TRINE UNIVERSITY

16TH ANNUAL

APRIL 27, 2018

ENGINEERING DESIGN EXPO

BIOMEDICAL • CHEMICAL • CIVIL • COMPUTER
DESIGN ENGINEERING TECHNOLOGY • ELECTRICAL • MECHANICAL • SOFTWARE

ALLEN SCHOOL OF ENGINEERING & TECHNOLOGY
trine.edu/engineering

ENGINEERING DESIGN EXPO 2018
INDUSTRIAL PARTNERS - PROJECTS

Biomedical Engineering
- Blaire Biomedical LLC
- Wishbone Medical LLC

Civil Engineering
- Engineers Without Borders – Indianapolis Professional Chapter
- Engineers Without Borders – Trine University Student Chapter
- Industrial Contracting and Engineering
- M & S Steel
- Perry Products

Design Engineering Technology
- Halex Co., a Scott Fetzer Company
- Heartland Global Services, Inc.
- Keystone RV Company
- Marathon Petroleum Corporation
- Metal Technologies, Inc.
- Triton Metal Products

Mechanical Engineering
- DENSO Foundation
- Foundry Educational Foundation
- Indiana Space Grant Consortium
- JR Automation Technologies
- Pokagon State Park
- Rolls-Royce
- Tenneco Inc. Clevite Elastomer Division – Angola, IN
- Tower Advertising, PhD Inc.

BOOKLET ADS
- Integrated Device Technology
- Kokosing Industrial
- Shambaugh & Son
- Vestil Manufacturing

EXHIBITORS
- Integrated Device Technology
- Shambaugh & Son
- Vestil Manufacturing

CORPORATE SPONSORS – DONATIONS
- Integrated Device Technology
- Kokosing Industrial
- Vestil Manufacturing

NOTES

IF YOU WANT SOMETHING NEW YOU HAVE TO STOP DOING SOMETHING OLD

- Peter Drucker

FROM THE DEAN

The Allen School of Engineering & Technology expresses its gratitude to the many individuals, companies and organizations who have contributed so much of their time, talent, materials and support to make the 2018 Engineering Design Expo an outstanding success.

Special gratitude goes to those individuals who served as industrial consultants. These busy people play an important part in the development of the projects by sharing their knowledge and experience. We also are grateful for the generosity of the many organizations that have sponsored or contributed materially and financially to the projects.

Although each student group has a faculty advisor, it is not uncommon for students to seek advice from other members of the Trine University family. Their interest and concern in helping students is also greatly appreciated.

We sincerely appreciate the area companies that are exhibiting their engineered products as part of today's activities. We are indebted to their support of Trine University academic programs throughout the year.

In addition to Deb Strong, who has been instrumental in assembling this booklet, I wish to personally thank the following members of the Trine administration, faculty and staff who have helped to make this year's expo a success:

Ryan Overton, Ph.D., Chair, Reiners Department of Civil & Environmental Engineering
Sean Carroll, Ph.D., Chair, Department of Electrical & Computer Engineering
Maria Gerschutz, Ph.D., Chair, Bock Department of Biomedical Engineering
Amanda Malefyt, Ph.D., Chair, McKetta Deptartment of Chemical & Bioprocess Engineering
Tom Trusty, Chair, Department of Design Engineering Technology
Darryl Webber, Ph.D., Chair, Wade Department of Mechanical & Aerospace Engineering
Jason Blume, Executive Director, Innovation One
Engineering staff: Karen Morthorst, Sue Radtke, Sheri Thomson, Jeff Raymond and Joe Thompson

And most importantly, the professors in charge of all of the design classes, whose work is on display today.

Finally, special thanks to all of the people in the offices of admission, university marketing and communications, and campus operations, as well as Bon Appetit Management Company, who helped to make this day a success.

