluation of the project's efficacy will include the use of surveys given throughout the academic year to evaluate thoughts, attitudes and feelings toward the applied active learning methods. Through this change project, future nursing graduates will have greater clinical judgment and decision-making skills due to their education harnessing active learning techniques, and one element causing the nursing shortage will be improved.

STUDENTS

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Ancillary Staff Utilization of Cloth Masks During a Pandemic

While the world is facing a pandemic, policies are in place to protect frontline healthcare workers and conserve the healthcare facility's dwindling reserves for personal protective equipment (PPE). However, those resources are diverted from the ancillary workers, staff that aid in the overall operations of an urban health care facility. Without these protections in place, ancillary workers have felt unsupported during these

uncertain times which could lead to decreasing levels of job satisfaction and well-being, which ultimately affects patient care. This project aims to facilitate the implementation of a policy to enhance satisfaction and well-being of ancillary staff during PPE shortages, by allowing them to bring or make their own cloth masks that follow CDC guidelines. The comparison is between ancillary staff who are able to bring their own cloth masks, compared to those who cannot. The outcome being increased satisfaction and well-being amongst the ancillary staff who can bring their own masks. The policy will be implemented by project coordinators by hosting informational meetings on CDC guidelines of mask requirements, where to purchase the materials and volunteer organizations that assist with demonstrations on how to make masks and in providing sewn masks to ancillary staff. While the policy is in place, the employee satisfaction survey will be conducted at three separate points to observe how the policy has affected staff. During the evaluation phase, the survey will be collected by the project coordinators and the data will be compiled and graphed to see if the implementation is successful.

STUDENTS

Margaret Fiorenza
Karly Tate

FACULTY ADVISOR

Robin Gates
Dr. Jennifer Klug

Implementation of the Vocera Handsfree Device to Improve Workflow and Nursing Staff Satisfaction with Communication on a Medical Surgical Unit

The purpose of this paper is to discuss the impact of a hands-free communication device (HCD) implemented amongst nursing staff on an acute care medical surgical unit. Without effective communication in healthcare, patient safety can be jeopardized, costs can increase, and patient and staff satisfaction decrease as a result. Several different methods of communication can exist amongst hospital staff such as pagers, hands free devices, cell phones, intercoms, and searching for the intended person. During investigation to improve communication on a unit primarily using pagers or person-to-person communication, a hands-free device called the Vocera illustrated significant results in improving workflow efficiency leading to increased staff and patient satisfaction. Lewin's Change Theory was utilized as a guide and followed in the implementation of incorporating a unit wide communication system change amongst nursing staff. This quality improvement project will take place on an acute care unit primarily focusing on communication amongst nursing staff. An implementation plan will be put into place that addresses the transition to using a Vocera, the possible barriers to Vocera, and the potential facilitators to succeed in the using the Vocera device. The successful implementation

of the Vocera hands-free communication will be monitored through an evaluation plan that specifically addresses both staff and patient perspectives through systematic surveys. In the end, the effectiveness of a Vocera versus no Vocera will be determined based on the final results of this year-long implementation quality improvement project.

STUDENTS

Hayley Simon
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Dr. Jennifer Klug

The Acceptance of Technology to Prevent Falls in Older Adults in Assisted Living Facilities

