MS OE

UNIVERSITY

CULMINATION

SENIOR PROJECT
SHOWCASE 2021–22

DESIGN PROJECTS | INTERNSHIPS | THESIS PROJECTS

Friends of MSOE:

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

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

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

Have a project idea?

Send your suggestion to Angela Rome, executive administrative assistant, by Aug. 5 to be considered for the 2022–2023 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 2021–2022 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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Guests may park in the State Street A Lot, 501 E. State Street; State Street C Lot, 429 E. State Street.

Civil and Architectural Engineering and Construction Management Department

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

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

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

Civil and Architectural Engineering and Construction Management Senior Design Student Projects

TEAM MEMBERS
Alexis Countryman (Env)
Grace Cushing (Env) (PL)
Jack Ferrante (Env)
Brandon Garrido (Env)
Bennett Harris (Env)
Josh Kleinschmidt (Env)

Project: Village of Raymond Sanitary Sewer
Faculty Advisors: William Krill

The Village of Raymond is currently one of the few areas in Southeastern Wisconsin that is using on-site treatment systems for wastewater. In order to promote development, the village is hoping to design and construct a sanitary sewer collection system. The wastewater would be transported and treated by Milwaukee Metropolitan Sewage District. The goal is to design a sanitary sewer system that can accommodate the village's needs as well as provide reliable service. The design will address the village's finances, project growth as well as environmental considerations. After collecting data and analyzing three different alternatives, a design including lift stations and gravity sewers was decided to be the best solution.

TEAM MEMBERS
Evan Apostoli (T)
Jack Horihan (T)
Xavier Hulbert (T)
Kyle Ignasiak (T) (PL)
Justin Klamik (S)
William Labeau (CM)
Ian McMinigal (T)
Jameson Petropoulos (S)
Jesus Vidrio-Avila (T)
Joe Voit (S)

Project: IH43/STH 32/STH 100 Interchange Reconstruction
Faculty Advisors: Philip Ciha, Dr. Todd Davis, Dr. Mitzi Dobersek, Dr. Jera Sullivan

The existing full cloverleaf interchange at IH43/STH 32/STH 100 — often referred to as the IH43 and W. Brown Deer Road Interchange — is located in Milwaukee County within the villages of Bayside, River Hills, and Fox Point. After conducting a rigorous alternative analysis, the team of MSOE seniors has determined that a diverging diamond interchange (DDI) would provide the best interchange design for this project due to its excellent accommodations and safety for all road users (motorists, bicyclists, and pedestrians), as well as its compact design — which is ideal for the urban location of this interchange. With the interchange type determined, the team has moved into creating a final design for the interchange. Currently, the team of transportation, structural, and construction management students are working to design the interchange's bridge expansions, retaining wall expansions, alignments, profiles, pavement, cross sections, traffic control devices (pavement marking, permanent signs, and traffic signals), public involvement plan, construction sequencing, and construction scheduling.

TEAM MEMBERS
Kelvin Chavez (S)
Joann Chavez-Martinez (T)
Dakota Cole (CM) (PL)
Dan Greenfield (S)
Nick Hollingsworth (S)
Matt Jancosek (S)
Beth Mical (S)
Matt Tonkel (S)

**Project: Harbor Yards Pedestrian Bridge
Faculty Advisors: Dr. Todd Davis, Mitzi Dobersek, Doug Nelson**

The Harbor Yards Pedestrian Bridge project is located between the Historic Third Ward and Harbor Yards District on the Milwaukee River. The bridge will provide pedestrians and bicyclists a direct route for crossing the river by connecting to the Kinnickinnic River Trail, the Hank Aaron State Trail, and the Oak Leaf Trail. This is a huge advantage of the project, as the current route to connect the various trails involves crossing many dangerous intersections. The pedestrian bridge will be unique in that it will be moveable to accommodate the large boats that travel along the Milwaukee River. The project will incorporate the decommissioned railroad trestle currently in the middle of the river, as well as the newly renovated Trestle Park located northeast of the bridge. This project is part of a larger development by the Mandel Group, which will include an apartment building, office building, and hotel to the northwest of the pedestrian bridge.

TEAM MEMBERS
Cody Smith (CM) (PL)
Deonte Vanselow (CM)
Arkadiusz Krupa (T)
Lyndie Krueger (T)
Lexi Timm (T)
Mercedes Lenz (EWRE)
Alex Luedke (EWRE)

**Project: Lake Country Subdivision
Faculty Advisors: Kristen Belan, William Krill**

The project purpose is to develop a profitable conservation style subdivision for the Lake Country Land, LLC parcel. We are working with Siepmann Realty Corporation (SRC) to continuously work toward an approvable General Development Plan (GDP) for these lands as required by the city. The GDP must propose land uses that are cohesive with the surrounding site. The project objective includes performing an alternatives analysis of various site layouts to select at least one feasible plan that can be presented to the city staff for discussion. The layout(s) will be based on existing site data, preliminary engineering design criteria provided by SRC, and federal, state, and local agency design criteria.

TEAM D
Kyle Hedblom
Matthew Kindred
Benjamin Kroeker
Monique Landry
Kendall Marks
Joshua Peterson
Cole Raines

TEAM E
Konrad Knap
John Kubicki
Gabrielle Leffler
Carson Manning
Zachary Morris
Samuel Wilshire

TEAM F
Shawn Flinn
Mia Parisi
Rishi Patel
Michael Pitrof
Steven Raymus
Danielle Szmergalski
Zachary Yergens
Alyssa Zillmer

**Project: Mixed Use Building for the City of St. Francis
Faculty Advisors: Christine Brotz, David Grassl, Michael McGeen, Tamara Omari, Cory Powers, Jayme Radomski, Robert Schumacher, Kristy Wolfe**

The site is located at the intersection of South Kinnickinnic and East Howard Avenue in the city of St. Francis. The challenge this year is to design a four-story mixed-use building that includes retail on the first floor, offices on the middle floors and a restaurant with a view to Lake Michigan on the top floor. The site is owned by the city and has been for sale for several years with no offers. The two parcels will need to be combined and will require rezoning. There are also two easements that will limit the placement of the building and height is limited due to its proximity to the Milwaukee Airport. Budget for this project is roughly $10 million depending on the proforma.

TEAM A
(Innovus Construction - Hotel):
Zach Barrow
Jacob Bentz
Connor Brennan
Jonathan Brogden
Ricardo Flores
Peter Gudopp
Egor Shalamov

TEAM B
(Morpheus Construction -
Apartment):
Adam Czarnecki
Andrew Driessen
Louis Halperin
Erik Herold
Trevor Kalkofen
Lucas Kidd
Nicholas Tomaso

TEAM C
(Paragon Construction -
Office):
Rachel Bomball
Liam Brown III
Logan Ellingboe
Joshua Ferm
Shelby Hauersperger
Cole Wilson

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

Project: Harbor Yards: a mixed-use development in Milwaukee's Harbor District
Faculty Advisors: Christine Brotz, Adam Friedman, David Grassl, Tamara Omari, Cory Powers, Jayme Radomski, Mark Rounds, Kurt Zimmerman

Located on the banks of the Milwaukee River, Harbor Yards is a mixed-use project on a brownfield site with an existing 168-foot-tall concrete grain elevator. The proposed development explores three different building types on adjacent parcels along the river: a high-end hotel, luxury apartments and an office tower utilizing the foundation of the demolished grain tower. The teams worked closely with Angie Tabrizi, a member of the development team at the Mandel Group, to determine the design parameters. The solutions posed by the teams share an aesthetic character that demonstrates a cohesiveness and collaborative effort not only within each team, but between groups and across disciplines, engaging with a civil engineering capstone team designing a pedestrian bridge on an adjacent parcel. The comprehensive proposed development recommends a total area of 608,000-square-feet and a budget between $163 million and $170 million, and it is expected to achieve a LEED Gold rating from the US Green Building Council.

Rader School of Business

Rader School of Business Senior Projects

Student:	**Stephen Agyare**
Faculty Advisors:	**Dr. Michael Payne**
Organization:	**Rader School of Business, Milwaukee School of Engineering**
Project:	**Marketing Analysis and Planning for Technical Sales Programs**

The goal of my project is to develop a marketing plan for the technical selling program for the Rader School of Business at Milwaukee School of Engineering. I will conduct market research on the programs to find how the RSOB can improve enrollment numbers, inquiries, and student applications for this program. My research will have a competitive analysis of other schools and how they implement their programs (and how effective they are) as well as our marketing strategy.

Student	**Tucker Ahl**
Faculty Advisor:	**Dr. Katrina Moskalik**
Project:	**Student Organization Advisor Support Research**

This project will deliver a concise, single-page, online information sheet that student organization advisors can access to view important information about student organizations at Milwaukee School of Engineering (MSOE) and outlines MSOE's expectation for how advisors can work with the Campus Life department to deliver consistent goals to improve student organization sustainability. A review of the data will also be created to provide current student organization leaders with the information given to advisors to be included within the existing student organization handbook. The goal of these deliverables is to encourage a higher level of integration for advisors, share best practices, and set a precedent for transition practices of student organization leaders.

Student:	**Jackson Bleeke**
Faculty Advisor:	**Dr. Katrina Moskalik**
Company:	**HUSCO International Inc.**
Project:	**Capacity Analysis Reporting Tool**

One of the largest challenges for the Off-Highway Supply team at my company is that our growing demand is limited by the production capacity of our manufacturing suppliers, so having the ability to quickly and accurately communicate our capacity demands is crucial for us to continue our growth and provide our customers with realistic fulfillment goals. This capacity analysis is currently done in a slow, unautomated process in excel that requires the data to be manually sourced, manually input, and then have calculations done by an analyst. The objective of this project is to create a tool tied to live data that will have the capacity analysis process done quickly, automatically, and with the most current data. It will also allow for ADHOC capabilities so when a problem that requires this information arises, it can be addressed almost immediately with this tool by a purchasing agent or analyst.

Student:	**Daniel Drag**
Faculty Advisor:	**Dr. Michael Payne**
Company:	**Mobile Air & Power Rentals**
Project:	**New Warehouse Floor Plan**

Mobile Air & Power Rentals currently has no warehouse organizational system that the company collectively uses, and this has caused for their warehouses to become overly disorganized and difficult to navigate efficiently. I have proposed a new floor plan that places units and parts in areas that best suit how often they are used, when their next use should be, and where they will best fit. I also have proposed a plan to use 5s and lean tools in order to maintain the new floor plans organization and keep the units in as best shape as possible since the units are often used in construction and have heavy wear and tear.

Student:	**Brayden Elliott**
Faculty Advisor:	**Dr. Michael Payne**
Company:	**Baseball Bat Grip (Zip'N'Grip)**
Project:	**Baseball Bat Grip Research and Development**

I have been working on and researching the required information to develop a fully functional baseball bat grip that aligns with my product image. My father and I came up with the idea to develop a baseball bat grip unlike current products on the market, that can be removed and transferred from baseball bat to baseball bat with simpler application features. Market research, financial research, legal research, and materials research and testing will be conducted to develop a prototype that can be tested and documented. The long-term goal is to develop a viable business model, marketing initiative, financial outlook, and the necessary legal requirements to develop and sell the product on the open market. By the end of this project, I plan to have a prototype that can be tested by high level baseball players, a patent on the design of the product, and a business plan to start the baseball bat grip business.

Student:	**Jaclyn Gieratz**
Faculty Advisors:	**Dr. André Köhler, Carol Mannino, Dr. Katrina Moskalik**
Company Advisor:	**Josh Nordahl**
Company:	**LEMAN USA Inc.**
Project:	**Improvement of the AP and AR Invoicing Process in the 3PL Contract Logistics Department**

LEMAN USA Inc. is a subsidiary of the Danish freight forwarding company Leman Holding A/S. As a third-party logistics provider, LEMAN USA Inc. offers product delivery services, freight forwarding and other logistics services such as inventory management, warehousing, and warehouse value-adding processes to customers in more than 150 countries.

Subject to the project is the 3PL accounts payable and accounts receivable invoicing process in the Contract Logistics Department. The process is about transforming vendor invoices into invoices for the company's clients as LEMAN USA Inc. commissions warehouse suppliers to manage their clients' warehouse operations. The objective of the project is to provide recommendations on how to increase the efficiency of the invoicing process between one specific vendor and client by 40% through the application of Lean tools. Correspondingly, the project pursues the reduction of cycle times and the elimination of waste, and thereby streamlining the process. The recommendations shall further ensure that all outsourcing expenses are recorded with an accuracy of 100% and all invoices are disclosed properly on the monthly financial reports. Within the scope of the project, it will be evaluated whether the recommendations are scalable to other vendors and clients.

Student:	**Sebastian Gripp**
Faculty Advisors:	**Dr. André Köhler, Dr. Katrina Moskalik, Dr. Michael Payne**
Company:	**KHS USA Inc.**
Project:	**Adapting the Warehouse Layout to RFID-driven Processes to Improve Efficiencies in Inventory Control Department**

As a global leader in the filling and packaging equipment industry for the beverage and liquid food sectors, KHS USA Inc. must adapt to increasing customer demands and technological progress. In 2021 KHS USA Inc. decided to implement new technologies into their warehousing processes. More precisely, a new Enterprise Resource Planning- and Extended Warehouse Management-systems as well as radio-frequency identification (RFID)-technologies were introduced with a go-live date during my project. With the current layout of the warehouse not being adapted to the new technologies and connected workflows, this represented the main reason for conducting my research. By taking a lean approach on process improvement and the adaptation of the warehouse layout, my objective was to drive up efficiencies and reduce backlogs. Thus, I aimed at the generation of faster revenue and reduction of tied up capital in the inventory control department.

Student:	**Luzie Hiller**
Faculty Advisors:	**Dr. André Köhler, Eric Lien, Dr. Katrina Moskalik**
Project:	**Improvement of the Sales Order Process – Smart Part Numbering System**

Hydro-Thermal strives to optimize part of their sales order process, between the order receiving and start of manufacturing. The objective is to reduce the corresponding process time by 70%. After examining the flow of orders, it was conducted that the most non-value adding time appears in the Engineering Department. As a result, the department's tasks were carefully evaluated and tracked. Three improvement possibilities, called Kaizen bursts, were found. One of the biggest was to reduce the time wastage at the product configuration. It was decided to improve the product configuration through automation and the development of a new system. After extensive evaluation and consultation with other departments, a decision was made to implement a smart (part) number system for standard products. One product type was selected, with the support of a Pareto Analysis, to observe the feasibility. The project applies lean management tools to present and analyze the current state. For the implementation, the theory of smart part number systems is applied.