Sincerely,

Timothy D. Tyler

Tim Tyler, Ph.D., P.E.
Dean, Allen School of Engineering & Technology

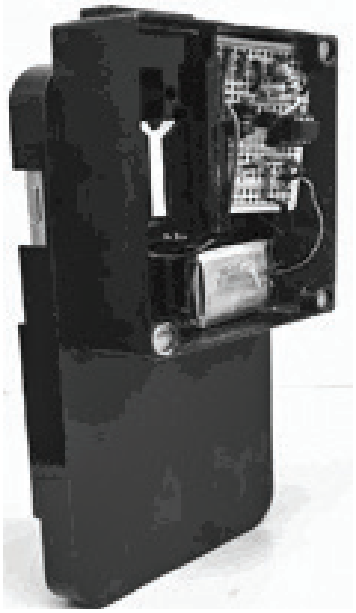
Vocal Assistance Device

Members: Bryce Hina, Hunter McMahan and Paul Jackemeyer
Advisor: Melanie G. Watson, Ph.D.
Sponsor: Bock Department of Biomedical Engineering

The purpose of this project is to create a vocal assistance device that will improve the speech quality of patients with laryngeal damage. The device components include acoustic filter, amplification and modulation digital systems accompanied by a microphone and speaker circuit. The device, itself, is small in size as to remain discreet and contains a rechargeable battery for everyday use. The main goal of this project is to improve the lives of those who have laryngeal damage, suffering reduced quality of life as they find everyday speaking and the comprehension of their vocal tones a challenging task.

Our group worked closely with Dr. Steven White, a laryngectomy patient, to set the requirements and desired features of our device. The desired features of the vocal assistance device included real-time acoustic signal filtering, voice amplification and modulation, a compact, discrete housing for the electronic components, and Bluetooth wireless capabilities. We then worked to implement as many of the customer needs as possible while adhering to the design requirements provided. After some initial research, we created specialized microphone and speaker circuits designed specifically for patients with laryngeal damage. In addition, we implemented real-time audio processing and Bluetooth wireless connectivity via a customized microcontroller. Audio signals were filtered, modulated and amplified using this microcontroller. We also designed two sturdy, discreet enclosures used to house all the electronics and circuits. These enclosure designs include a necklace and lapel pin option to suit patient needs.

SmartMed Case



Members: Robin Furnish, Madison Hatkevich, Anna Kersey, Mahmoud Khalil and Paul Jackemeyer
Advisor: Melanie G. Watson, Ph.D.
Sponsors: Bock Department of Biomedical Engineering and Blaire Biomedical LLC

The purpose of this project is to create a handheld, low-cost hematology device capable of securing to a smartphone and performing blood cell analyses in real-time. Ideally, the device would provide simplified complete blood counts (CBCs) via smartphone. Currently, the device is able to quantify white blood cells (WBC) at the point-of-care. This technology would significantly decrease risks associated with hospital-acquired illnesses as well as increase the frequency of CBC testing for chronically ill patients.

Overall, the device operates on the electrokinetic principle of charge-based microfluidic live and dead WBCs and red blood cell (RBCs) separation. Negatively charged WBCs and RBCs are manipulated via a >180 V electric field system into specific loci within a hybrid microfluidic paper-based analytical device (μPAD). The smartphone camera images the live WBC and RBC components while a proprietary phone application processes the images, quantifying blood cell counts.

This year, several tasks were performed to improve the previous design. A 3D-printed blood-testing cartridge was designed and developed to fit inside the optical analysis (OA) box. This cartridge houses the μPAD and facilitates direct transfer of separated blood cell samples to an imaging region aligned with the smartphone camera. Additionally, the OA box was outfitted with a rechargeable 3.7 V lithium-ion battery, miniaturized cell cytometer circuit, and a user-friendly push-push mechanism designed for easy cartridge entry and removal. Furthermore, microscopy stain/dye combination tests were performed to improve cellular detection and quantification results. Finally, a standardized testing procedure was developed to increase results uniformity and repeatability. In turn, the standardized procedure aided in increasing the computational image analysis accuracy rates up to 70%. Future work will involve the implementation of an advanced magnification lens to increase the current image analysis accuracy rate.

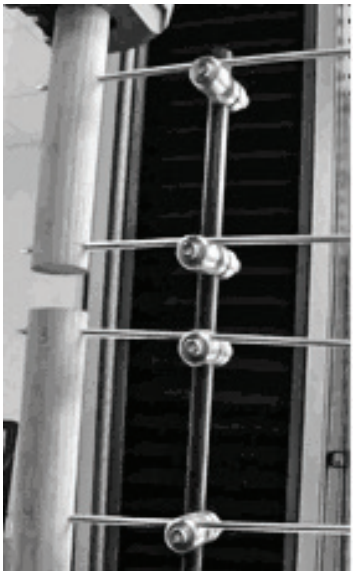
Surgical Measurement Tool Device

Members: Haley Smith, Austin Crouse and Ryan Bosse
Advisor: Melanie G. Watson, Ph.D.
Sponsor: Innovation One & Wishbone Medical LLC