Falls are a major threat to older adult residents of assisted living facilities, increasing risk for injury-related morbidity and mortality, as well as leading to psychosocial issues and increased costs. For this reason, it is vital to assess methods to prevent the occurrence of falls. Technology can be very beneficial in preventing falls; however, without ensuring older adults' willingness to accept the technology, even the most effective technology is moot. Many older adults are hesitant to use technology for a variety of reasons; therefore, it is crucial to focus on factors which can be implemented to increase older adults' acceptance of technology. A literature review revealed that perceived ease of use, perceived usefulness, an opportunity to interact with technology prior to committing to its use and reinforcing the desire to age in place are all factors which may enhance older adults' acceptance of technology. It is recommended that these concepts be considered when assisted living facilities utilize fall prevention technology in an effort to reduce falls. Using the Technology Acceptance Model assists in assessing how technology is accepted in society and what factors influence acceptance and usage of technology. Key stakeholders should be considered, including assisted living facility administrators, direct care staff and residents. Though it is an unrealistic goal to eliminate falls entirely, there are many promising strategies supported by literature that point to decreasing falls in older adult residents of assisted living facilities. Evaluation will include continued monitoring of technology acceptance and prevalence of falls in assisted living facilities. The hope is to decrease the prevalence of falls in older adults, leading to longer, healthier lives.

STUDENTS

Bethany Stone
Tamara Weaver

FACULTY ADVISOR

Robin Gates
Dr. Jennifer Klug

Enhancing RN Safety During Mask Shortages

With the emergence of COVID-19, a crippling shortage of N95 and surgical masks has contributed to nurses to feel unable to perform their job safely. By following the Centers for Disease Control and Prevention (CDC) guidelines for N95 and surgical mask use, reuse and storage, current supply levels will increase thus enhancing the nurse's sense of wellbeing and safety. Implementing increased Periodic Automatic Replenishment (PAR) levels in anticipation of a N95 and surgical masks shortages would be a critical first step. Utilizing CDC guidelines to create a protocol to enhance N95 and surgical mask supplies is a crucial next step. Hospital administrators will need to work with their risk management and infectious disease departments to identify the potential mask shortages. Once a possible shortage is identified, the protocol will be enacted upon. Educating and training of RNs would be implemented as part of protocol. To evaluate the success of the implementation plan, nurses will take a series of surveys. Surveys will be taken prior to the start of implementation of protocol and again within two months of the start of the protocol. Doing so will verify whether their sense of wellbeing and safety has improved, declined or remained the same. The protocol will need to be re-evaluated annually by a team consisting of risk management, infectious disease, administrators, and nurses. Enhancing N95 and surgical mask supplies is crucial to providing a safe work environment for nurses. It is imperative that these changes take place to protect our healthcare from devastation.

Fall 2020 Senior Projects

STUDENT

Gabrielle Bernarde
Kylie Kamm
Tan Liu

FACULTY ADVISOR

Dr. Jennifer Klug

Decreasing Readmission Rates Through Use of Home Visits Post-Discharge

There is an increasing number of children sent home with gastric tubes such as nasogastric, j-tubes, peg tubes and nasojejunal tubes. Readmission rates within a 30-day period after discharge have been affected by home care of gastric tubes among the pediatric population. The goal of implementing home health visits by a registered nurse is to prevent readmissions and improve patient outcomes. Evidence supports the use of home health visits to reduce readmission rates by emphasizing discharge education and reacting to potential complications in patient situations sooner. The project plan is to implement home visits throughout the 30-day post-discharge time frame. Visit lengths may vary based on patient condition and educational needs. The registered nurse will complete visits to the patients' homes in which the registered nurse will reassess patient/caregiver knowledge, comfort, and ability to perform skills in order to maintain the feeding tube in place. The plan will be evaluated through patients' status followed in the home health nurse's documentation and number of readmissions in the 30-day time period.

STUDENTS

Britne Chike
Shantel Stephens
Tiffany Vang

FACULTY ADVISOR

Robin Gates
Dr. Jennifer Klug

Reducing Hospital 30-Day Readmission Rates for Elderly Patients with Congestive Heart Failure and Depression

Patients with depression and Congestive Heart Failure (CHF) are often noncompliant with their medications leading to frequent readmissions to the hospital. There is a significant need to identify and address the toll depression may take on the health and well-being of an individual with other health conditions, specifically CHF. Depression and CHF are so closely linked that it leads to medication noncompliance with the result of readmissions due to CHF exacerbations. Enhancing medication compliance decreases the incidence of complications and reduces the need for 30-day readmissions. The primary outcome of this project is to decrease the incidences of 30-day readmissions. Home health visits will help enhance the patient's self-care of their disease through education and medication adherence, thus preventing CHF exacerbation readmissions.