Student:	**Bennet M. Kruse**
Faculty Advisors:	**Dr. André Köhler, Dr. Katrina Moskalik**
Company Advisors:	**Mrs. Kaoseng Vang, Mr. James Wong**
Company:	**KHS USA Inc.**
Project:	**Inventory management: Improvement of safety stock levels and sourcing methods for manufacturing parts at production company KHS USA Inc.**

This thesis documents an improvement project at the filling machines and packaging company KHS USA Inc. The project's main goal is to improve sourcing methods and safety stock procedures in the inventory management of manufacturing parts which are ineffectively managed in current state. To find the cause of the inefficiency a root cause analysis is applied. After, necessary data is mined, edited, and analyzed to create a data-driven foundation for decision making on safety stock levels and sourcing frequency. The different analysis applications use tools like the ABC-XYZ analysis, cause-and-effect analysis, FMEA, EOQ, and various methods of statistical analysis. The results of the project are differentiating recommendations of action that depend on different characteristics of the manufacturing parts. Generally, it is recommended to outsource C parts or produce them to stock twice a year. A and B parts are more complex and are recommended to keep stocked under the utilization of the EOQ. In the future, the recommended actions need to be implemented into the company's new ERP system SAP. The implementation is prepared but not executed in the scope of this project.

Student:	**Christian Meisinger**
Faculty Advisors:	**Dr. André Köhler, Dr. Katrina Moskalik**
Project:	**Increasing youth participation in ice hockey**

Growing up playing hockey has given me experiences like no other. And while I am fortunate enough to have gotten these opportunities, many families and youth simply cannot for a multitude of factors. I want to analyze where the barriers to the sport exist and find ways to increase involvement at the youth level. And while I realize that not everyone may be interested in every sport, the more exposure kids can have to a larger variety of sports can give them a greater sense of what they truly enjoy doing.

My project is to find ways to increase participation in ice hockey at the youth level. Hockey, while not alone (club soccer, lacrosse, etc.), is a rather expensive sport for parents to get their kids involved in. And for many, this is reason enough for kids to not get involved despite potential interest. Another key area I plan to research is why some areas seem to be experiencing a decline in player participation at the youth level while others are experiencing a boom. My project will analyze the many problems these organizations face and how they impact accessibility to the sport.

Student:	**Sarah Nasser**
Faculty Advisors:	**Dr. Katrina Moskalik**
Project:	**Heated Car Cover Product Feasibility Research**

When it comes to car storage at this time of year, it can be a headache to figure out where to store your vehicle, whether you can trust the facility, and the costs of maintaining your garage at home at the proper temperature. I am certain that an easy-to-install, all-season heated car cover may alleviate all of your worries. My solution is an all-season, heated cover that allows you to store your vehicle both indoors and outside at the correct temperature and humidity level. The auto-deploy feature will cover the perimeter of your vehicle with a click of a button, and magnets will keep the cover in place when in use. An easy-to-use dial will display a recommended setting for car storage, as well as the possibility of customizing your own settings for daily use. This heated car cover would spare the consumer the time-consuming, and sometimes impossible hassle of trying to scrape snow and ice from the car and provide added protection from winter elements.

Student:	**Stian Owens**
Faculty Advisors:	**Dr. Michael Payne**
Company:	**Sekiv Solutions**
Project:	**Marketing Plan for Sekiv Solutions**

This capstone project is with a company called Sekiv Solutions. They are a small civil engineering and design firm that my dad and his friend started over 10 years ago in Richmond, Virginia. Because they are a small business, the owners are forced to play many different roles within the business, which takes up a great deal of time. The owners must prioritize the engineering and design work of the company, so no one has been able to focus on the business side of the company. One area in particular that has not been given much attention is the marketing of Sekiv Solutions. Their current marketing strategy includes one-on-one business development, cold calls and emails, referrals, and formal requests for proposals issued by public agencies. Through these methods, their current strategy and approach is to obtain more projects. Research on various marketing strategies for construction companies is done and presented throughout this project. Also, a marketing plan is created that includes the following information: present business situation, value statement, market analysis, marketing environment, target market, SWOT analysis, and a sales and marketing strategy.

Student:	**Maarten Ramm**
Faculty Advisors:	**Dr. André Köhler, Eric Lien, Dr. Katrina Moskalik**
Company:	**KHS USA Inc.**
Project:	**Purchasing Strategies–Developing a strategic view on commodity purchasing**

My project is taking place in the Purchasing Department which consists of eight different commodities. The problem is that a 40-year-old history of non-strategic purchasing is prevailing, which now needs to change towards a more strategic purchasing approach. I am working closely with the commodity buyer for the machining commodity. Together, we are analyzing the whole commodity, answering questions like: Who are key suppliers? What are main issues with each supplier? What are they good at? All these questions require analysis such as looking at key performance indicators connected to these suppliers, meeting in person to find out strengths and weaknesses, and analyzing previous business with them. This analysis should ultimately deliver deeper insight on each of the suppliers to determine what business should stay with one supplier, what business should be moved to another supplier, and which suppliers are not suited to continue working with. Overall, the project has the potential to significantly improve lead-times, quality, and cost in this purchasing commodity.

Student:	**Julia Schuldt**
Faculty Advisors:	**Dr. André Köhler, Dr. Katrina L. Moskalik, Dr. Michael Payne**
Company:	**KHS USA Inc.**
Project:	**Process Improvement by Adapting of the Workflow and Manpower to the new ERP-system and RFID technology applied in the Inventory Control Department**

KHS USA Inc. is one of the market leaders in the production of machines for the beverage, food, and non-food industries. Therefore, the long-standing manufacturing company aims to compete with its competitors with short product development, effective production, and outstanding services with the focus on continuous improvement. In the Inventory Control Department, KHS USA Inc. copes with many order backlogs everyday which causes delays for internal and external customers. In April 2022, KHS USA Inc. implemented the new Enterprise-Resource-Planning system SAP S/4HANA in the complete plant and new RFID technology in the warehouse. This requires an adaptation to new processes and enables optimization of work processes. My objectives of the project are recommendations for a reduction of order backlogs in the warehouse through the optimization of work processes and an adaptation of the manpower structure. With the application of Lean Six Sigma tools, the project goals are to draft higher efficiency for a faster revenue generation through shorter cycle times.

Student:	**Malte Stellmacher**
Faculty Advisors:	**Dr. André Köhler, Dr. Katrina Moskalik**
Company:	**Hydro-Thermal Corporation**
Project:	**Improvement of Inventory Accuracy and Warehouse Layout Through Better Inventory Management**

This thesis consists out of two parts leading to improved warehouse operations at the corporation. On the one hand, HTC experiences inaccurate inventory records. These inaccurate inventory records complicate or disable precise purchasing processes and can result in production difficulties such as idle machines as well as not being able to stick to production schedules. This eventually leads to additional costs for the company and can also have negative impacts on lead times and customer satisfaction. The project identifies the current inventory issuing system called "backflushing" as the root-cause of inaccurate inventory records and delivers thought through Lean recommendations and general process changes to eliminate the problem. On the other hand, the constant growth of HTC, and the lack of space resulting from it, led to the current warehouse/facility layout not being ideal anymore. To introduce a purposeful material flow and efficiently use available space, the project also aims for rearranging the departments and racks in the company's main building, finally resulting in an enhanced layout fitting the future aspirations of the corporation.

Student:	**Brandon Turer**
Faculty Advisor:	**Carol Mannino**
Project:	**Do Any Physical Attributes of NHL Players Contribute to Winning Faceoffs**

As part of my internship, I analyzed NHL faceoff data from the 2018-2019 regular season, 2019-2020 regular season, and 2020-2021 regular season. Using every faceoff taken in those three seasons, I looked at players' height, weight, handedness, strength, zone taken in, and which specific faceoff dot the event occurred in. The data was analyzed in Python where I was able to create data frames with specific information to analyze it in different ways. This allowed me to see that weight and height were not significant factors overall, nor were they significant in any specific faceoff dot. Overall, the average weight of a player winning a faceoff was 199.96 lbs. compared to 199.44 lbs. for losers. When analyzing players by specific dots, it is clear that players are more effective at winning faceoffs on their strong side. A player's strong side coincides with their handedness. When a player is looking at the faceoff dot, if the dot is to their right, then that is the strong side for a righty, and vice versa. All in all, the biggest indicator of winning faceoffs is whether a player is taking the faceoff on their strong side.

Student:	**Marc Alexander Wegener**
Faculty Advisors:	**Dr. André Köhler, Dr. Katrina Moskalik, Gene Wright**
Company Advisor:	**Joshua Derouin**
Company:	**Birdsall, Voss & Associates Inc.**
Project:	**Development of a methodology for evaluating higher education marketing**

The thesis was written as part of an internship at Birdsall, Voss & Associates Incorporated (BVK). BVK is a full-service independent marketing agency based in Milwaukee. The core customer segments of BVK include healthcare, travel and tourism, and the primary focus of this paper, higher education. In an era of declining college enrollment, steadily rising tuition and discount rates, and the ripple effects of a devastating pandemic, the pressure to stand out and meet higher education goals has never been more significant. Institutions are under intense pressure to maintain or increase enrollment, attract more philanthropic support, and enhance their reputation through effective marketing.

This paper presents a methodological approach for evaluating the marketing performance of the areas of brand, admission, and development based on performance indicators for achieving organizational objectives. Synthesizing various KPIs and measurements allowed the three contributing areas to be weighed and combined into one institution rating. An approach to assessing the marketing performance was presented, challenges were outlined, and actions to achieve marketing goals were defined. The project outlined the general structure of interactions between brand, admission, and development, which can serve as a basis for further research and concept development.

Humanities, Social Science and Communication Department

User Experience Senior Projects

Student: **Xuejie Ren**

Project: **User Experience Intern at Harbin Longjia Food Company, Dongbei, China**

Xuejie's first internship responsibility was research. She quickly learned that creating personas in China was going to be different than what she had learned in her MSOE UX courses. People she interviewed were very reluctant to provide routine personal information (age and job, for example). Instead, Xuejie needed to focus on asking for information specifically related to the commercial context—e.g., why customers had chosen Harbin Longjia Food Company, what they liked or disliked about the website, etc. Then people were willing to talk with her. The personas Xuejie created helped the team develop a better understanding of the target audience: people who would use the website to rent cold storage.

Student: **David Xiong**

Faculty Advisor: **Dr. Katie Panciera**

Project: **User Experience Intern at Hanson Dodge**

During his internship at Hanson Dodge, David worked on a number of projects with active clients from wireframes to strategy and competitive research. Much of his documented work involved analysis of competitor websites including everything from color and font choices through information architecture. Understanding the context of a site or campaign is pivotal to being able to help them improve their offerings, so while this work is often ignored it is highly valuable.

Student: **Melissa Lin**

Faculty Advisor: **Dr. Nadya Shalamova**

Project: **Digital Experience Intern at MGIC**

During her internship at Mortgage Guaranty Insurance Corporation (MGIC), Melissa performed various tasks that contributed to the Digital Experience Team of MGIC under Rebecca Arnell. Some of the tasks she accomplished include maintaining the website, making website updates, completing web requests, deployment validation, creating mock-ups, and generating transcripts. Besides these general tasks, Melissa was entrusted with many large projects for MGIC, including the creation of MGIC's technology partners individual company page, MGIC's about page redesign, and MGIC's self-employed borrower page.

Student: **Zechuan Fu**

Faculty Advisor: **Dr. Katherine Wikoff**

Project: **User Experience Intern at The Community**

Fu completed his UX internship for a Milwaukee-based non-profit organization called The Community. More specifically, Fu's internship project involved creating a website home for a series of podcasts called "All in Wisconsin," produced in partnership between The Community and Milwaukee School of Engineering (MSOE) University Scholars program. The founder and executive director of The Community, Shannon Ross, was Fu's "go-to" contact for all questions regarding the website. Dr. Michael Carriere, director of MSOE's University Scholars program, served as Fu's company supervisor and completed the internship evaluation.

Student:	**Yuhang (Bruce) Liu**
Faculty Advisor:	**Dr. Katherine Wikoff**
Project:	**User Experience Intern at The Community**

Bruce completed his UX internship for a Milwaukee-based non-profit organization called The Community. More specifically, Bruce's internship project involved updating and expanding the website home for the series of podcasts called "All in Wisconsin," produced in partnership between The Community and Milwaukee School of Engineering (MSOE) University Scholars program. This website was originally set up during another MSOE UX student's internship (Zechuan Fu's internship). Bruce's internship experience involved updating and expanding upon the original work done by Zechuan Fu.

Student:	**Chris Wiemer**
Faculty Advisor:	**Dr. Katie Panciera**
Project:	**Software Development Intern at Ministry Brands**

Throughout his internship with Ministry Brands, Chris worked on front end development, design, and UX writing. While his focus was designing certificates and writing code to automatically generate those certificates for members, when relevant, he also performed a text audit (including revising help text) and created a flow to enable teachers to text their class members. He did all of this while navigating through a massive acquisition that significantly disrupted work, leadership, and priorities.

Electrical Engineering and Computer Science Department

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

TEAM MEMBERS
Benjamin Buschkopf (EE)
Piotr Kurpios (EE)
Joshua Robertson (EE)
Gavin Watson (EE)
Jonathan Weeks (CE)

FACULTY ADVISOR
Dr. Edward Chandler

Automated Antenna Measurement System

An antenna radiation pattern is a representation of how power radiates (and is received) from the antenna as a function of the angle. The radiation pattern is desirable to know for both commercial and educational applications. Due to the cost and required physical space for existing systems, automated testing methods for measuring, documenting, and graphing an antenna's radiation pattern are not currently available at Milwaukee School of Engineering. The Automated Antenna Measurement System (AAMS) seeks to solve this problem by implementing an automated, low-cost solution that measures a relative radiation pattern. To measure the radiation pattern using the AAMS, a probe antenna transmits a constant RF signal to an antenna under test (AUT). The AAMS automatically rotates the AUT while simultaneously measuring its power received and angle of rotation. The antenna can be mounted by the user to measure the azimuth or elevation radiation patterns. Using the collected data, a computer constructs the relative radiation patterns of the antenna under test.

The team would like to thank Mr. Bob Radke for his generous donation of materials for this project.

TEAM MEMBERS
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Juan Bautista (EE)
Richard Castro (EE)
Connor Pupp (EE)
Jashanpreet Singh (EE)

FACULTY ADVISOR
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Automatic Pressure Transducer Calibrator

The Milwaukee School of Engineering Fluid Power Institute™ (FPI) is a hydraulic testing facility. FPI tests a variety of hydraulic components under different pressure, temperature, and flow conditions for a variety of customers such as Caterpillar, John Deere, ExxonMobil and the military. Part of the testing process requires accurate knowledge of the hydraulic pressure. This pressure is measured using a pressure transducer. Prior to testing, the pressure transducers are calibrated using a manual process. Manual calibration takes additional time and is prone to human error.

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Fluid Power Institute™

This project is an Automatic Pressure Transducer Calibrator (APTC). The APTC automates the calibration process. The APTC provides FPI with the ability to quickly and accurately calibrate the pressure transducers used in the testing process. In addition, the APTC is portable and can be easily relocated to different testing areas.