The purpose of this project is to design a surgical instrument to reduce the overall 37% error made during the bone realignment stage of an osteotomy surgical procedure. This particular surgical procedure is performed to correct bone malalignment and gait pattern issues, and redistribute diseased compartment load-bearing weight with well-preserved articular cartilage. Currently, related surgical instruments have several limitations, including high costs, extended procedure times and biocompatibility concerns. The scope of this project is to create a device capable of measuring rotation angles during pediatric osteotomies. The device's required features included flexion/extension, rotation angles, distance and abduction/adduction, and contain wireless connectivity capabilities. Additional device features include a single-use design, compatibility with pediatric patient anthropometrics, small/compact housing, and design for sterile packaging.

To begin the project, our group collaborated with an orthopaedic surgeon, who provided helpful information, including the integration of Bluetooth technology to achieve our wireless connectivity objective. With this information, we designed a compact device to house micro-controllers, a 9 V battery and other electronic components used to calculate all the required angles and distance measurements. An algorithm was generated to calibrate and collect angle, distance and abduction/adduction data points via the aforementioned components. The algorithm also wirelessly transmits these data points to an Android phone application used in the surgical suite away from the sterile field. Due to the use of cost-effective components, the device may be disposed of after one use to eliminate infection risks. The device will be used after the initial cut to the bone has been made to affirm the angle the surgeon must achieve to correct the weight-bearing load, or maligned bone.

Pediatric External Fixator System

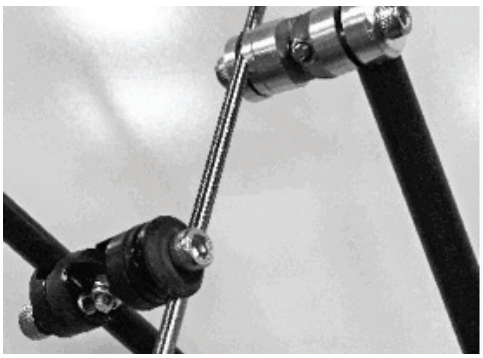


Aluminum design testing using ASTM compression standards for single clamp external fixation systems

Members: Joshua Donahey, Rourke Carroll, Cody Reer and Elizabeth Propes
Advisor: Melanie G. Watson, Ph.D.
Sponsor: Innovation One & Wishbone Medical LLC

The purpose of this project was to design, prototype and test an external fixator system exclusive to pediatric patients. External fixator systems are not an unknown medical device commodity and are extensively used in orthopedic procedures. However, there are no external fixator systems available on the market exclusively for pediatric patients. The goal of this project was to design a universal pediatric external fixator system that can be used by all orthopedic surgeons and practitioners to suit multiple surgical needs.

Wishbone Medical LLC provided our group with a list of customer requirements and potential device features. These requirements included a lightweight, single-use design that incorporates additional angles of rotational motion, offering increased practical versatility as compared to the current market standard. Additional features included the development of sterile packaging designs as well as minimizing manufacturing and material costs. Our group manufactured two prototypes: one with 3D-printed ABS plastic clamps and one hand-manufactured clamp using aluminum. Both external fixator clamps accommodate 8–11 mm connecting rods and 4–6 mm pins, allowing an orthopedic surgeon multiple options in the operational room. A potential benefit of the ABS plastic clamp is that it was designed to be 3D-printed, and sterilized in the field. As both devices will be the first external fixator systems exclusive to pediatric patients, they have the potential to hold 100% of the market share as well as revolutionize the surgical process for external fixator pin-in-bone placement.



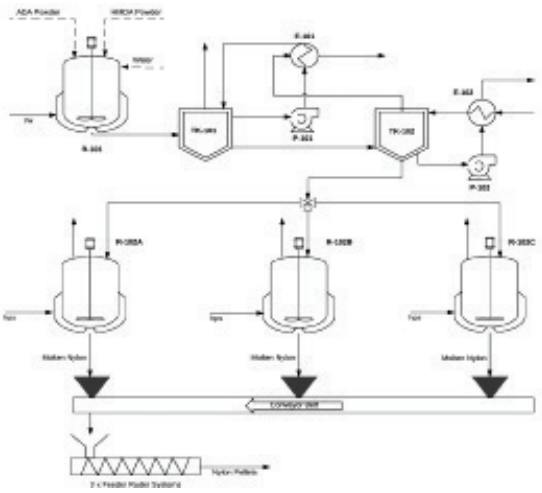
Aluminum clamp using an 11mm rod (large) and a plastic 3D-printed clamp using an 8mm rod

MCKETTA DEPARTMENT OF CHEMICAL & BIOPROCESS ENGINEERING

Each year the Chemical Engineering class participates in the AIChE National Student Design Contest. Unfortunately, contest rules prohibit publicly presenting the results until after June 1. In addition to this contest however, the seniors complete a minor design project. The AIChE Contest problem for the previous year is given below in addition to the Chemical Engineering Minor Design Projects.