Winter 2020–21 Senior Projects

STUDENTS

Alexandra Adams

Joshua Klane

FACULTY ADVISOR

Dr. Jennifer Klug

Increasing Breastfeeding Rates Among Adolescent African American Mothers Through Virtual Social Support

The goal of this professional practice project is to improve the initiation and continuation rates of breastfeeding among African American adolescent mothers in urban healthcare facilities by enhancing their social support systems through technical breastfeeding education and psychosocial support provided primarily by trained peer counselors in collaboration with Internationally Board-Certified Lactation Consultants (IBCLCs). Among racial groups in the United States, African American women have the lowest initiation rates of breastfeeding. Adolescent mothers in the United States are less likely to initiate breastfeeding than their older counterparts. African American adolescent mothers face social, cultural and economic barriers to initiation and continuation of breastfeeding. Literature reveals that positive social support is a strong predictor of initiation and continuation of breastfeeding. Social support will be provided for participants for three months postpartum through weekly virtual meetings facilitated by a trained peer counselor. Adolescent women between the ages of 13 and 19 in urban labor and delivery healthcare facilities will be introduced to the program and given the option to participate. Success of the intervention will be evaluated by self-reported breastfeeding continuation rates of participants at one and three months postpartum. Breastfeeding continuation rates will be compared to those of mothers who opted out of the program and who are receiving standard postnatal care from the healthcare facility. The success of this piloted program will facilitate promotion of wide scale implementation and thereby help to address the racial disparities in breastfeeding that exist in our healthcare system.

STUDENTS

Dan Becerra

Eric Chan

Alina Rahman

FACULTY ADVISOR

Dr. Kathleen Mussatto

The Effect of Aromatherapy Massage on Pain and Quality of Life in Cancer Patients

The aim of this project is to implement aromatherapy massage as supportive therapy for pain relief and improving quality of life in cancer patients. Based off extensive literature reviews, this project focuses on pain, sleep, depression, anxiety, nausea, vomiting, constipation and fatigue. The motivation for initiating this project is to provide much needed relief to a population that is already suffering. Pain is the most common problem suffered by cancer patients and bleeds into many aspects of life, which lowers its quality. There is no standardized protocol for aromatherapy massage, this project aims to bridge that gap by working with a multidisciplinary team to create it. The project plan is to add a McGill Pain and Quality of Life Cancer Patient/ Survivor Questionnaire to the pre-visit forms for one month in an outpatient oncology clinic. Once a baseline is established, 100 patients with at least a pain scale of 4/10 will be selected from this group. These participants will receive a 30-minute aromatherapy massage every other week to complete three total sessions. After each massage they will fill out questionnaires and their results will be added to an excel sheet. Once the results are received, an evaluation team of data analysts, doctors, nurses, psychologists and aromatherapists will review the data to observe the benefits and the need to tweak the standardized protocol. This project will provide an effective treatment to change the lives of many patients and their families.

STUDENTS

Evelyn Berg

Sabrina A. Fuchs

Jennifer M. Lief

FACULTY ADVISOR

Dr. Kathleen Mussatto

Insulin Pump Education for Labor and Delivery Nurses

Continuous subcutaneous insulin infusion (CSII), otherwise known as insulin pumps, are a relatively safe and effective method of technology broadly used to reduce episodes of hyperglycemia and improve overall glycemic control. Diabetes mellitus is a common condition during pregnancy, yet there appears to be a knowledge gap amongst healthcare providers in the use and management of insulin pumps. Nurses are often unclear of how to manage insulin pumps in the inpatient setting, requiring them to either be educated by their clients, or recommending that the client transition to multiple daily injections for the duration of their hospital stay. A thorough literature review was conducted to gather guidelines to assist in determining whether clients meet certain criteria for inpatient insulin pump use as well as the nurse's role in inpatient insulin pump management. The intention of this

project is to create an educational plan for Labor and Delivery nurses to address knowledge deficits in insulin pump use and management. Implementation will occur through use of an online learning module, embedded with a pre-test and post-test to evaluate the successfulness in terms of nursing knowledge and competency. Allowing clients the flexibility and autonomy to maintain insulin pump therapy during hospitalization provides them with a sense of control over their care and an overall more satisfying hospital stay.