TEAM MEMBERS
Kathryn Bay (BME)
Noah Blue (BME)
Adam Graham (BME)
Jacqueline Teele (BME)

FACULTY ADVISOR
Icaro dos Santos

Artificial Intelligence Partial Hand Prosthetic

In the manufacturing and construction industry, the leading injury is upper limb amputations and 90% of those amputations are partial hand amputations. There is no partial hand prosthetic on the market that is durable, compliant, reliable, and affordable. The goal is to create a high-powered prosthetic for individuals who have lost their index and middle fingers. In the design, an AI neural network is implemented utilizing MATLAB to allow for more natural movements of the prosthetic, tailored uniquely to the user. The prosthetic produces quick, accurate, and realistic movements of grasping and releasing to give back the functionality of an individual's whole hand, allowing them to return to their labor-intensive work environment where they operate heavy machinery and various power tools. Research and applications of FDA codes, standards, and regulations are implemented into our design to ensure the product is compliant and ready for market production.

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Tyler Branter (EE)
Zachary Camerson (EE)

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Constant-Torque DC-DC Converter for Electric Bicycles

The human body is capable of optimizing power output at a specific constant torque value when pedaling a bicycle. The preferred force on the pedals is specific to each person. Traditional multi-speed bicycles utilize a geared chain transmission that allows the torque to be varied via a range of gears. Electric bicycles often have geared systems with pedal assist to help control the torque applied to the pedals.

This project is the DC-DC converter that will be placed between an alternator connected to the pedals and the battery/motor drive system used to power the electric motor. The converter will enable the user to experience a controlled torque while still providing energy to the battery/motor drive system of the e-bike.

The team would like to thank Mr. Bob Radke for his generous donation of materials for this project.

TEAM MEMBERS
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FACULTY ADVISOR
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DC-DC Converter for PV Emulator

Enormous amounts of energy are radiated by the sun every day, but humans have yet to take full advantage of this radiated energy. Continued refinements and progress in electrical solar power generation devices are a path toward meeting an increasing percentage of the world's power generation sources by utilizing the sun's free energy. However, efforts for refinement and progress in this area are hampered by a lack of equipment to quickly and accurately test electronic converters involved in solar power generation.

Photovoltaic (PV) panel emulators have been developed and utilized to test devices that are employed in solar power generation installations that operate downstream of photovoltaic panels, particularly those that operate using maximum power point tracking (MPPT). By emulating the current-voltage (I-V) characteristic of a particular solar panel for a given level of solar irradiance, these emulators allow for testing of such devices without the need for actual solar panels being irradiated to produce power. This design project seeks to provide a solution to the problems of voltage regulation inefficiency, high costs, and oversized scales of scope that plague the DC-DC converters in most PV panel emulators on the market today. To achieve this goal, a highly programmable, highly efficient, and low-cost DC-DC converter has been designed. This report contains the design details for this converter.

The team would like to thank Mr. Bob Radke for his generous donation of materials for this project.

TEAM MEMBERS
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Caitlyn Spreitzer (BME)

FACULTY ADVISOR
Dr. Ahmed Sayed
With special thanks to Dr. John Bukowy

SPONSOR
University of Miami

Deep Learning Classification of Breast Tumors

The goal of this project is to successfully implement a deep learning algorithm to segment and classify breast tumors from MR images as benign (noncancerous) or malignant (cancerous) with a 95% accuracy. The final design includes an artificially intelligent medical device that will assist clinicians in making diagnoses of breast cancer while cutting costs and improving efficiencies in the current diagnostic process. Several different tools within Mathwork's MATLAB software as well as Rosie, MSOE's supercomputer, were used throughout the network design and testing process. A popular and well-respected classification convolutional neural network, AlexNet, is used in this medical device for classification while transfer learning using a modified custom segmentation neural network was utilized for segmentation. The network was fully

trained using a modified subset of 196 labeled and segmented MR images acquired from our collaborators at the University of Miami. The trained and modified network will be implemented into a user-centric software that will allow a clinician to input an MR image and receive information regarding the network-proposed diagnosis with a confidence level as well as a specified region of interest.

Eden Garden Watering System

The Eden Garden Watering System is an automated irrigation system designed for use in consumer and small-scale commercial gardens. The system utilizes moisture probes embedded in the garden soil to provide feedback to the controller with information regarding the soil's current moisture levels. The system uses this information to autonomously maintain a set moisture level for the garden soil using driplines throughout the garden bed, which water the plants as needed. The system is designed to be user-friendly and will be controllable through a cell phone app, which will allow the user to set a desired moisture level, manually initiate a watering cycle, or view current data for their garden. To increase ease of use, the in-garden components of the system will use solar power to recharge its internal batteries.

The team would like to thank Mr. Bob Radke for his generous donation of materials for this project.

TEAM MEMBERS
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Going Off the Grid

J.W. Speaker would like to go "off the grid" to reduce their energy costs by utilizing a fully renewable energy system. This will be accomplished using solar power, wind power, energy storage, controls, and a distribution system. Our solution utilizes MATLAB to model each subsystem individually before combining them into the overall system. Historical data is used alongside theorized scenarios to demonstrate proper operation throughout various weather conditions.

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Hailey Malloy (EE)
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SPONSOR
J.W. Speaker

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SPONSOR
Molson Coors Beverage
Company

MOLSON
COORS beverage company

Machine Learning Label Recognition System

Molson Coors Beverage Company requires an improved system for the automated detection of labeling defects during production. Their existing machine vision systems require manual configuration for each product, lacks resistance to environmental conditions, and are expensive. Our system is built around two off-the-shelf parts and a machine learning algorithm whose parameters can be stored and loaded as needed. A high-speed camera captures images of each item on the production line and sends the data to a single-board computer, which applies its training to generate an accept/reject decision based on the condition of the label. While the model training takes place on external servers, immediate decision-making occurs locally to maximize speed. Compared to current machine vision systems, our system is less expensive, can be implemented anywhere, and can be configured using saved machine learning models, nearly eliminating the labor costs associated with manual configuration.

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FACULTY ADVISOR
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with assistance from
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Mobile, Active, External Hemorrhage Tourniquet Trainer (MAEH) Tourniquet Trainer

Research of injury patterns show that a hemorrhaging event caused by trauma to an artery leads to an extremely fast death. To combat this, tourniquets have been developed to minimize the risks of bleeding out and provides first responders with an opportunity to treat the patient. Tourniquet application is often a complex and difficult task and fresh trainees often experience the Dunning-Kruger effect, which causes individuals to overestimate their skills and abilities when completing such a time sensitive and demanding task. Unfortunately, many hospitals and training programs cannot afford to purchase lifelike mannequins for training programs and are often forced into using low fidelity devices that do not replicate any human feel or active bleeding. From this, there is a need for a medium fidelity task training device that replicates the feel of a human leg, with accurate blood flow, and compression as the tourniquet is applied.

TEAM MEMBERS
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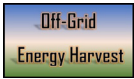**FACULTY ADVISOR**
Dr. Eric Durant

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NVIDIA

NVIDA GPU Firmware Debug

NVIDIA's GPU Firmware (GFW) team has a severely limited set of tools to debug the firmware on their GPUs (graphics processing units). Their current solution for GPU UEFI firmware and GPU microcode (embedded firmware) restricts engineers to writing to scratch registers and forces them to rely on simple trial and error debug techniques. Our project focuses on solving this problem by using the emulator QEMU to emulate the machine's CPU and GPU to allow a visual display of stepping through NVIDIA UEFI drivers and applications. Our solution will be easy to install on an engineer's workstation by running a Windows or a Linux executable script to build and download the environment. The engineer will then be able to include drivers or applications they want to step through to see how the EFI executable is running.

TEAM MEMBERS
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Off-Grid Energy Harvest

Our goal is to build an ecofriendly wind and solar powered off-grid generator for citizens in Puerto Rico. Most Puerto Ricans do not have a stable power grid due to local weather fluctuations and other factors. We designed our system off the average daily use of power per house in Puerto Rico to meet the daily peak watt hours of 16 kWh. Our generator consists of a solar array, wind turbine, battery, inverter, and controller subsystems. This system will be able to power the average Puerto Rican home for a minimum of one day and will connect to the pre-existing circuit breakers in the home.

TEAM MEMBERS
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Joy Cross (CE)
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FACULTY ADVISOR
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RAD-ish Hydroponic Control

Our team is working to create a fully automated hydroponic system to grow plants. Hydroponics is the process of growing plants in a controlled soilless environment. Usually with hydroponics the plant owner would have to manually check pH levels, balance the pH, and add in mineral feed to the water. This project sets out to create a system that can automatically handle those features as well as control the water pump cycle and monitor the temperature and humidity of the plants environment. To create a more seamless user experience, we are also developing a mobile application to both monitor and control the system remotely. The goal of this project is to create a working consumer scale product, for use by hobbyist in a home environment; however, we are designing the system to be modular and scalable, so it has the potential to satisfy larger-scale agricultural needs.

The team would like to thank Mr. Bob Radke for his generous donation of materials for this project.

TEAM MEMBERS
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FACULTY ADVISOR
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SPONSOR
Plexus
MSOE Innovent Center

RowTrak

The idea behind RowTrak is to create a boat tracking device for rowing teams. While there are similar devices on the market, they cost an extravagant amount of money (upwards of $900 per unit) and are not universally compatible. Since an average rowing team uses multiple boats, an investment of over $900/device can add up very quickly. The device we are looking to create in this project is a low-cost (around $150), universal solution that not only provides basic tracking features but also includes some high-end features that can be useful to evaluate performance of the boat. This device would be able to transmit GPS data, performance statistics (stroke rate, speed, direction, etc.), and an SOS beacon for multiple boats in real time to a website that can be accessed remotely from any location.

The team would like to thank Mr. Bob Radke for his generous donation of materials for this project.

TEAM MEMBERS
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Sendai Granular Synthesizer

The Sendai Granular Synthesizer is a compact and portable musical instrument that can record sound samples and play them back using granular synthesis. Granular synthesis is a synthesis technique that layers together several short sections of a sound sample which are selected from the main sample in a random but controlled fashion. The Sendai allows users to experiment with creating unique sounds whenever and wherever they find inspiration. The device features one octave of keys for pitched playback of the grains, a graphical display for visualization of the recorded sample, and several buttons and knobs for quick and convenient modification of commonly adjusted parameters. The device flexibly allows users to record sound from an onboard microphone or through the included ¼"/XLR jack and allows playback on onboard speakers or through a ¼" output jack. Additionally, the Sendai can be integrated into a studio setup, with enabled external MIDI control.

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SPONSOR
Plexus

Smart Patient Mattress Pad

Patients admitted to critical care areas for long periods of time require special attention to avoid occurrence of bed ulcers. There is a need in the medical market for a device that assist nurses and caretakers to prevent ulcers from forming. Nationally, pressure ulcers cost medical institutions $11.6 billion a year. Reducing the risk of a patient developing ulcers will save caretakers time and money, while also improving the well-being and health of the patient. The Smart Patient Mattress pad aims to design a peripheral device to assist caretakers in reducing the likelihood to develop bed ulcers. The device will monitor signs that are known for causing ulcers using pressure sensors, moisture sensors, and vital signs to alert the caretaker of areas where there is a possibility of ulcers forming. The device UI design is intended for usage in both health care facilities, senior living, and at home use.

TEAM MEMBERS
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Peter Roels (CE)
Isaiah Rondeau (SE)

FACULTY ADVISOR
Dr. Gerald Thomas

SureLock

SureLock is a smart locking system designed for use in cabinets and drawers. The intended use for this product is to protect places where harmful chemicals, alcohol, or important documents may be contained. Our system combines a base station with self-contained, independent locks which connect wirelessly to the base station. This system allows the user to control any of the locks on the system from anywhere using their smartphone, as long as they have an internet connection. The system is designed to be scalable, so the user can install just as many locks as necessary. The system will include the option to have the locks alert the user if they have been left open too long as well as the option to lock when the user leaves their house. We hope this product will present a viable alternative to other commercially available home safety locking devices at an affordable cost.

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T9 Guitar Effects Pedal

The T9 Effects Pedal

Guitar players use a variety of effects pedals to create distinct sounds. The current effects pedals market can be divided into analog and digital pedals based on the technology used to generate effects. Many analog pedals only support one effect with minimal user configurability. Effects pedals which contain multiple effects typically use digital signal processing. Most digital effects pedals with multiple user-configurable effects exceed the price range of the amateur musician. This project solves that problem with a lower cost multi-effect digital guitar pedal. The T9 digital effects guitar effects pedal utilizes advanced digital signal processing (DSP) with low latency, high audio fidelity and ultra-low Total Harmonic Distortion (THD). Over 10 different effects are currently available with user-modifiable parameters on each effect. The pedal will be powered through a standard 9V DC supply, which is the common standard for guitar effects pedals and powered pedal board systems.

The team would like to thank Mr. Bob Radke for his generous donation of materials for this project.

TEAM MEMBERS
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SPONSOR
TAPCO

TAPCO Connected Vehicle School Bus Warning System

The TAPCO Connected Vehicle School Bus Warning System is a system of Connected Vehicle devices used to signal nearby drivers and pedestrians in the event of a school bus crossing. Connected Vehicles use On-Board Units (OBUs) and Roadside Units (RSUs) to transmit and receive vehicle information to optimize safety, system efficiency, and mobility on our roadways. In our system, the school bus broadcasts a warning signal during a crossing. Nearby vehicles then receive this signal and display a warning on their Human-Machine Interface (HMI). Nearby Roadside Units also receive this signal and activate warning equipment like signs or lights. This project is sponsored by TAPCO (Traffic and Parking Control Company) who specializes in roadside safety equipment and systems.

TEAM MEMBERS
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Tilt-Assist Tray

When ferrying a platter full of drinks, staff at restaurants and bars often have difficulty in avoiding spillage. The Tilt-Assist Tray project seeks to solve this problem by electronically sensing and correcting any tilt in the drink tray. This solution is implemented by using several key components: an inertial measuring unit (IMU), a rechargeable battery, a microcontroller, and four lifting actuators. The value provided by the Tilt-Assist Tray project is in the reduction of drink spillage, the reduction of customer dissatisfaction, and the reduction of effort required by the workers to avoid spillage.

The team would like to thank Mr. Bob Radke for his generous donation of materials for this project.

TEAM MEMBERS
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Morgan Traughber (EE)
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SPONSOR
Plexus

Vehicle Life Support

This project is designed to create a safe and effective way to heat the cab of a pilot vehicle without leaving the engine running all night. In many colder climates, pilot car drivers must keep the engine running throughout the night to keep the vehicle engine from freezing and, most importantly, to keep themselves warm inside the cab. However, this comes with a risk of carbon monoxide poisoning, substantially higher gas consumption, and decreases the life of a vehicle's engine through wear and tear of running the vehicle for long periods of time. This project looks to design a solution to mitigate these problems without sacrificing the safety or comfort of the pilot drivers.