Chemical Engineering Design Major Design Project from 2017: Manufacturing Facility for Nylon 6 6

Members: **McKetta Department of Chemical & Bioprocess Engineering, Trine University AIChE 2017 National Student Contest – Winner – individual category**
Safety and Health Division Winner
Advisor: **John Wagner, Ph.D.**



As part of the senior design course, students in the McKetta Department of Chemical & Bioprocess Engineering compete in the AIChE National Student Design Contest. Last year, the contest problems involved the design of a facility to produce nylon 6 6.

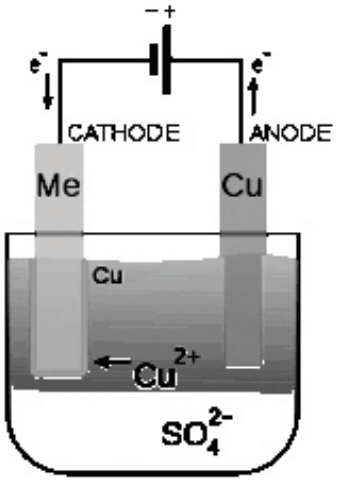
Oanh (Skye) Nguyen from Trine University won both the national contest and a safety award, while Kevin Mercks won a national safety award for his entry.

The process flow diagram for Skye's semi- batch process is given above. The total capital investment was estimated to be $23 million with a rate of return of just under 50%. However, this rate was very sensitive to the price structure, which can be volatile.

Copper Electroplating for Educational Outreach

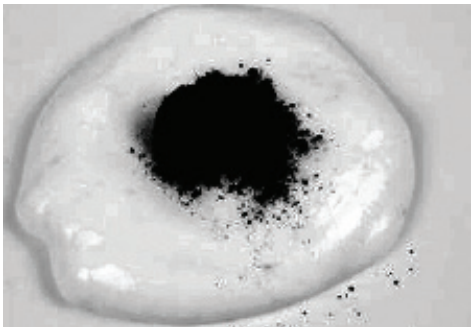
Members: **Mitch Bedree and Raleigh Whitham**
Advisor: **John Wagner, Ph.D.**

This project will develop a kit for Trine students to use as an educational outreach tool for high school students. The presentation will begin with the setup of the electroplating apparatus. The electroplating solution will consist of oxalic acid, trisodium phosphate and ammonium sulfate in water. As the electroplating process takes place, the students will have an opportunity to learn about basic electrochemistry and electroplating. The students will then be able to observe the effects of the electroplating before a short summary discussion. Each kit will contain the chemicals needed to make the electroplating solution, a beaker to contain the reaction, copper, a DC power supply and items to be electroplated.



High School Outreach: Magnetic Slime and Electroplating

Members: **Anndi Wood and Megan Manes**
Advisor: **John Wagner, Ph.D.**



The purpose of this project is to create instructional kits to introduce high school students to chemistry and chemical engineering. The leader of the demonstration will begin by introducing the topics of polymers and magnetism. After the students have gained a brief understanding, they will work in groups to apply these topics and create magnetic slime from raw materials. Each kit will contain white glue, liquid starch, black iron oxide and a neodymium magnet. After the slime is created, students will have the opportunity to test the magnetic properties of their slime. The kits contain enough materials to allow each student participating in the demonstration to take their slime sample home.