STUDENT

Kelly Bergman
Rachel Skalisky
Delaney Verba

FACULTY ADVISOR

Dr. Jennifer Klug

Decreasing Surgical Site Infection Rates Through Pre-Surgical Client Education

By the year 2010, over five million total knee replacements were performed in the United States, and this number continues to rise. All surgeries have the risk of potential complications, such as surgical site infections (SSIs). According to the Centers for Disease Control and Prevention (CDC), SSIs are infections related to an operative procedure that occurs at or near the surgical incision within 30 days of the procedure or within 90 days if prosthetic material is implanted. Despite following specific preoperative and postoperative measures to foster client safety, SSIs continue to be a major issue within the health care system today and are responsible for significant cause of the morbidity and mortality following surgeries. Client education has been identified as a very important intervention in controlling and preventing SSIs. The focus of this project is on administration of preoperative infection prevention education in group settings. This project will be evaluated based upon client preoperative understanding of infection prevention education and occurrence of post-operative SSI. The goal of this project is to promote and implement preoperative education to reduce the prevalence of a very preventable complication.

STUDENT

Jamie H. Hemmer
Megan M.B. Rusch

FACULTY ADVISOR

Dr. Jennifer Klug

Increasing Intimate Partner Violence Screenings in the Emergency Department

On average, nearly 20 people per minute are physically abused by an intimate partner in the United States. During one year, this equates to more than 10 million women and men. During the first three months of the COVID-19 national shut-down, intimate partner violence (IPV) calls increased by 7.5% across the United States. Despite the apparent necessity of IPV screenings in the emergency department (ED), compliance by ED nurses remains relatively low. Individuals

experiencing IPV are further sequestered from support and resources due to the global COVID-19 pandemic, making IPV screenings even more pertinent to patients seen in the ED. Implementing a standardized IPV screening protocol in a small community emergency department (ED) will increase the amount of IPV screenings done on female patients. Provider cooperation will be important in providing support for ED nurses to complete the IPV screening protocol on female patients seen in the ED. To reinforce the need for IPV screenings, posters will be placed throughout the ED including 12 patient rooms, staff room, locker room, nurses' stations, patient waiting room and bathrooms. To determine if implementing a standardized IPV screening protocol for female patients seen in the ED was a success, chart audits will be done to determine the frequency of screenings done six months prior to and one, three and six months after implementation. Implementing IPV screenings will provide additional resources and support for those experiencing IPV.

STUDENT

Muriam Hussain
Kelly Saxby

FACULTY ADVISOR

Dr. Kathleen Mussatto

Nurse-to-Patient Ratio and Nurse Job Satisfaction

By standardizing the nurse-to-patient ratio, the hope is to improve nurse job satisfaction. While nurse job satisfaction is based on many factors, including management, this project focuses on the one factor of patient assignment. The literature review determined that standardizing the ratio increased nurse retention and decreased burnout. The standardization also reduces the cost to the organization. Based on research, the determined ratio chosen was one nurse per four patients. Research showed greater than six patients decrease the patient safety. When choosing the standardizing ratio of four or five patients per nurse, four patients were ultimately chosen. One nurse to four patients helps reduce hospital costs that occur due to burnout, turnover, and nurses leaving the profession. The ratio will be implemented in a medical surgical unit working closely with staff nurses and floor management in hope to ensure effective and beneficial change. Working with management, new nurses will be hired to give the unit the ability to standardize the ratio. Nurse job satisfaction will be measured at the beginning of the change and six months after the implementation. To further support the nurse standardization, the project team will use the Perocca Patient Acuity Tool (PAT) scale to help equalize workload among nurses. The hypothesis is nurses will have increased job satisfaction leading to nurse retention at the organization.