The team would like to thank Mr. Bob Radke for his generous donation of materials for this project.

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WalkPal

WalkPal is an assistive walking device intended to improve the traditional walker by incorporating fall detection and prevention measures. The device prevents falls through the use of an instability detection and automatic braking system. The device also has a fall detection system to detect falls early and minimize the consequences of falls. The device also includes an object detection feature which provides the user a visual and audio alert when there is an object in the path of the walker. The walker also includes an on-board display in the form of a tablet. The tablet is incorporated with the device as a whole through the WalkPal app, which allows the user to track health data, receive alerts, and manage their device settings. Overall, this device provides older adults the safety they need to remain independent for longer.

TEAM MEMBERS
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Wall Humidity Sensor

Manually measuring and recording humidity and moisture data for structural walls across an entire building, on a regular basis over a span of years or decades, would be time consuming and expensive due to the cost of external measurement devices and human labor. Currently, to gather data on the moisture content of a wall, an inspector would have to use a moisture measurement device, which can be destructive to softer materials like drywall, manually record the data into some sort of database, and return at regular intervals to measure the entire building again. This solution, even done in monthly intervals, is invasive for tenants and would accrue major labor costs. Additionally, measurements in hard-to-reach places may be avoided or outright impossible, meaning problems could arise without being detected. Presently, there is not an easily implemented solution on the market that can automatically monitor humidity or water saturation in walls, provide real-time alerts that the readings are at a dangerous level, or support long-term automatic data collection. Our solution involves the development of a set of devices, a Sensor Unit and Main Hub, that allow for just that functionality. The Sensor Unit uses a microcontroller and several sensors powered by POE (power over ethernet) and measures the temperature and humidity within a wall as well as the moisture content of the wooden stud it is mounted to. This data is sent via Ethernet to the Main Hub where the data from the unit(s) is saved to a database and output to a visual display. The ability to constantly monitor the conditions inside of walls without the need of an inspector or the worry of replacing batteries elevates our project solution above the rest in a largely untapped market. Our current solution is designed for walls constructed with drywall and wood stud construction.
The team would like to thank Mr. Bob Radke for his generous donation of materials for this project.

TEAM MEMBERS
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Hannah Michelson (CS)
Zachary Pasbrig (CE)

FACULTY ADVISOR
Dr. Eric Durant

Wave Height Internet Measuring System

The purpose of the project is to have a cost effective and easy to replicate device to measure wave heights in freshwater lakes. The project is meant to become open source for amateur electronic enthusiasts to recreate and measure their own lakes. The device is designed to be mounted to a pole and positioned over the water. It is designed for simple installation, removal, and maintenance.

It is designed to operate from April through October. The device will operate continuously off battery power and recharge with a solar panel. It transmits measurements over Wi-Fi to a database. Our initial installation and development were sponsored by the Eagle Spring Lake Management District, who have coordinated with the National Weather Service to distribute the wave data.

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(with thanks to Drs. Charles Tritt, Larry Fennigkoh & Jeffrey LaMack)

SPONSORS
MSOE Innovent Center
Meharry Medical College

Wireless Nighttime Bruxism Monitor

Sleep Bruxism is a muscle disorder in which 8% of middle-aged adults grind or clench their jaw, producing up to 250 Newtons of force on the teeth, which can cause enamel deterioration, sleep disruption and headaches. Currently there is no accurate way of monitoring bruxism, and only methods of identification, which are slow and lead to little objective data on important parameters like identifying location, frequency, and intensity of teeth grinding, which would be crucial in performing proper treatment and mitigation methods. Our device has the potential to accurately diagnose the location, quantity and intensity of sleep bruxism or nighttime teeth grinding in a patient as well as protect the patient's teeth from damage. The device will consist of five force sensing resistors mounted on a mouthguard that will measure the forces applied on the jaw. This will enable dentists to better understand the disorder and provide specialized treatment to their patients.

The team would like to thank Mr. Bob Radke for his generous donation of materials for this project.

Computer Science and Software Engineering–Presented in Diercks Hall

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Bryan Morales (CS)
Jeromy Schultz (SE)
Chet Witte (CS)

FACULTY ADVISOR
Dr. Sohum Sohoni

SPONSOR
MSOE STEM Center

A14K12

Computer science education in elementary, middle, and high school institutions is often not available in a student's curriculum. MSOE's STEM Center organized various programs to help educate young students about STEM fields. Our project consists of designing, developing, and deploying a website that contains interactive lessons to help high schoolers learn and explore the field of computer science (CS). The different sections of the website will offer lessons in the areas of artificial intelligence (AI) and data science (DS). The website will be constructed using a JavaScript frontend for servicing end-users and a Python backend to serve up our DS, machine learning, and deep learning lessons. We have released a survey to high schools in Wisconsin to collect data about how well students know CS and their interests for datasets to use on the website.

TEAM MEMBERS
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Hunter Hess (SE)
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FACULTY ADVISOR
Dr. Walter Schilling

Apollo Learning Platform

The Apollo Learning Platform is a web application, providing a method for taking notes while watching asynchronous video lectures. By integrating the video player and note manager, we can provide a richer note taking experience. Users' notes can contain both text and screenshots, linked to timestamps within the video. The list of videos is curated on a course-by-course basis by the professor. Using this system, students will be more engaged with video lectures and will be able to study more effectively, with their notes and videos in the same environment. To facilitate studying, Apollo also includes an advanced search feature, allowing users to search through both their notes and videos' transcripts.

TEAM MEMBERS
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Paul Rinaldi (SE)
David Schulz (CS)
Jesse Sierra (SE)

FACULTY ADVISOR
Angela Wiedenhoeft

ChemChain

The purpose of ChemChain is to be a Proof of Concept (PoC) tool that tracks chemical supply chain actions and assets using blockchain technology. Currently, the state of the chemical supply chain relies on paper and people. Using Hyperledger Fabric, AWS, Golang, and other technologies, this tool allows for faster lookup times, more accurate documentation, and immutable records along with many promises of a Proof of Authority blockchain.

TEAM MEMBERS
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Nicholas Johnson (CS)
Ryan Lumaye (CS)

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SPONSOR
Cognex

Cognex: InSight System Profiling

Cognex is a manufacturer of machine vision systems, software, and sensors. Their cameras and software are used to perform a variety of tasks ranging from defect detection to scanning barcodes and serial numbers in the manufacturing process. Cognex requested a tool to troubleshoot unexpected behavior of their real-time systems more efficiently. We designed an application that provides visualizations of timing and relational data to diagnose errors and identify performance bottlenecks. To accomplish this, we integrated process tracking functionality into Cognex's existing codebase in a non-intrusive way and developed a process for delivering the data to a web client. The web client was developed using Angular, a modern website development framework, which allow a user to view relationships between events, create criteria-based filters, and view statistical information. The project was designed in a modular fashion to support future development and expansion by Cognex engineers.

TEAM MEMBERS
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Anthony Lohmiller (SE)
Kammein Mitchell (SE)

FACULTY ADVISOR
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Deerfield Glass

Ecommerce companies need a way to track data on shipping, orders, transactions, and inventory. While larger companies such as Amazon have ways of doing this, smaller companies such as Deerfield Glass have no such simple means. We are developing a website with a companion mobile app precisely to remedy the problem and open a potential market for business analytical tools for mobile instead of restricting it to desktop.

TEAM MEMBERS
Nathan Chapman (CS)
Jack Flitcroft (CS)
Stuart Harley (CS)
Errin Miller (CS)
Kyle Rodrigues (CS)

FACULTY ADVISOR
Dr. Eric Durant

SPONSORS
Dr. Kevin Cohoon
Medical College of Wisconsin

EKG Illness Classifier

An electrocardiogram, also known as an EKG, is a medical test that monitors the state of the heart by recording the electrical signals that it produces. The data captured by the test provides detailed information about how well the heart is functioning. Many diseases throughout the body display cardiac symptoms that can be picked up by an EKG. Using the power of deep learning, we created AI models to predict whether a person has a traumatic brain injury or COVID-19 from their EKG. These models could assist medical professionals in diagnosing these illnesses. They could also be integrated with current smart watch technology to provide instant diagnoses of these health issues, revolutionizing the healthcare industry.

TEAM MEMBERS
Jazmin Folker (CS)
Hailey Hable (SE)
James Lang (SE)
Chanfais Moua (SE)
James Rector (CE)

FACULTY ADVISOR
Angela Wiedenhoeft

Hello Audrey

Hello Audrey is a website utilizing React, Django, and Amazon Web Services (AWS) created in order to allow children with speech disabilities to receive counseling and assistance from speech pathologists. The site is intended to allow children to record and submit recordings and receive live feedback from pathologists on the site itself. We are utilizing AWS to host the website, as well as store user recordings and other necessary information. Website is HIPPA compliant and utilizes JWT tokens to handle site authentication.

TEAM MEMBERS
Michael Caballero (CS)
Ethan Hindes (CS)
Evan Lipnitzky (SE)
Vilayvan McGann (CS)
Max Milkert (CS)

FACULTY ADVISOR
Dr. Gerald Thomas

SPONSOR
Molson Coors Beverage Company

Molsonator

Molson Coors Beverage Company (MCBC) reports temperature deviations during the fermentation process to be a costly expenditure worth solving. While the steady state conditions of beer fermentation are well understood and controlled, the early stages of the fermentation process are often prone to error. Slight deviations in temperature, oxygenation, and other environmental factors at this time can alter the flavor profile of the beer, sometimes enough that it can't be brought to market. Our proposed solution to MCBC leverages machine learning to predict when the fermentation process is complete and uses time series data analytics to diagnose and suggest corrective action for the observed variance at the beginning of fermentation. It also improves the company's response time to these events from days to minutes, potentially saving MCBC from thousands of gallons of wasted product each year.

TEAM MEMBERS
Lucas Cabello (SE)
Valerie Djohan (CS)
Nick Marinello (SE)
Sagun Singh (CS)
David Yang (SE)

FACULTY ADVISOR
Angela Wiedenhoeft

MSOE Raider Buddies

A mobile application where MSOE students can meet other students based on their common majors, minors, and interests. Students can create an account based on their information and our Matching Algorithm will recommend other students that are similar to them as potential study buddies.

TEAM MEMBERS
Trenton Bowser (CS)
Nathan DuPont (CS)
Chip Hennig (CS)
Julian Singkham (CE)
Joseph Weller (CS)

FACULTY ADVISOR
Dr. Sohum Sohoni

SPONSOR
Raider Robotics VEX U

Object Identification, Localization and Deep Reinforcement Learning for Mobile Robotics Platforms

Integrating robots into any environment requires a robust and complete understanding of the state space, especially when the environment consists of multiple independent agents trying to complete their own goals. Our project sponsor, the Raider Robotics VEX U Team, requested a ROS (robot operating system) enabled software system to be created to help solve this problem, allowing for their robots to autonomously navigate and fulfill goals in a dynamic state space where multiple other robots are competing. The software solution we designed includes a custom SLAM (simultaneous localization and mapping) package for identifying objects surrounding the robot. The robot then uses a separate real-time deep reinforcement learning model to determine which actions in the state space have the highest potential reward and assigns the robot to autonomously take said actions. This software solution runs on a custom NVIDIA Jetson Nano compute platform located on-robot.

TEAM MEMBERS
Jonas Cira (SE)
Luis Diaz (EE)
Evan Hecht (SE)
Milan Kablar (SE)
Urhum Shiekh (CS)

FACULTY ADVISOR
Dr. Walter Schilling

Raider Rumble

This project is a two-player MSOE themed fighting game with a custom arcade cabinet. In this game, you can fight as playable characters representing the majors offered here at MSOE. The stages the characters fight on are designed based on prominent locations on campus (the Campus Center, Diercks Hall, etc.). In order to create this game, the Godot game engine was used in pairing with its default language GDScript. The project involved not only the creation of the game, but also the cabinet's electronic hardware. In order to run our game, the arcade cabinet is equipped with a Raspberry Pi 4. This Raspberry Pi interfaces with a custom-made PCB with microcontrollers in order to take in player input via the buttons and joysticks. The entire arcade cabinet will be donated to MSOE for use by current and future students!

TEAM MEMBERS
Matthew Aleck (CS)
Jesse Granius (SE)
Joseph Rundlett (SE)

FACULTY ADVISOR
Dr. Walter Schilling

SPONSOR
Dr. Christopher Taylor

Semester Conversion

MSOE is set to transition from a quarter-based system to a semester-based system beginning in the 2023-24 academic year. The Semester Conversion Tool is a software application designed to ease this transition for MSOE students and advisors. Students and advisors can upload a history of courses. Then the completed courses under quarters are then converted to determine what classes for the major are already completed. The tool then generates a flowchart containing course recommendations for each future term. Courses in this flowchart of recommended courses can be moved between terms and recommendations can be redone based upon changes made. The recommended courses and customized track can then be exported and saved for reuse next term.

TEAM MEMBERS
Saad Alshimshir (EE)
Nicole Buerger (SE)
Hayden Klein (CS)
Anthony Matson (CS)
Jesus Ramos (CS)
Tou Tong Xiong (CE)

FACULTY ADVISOR
Dr. Sohum Sohoni

Syringe Volume Verification in High-Alert Medications

One of the largest issues for nurses in hospitals today is medication accuracy. It's easy for tired nurses to mistakenly administer too much or too little medicine to a patient. This becomes increasingly dangerous when high-risk medicines such as insulin or heparin are administered incorrectly, which can lead to unintended effects for the patient. This product is intended to remove the human element of error and instead verifies that medicine is administered with precision. This verification is accomplished via a pair of technologies: an AI model that can verify if a syringe holds enough medicine, and a companion app that sends data to the AI model and reports back to the nurse. The app bridges the AI model allowing the nurse to easily snap a picture of the syringe and receive a response from the AI model, confirming if the medicine is good to give.

TEAM MEMBERS
Brian Birbrayer (CS)
Austin DeMars (SE)
Noah Ernst (SE)
Jace Olson (SE)
Riley Wikel (SE)

FACULTY ADVISOR
Dr. Walter Schilling

SPONSORS
Gary Shimek
Elizabeth Jerow

Textbook Connection

Textbook Connection provides MSOE students an opportunity to borrow textbooks for their classes free of charge. We are developing this web application with React and ASP.NET Core while maintaining it through Azure Cloud Services. The program allows the library staff to manage books, loan requests, donations, and more. The application for the project has been developed to be available for any MSOE student using a computer or mobile device. Students are encouraged to use this resource to build a greater collection of textbooks for their peers to borrow. This project would not be possible without the help of students, MSOE alumni and the effort of the MSOE Library.