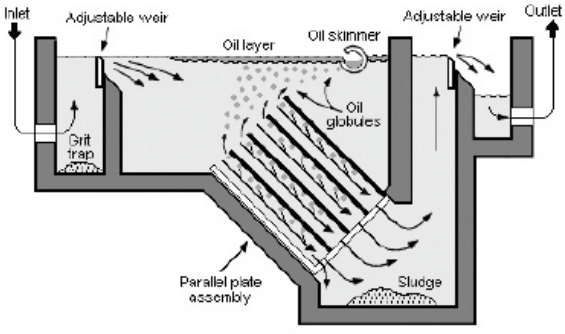
Brewing in a Coffeemaker

Members: **Daniel Barzycki, Jed Bowen and Riley Johns**
Advisor: **John Wagner, Ph.D.**

The goal of this project is to design an automated control system for a small, semi-batch brewing process inside a coffeemaker. This process requires several different operating temperatures (within a range of 65°F to 212°F) and thus needs a temperature control system. The control unit consists of a thermocouple and a controller. The type-K thermocouple fits through a weldless bulkhead into the coffeemaker and sends readings to the Raspberry Pi controller that turns the built-in heater on or off. This brewing process can be used both to demonstrate an enzymatic reaction and as a controls experiment.

Wastewater Treatment Video

Members: **Zack Skorka and Nicholas Shane**
Advisor: **John Wagner, Ph.D.**



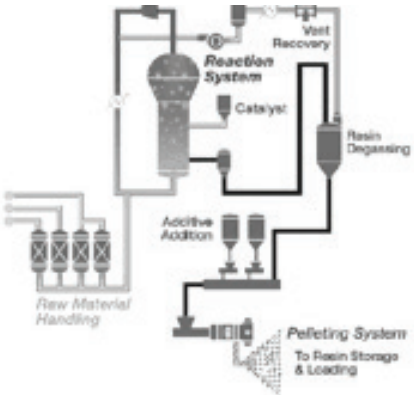
This two-to five-minute video will demonstrate one of many ways that chemical engineers have an impact on industrial wastewater treatment and will be created as a high school outreach. The video will explore some of the problems in cleaning water from different industrial processes, the consequence if these problems go unsolved, and how chemical engineers have solved some of these problems. This video will be submitted to the AICHE national video competition and must abide by AICHE contest rules.

Manufacturing of Polyethylene

Members: **Anas Qari, Brett Balka and Sebastian Ponicki**
Advisor: **John Wagner, Ph.D.**

The goal of this project is to present an analysis and explanation of the process for manufacturing polyethylene plastics, which exist in three forms: Low Density form (LDPE), Linear Low Density form (LLDPE) and High Density (HDPE). The process that we will examine is known as UNIPOL, which was developed by Univation Technologies and is currently in use at 110 operating reactor lines in 25 different countries (thus producing 25 million tons of PE annually).

Locations where the UNIPOL process is used (from univation.com)



The UNIPOL process diagram (from univation.com)

The process we will use includes a reaction system to turn the ethylene feedstock into polyethylene, and a pelleting system to turn the resin into the final product. Furthermore, the process only uses three main pieces of major rotating equipment - cycle gas compressor, a vent recovery compressor and the pelleting system - thus making the process simpler, safer, and cheaper to operate.

REINERS DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING

New Trine University Entrance

Members: **Chad Holdwick, Ethan Price, Saif Almutairi, Alex Bourke, Adam Ciszewski and Joe Lancaster**
Advisor: **Prof. T.J. Murphy**

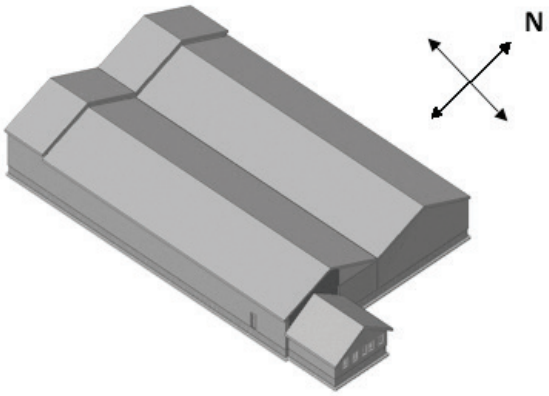
The purpose of this project was to design a new roadway that leads into Trine University and to implement a traffic signal at the intersection of McKinley Street and US 20. This road would run south from the new intersection, behind the golf course apartments, and connect with Thunder Drive by the tennis courts. The main goal of this project was to create a road that connects to the MTI Center to improve traffic flow. The design team investigated alternative paths, intersections and road layouts.