STUDENTS

Erin Nettesheim

Lily Pittelkow

FACULTY ADVISOR

Dr. Kathleen Mussatto

Insulin Syringes versus Insulin Pens and the Effect on Patient Adherence

There are over six million people in the United States with diabetes that are insulin dependent and face many barriers to adhering to their insulin due to factors associated with insulin delivery devices (Sarbacker & Urteaga, 2016). For adult individuals newly diagnosed with diabetes mellitus (DM) who require insulin, proper treatment adherence to insulin regimen is vital to the patient's health. Currently, there are many different types of insulin delivery products on the market that a patient may choose from. This evidence-based practice project seeks to address the question, among the outpatient adult diabetic population, does utilization of the insulin pen versus the practice of insulin syringe and vial administration increase patient adherence with insulin treatment. Education will be provided to newly diagnosed diabetic patients regarding how to use their selected insulin delivery device. After three months, adherence data will be collected via survey in both electronic and paper format from both groups of patients. The survey will ask the patients about demographics, confidence in insulin delivery device usage, adherence to insulin treatment, and any potential barriers they find with their devices. The data from the surveys will be statistically analyzed and it can be determined if one device is associated with a higher level of patient adherence in comparison to the other, which will provide clinical value to this patient population. Finally, a recommendation for practice can then be made to the outpatient diabetic clinic based on this data to help increase overall patient adherence to insulin regimens.

Spring 2021 Senior Projects

STUDENTS

Mallory Burns
Nora Butte
Hailey Fox

FACULTY ADVISOR

Dr. Amy Ketchum

Staff Education on Labor Positioning

Staff on a 20 bed Labor and Delivery unit at a Midwestern hospital will attend an hour-long educational seminar on the benefits and risks associated with supine and upright labor positioning. This staff education will start with a pre survey to see where staff knowledge is in regard to supine and upright labor positions. The seminar will end with a post survey to see how likely staff are to implement supine and upright positions into practice after learning the benefits and risks to each.

STUDENTS

Leah Becker
Chloe Garcia
Nick Hickman

FACULTY ADVISOR

Dr. Jennifer Klug

POUR Risk Assessment Implementation Promoting Early Discharge

This project's professional practice change is to send day surgery patients home post-operative from hip and knee arthroplasties without a void order if they are determined to be low risk of post-operative urinary retention (POUR). The project's goal is to decrease the patients' length of stay in the recovery area without increasing rates of readmission to the emergency department (ED) or clinics associated with the day surgery center due to POUR complications. This will be done by implementing the use of a risk assessment tool for POUR during patients' pre-operative surgical appointment. Data will be assessed regarding the total time spent in the recovery area and the rate of return to the ED or other associated clinics to assess the appropriateness of this change.

STUDENTS

Katie Clements
Megan Core
Jeray Riffel

FACULTY ADVISOR

Robin Gates

Enhancing Use of Sepsis Screening Tools on the Medical Surgical Floor

Sepsis is a critical infection which can present and progress rapidly in just hours. Each nurse is educated to fill out a sepsis screening tool during each assessment of the client on the medical surgical floor. It has been recognized that this tool is often skipped over or not implemented correctly during practice. This mistake can lead to adverse events for the clients, including death. Our professional practice problem outlines how the utilization of this tool can be increased, which groups of individuals are included in this project, the positives and negatives of properly utilizing the screening tool, and the importance of this sepsis screening tool in the nurse's assessment to save lives.