Mathematics Department

Actuarial Science Senior Projects

STUDENT
Tom Crivello

Amica Life X-Factors

I presented on a project I had done during my internship with Amica Life. For this project, I created a workbook that would test various increases/decreases to our X-Factors so that we could update them to better reflect historical data. My workbook functioned as follows: The user inserts data from the IFE data file, the user inputs an increase type/amount and the year, the formulas retrieve and calculate mortality rates using CSOs and current X-Factor tables for a chosen year, a macro runs 1000 Monte Carlo simulations to calculate expected total death benefits, a simulation results tab summarizes the data. Through comparing actual death benefits to expected death benefits for the last 5 years, we found an increase to X-Factors that better reflected our experience.

STUDENT
Katie Kooiker

Comparing Curv Scores to Markets

I worked for Milliman Intellicript as an actuarial intern on the Curv – Group Health team. Curv – Group Health is a predictive modeling tool that quickly assesses a group's morbidity from its members' prescription and medical histories. As a consulting firm, we provide our clients with the knowledge behind their Curv scores and how they can use our predictive tool to enhance their underwriting. I can't go into many details without revealing confidential information, but through my internship I worked on creating benchmarking reports that give an understanding of where a client's Curv score falls in comparison to the markets that they do business in.

TEAM MEMBERS
Benjamin Krause
Brandon Stoller
Kyle Zacher

FACULTY ADVISOR
Dr. Brandon Reid

Crime Trends and Modeling

Examining violent crime data of 68 U.S. jurisdictions collected by the Marshall Project, we sought to implement the underpinnings of the Black-Scholes model to simulate occurrences and subsequent costs to society of violent crime. We tested our data to ensure its normality, a vital assumption for our proposed geometric Brownian motion model and assessed various published studies to estimate the cost of each individual category of violent crime to perpetrators, victims, and society at large. We then conducted simulations in Excel for crime rates and costs over time based on our model, which accounted for the correlations between individual crimes and general criminality in a given year. Our simulation results, suitably accurate compared to actual values, present a basis to assess policies implemented to reduce the cost to society of violent crimes.

TEAM MEMBERS
Brendan Ferguson
Jacob McClelland
Jillian Ruark

FACULTY ADVISOR
Dr. Brandon Reid

March Madness

Using several different math modeling techniques, we created an algorithm to identify the probabilities each team has of winning any possible matchup in the NCAA Men's Basketball Tournament. The analysis was done using a logistic regression, which is a transform of a linear regression so that it outputs values between 0-100%. Other models used included linear regression, tree models, and XGboost. After separating our data between training and testing values, we determined that the logistic regression was the most accurate for determining the correct winners of every game.

TEAM MEMBERS
Joe Cibulka
Kalvin Fellows
Joe Gerhartz
Eric Yonekura

FACULTY ADVISOR
Dr. Brandon Reid

Predicting NBA player Salaries

In order to predict NBA player salaries, we took every player that played for the first 8 years of their career from the years 2004 to 2015. We used their basic counting stats from their fourth year to create a dataset for our players. We also filtered certain players out and fixed gaps in the dataset. We then used R to create a linear model to best predict their salaries. After, we did individual analysis on 18 players from the 2018 Rookies to determine how accurate our model was based on the players' current salaries in 2022 and explained why the model predicted salaries may have differed from their actual salaries. We then created a business model to invest in a player's earnings so they receive a set portion of their earnings immediately, while investors and the company got a portion of their future earnings.

TEAM MEMBERS
Janna Meyer-Steinhorst
Sofia Paredes
Noah Wagenknecht

FACULTY ADVISOR
Dr. Brandon Reid

INDUSTRY ADVISORS
Steve Jagodzinski
Joey Sveda
(Pinnacle Actuaries)

Show Me the Money!

The goal of our project was to create a pricing model for college income share agreements using both government and academic data. We presented this project as part of Pinnacle U and were advised by Pinnacle actuaries, Steve Jagodzinski and Joey Sveda. With the data we collected, we predicted graduation rate and starting salary to accurately price the model. We chose to focus on majors offered at MSOE and how the skills from those majors could be utilized in the labor market. The model provides an alternate source of tuition funding for STEM related majors seeking employment in related fields. Specifically, we used R Studio to create a quasibinomial model for graduation rate, and, along with Sure Independence Screening for dimension reduction, a linear model for starting salary. Other topics included in this presentation were a demonstration of the pricing model, future works and its insurance application.

Mechanical Engineering Department

Industrial Engineering Projects

TEAM MEMBERS
Jake Chudecke
Bryan Roob

FACULTY ADVISOR
Dr. Doug Grabenstetter

Dakonte Product Group (DPG 1)

Over the course of two quarters at MSOE, a team of two industrial engineering seniors worked with a client at Dakonte Product Group to create, organize, and standardize a new heat-sealing process as well as a redesign of the shipping department. The team used multiple industrial engineering tools such as spaghetti diagrams, process flow charts, lean eight wastes, ergonomic evaluations, and hypothesis testing while following the Six Sigma design, measure, analyze, improve, and control outline to approach the project. In the end, the team was able to achieve the determined goal of reducing the average production time by 3.7 minutes through their various recommended changes.

TEAM MEMBERS
Conner Bennett
Trent Gallett
Trenten Riemersma

FACULTY ADVISOR
Dr. Doug Grabenstetter

Dakonte Product Group (DPG 2)

This report documents the work and progression of a project at Dakonte Product Group (DPG). The client had noticed shortcomings in the production floor layout and believed that they were negatively impacting the manufacturing lead time of the vinyl ticket holder process, thus not allowing DPG to meet increasing demand. The team used various industrial engineering methodologies to provide recommendations for improving the production floor organization and layout at DPG. Systematic layout planning was used to evaluate different production floor layouts. Additionally, using historical time study data, a discrete event simulation model using various statistical distributions was created that modeled the ticket holder creation process and calculated the lead time of the suggested layout updates. Based on our findings, recommendations were developed that, if implemented, would reduce the manufacturing lead time by 20% and the travel distance by 34% for the vinyl ticket holder process.

TEAM MEMBERS
Ian Bar-Din
Cesar Hernandez-Mora
Luis Lucero

FACULTY ADVISOR
Dr. Leah Newman

FORCE America

This project was performed at the Electrical Division of FORCE America located in Waukesha, Wisconsin. The purpose of the project was to apply industrial engineering tools to improve problems within the newly established wire harnessing cell. The team focused on solving ergonomic issues and reducing production inefficiencies. Quantitative tools such as ergonomic risk measurements and process simulation tools were utilized to determine the problems. The team generated recommendations to reduce ergonomic and production inefficiency problems within the cell. Recommendations included electrical tooling to reduce operator risk and reducing travel time for required non-value-added steps in the production process. The final ergonomic recommendations could reduce RULA and REBA scores below four for crimping actions and a NIOSH lifting index below one for lifting operations. The final production time recommendations could reduce manufacturing critical-path time by 26.25% and save $12,600 per year due to an insufficiently equipped cell and lengthy inspection processes.

TEAM MEMBERS
Abigail Burg
Alex Wilhelm Holborn
Matthias Winters

FACULTY ADVISOR
Dave Kohlmann

Friedens

Friedens Despensa de la Paz food pantry is a non-profit organization located in Milwaukee, Wisconsin. Due to no standard workflow for sorting or packing food as well as a shrinking volunteer force, volunteers were spending excess time moving goods, double handling goods and adding to an unorganized environment which detracted from volunteer utilization. To decrease the total time it took volunteers to sort, unpack pallets, and pack food boxes by 25%, the team conducted time studies as well as used spaghetti diagrams, Simplified Systematic Layout Planning, statistical analysis, and AutoCAD to create three solutions. The first solution accounted for restrictive COVID-19 guidelines that do not allow community members to create packages. The second solution allowed for clients to create food packages and the third solution allows community members to package food boxes and socialize in a designated common space. The team created a layout for the process flow and work aids for volunteers to use during the sorting and packaging process.

TEAM MEMBERS
Cooper Harrison
Emma Ruder
Taylor Williams

FACULTY ADVISOR
Dr. Aaron Armstrong

General Electric (GE)

GE Healthcare manufactures detectors for Computed Tomography (CT) machines at their West Milwaukee plant. At that plant, one of their production cells, specifically the automated system at the beginning, is unreliable and frequently halts production, causing the line to consistently miss its production goals. To remedy this, the senior design team created a manual backup system and standard cell operations sequence for operators to use when the automated system goes down so that they can maintain production. After designing the system, the team simulated the future state of the line to show that implementing the manual system would significantly increase production output to meet demand and save money on overtime costs.

TEAM MEMBERS
Zachary Horanoff
Tayler Kozelek

FACULTY ADVISOR
Dr. Leah Newman

KHS

This project was conducted for KHS USA, Inc. The project's focus was the new filler valve rebuild department, which are essential to KHS's beverage filling machines. The objectives were creating work instructions for the department, generating recommendations for decreasing operator times and distances traveled, ergonomic improvements, and department layouts. For each, a 10% decrease was desired. Assessments and evaluations were done in each category to generate recommendations for department improvements. The team recommends that KHS purchase a washer for the department, in addition to rearranging the department into the pairwise exchange layout. If no washer is purchased, the team recommends the modified spanning tree layout. The team also recommends ergonomic improvements, such as limiting utilization of the carts and ensuring ergonomic tools. These will benefit the company's current and future states; they provide inexpensive options to reduce risks of employee health problems and increase their process efficiency.

TEAM MEMBERS
Daniel Drzewiecki
Drew Knuth
Garrett Schultz

FACULTY ADVISOR
Patrick Gathof

Parker Hannifin

This project primarily focused on the MSOE senior design team evaluating the feasibility of implementing a designated work cell for single crimp products. The team studied and observed the value stream and crimping process within the Eagles Work Center. Additionally, the team observed current causes of downtime within work cells. The team identified problems within the work cells which caused Parker Hannifin to not achieve their production goal in units per labor hour (UPLH) for hydraulic hose fittings. After researching mixed model line designs, the team conducted time studies, analyzed machine capabilities, production capacities and studied the current sequencing process. From this, solutions were developed to improve cycle time which aligned production closer to the goal. These solutions included a deterministic sequencing tool, improved cell layout, and a capacity simulation. These projected improvements met the team's objective of decreasing the gap in UPLH, with the projected annual labor expense savings of $80,500.

TEAM MEMBERS
Jorich Balabagno
Abdulwahab Bastaki

FACULTY ADVISOR
Dr. Aaron Armstrong

Planet-to-Plate

The student team was tasked with assisting Planet to Plate with improving their hydroponic farming process within their Milwaukee facility. This was done through the reduction of harvesting times and the balancing of labor utilizations. The team conducted time studies and analyzed the process using MPX queueing modeling software. The team then developed recommendations to improve on their processes based on these results. If the recommendations are successfully implemented, harvesting process times should be reduced by 14% and production capacity should increase by 12%. In addition, standard work instructions were made for current and future employees to use. The results from the recommendations should allow for balanced labor and steady throughput and production without requiring overtime from the employees. The recommendations will cost approximately $7,500 annually to achieve the required level of production.

TEAM MEMBERS
Jordan Branske
John Shields III
Lena Slater

FACULTY ADVISOR
Dr. Doug Grabenstetter

Velvac

After acquiring the shipping data for all domestic/
international shipments and freight, the group was able to
provide recommendations and initiatives to reduce Velvac,
Inc.'s shipping costs by approximately $256,000, which
met the goal of a 4% reduction in cost. Outlined through
the initiatives in this report are the efforts to drive down
their expenditures; this is done by streamlining shipping in
Canada (removing the third-party logistics (3PL) warehouse
in Canada), expanding multi-stop possibilities for existing
truck routes for inbound intercompany freight, and relocation
efforts for the California 3PL warehouse. The team included
these initiatives (with their respective savings) in the report
to demonstrate recommendations for Velvac's Logistics and
Fulfillment Department.

Mechanical Engineering Projects

TEAM MEMBERS
Jake Barton
Shayla Hertzke
Nathan Mueller
Isaac Slark

FACULTY ADVISOR
Dr. Subha Kumpaty

Electric Wheelchair Attachment Mechanism

In India, everyday travel for individuals using a wheelchair is limited and labor-intensive to get from one place to another. A mechanism was developed and designed to attach a powered drive unit with a wheel to a standard wheelchair. Details of the mechanism's functionality, strength, estimated weight, and projected cost were all considered throughout this project. Additionally, refinement of the design was based on the consideration of material selection, factor of safety, and manufacturing process. A full-scale prototype was built to validate the analysis and physically demonstrate the legitimacy of the mechanism design. With this device made available at an affordable price to the community in India, individuals who use a wheelchair can access warranted freedoms that were previously restricted.

TEAM MEMBERS
Jessica Jefferson
Rachel Kohl
Ron Marchionna
Sam Paxton
Brian Prymon

FACULTY ADVISOR
Dr. Kevin Hart

Moon Jumpers (AIAA Space Mission Design Group 1B)

Working with inspiration from the AIAA Senior Design Competition's Space Mission Design prompt, the team set out to design and investigate a lunar module capable of landing, traversing, and sampling both Martian moons, Phobos and Deimos. To this goal, the group broke the design into subsystems that were modeled with inspiration from research on state-of-the-art and prospective lunar missions and technology. The design that follows supports a mission 30 days in length with a crew of two, as well as five planned sampling locations on each moon. The presented work will describe the research and function of many innovative subsystems of the vessel, including propulsion, landing gear, life support systems, and a sample retrieval rover. The project details what factors would contribute to a successful mission, and how the chosen designs and resulting cumulative design strive to match that standard.

TEAM MEMBERS
Jorge Gutierrez
Collin Ostrowsk
Morgan Patch
Christiana Roebke
Katherine Wolfgramm

FACULTY ADVISOR
Dr. Mohammad Mahinfalah

2022 ASME Student Design Competition H$_2$Go Revisited

The 2022 ASME Student Design Competition tasked teams with creating a vehicle that is powered entirely by the potential energy of water poured into it, scoring points based on the volume transported. During a rigorous design process, multiple design concepts were evaluated based on established design criteria. In the final design, The Adiabatic Flame focused on using small vertical displacements of transported water to create a large amount of torque in the vehicle's gearing and increase its distance traveled. The team performed extensive prototyping and testing, including 3D printing, building scale models, and evaluating material performance. Almost every component of the vehicle was custom designed and manufactured to maximize the volume of water transported. After assembly, time was put towards reducing friction between internal components. At the competition, the team placed first out of 19 teams internationally with a final score of 327,898 points.

TEAM MEMBERS
Daniel Ciochon
Tyler Johnston

FACULTY ADVISOR
Dr. Nebojsa Sebastijanovic

Baja Braking Redesign

The Senior Design SAE Baja Braking Team implemented engineering principles, following the SAE Baja rulebook, to redesign the braking system for MSOE's new SAE Baja competition vehicle. The braking team is responsible for all components from the brake pedal to the wheel hub. The hydraulically actuated friction braking system was designed to act on all four wheels operated by a single foot pedal ensuring operation feasibility and safety. The system was designed in accordance with the 2022 SAE Baja competition rulebook. Parts were designed to be manufactured in house to reduce manufacturing costs. A full braking system prototype is to be constructed for MSOE's Baja Club Team vehicle.