The group completed a topographic survey to create a topographic map and determine vertical and horizontal alignment for the road. The group did earthwork calculations following INDOT standards to design a signalized intersection. All of this was performed using AutoCAD design software. A traffic study also was performed by the group at the intersection of Summit Street and US 20, because this was determined to be the western entrance into Trine University. This information allowed for our group to meet design criteria for the new intersection. The final design includes a traffic signal, new entrance into Trine University, rain garden to account for storm water, and a six-foot-wide sidewalk that runs the length of the new roadway.

Tri-State Gymnastics Gym Addition

Members: **Mariah Fenimore (Project Manager), JJ LaBounty, Charlie Mattox and Jake Shelley**
Advisor: **Prof. T.J. Murphy**

Tri-State Gymnastics is a local gymnastics training center in Angola, Indiana. Enrollment has nearly doubled since 2014. To compensate for growing interest, owner Misti Evans would like to extend the gym area to double its square footage for a bigger training area and a parent viewing area, as well as additional interior rooms to continue building enrollment. The extension is planned for the property on the north side of the existing building, which is a flat, open area. The current building is 10,506 square feet. The new addition will extend the back wall on the north side of the building to add an additional 10,440 square feet. A portion of the north wall will be removed for the addition to be constructed. There will be four interior walls. Two interior walls will be a continuation of the current interior walls for the parent viewing area. Two new interior walls will be added on the back side of the remaining north wall to create new interior rooms.



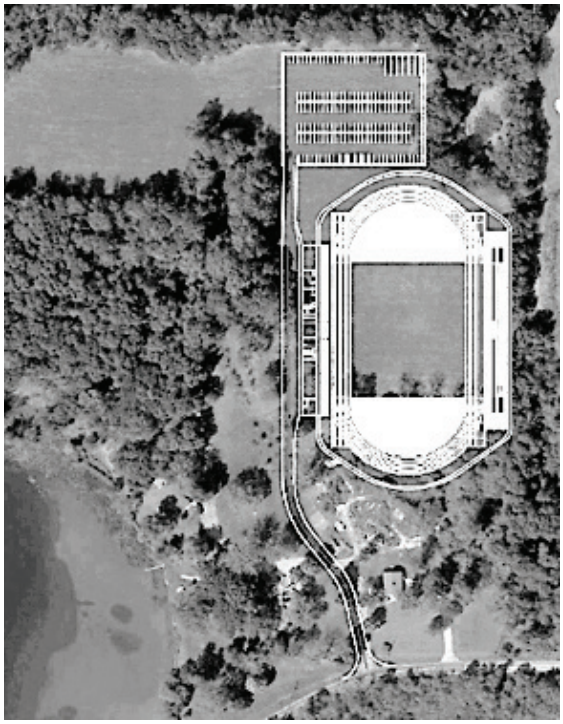
The group surveyed the property and took soil borings to characterize the conditions of the site. The group designed the roof, roof support trusses, columns, beams and footings for the new building. Additionally, a new parking lot and driveway were designed. The parking lot added 24 new spaces, and the driveway allows for better flow of traffic around the gym. Finally, a storm water management system was developed to use a Low Impact Development (LID) infiltration trench, which mitigates the impact of the storm water runoff due to the new construction.

Trine University Outdoor Track Facility

Members: **Patrick Richardville, Nicholas Gollifer, Nicholas Hayes, and Khalaf Aldawsari**
Advisor: **Prof. T.J. Murphy**

The purpose of this project is to address the need for an outdoor track facility at Trine University. For the outdoor season, the Trine track and field team currently travels to Angola High School to practice, and the team competes in most of its meets out-of-state. The proposed location is south of Trine's campus between Zollner Golf Course, Fox Lake, and Fox Lake Road. The proposed facility includes an IAAF Standard 400m track surface in our school colors, navy and Vegas gold, a two-story stadium that includes seating for 1,500 spectators, men's and women's locker rooms, bathrooms, concessions, ticket booth, weight room, athletic training room, conference room, timing booth, and coach's offices that overlook the track.

The project included a topographical survey, soil borings, structural design, hydraulic analysis and environmental assessment. During design, two unique challenges were faced: a 60-foot change in elevation between the proposed parking lot and Fox Lake Road, and wetland mitigation and replacement.