STUDENT

Nicole Dessloch
Molly Lescrenier
Derek O'Shaughnessy

FACULTY ADVISOR

Robin Gates

Implementing Education to Prevent Ventilator-Associated Pneumonia

The purpose of our project is to decrease the incidence of ventilator associated pneumonia (VAP) through implementation of educational training programs for nurses caring for ventilated patients, ages 18-85, in a surgical intensive care unit (ICU). The VAP bundle, although proven effective, has been shown to not be utilized efficiently among staff members. Through implementation of high-quality education modules and learning exercises, we aim to increase knowledge of the nursing staff regarding the components of the VAP bundle and methods of prevention. We chose this topic due to the high mortality rates of VAP and the educational gap between theory and practice that has been identified in literature. Nursing staff will complete mandatory online training modules regarding the VAP bundle within a one-month period. We will evaluate effectiveness of the teaching by comparing the number of patients hospitalized with VAP over a one-year period before and after implementation. Utilizing education modules and learning techniques, we hope to decrease the number of patients acquiring VAP.

STUDENT

Elizabeth Falk
Elizabeth Kluz
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FACULTY ADVISOR

Dr. Jennifer Klug

Implementation of a Standard Frailty Assessment in Addition to Fall Risk Assessment to Reduce Severity of Falls in the Elderly of Assisted Living Facilities

Frailty is a major factor in increasing healthcare costs, morbidity and mortality while reducing overall outcomes and quality of life for geriatric clients. Currently, there is no standard frailty assessment implemented in healthcare. It is a recommendation to implement a standard frailty assessment in addition to fall risk assessments to reduce severity of falls that geriatric clients of assisted living facilities can experience. Several frailty assessments will be reviewed and plans for implementation, budgeting and evaluation of implementing a standard frailty assessment will be discussed.

STUDENT

Eleanor Gosling
Thomas Nowak

FACULTY ADVISOR

Dr. Amy Ketchum

Implementation of Electronic Health Record-Enhanced Checklist: Increasing Compliance of Central Line Acquired Bloodstream Infection Bundles

This project seeks to increase the compliance rate of maintenance bundles for central lines in the neonatal intensive care unit or NICU. The neonatal intensive care unit (NICU) population have some of the highest rates of CLABSI and are at increased risk due to immunodeficiency, high acuity of care needed, prolonged hospitalization, need for total parenteral nutrition, and frequent placement of invasive devices. Although there has been success in the overall reduction of central line bloodstream infections amongst the NICU population, there is significant evidence that reveals inconsistencies with compliance to documentation of line cares. Adhering to documentation is crucial to facilitate effective communication amongst all members of the health care team. Increasing compliance will be done through implementation of an enhanced electronic health-record checklist, along with a unit-wide real-time dashboard to improve compliance with documentation of central line cares.

STUDENT

Michael Kral
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Eric Van Dyck

FACULTY ADVISOR

Dr. Amy Ketchum

Increasing Hand Hygiene Compliance Through Behavior Modification

The emphasis of hand hygiene has been given global spotlight to the general public due to the COVID-19 Pandemic, yet compliance among healthcare workers remains dismal. With the prevalence of health care associated infections rising, the cost to patients and hospital systems has also increased in respect to morbidity, mortality, and financial bottom line. Evidence suggesting hand hygiene is the simplest and most effective way to reduce transmission of microbes and infections is prevalent in literature, however healthcare workers identify continued barriers to performing hand hygiene including lack of time and lack conscious intent. This professional practice project aims to capitalize on current research to determine how behavior modification with visual cueing may impact hand hygiene compliance rates. Evaluation of success will be conducted through compliance monitoring via electronic hand hygiene compliance monitoring systems and staff surveys. Current research exists in both areas and this study will aim to explore areas where these studies identified limitations and barriers for further success. As a microscopic lens becomes narrowed on infection prevention measures, a

regression to the basics of hand hygiene may provide further insight to health care managers for a potential reduction in morbidity, mortality and costs.