TEAM MEMBERS
Tim Baldocchi
Andrew Jackson
Gavan Schotzko

FACULTY ADVISOR
Dr. Nebojsa Sebastijanovic

Baja SAE Chassis Senior Design

The purpose of this project was to design and fabricate a new chassis for the Baja SAE Club Team which minimizes cost and weight. The need for a new chassis was motivated by a change to the Baja SAE rules which stated for this competition year and moving forward, all vehicles must be 4WD compatible. Due to the previous vehicle being 2WD, the entire vehicle needed to be redesigned to accommodate the new rule. The new chassis, therefore, incorporates the new suspension, 4WD, steering, and braking designs while abiding by the SAE rules. The finished vehicle will serve as the groundwork for the MSOE Baja SAE club team to compete in competitions during the 2022-2023 school year and beyond.

TEAM MEMBERS
Kyle Blake
Logan Stretz

FACULTY ADVISOR
Dr. Nebojsa Sebastijanovic

BAJA Front Suspension Redesign

The Milwaukee School of Engineering's SAE Baja Club needed a new vehicle for competition to incorporate a four-wheel drive system to meet the new SAE Baja rules. From this, our team was tasked to make a new front suspension assembly to allow room for the new CV-axles for 4WD capability as well as optimize the new front suspension to compete in SAE Baja competitions while meeting all SAE Baja rules and regulations. This was needed due to the current design not allowing for the compatibility of a 4WD system. The front suspension as well as the rest of the vehicle is planned to be built and ready for competition at the end of May 2022. This is in hope for the SAE Baja Club to compete in summer events to keep the reputation of MSOE as one of the best engineering schools in the country.

TEAM MEMBERS
Austyn Bella
Joe Jurss
Jesse Lambrecht
Ty Miklowski
Donovan Miller
Will Smith

FACULTY ADVISOR
Dr. William Farrow

Aldon Company Dead Man Brake

The Aldon Company produces a wide variety of railroad equipment including push carts that roll on the railroad tracks used by maintenance personnel. These carts carry up to 5,000 pounds of tools and equipment but currently do not have a brake other than a parking brake which is only engaged when the cart is completely stopped. This project has developed a "Dead Man Brake" that engages to stop the cart if control is lost and will function as a variable brake system. Variable braking allows the user to slow the cart to a controlled stop during normal operation. The team developed the brake as a modular system that could be included on new Aldon carts or retrofitted to Aldon carts already in the field. The team would like to thank their project sponsor: Aldon Company Inc.

TEAM MEMBERS
Michael Arciszewski
Italia Fields
Zachary Fisch
Donn Jan Gervacio
Mikhaella Tolentino

FACULTY ADVISOR
Michael Swedish

NASA Autonomous Plant Watering System

NASA's Project Veggie, a group specializing in space gardening, has an end goal of growing and sustaining salad-like crop growth on the International Space Station (ISS) with minimal astronaut intervention. NASA has passed on the assignment of creating an autonomous water delivery system to Team GROW, as well as the three preceding MSOE senior design teams (Team BoOM, Team ISSa, and Team Auto Bots). Target specifications and key objectives for this year's project were to create an autonomous system to maintain NASA's Outredgeous lettuce (post-germination) for three full watering cycles without astronaut intervention while also iterating on past years' accomplishments. The system was required to operate in its entirety without the use of electricity and in the microgravity environment of the ISS.

TEAM MEMBERS
Joseph Carey
Hannah Marron
Ivan Moreno
Hazel Ringpis
Cassandra Viol

FACULTY ADVISOR
Dr. Prabhakar Venkateswaran

AIAA Foundation Student Design Competition 2020/21 Undergraduate Team – Concorde Turbojet Engine Redesign

The original Concorde was a supersonic passenger aircraft retired in the early 2000s for its large number of significant drawbacks. Its turbojet engines suffered from high operating costs, low fuel efficiency, and excessive noise. A new low-bypass turbofan engine was required to be designed and integrated within the existing airframe to increase fuel efficiency, decrease operating costs, and reduce noise using modern materials and techniques. A new turbofan engine was designed which included prescribing parameters for major components such as the supersonic inlet, turbomachinery, combustor, and nozzle. The engine was designed to the requirements set by the 2020-21 AIAA Student Engine Design Competition.

TEAM MEMBERS
Adam Aragon
Jacob Beine
Darrian Garrett
Jason Herrera-Diaz
Matthew Shales
Jacob Sirny

FACULTY ADVISOR
Dr. Luis A Rodriguez

National Fluid Power Association: Fluid Power Vehicle Challenge

The NFPA tasked students with designing a human-powered, fluid-power driven vehicle to compete against other schools across the country. The 2021-2022 MSOE team developed the RATT, Rowing Actuated Tadpole Tricycle, to bring an innovative and unique approach to this annual competition. They combined numerous different novel solutions to create one of the most unique vehicles in the competition's history.

TEAM MEMBERS
Seamus Barry
Sam Makovec
Nathan Sebsibie

FACULTY ADVISOR
Michael Swedish

Passive Frozen Food Stowage (PFFS)

The National Aeronautics and Space Administration (NASA) plans for the first crewed mission to mars in the next few decades. A human crew will require food, a place to store it, and a method to preserve it. NASA came to students at Milwaukee School of Engineering in 2019 requesting proof of concept for a passive food stowage system to conserve electricity. Two teams prior created a heat transfer model simulating a method of maintaining the food temperature from 0–4 °C. They experimented with Aluminum's thermal expansion for passively cooling the food. This displacement would actuate a louver (essentially a highly emissive door) that would discard heat into space by radiation and control the food temperature. In this year of the ongoing project, PFFS worked on shifting the food temperature to -20–0 °C, analyzing the effect of thermal transience, and applying this to a rigid and inflatable module.

TEAM MEMBERS
Michael Anderson
Garrett Bachmann
Matthew Schmidt
Zachary Wehner

FACULTY ADVISOR
Dr. Michael Cook

Rockwell Automation: Low Voltage Motor Control Cabinet Autonomous Maintenance Phase II - Extraction and Return

Rockwell Automation manufactures low voltage motor control cabinets (LVMCCs), which include modular "drawers" requiring employees to wear significant personal protective equipment (PPE) when withdrawing or replacing modules. Rockwell Automation wants to implement an autonomous withdrawal and replace solution to not have employees encounter hazardous working conditions while increasing efficiency. Phase I of the project was completed by an MSOE senior design team last year, which they were able to create an autonomous vehicle that can locate the LVMCC. This year, Rockwell Automation initiated an MSOE senior design team to work on Phase II, which consists of fully extracting a module, delivering it to a human, and returning a module to the LVMCC.

TEAM MEMBERS
Marybeth Abts
Michael Spence

FACULTY ADVISOR
Dr. Robert Rizza
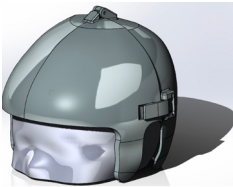
Design of a Cranial Helmet for Plagiocephaly Using Additive Manufacturing

Infants who suffer from plagiocephaly, known as flat-head syndrome, are inefficiently treated by existing corrective cranial helmets. Additive manufacturing can reduce the current high costs, elasticize rigid materials used, create efficient designs and reduce extensive manufacturing times. Selective laser sintering was utilized in designing a lightweight, inexpensive, biocompatible cranial helmet manufactured from BASF Polypropylene to symmetrize the patent's skull to a desired cranial vault asymmetry index of 0%. The design fully integrates additive manufacturing—eliminating post-manufacturing processes—to achieve a print-time of 48 hours. A bivalve, fully enclosed design was utilized because of its ability to correct all severities of plagiocephaly. A lattice structure, or hole pattern, was applied to reduce weight, lower cost and increase breathability to the patient's skin. While a significant amount of material was removed by the lattice structure, optimization has yet to be done to increase material thickness in areas with high loads.

TEAM MEMBERS
Francisco Andrade
Joshua Beier
John Cruz-Barcenas
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FACULTY ADVISOR
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SWITCH MOBILITY REP.
Vinay Sharma

Switch Mobility Private Limited

TEAM MEMBERS
Cebula Kacper
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FACULTY ADVISOR
Dr. Kevin Hart

TEAM MEMBERS
Tobias Buck
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Jonas Moeller
Ole Pattberg
Finn-Niklas Schurbohm

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Dr. Kevin Hart

Torque Sensor for Switch Mobility

The team at Switch Mobility tasked the MSOE design team with creating a device that will deflect when a torque is applied by a rider on an e-bike. This device must displace a maximum of 3 degrees with a 100 N-m load. After every displacement the device must return to the original position with no load. It must also be able to last thousands of cycles and have no performance change when in differing temperatures. Switch Mobility also asked the MSOE design team to design attachment options to secure the device to the existing housing. The team drafted a few separate concepts to present to the company. Extensive material research was completed to see which type of material would perform best under the simulations for the designs. As the team narrows the focus on certain materials, 3D-modeling and testing will continue while maintaining communication with Switch Mobility.

AIAA Space Mission Design Team 1a

As there's little understanding of crewed space travel beyond Earth's moon, the Martian moons are the next steppingstone to further advance our understanding of crewed space missions. This project focuses on a designed research mission utilizing a crewed exploration excursion vehicle (EEV), with the intent of exploring and sampling data from the Martian moons, Phobos and Deimos. The design includes a complete EEV structure, electrical and thermal systems, propulsion, and mission operation, as well as telemetry and attitude control systems. The vehicle is designed to perform orbital transfer maneuvers over a 30-day mission period, visiting both Martian moons in the process.

Design of a lunar vehicle for the two Martian moons

NASA plans manned exploration of the Martian moons, but until now there is no exploration excursion vehicle (EEV) for the task. Therefore, a new EEV needs to be conceptualized and design objectives and constraints developed. The focus is to be laid on the vehicle technology required to transport 50kg of samples, 200kg of equipment and 2 persons from an orbiter to the lunar surface and back. The total cost of the whole mission is not allowed to surpass 1 billion dollars. For this purpose, multiple preliminary concepts for predetermined subsystems were developed and evaluated for their suitability. Future work will include the final implementation of the subsystem and further refinement of the subsystems. This project aims to inspire future development in space explorational field.

TEAM MEMBERS
Alexandra Barker
Ashley Hancock
Dan Inmon
Alan Thomas
Sam Wiess

FACULTY ADVISOR
Dr. Michael Sevier

Design of an Animatronic Hodag

Old-World Wisconsin has tasked an MSOE senior design team with the creation of an animatronic hodag, serving as an additional attraction in their annual Legends and Lore Event. To ensure the final product achieves its full entertainment potential, the animatronic must be large enough to be visible to everyone in a large crowd gathered near it. The hodag will also contain features consisting of movement, lighting, sound, and hot breath created with a fog machine. Additionally, it must require minimal user input by staff so they may focus on guests, and it must have the ability to perform all functions by itself once plugged in. Old-World Wisconsin would like this attraction displayed at their October 2022 Legends and Lore event and must be completed by the end of May 2022.

TEAM MEMBERS
Changhyuk (Brian) Kim
Simo Huhtanen
Trevor Ponath
Paul Rizza
Harlan Schwanebeck

FACULTY ADVISOR
Dr. Mohammad Mahinfalah

American Society of Mechanical Engineers (ASME) Student Design Competition

This senior design group has designed a water powered vehicle that transports the water from a loading area to an unloading area as outlined by the ASME guidelines. The group designed a "drop tank" vehicle where a water tank drops and using a gear and pulley system propels the vehicle forward. The final design has several subsystems which go into the vehicle. These include an aluminum frame, a drive system consisting of plastic gears and a pulley system, drain system with two ball valves, and other miscellaneous components to give support and stability to the vehicle. The team competed in the online competition and placed third.

TEAM MEMBERS
Brodi Johnston
Allen Lowenstein

FACULTY ADVISOR
Dr. Nebojsa Sebastijanovic

SAE Baja Steering

The SAE Baja competition is a collegiate design series competition, where students put classroom theory into practice to design and build a small off-road vehicle. The steering team is responsible for everything from the steering wheel to the knuckles. The steering system is to be designed such that the front wheels of the vehicle can be turned easily and safely during operation with accordance to the SAE rulebook. The steering system will be used to change the direction of the vehicle, being tested directly in the maneuverability and endurance events. Each of the components were designed to be easily manufactured in house or sourced for a low cost. A full prototype steering system is to be made for the Baja club team to be used on a new vehicle.

TEAM MEMBERS
Jordan Kopac III
Kyle Grimm
Connor Sadowski
Matthew Seymore

FACULTY ADVISOR
Dr. Matthew Schaefer

Design of a SAE Formula Hybrid Front Suspension

The MSOE SAE Formula Hybrid car is a student built, high performance race car used for competition in London, New Hampshire. It is essential for it to have a high performing suspension system in place, in order for it to perform at the best of its capabilities. The objective is to design a front suspension system for the next generation MP6 Formula Hybrid car that will improve handling, speed around corners and maximize the grip of the tires. Design constraints include meeting SAE Formula Hybrid rules, weigh less than the current MP5 system, mount to the MP6 chassis and use current uprights and wheels. The approach to this design includes studying current suspension technologies in use in the racing community, modeling the design, performing structural and dynamic analysis and finally constructing a prototype.

TEAM MEMBERS
Alex Li
Nathan Rivera
Nicholas Udell

FACULTY ADVISOR
Dr. Anand Vyas

Design of an Ambient Air Filtration Demonstration Cart

Intelligent Ventilation Energy Controls (IVEC) manufactures industrial air cleaning systems. Their current demonstration at tradeshows requires transport of their full-sized filtration units which comes at a significant cost to the company due to the transportation, set up, and maintenance of the units. The cart will use 1:7 scale models of IVEC's General Ventilation Self Cleaning Dust Collector (GVSC), General Ventilation All Purpose Dust Collector (GVAP), General Ventilation Manual Cleaning Dust Collector (GVMC) and General Ventilation Mist Collector (GVMST) to filter propylene glycol fog from the air in the cart to simulate the filtration of industrial air pollutants. The models will demonstrate the filtration functionality, air flow dynamics, and modularity of the full-size units to allow IVEC to successfully promote their products at tradeshows in a way that is engaging to potential customers and cost effective for the company.