Engineers Without Borders Comuna Guangaje Water Project

Members: **Bradley Whitehead, Rebecca Plantz, Francisco Perez and Braydon Poulson**
Advisor: **Professor T. J. Murphy and Tim Tyler, Ph.D.**
Partners: **Engineers Without Borders Indianapolis Professional Chapter**
Engineers Without Borders Trine University Student Chapter

Comuna Guangaje is a small, rural community of approximately 400 residents in the Ecuadorian Central Highlands region. This community's location and altitude create a semi-arid climate year-round and treacherous terrain. The community chronically lacks adequate water due to a combination of sporadic rainfall and the inefficiency of its existing ground water collection system. Residents currently live on approximately 15 liters of water per day for drinking and cooking needs. This is roughly one-fourth of the water used in a single shower for the average American. The goal of this project is to determine, design and implement solutions that will provide access to water for the community. The senior design group is collaborating with the Trine University Student Chapter of Engineers Without Borders and with the Indianapolis Professional Chapter of Engineers Without Borders. The Indianapolis chapter consists of Roger Ward, Allen Boyd and Kendra Harding.

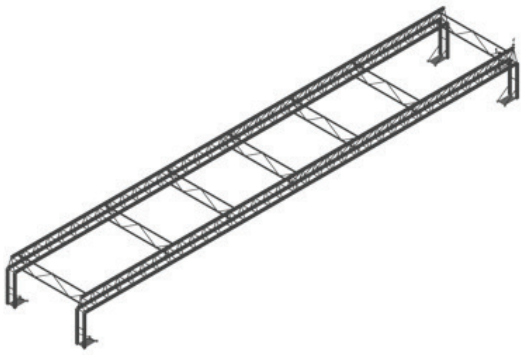
An initial assessment trip was conducted in September 2017. Three students and one faculty, along with three engineers from the Indianapolis chapter, traveled to Ecuador to assess the community's water problem and collect data. The area contains a number of natural springs, some of which are high mountain springs, while others are lower and feed small creeks in the valley. Four possible solutions were determined. Two options consist of pumping water from separate sources into the existing water system. The third option is to install spring boxes that collect water from the high mountain springs. The fourth option is to install rain catchment systems on all houses. The final implemented solution will consist of a combination of these four options. Each option was graded on effectiveness and sustainability. The first implementation trip is scheduled for September 2018.

American Society of Civil Engineers Steel Bridge Competition

Members: **Andrew Hauersperger, Trevor Creager, Austin Gurley and Dayton Sweet**
Advisor: **Professor T. J. Murphy**
Partners: **M & S Steel, Industrial Contracting and Engineering, Perry Products**

The ASCE Steel Bridge is a 1:10 scale replica for a mass transit bridge for the Burgeon County Transportation Commission (BCTC). The bridge is designed to carry mass transit, bicycles, pedestrians and emergency vehicles. The intent of the bridge is to serve growing populations without overwhelming antiquated road infrastructure for the Willamette River. The bridge will be erected under simulated field conditions and will be tested for stability, strength and serviceability using standardized lateral and vertical loads. Important considerations for the bridge and design are construction costs, construction duration and aesthetics.

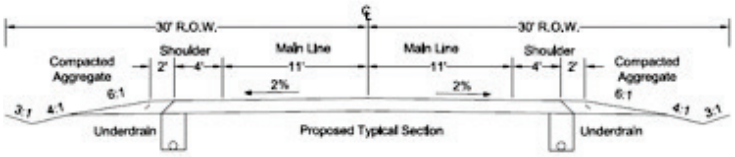
The group designed the bridge following ASCE Steel Bridge rules, which define how high, wide and long the bridge can be. The rules also specify the types of steel that can be used. The group used A500 steel for all of our members and used Visual Analysis software to design the bridge. We used this software to design all of our members and to maximize our strength while minimizing weight. We tried to utilize new connection types and create each member to fit specifications to minimize our build time. The bridge uses 1-by-1-inch HSS members for its main members and a Howe truss to distribute the loading placed on the bridge.



The group competed at the ASCE Great Lakes Region Student Conference Competition in Chicago on April 20, 2018. The results were not known when this abstract was published.