STUDENTS

Cayley McKowen
Danielle Valley
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FACULTY ADVISOR

Dr. Jennifer Klug

Reducing Loneliness Among Cognitively Intact Residents in Assisted Living Facilities by Implementing the Use of Technological Interventions

The purpose of this project is to recommend technology-based interventions to reduce feelings of social isolation and loneliness for residents in assisted living facilities. An aspect of our project will use the UCLA Loneliness Scale to determine the status of individuals living in these homes. Recommendations will be based on previously developed research in hopes to present a variety of interventions with varying financial requirements to assisted living facilities to improve resident outcomes. We are working in conjunction with MSOE nursing faculty and with Direct Supply, the innovative employee-owned company that provides specialty equipment and services to the senior living industry. Our goal is to be able to present these recommendations in May of 2021.

STUDENTS

Karina Mora
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Anna M. Spaude

FACULTY ADVISOR

Dr. Jennifer Klug

Increasing Technology Acceptance for a Safer Environment

Innovative technology is created every day, advancing the healthcare system and increasing patient safety. Surveillance artificial intelligence (AI) technology can be utilized in assisted living facilities to analyze the fall cause, assist in the assessment of physical damage, and identify and alter environmental factors. With this new surveillance technology, key stakeholders may be skeptical of the use of cameras. Therefore, nursing leaders are vital in increasing technology acceptance. The goal is to utilize research findings to provide recommendations to assisted living facilities to assess then minimize resident falls by increasing technology acceptance. Utilizing the Transtheoretical Model of Change allows active participation of all stakeholders (especially management teams of the assisted living facilities, staff members utilizing the technology, residents and resident families). It allows them to progress at their own pace. However, this recommendation process grants all assisted living facilities freedom to individualize and personalize their implementation and evaluation processes. In order

for acceptance of surveillance technology within assisted living facilities to be successful, effective communication will be needed for all key stakeholders, as well as thorough employee training, education on the technology, opportunities for feedback and concerns, and continuous support throughout the process.

STUDENTS

Brianna Clerkin

Lauren Cotten-Taylor

Mayelie Kamara

FACULTY ADVISOR

Dr. Amy Ketchum

Early Identification of Pressure Injuries in Darker-Skinned Individuals

The project's goal is to assist nurses in the early identification of pressure injuries amongst darker-skinned individuals. The Centers of Medicaid and Medicare services view hospital-acquired pressure injuries as never events, which are recognized as circumstances not to be covered by their services. There's a plethora of data regarding staging for pressure injuries in lighter skin tones, specifically in stage one, that starkly contrasts the lack of data related to darker skin tones. The lack of information in this patient population is negligent and harmful, creating health disparities and steadily rising morbidity rates. To improve patient outcomes, nursing staff must be able to recognize pressure injuries at stage one in darker-skinned patient populations and have more readily available data for nursing staff to implement a patient-specific treatment plan for an injury before it progresses. Our team will work with the nursing staff on a medical-surgical unit over a month period within eight sessions, primarily using computer modules, relevant pictures depicting pressure injury staging on various skin tones, graded assessments, and teach-back techniques; these methods will be used to enlighten staff on early detection of pressure injuries in darker-skinned individuals.

Physics and Chemistry Department

BioMolecular Engineering Senior Projects

TEAM MEMBERS

Jon Cobb
Griffin Dunn
Taylor Muth
Chloe Simchick

FACULTY ADVISORS

Dr. Jung Lee
Dr. Wujie Zhang

EXTERNAL ADVISORS

Dr. Xiaolin Xua, Shanghai First
Maternity and Infant Hospital
Dr. Junhong Chen, University
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SPONSORS