TEAM MEMBERS
James Leigh
William Jalocha
Ryan Peters

FACULTY ADVISOR
Dr. Anand Vyas

Steward System Tradeshow Unit

Our client, Ivec Systems, is a current industry leader and pioneer in energy-efficient industrial filtration and ventilation with their Steward System which allows for a dynamic ventilation response with efficient use of fan assistance and ducting. Our newly-designed show cart showcases how the Steward System operates on an industrial scale and saves energy in real-time. The cart design was split into three main subassemblies that make up this show cart: the Cabinet, Duct System, and Digital Display Apparatus. This show cart will effectively showcase the Steward System to Ivec's customers, showing the benefits that this system would have to any application, and lowering the overall power consumption in many industrial plants. It will help our client stand out from its competition giving them a clear edge in tradeshows.

TEAM MEMBERS
Daniel Gottfried
Peter Holtzen
Ahmad Al Osimi

FACULTY ADVISOR
Dr. Michael Cook

New PneuMan – Electromechanical Team

In the early 2000's a senior design team at MSOE create and humanoid robot made of both electrical and pneumatic components called PneuMan. Since then, their project has been disassembled and its parts have been used for other senior design projects. Last year two teams were assigned to create a new version of PneuMan but with one team focusing on the electromechanical systems and the other team focusing on the pneumatics systems. The major components of the upper body were split up between the teams notably with each team designing an arm. In this oral presentation, a design for an electromechanical arm will be presented. This design will include details about how the arm will be driven, CAD models of the current arm design, the materials and manufacturing methods to create the arm, and a detailed overview of the budget. Future work will involve testing the current prototype of the lower arm and creating new full-arm prototypes to be tested.

TEAM MEMBERS
Evan Hartjes
Alexander Renken
David Reyes
Scott Shappert
Zachary Wehr

FACULTY ADVISOR
Dr. Mohamad Mahinfalah

MILWAUKEE TOOL REPRESENTATIVES
Nolan Henton
Julia Marsh

Nailer Dynamic Seal Evaluation

A dynamic seal allows linear translation via pressurized air. In an electric nail gun, this motion provides the force to strike the nail. Therefore, a thorough understanding of factors that affect the performance of the dynamic seal is critical to optimal nail gun design. The purpose of this senior design project is to develop a test fixture and test plan to test the performance of the dynamic seal inside of Milwaukee Tool's 18V Gen II 18-gauge brad nailer. Six variables have been identified as affecting the performance of the dynamic seal, including the temperature, speed of translation, surface roughness, type of grease, number of seals and type of seal. The test fixture varies these six variables and collects data regarding the performance of the seal. Analysis of this data provides correlations of the effect of these variables on the performance of the seal.

TEAM MEMBERS
Marissa Bousk
Caleb Foster
Tyler Gronert
Matt Krcma
Erik Nelson
Jerred Wilhelm

FACULTY ADVISOR
Dr. Richard Dykowski

Aldon Company, Inc. — Design of a Universal Derailing System

Operating stand derail systems currently on the market require specific sizing to the installation site as well as modifications to the track's structure. Aldon Company, Inc. has requested a design for a permanent operating stand actuated derail system that is size adjustable to any timber-tie constructed track and must withstand multiple derail events. The derail must operate effectively on a common, six-axle, 400,000-pound locomotive traveling at 10 miles per hour.

TEAM MEMBERS
Austin Bukowski
Corbin Gustafson
Erik Johnson
Mitchell Kohlmetz

SENIOR DESIGN SCHOLARS*
Maximus Bryant and Ben Liebl
(Rufus King IB High School)

FACULTY ADVISOR
Dr. Luis A. Rodriguez

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American Family Insurance

PneuMan 2.0 – Pneumatic Team

PneuMan 2.0 is a humanoid robot from the waist up, powered by both electrical and pneumatic actuation. In the year 2000, senior design students endeavored to create PneuMan 1.0, a robot designed to act as a spokesperson for the university and show some the exciting things possible at MSOE. Now, in the year 2022, a group of senior design students seeks to capture the same ambition of the original PneuMan. PneuMan 2.0 moves and gestures with his hands, his facial expressions have the potential to exude excitement, fear, surprise, joy and more, and his arms capable of grabbing and lifting small objects. When PneuMan 2.0 is complete, he will be brought to the schools of students who are excited about STEM studies and perform for them.

TEAM MEMBERS
William Busch
Jack Haek
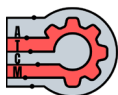Andrew Ramirez
Alexander Reid

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FACULTY ADVISORS
Dr. Eric Durant
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Dr. Nathan Patterson

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American Family Insurance

The Automated Tool-Changing Machine

The Automated Tool-Changing Machine (ATCM) acts as an all-in-one manufacturing and prototyping device and is optimized for use in both small-scale research and development applications and small, hobbyist-level workshops. This device seeks to combine several common prototyping devices, including 3D printers and CNC Milling devices, to take up a much smaller overall footprint in the user's workspace. The machine will allow users to combine manufacturing processes using the included software in order to achieve the rapid prototyping capability of 3D printing alongside the accurate material removal of a CNC machine in one set-up procedure.

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

THL/MSOE Bachelor Theses

STUDENT
Tobias Buck

FACULTY ADVISOR
Dr. Nebojsa Sebastijanovic

Design and analysis of a suspension system for a walking lunar exploration vehicle

To advance the colonization of space/Mars, NASA is planning the next steps on how to safely get from Mars' orbit to its surface and back, with the first step of developing a waking exploration excursion vehicle. The vehicle will have feet with drills and other mechanisms to dig into the ground of the moons. The goal of this thesis is to design the suspension system, perform structural strength analysis based on expected loads, and optimize it to reduce the movement of the chassis. This will be accomplished by evaluating dynamic characteristics of the suspension system and utilizing springs and dampers.

STUDENT
Thorben Kreutzfeldt

FACULTY ADVISOR
Dr. Patrick Comiskey

Investigation of the critical penetration depth of fluid going through a porous material

Droplets impacting a porous surface occur in many engineering applications and the understanding of this behavior is getting more important, especially with the growing COVID-19 pandemic. In this study, a drop of a fluid impacting a porous material is simulated. With the help of that simulation, the critical penetration depth, or the critical thickness of the membrane that liquid does not penetrate past, will be determined. The results of the simulation will be used to evaluate an existing analytical solution of the velocity profile.

STUDENT
Jonas Moeller

FACULTY ADVISOR
Dr. Kevin Hart

Experimental validation of strength and stiffness models for glass/epoxy particulate composites

Various theories have been established describing the behavior of particulate-filled materials predicting the strength and modulus. The mechanical properties are affected by size, shape, and distribution of the reinforcing particles. The scope of the thesis was to analyze a composite of epoxy mixed with glass beads in a press and validating the existing theories with the experimental data. For the experiment, the size of glass beads inside of the epoxy is varied as well as the volume percentage of the glass beads to epoxy. Multiple sets of data were obtained to plot and evaluate the effects on different compositions in the particulate-filled material.

STUDENT
Ole Pattberg

FACULTY ADVISOR
Dr. Kevin Hart

Development of a fatigue test bench to investigate Paris Law constants of a 3D-printed specimen

A newly development filament for additive manufacturing has been used to fabricate additively manufactured structures with improved interlaminar fracture strength. In this study, fatigue properties of materials made with this novel filament will be examined by creating a 3D-printed sample and testing it for fatigue strength. The special characteristic of this filament is that it consists of two different polymers with different melting temperatures. The task is to design and build a machine which can place a 3D-printed specimen with an initial crack into cyclic loading such that the Paris Law constants can be obtained by testing multiple samples.

STUDENT
Finn-Niklas Schurbohm

FACULTY ADVISOR
Dr. Vincent Prantil

Design, analysis, and optimization of the frame for a lunar mining robot

The Lunabotics is an Artemis student challenge to build a robot for a lunar mining mission. The Space Raiders is an MSOE team that has participated in this challenge since 2010. The current mining robot design of the 2021 MSOE Space Raider team contains a frame to which all major components are mounted, including the excavator and the drivetrain. The frame assembly supporting the excavator mechanism can tilt backwards to make the mining robot more compact. The goal of this thesis was to optimize the frame in terms of weight and strength, as well as investigate different materials and connection options, using the loads acting on the vehicle. The new frame design must be incorporated into the current vehicle design and meet all competition rules.

School of Nursing

Summer 2021 Senior Projects

STUDENT
Vanessa Almeida

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Case Management Promotes Increase in Mental Health Care Continuity Among New Veterans

Over a million veterans received treatment for mental illness in the United States in 2018 (U.S. Department of Veterans Affairs, 2021). The Veterans Association (VA) offers many mental health resources for those who can access them; therein lies the issue with prevention and continuity of care for military personnel processing out of the military and newly discharged veterans. Each year veterans report not understanding how to obtain mental health services or who to contact for resources. The issue is that no one provider assists the veterans with obtaining continuous mental health services during discharge and their first appointment with the VA. During the transition from active duty to civilian life, case management for a new veteran would greatly benefit their continuity of mental health care. The virtual agency programs' case management works with the VA and the Department of Defense (DOD) to help veterans with this issue. The program aims to increase veterans' use of mental services during transition from active to discharged to eliminate gaps in care. These veterans will be monitored for a minimum of a year or until discharged by the appropriate mental healthcare provider. Continuous support for the veteran can promote adherence to medical serves and prevent worsening of mental illness (Committee on the Assessment, 2014, p. 424-425, VA to Increase Veterans' Access, 2018).

STUDENTS
Claire Brzenk
Christopher Farruggia
Taryn Kilgore

FACULTY ADVISORS
Robin Gates
Dr. Jennifer Klug

Implementing a Sleep Hygiene Protocol for the Surgical Intensive Care Unit

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

STUDENTS
Danielle Burr
Xandra Slowley

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

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

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

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

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

STUDENTS
Erin Kinney
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Genesis Santana

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

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

STUDENTS
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Mary Beth Tyson
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FACULTY ADVISORS
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Dr. Jennifer Klug

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

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

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

STUDENTS
Ashton Bard
Paige Garski
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FACULTY ADVISOR
Dr. Jennifer Klug

Increasing Student Nurse Confidence in Identification of Fetal Alcohol Spectrum Disorder by Implementing Screening, Brief Interventions, and Referral to Treatment into the BSN Curriculum

Fetal alcohol spectrum disorder (FASD) is the number one preventable developmental disorder. Nursing students have identified that there is room for improvement in their education related to addressing ethically complex situations, like drinking during pregnancy. This current gap in the curriculum about FASD prevention and screening tools is leading to decreased confidence in new graduate nurses when faced with the need to initiate these critical conversations. Adding this education will more fully prepare the student nurses for addressing complex social issues such as FASD. The plan for addressing this problem is to recommend implementing additional information into the BSN program to educate nursing students on FASD and screening tools such as Screening, Brief Intervention and Referral to Treatment (SBIRT) to help increase confidence in new graduate nurses. It is recommended to add didactic education and simulation hours into the curriculum to reinforce the new information. The didactic portion will be given earlier in the program so there is more opportunity to practice the newly presented tools in the clinical settings and simulations. The students in the BSN program will be surveyed at the start of their clinical classes, at graduation and six months post-graduation to determine confidence level in the clinical setting. Students will be more confident as new graduate nurses and will be able to appropriately handle ethically complex situations.

Fall 2021 Senior Projects

STUDENTS
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FACULTY ADVISOR
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Behavioral Health Education for Emergency Department Nurses

In recent years, the demand for behavioral health (BH) needs has demonstrated an increase in incidence and prevalence of BH issues. Studies have shown that 1 in 8 visits to the emergency department (ED) are for a BH complaint, but the ED is not a therapeutic environment for BH patients and can lead toward an escalation of behavior. In addition to environmental concerns, limited education on BH in nursing school can contribute to the lack of comfort and preparedness nurses feel when working with BH patients. To combat these factors, the purpose of this change project is to provide education to ED nurses on managing BH needs encountered in practice. An evidenced based educational program was created and includes mental health first aid, as well as nonviolent crisis intervention components to be completed in 8 hours of online training and 8 hours of in person training. Through this training, nurses will be able to learn and identify warning signs, addiction concerns, and strategies for de-escalation and crisis situations. To evaluate the efficacy of the training program, nurses will take a baseline survey to gage knowledge and specifics before training. Additionally, a post training survey will assess the knowledge gained and the contributed competency. Further evaluation will continue at the 6-month mark to review an improvement in patient outcomes and responses to care, such as the change in the number of inappropriate 1:1 observation orders, and an increase in appropriate patient referrals to BH facilities.

STUDENTS
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Anna Schmidt
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Dr. Heidi Wheeler

Impacts of Education on Nursing Staff Within Long-Term Care Facilities

By the year 2050, the geriatric population will become a significant percentage the of patients receiving health interventions. Within this population, many seniors experience chronic conditions and or diseases which may require admission to a long-term care facility (LTCFs). Life for the residents will change as they face challenges adapting to a new way of life in an unfamiliar environment, and risk factors such as loss of independence and morbidity may lead to depression. To increase nurse preparedness for recognizing

depression within this setting, we plan to implement a two-hour depression-center teaching session. That will cover clinical manifestations, assessments, risk factors, complications, and utilization of screening tools to identify, treat, and ultimately decrease depression in LTCFs. The effectiveness of teaching will be evaluated using participant surveys before and after each session with a follow-up survey after six months to determine how effective the changes are within LTCFs practice. Strategies to minimize barriers involve opportunities for participating nurses to share their opinions and reflections for accepting or resisting the change. The current practice calls for a holistic and evidence-based approach to adequately care for depression within the geriatric population, which is why early depression detection is essential and contributes to maintaining an individual psychosocial and emotional well-being while living in these facilities.

Winter 2020–21 Senior Projects

STUDENTS
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Brittany Luch
Meghan Morrissette

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Dr. Kathleen Mussatto

Implementing Continuous Suctioning to Reduce Ventilator-Associated Pneumonia (VAP) in the Adult Intensive Care Unit

Patients who are intubated and ventilated in the intensive care unit (ICU) are at risk for developing ventilator associated pneumonia (VAP). The use of a specialized endotracheal tube (ETT) that allows for continuous suctioning is an intervention that can significantly reduce the incidence of VAP. The occurrence of VAP in the ICU is the second most common hospital acquired infection and directly linked to mechanical ventilation. The morbidity and mortality that result from the development of VAP is significant, and a change in protocol to continuously suction intubated and ventilated patients should be made to decrease the prevalence of infection rates. Moreover, a diminished incidence of VAP will yield a shortened length of hospital stay and curtail costs. This change in practice will occur in the adult general ICU. Six months after use of the new ETT and continuous suctioning is implemented, the rate of VAP will be compared to the baseline data from the six months prior to implementation. Finally, after assessing the data collected, we will propose to permanently change the protocol for suctioning patients needing longer ventilation time.

STUDENTS
Emma Dellmore
An Ha
Tanisha Neeley

FACULTY ADVISOR
Dr. Amy Ketchum

HealthIO Leadership Change Project Collaboration: Social Determinants of Health Education Module

Unmanaged chronic illness among adolescents leads to a lifetime of irreparable physical, mental, and financial consequences. By addressing social determinants of health (SDoH) among adolescents, third party health and wellness organizations can prevent acute events and promote better health management. Adolescents need strong, consistent support systems and accountability to navigate the complexities of managing new medications and lifestyle changes required for health management. Use of digital therapeutics (i.e. telehealth, mobile apps, virtual health coaching) will give adolescents greater access to these necessary support systems. Partnering with Milliman HealthIO (HealthIO), Milwaukee School of Engineering (MSOE) nursing students are addressing adolescents' health management by developing a SDoH education module for health coaches (HCs). HealthIO HCs will incorporate SDoH screening tools, therapeutic communication, and resource referrals into their practice with clients. A qualitative post-education survey will be completed once by all current and future HCs, to determine effectiveness of the SDoH education module.

STUDENTS
Michael Harris
Chinyere Nwachukwu
Uyi Ovuede

FACULTY ADVISOR
Dr. Kathleen Mussatto

Reduction of Falls Using Adequate Lighting in Assisted Living Facilities

The main purpose of our project is to help reduce falls in assisted living facilities. Our goal is to identify how modifying lights can help reduce falls amongst residents in assisted living facilities using motion-sensing lights that emit wavelengths that are less likely to cause disruptions of circadian rhythms. This project will explore the effects of lighting interventions, including adequate lighting, selective light hues, and motion-sensor lights to reduce falls and minimize disrupting the circadian rhythm of residents in assisted living facilities. Challenges include a lack of definitive information or extensive research on the lighting intervention that will be most effective on fall reduction, budgeting the cost of changing pre-existing light fixtures, and assessing staff satisfaction over the implementation period. The success of this project will be determined by how much falls have been reduced in the facility after the implementation of the identified lighting interventions. Overall, we conclude that falls can be reduced using interventions such as modifying lights to have the least effects on the circadian rhythm and adequate lighting to optimize resident safety.

STUDENTS
Serena Hill
Leah Janes

FACULTY ADVISOR
Dr. Jessica Barkimer

Consistent Use of Mental Health Simulations in Baccalaureate Nursing Programs

Mental health illnesses are a pervasive issue in the United States and impact all fields of nursing. There is a need for improved mental health education to enhance the skills of all future nurses. After experiencing mental health situations, student nurses report an increased understanding of mental illness and provide a better quality of care for this population. Improving undergraduate baccalaureate nursing students' mental health education also allows them to better understand mental illness and combat misinformation and stigma. However, some nursing programs are unable to ensure exposure to mental health situations due to difficulties finding mental health clinical sites or a lack of simulations. This proposed professional change project will examine how the consistent implementation of an existing high-quality simulation in a Midwestern university's baccalaureate nursing curriculum can ensure exposure to mental health situations and change nursing students' preparedness for the care of mental health patients. This project will use the Committee on Academic Practices (CAP), the International Nursing Association for Clinical Simulation and Learning (INACSL) simulation standards, and the SET-M tool to evaluate the longevity, consistency, and efficacy of the simulation. The project is at the current stage where evaluation tools and resources have been analyzed and determined. Going forward, a future senior project group will need to present findings to the CAP committee and implement the addition of the simulation with the SET-M tool to course content and biennial CAP committee review to implement a consistent mental health simulation in this Midwest university's undergraduate nursing program.

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Implementing Uninterrupted Breaks to Reduce Medication Errors During 12-Hour Shifts in an Intensive Care Setting

Research has shown that the risk for medication error rates is higher among nurses who work 12-hour shifts. Considerable harm can come from this as thousands of patients die secondary to medication errors in the United States each year. The purpose of this project is to reduce the number of medication errors made by nurses who work 12-hour shifts in the intensive care setting. This project aims to improve patient safety by supporting nurses who work 12-hour shifts through the implementation of uninterrupted breaks. The plan is to implement a break buddy policy over six months, where one nurse will be paired with another to cover each other's assignments while the other nurse takes a 30-minute uninterrupted break. The effectiveness of the project will be evaluated by examining the number of medication errors reported over the six months compared to the number of medication errors before the intervention. Data will also be gathered via a break checklist from each shift to determine adherence to the break protocol. Longer nursing shifts are common, however the risk for error is much higher during longer shifts. We propose uninterrupted breaks as a way to improve the safety of longer shifts with the goal of reducing medication errors.

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Leveraging Technology to Reduce Medication Errors at Time of Administration

In the U.S. approximately 8,000 people die annually due to medication errors and cost hospitals approximately $40 billion/year. 70% of medication errors involve high-alert medications while 28.3% of medication errors are attributed to dosing errors. Medication administration technologies have shown the ability to prevent these types of errors. To date, there are no technologies that accurately assess whether a dose drawn into a syringe was accurately performed. Successful execution of this technology potentially eliminates time and staff-intensive independent medication double checks, improves nurse efficiency and patient safety. This paper explores the development of machine learning, mobile phone application technology integrated with patient electronic charts to verify that correct volumes of high-alert medications are accurately dosed. Roger's five-stage change theory will be employed by the research team to develop a budget for implementation; engage stakeholders such as hospital boards and nurses; partner with an engineering team

for technology development; engage stakeholders such as hospital boards and nurses; provide device training directly to nurses; and finally implement a three-month pilot study in six different hospital units to measure technology effectiveness at preventing dosing errors. Nurse feedback through multiple modalities to evaluate device workflow efficiency and overall success of the device will be utilized. This research team contends that integration of mobile phone application and camera innovations into the administration of syringe-based medications has the potential to leverage widely available technology to deliver high-alert medications safely and efficiently.

STUDENTS
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Preventing Suicide in Children Ages 7-12

Suicide is the second leading cause of death among children. Because of aspects like the COVID-19 pandemic and the rise of social media, children are at an increased risk of depression and potential suicide ideation. To decrease risk, the of suicide ideation, early prevention is necessary. Since children spend most of their days at school, the approach to incorporate a curriculum that is focused on suicide prevention may have a positive effect on students and give them the tools they need to face a crisis situation. Milwaukee School of Engineering nursing students have collaborated to address the problem of pediatric suicide in children ages 7-12 by providing a framework for suicide prevention and emotional education to lower the risk of pediatric suicide and suicide ideation. The program's effectiveness would be evaluated by pre and post surveys that use a mixture of standardized resources such as the Children's Depression Inventory 2 or the Strengths and Difficulties questionnaire along with program specific questions. The survey will detail general knowledge, suicide risk, and identification of resources. Based on results of the surveys, a conclusion will be drawn on whether implementing this education between the ages of 7-12 years makes a positive difference in the lives of students and the long-term reduction in suicide ideation and attempts.

STUDENTS
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Identifying and Reducing Implicit Bias Through an Interprofessional Community Clinical Site

Nursing students have limited opportunities for direct patient care in community health settings. Lack of opportunities to engage with vulnerable populations such as unhoused people can limit educational experiences which potentially can impact the quality of care provided to these populations. This project aims to determine what types of clinical experience best prepare student nurses to provide quality care to all clients by identifying and reducing implicit bias and preparing them to work well in interprofessional teams. One documented way to provide both nursing care to unhoused individuals and direct patient care experience to students is the formation of a mobile health clinic. Using standardized tools to measure implicit bias and effective interprofessional team management in addition to surveying client satisfaction will provide evaluative data to refine the operation of the clinic and the student experience. Using the plan outlined in this paper as a framework, an urban university can implement and maintain a mobile health clinic to better prepare future nurses for an expanded role in providing primary care to an increasingly diverse population.

Spring 2022 Senior Projects

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Student Wellness Initiative

Our project focused on promoting and preserving student wellness in individuals enrolled in a BSN program. The American Association of Colleges of Nursing (AACN), a national organization dedicated to advancing nursing education, issued a call to action emphasizing the importance of prioritizing practice and programs to prevent student crises in the academic setting. In addition, the AACN identified self-care and wellness as core competencies for BSN students. An in-depth literature review is being conducted to identify evidence-based interventions that can be recommended for implementation within the School of Nursing. Additionally, the literature review will allow for specific areas of need or common themes correlated with decreased student wellness. These interventions will be recommended at the end of the quarter and presented to nursing faculty and students. It is our hope that these interventions are successful in their intent to promote and preserve student wellness.

STUDENTS
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Promoting Efficient Screening for Child Abuse and Neglect in Nursing

An efficient screening tool for abuse/neglect is needed for nurses to assess the pediatric population. Efficient screening includes identifying, assessing, and analyzing all clinical situations. In addition to using well-developed screening tools, promoting nursing confidence in addressing child abuse/neglect is necessary to achieve optimal outcomes for patients.

STUDENTS
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Nurse Burnout and Shift Hours

Nurse burnout is a complex issue that has significant impacts on nursing staff, patient outcomes, and organizations. There is a correlation between nurse burnout, shift length and hours worked. The variable nature of staffing creates challenges which often leads to mandatory additional hours for nurses. Creative scheduling solutions are explored to decrease the number of hours a nurse works in a given day.

STUDENTS
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Understanding Demographics to Provide Access: Providing a Healthcare Clinic to Access Prenatal Care

This is an integrated change project with a national healthcare organization to help develop a women's healthcare clinic within a local urban hospital. This part of the project focused on access and collecting demographic data to help understand the community being served, specifically with a focus on prenatal care. The goal is to facilitate the forward movement of the healthcare clinic. After collecting the data, this group examined potential barriers to access for prenatal care.

STUDENTS
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Suicidal Ideation: Assessing and Generating Safety Plans for Clients in the Emergency Department

Safety planning is a specific and evidence-based intervention for suicidal ideation that can be utilized by providers to bridge the gap between emergency department visits and outpatient management. Safety plans are effective and efficient in promoting patient empowerment through the use of self-identified coping strategies, social support systems, and outside resources in times of crisis. Safety plans can combat current inadequacies within the emergency department when it comes to managing mental health problems.

STUDENTS
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Delirium Prevention in Older Adults using Non-Pharmological Methods

This professional practice project consists of non-pharmological methods of preventing delirium in older adults (age 65+) in an acute care facility on a medical surgical unit at a regional hospital. This project is tailored to our key stakeholders, including hospital administration, medical surgical nurse managers, and medical surgical nurses and nursing staff. Delirium is a huge financial burden on the hospital, patient, family and community, which is why it is important to address.

STUDENTS
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Addressing the Impact of Masked Communication on Those Who Have Hearing, Cognitive, and/or Communication Impairments

Healthcare systems were immensely impacted by the pandemic and results continue to carry into current practice. One result of the pandemic is the use of masks in all patient care settings. Masks have benefits that are proven to decrease the spread of COVID-19, however the impact they have on effective communication needs to be addressed. Patients in the acute care hospital settings are seen by numerous health care providers and team members, each playing a different role in educating patients. The use of masks, removes the opportunity for patients to read lips or see facial expressions. This can lead to mistrust between nurses and patients as well as errors in communication. This can be further exacerbated for patients with hearing, cognitive or other communication impairments. Finding alternative teaching methods to support effective discharge education for this population is the focus of this project.

Physics and Chemistry Department

BioMolecular Engineering Senior Projects

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Dr. Eryn Hassemer

EXTERNAL ADVISORS
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(Exact Sciences)
Dr. Sanjib Bhattacharyya
(Milwaukee Health
Department)

Multiplexing an LFIA to Differentiate between COVID-19 and Influenza Viruses

This project aims to create a dual COVID-19 and Influenza lateral flow rapid test. This test would allow for the differentiation between the extremely similar symptoms of these two diseases. Currently available tests are limited to single antigens or are prohibitively expensive for end users. This test uses novel methodologies of testing to potentially improve specificity and decrease costs.

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SPONSORS
National Natural Science
Foundation of China
MSOE Innovent Center

Development of Gelatin-Coated Microspheres for Bioprinting Vascularized Tissues

The goal of this project is to develop gelatin-coated pectin microspheres for novel bioink design. This research is part of a continuation project with the aim of developing a novel bioprinting method for creating functional, vascularized tissues and organs. The process begins by using an electrospray to produce pectin-based microspheres, which are then coated with gelatin. These are then crosslinked with either transglutaminase or 1-ethyl-3-(3- dimethylaminopropyl)-carbodiimide hydrochloride (EDC) to stabilize the microsphere system. Then the crosslinked microspheres are incorporated into a bioink which is used for bioprinting scaffolds for various tissues and organs that promote cell proliferation. Overall, this team investigates and compares the effects of different crosslinking agents, focusing on microsphere system stability and degradability. A bioink containing these gelatin-coated crosslinked microspheres has the potential to become a reliable and cost-efficient alternative to fabricate human organs and tissues.

TEAM MEMBERS
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A Novel Design for Cell Storage

Team NTR BioEs looks to develop a novel method of mammalian cell storage in order to replace current cryopreservation techniques. This novel design aims to reduce costs associated with equipment requirements and product transportation along with improvements in viability of mammalian cultures. In order to achieve an efficient novel cell storage design, the team has continued prior research into lyopreservation methods. Throughout the duration of the project, the bulk of experimentation and research has been focused on finding methods to improve cell viability after the rehydration of lyophilized mammalian cells. To improve cell viability, the team has performed experimentation to transfect "plasmid X" into HeLa cell lines. Genes contained within "plasmid X" have the ability to improve the structural stability of DNA within recipient organisms. The team has attempted to transfect this plasmid into the HeLa cell cultures using methods such as electroporation and lipofection.

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Validation of Solar Dehydrator for Food Drying Applications

Annually, 2.8 trillion pounds of food waste is generated and discarded, and in sub-Saharan Africa, 95% of the food waste is due to spoilage or loss before reaching the market. Poor food preservation methods aggravate this problem. Agricycle© passive solar dehydrators show potential for preserving fruits and vegetables to prevent food waste. This study serves to develop a controlled laboratory environment to investigate Agricycle© dehydrators and the quality of produce that undergoes solar dehydration. By assessing features such as microbiological load, nutritional value, and water content, this study intends to validate Agricycle© passive solar dehydrators as a simple and effective solution to sub-Saharan African food waste.

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Identification of an Alternative Covid-19 Vaccine Target

Spanning over two years, the current Covid-19 pandemic has been addressed with mRNA vaccines emulating the spike (S) protein in SARS-CoV-2. Team Variant proposes the use of the nucleocapsid (N) protein as an alternative antigen source for a future SARS-CoV-2 vaccine to protect the public against current and future variants of the virus. By collecting FASTA files for SARS-CoV-2 variant sequences from various countries, conservation of the N- protein across variants is observed through evolutionary genomics. Sequence alignment and phylogenetic trees are generated using the Jalview software and the SARS-CoV-2 proteins are visualized through PyMOL and ColabFold. As the protein sequences of SARS-CoV-2 are collected through both the PDB and ColabFold predictions, their 3D structures are inputted into a machine learning program to further evaluate potential mutations across variants.

Notes:

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