Innovent Center
National Natural Science
Foundation of China

Development of Gelatin Microspheres for Bioink

The goal of this project is to develop gelatin microspheres for use in bioinks. It is one part of a much larger project to develop a bioink which can be used to print functional, vascularized tissues and organs. This starts with producing microspheres loaded with bioactive agents first at the macroscale, then using the electrospinner to achieve spheres at the microscale. These spheres are then mixed with two types of cells: bone marrow mesenchymal stem cells and human umbilical vein epithelial cells (HUVEC). The stem cells are involved in tissue repair, and the HUVECs participate in vascularization. The cells and microspheres are then mixed into a bioink which can be used to generate a scaffold with cells of the desired shape for transplantation. Our project seeks to optimize the microsphere development procedure to eliminate the need to use the double-emulsion technique and the chitosan coating by using gelatin.



TEAM MEMBERS

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Molly Jaske

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Dr. Eryn Hassemer

EXTERNAL ADVISORS

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Megan Duersteler (MDG)

SPONSORS

Microbial Discovery Group
Innovent Center



Team GoGut

Probiotic Modulation of Immune Response

In conjunction with Microbial Discovery Group (MDG), Team GoGut is testing a novel *Bacillus* probiotic, developed by MDG, in a co-culture with pig gut cells, IPEC-J2, that will minimize the use of antibiotics in healthy livestock feed, while also providing a more economical alternative for preventing bacterial infections. Probiotics not only combat bacterial infections but can also maximize the health of the livestock through promoting the growth of healthy bacteria and increasing the production of various beneficial proteins and molecules. Team GoGut is focusing on the co-culture and testing of the novel *Bacillus* strains with IPEC-J2 by visualizing the health of Tight Junction Proteins (TJPs) between the cells through an immunofluorescence assay. Using procedures designed by the 2018-2019 Team Guts and Glory and 2019-2020 Team Chrysaor, Team GoGut cultured the *Bacillus* with the IPEC-J2 cells to simulate the effect the probiotic would have in the gastrointestinal environment of livestock.

TEAM MEMBERS

Mark Dolatowski
Andrew Larson
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SPONSORS

Sysmex America
Innovent Center
Wisconsin Economic
Development Corporation



Sanguine



Scientists



Engineering Pectin-Based Hydrogel Systems for Creating Artificial Red Blood Cells as Oxygen Therapeutics

Team Sanguine Scientists is testing the performance of a novel polymeric microcapsule system that will serve as an alternative to natural human blood and improve the supply of oxygen therapeutics. The pectin-based particles are encapsulated with hemoglobin via an electrospraying process in order to attain the functional characteristics of red blood cells, such as size and biconcave shape. This project focuses on the in-vitro validation of the product to ensure proper safety as a blood alternative by testing its ability to bind and release oxygen and its biocompatibility with human blood. Oxygen transport properties will be measured with a Hemox Analyzer to verify at least 90% of the transport ability of natural red blood cells is achieved. Biocompatibility will be assessed through the use of a hemolysis assay and cytokine array, two technologies made.

TEAM MEMBERS

Bella Cabrera
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Cecily Brose
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Brian Walsh
Idella Yamben
(Ideadvance)

SPONSOR

Avidity, Inc.

**Novel Cell Storage Process and Device**

Servacell has further developed a novel cell storage device and process to store viable cells in a temperature independent environment, offering biomanufacturing facilities an economical cell storage method that saves time and space.

Current long-term cryopreservation methods for biological materials include -80°C freezers and liquid nitrogen Dewars. Samples are usually stored at -80°C in freezers, while Dewars use liquid or vapor phase nitrogen to keep the samples at -196°C and -135°C , respectively. Dewars require weekly nitrogen refills costing biomanufacturing facilities \$5,000 to \$12,000 a year per tank. The use of liquid nitrogen Dewars also demands specialized training to ensure safe retrieval of biological materials without jeopardizing sample viability. Furthermore, Dewars occupy valuable lab space. By introducing a novel hardware and processing method for long-term storage, biomanufacturing facilities can eliminate shipping and housing fees associated with liquid nitrogen Dewars.