Steuben County Road Project: County Road North 100 East

Members: Rick Perry, Lucas Richardson, Chelsea Oakley and Michael Trader
Advisor: Prof. T.J. Murphy



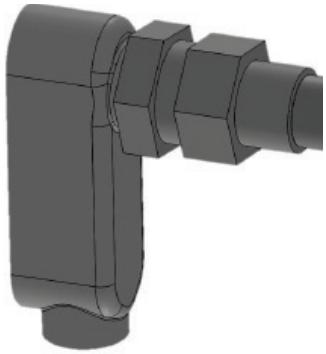
The main purpose of this project is to improve the comfort and safety of travel on CR North 100E. The safety issue is due to the drastic changes in vertical elevations along the length of the road and limited sight distances at several intersections. One of these intersections, CR N 100 E and CR E 200 N, contains a dangerous horizontal "s-curve" that also needs to be straightened to improve the safety of the intersection. CR N 100 E passes through residential and agricultural land, containing many nearby wetlands that have been formed due to runoff and poor drainage. The cross section of the existing road has 11-foot travel lanes with no shoulder, 40 feet of right-of-way, and poorly defined ditches.

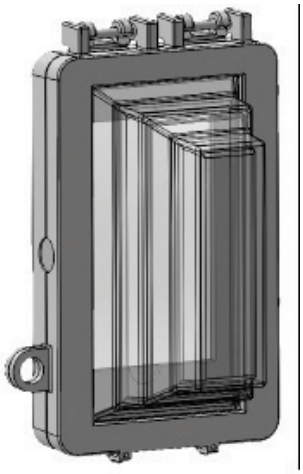
The group performed a topographic survey of the edge of pavements along with all the existing structures, signs, utility poles and culverts along the roadside. The group also analyzed the drainage culverts to ensure they had capacity to convey the storm water runoff from the agricultural fields and into the ditches. The group took soil borings using hand augurs and analyzed them in the lab in order to characterize the soil that would be part of the new road subgrade. The group evaluated traffic data to estimate the Annual Average Daily Traffic of the roadway, which is needed to design the pavement. The pavement was designed using an INDOT pavement design program named PaveME, to accommodate the site traffic and soil characteristics for the proposed roadway. Additionally, the proposed vertical and horizontal alignments of the intersection and the entire roadway were then designed to reduce the roller-coaster feel of the roadway and meet all stopping sight distance requirements.

DEPARTMENT OF DESIGN ENGINEERING TECHNOLOGY

Conduit Body / In-Use Cover Redesign Project

Members: Eddie Childers, Jessie Dowell, Grant Hensley and Kevin Moden
Advisor: Prof. Tom Barkimer
Sponsor: Halex Co., a Scott Fetzer Company





The team is sponsored by Halex Co., a Scott Fetzer company that runs by the motto, "Yes, we can do that!" The company manufactures and designs various electrical products for industrial and consumer applications. The team was challenged with two separate problems involving Halex products. The first was redesigning a Conduit Body LB for limited-space applications. The problem occurs when installing into tight locations where the user is not able to rotate the body freely to tighten the LB. The team developed the idea of creating a union-style free-rotating fitting that eliminated the need for rotating the body during installation and proposed solutions for a secondary part that acts as a compression fitting union. The second problem was to design a weatherproof in-use outlet cover that meets the Extra Duty standard and is collapsible. The current products on the market damage the wires by exceeding the recommended bend radius or are too large to be aesthetically pleasing. Halex desires that the cover be injection molded and have a competitive price point with other covers on the market. The team investigated various methods of collapsibility and chose to pursue a model that folds into itself as a single unit and is self-supportive when expanded.

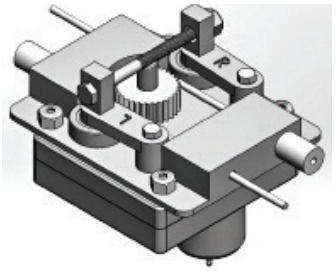
Tube Laser Cart and Crane Project

Members: Joseph Domogalik II, Thomas Lapham, Zachary Thiel and Ryan Voirol
Advisor: Tim Jenkins, Ph.D.
Sponsor: Triton Metal Products

Triton Metal Products (Triton) is a custom metal fabricator here in northeast Indiana. One challenge during production is the loading of the Adige Tube Laser machine used to make specialty material cuts. The proposed crane and cart are solutions for laser operators to assist in loading the machine on the single tube side and bundle tube side. Due to limited space, a forklift cannot safely and efficiently load the machine without causing damage to the machine on either side. The crane is the solution for the forklift's problems. The crane assists operators in loading bundles of tubes on the back side of the machine. The crane utilizes a motorized electric trolley and hoist rated for 6,000 pounds. The trolley contains a user-friendly remote the operator uses to control the material during transport. The cart shown is the solution for operators to safely load a single bar of material on to the machine at a time. The cart is sitting at the same height as the loading table on the machine. Operators can easily roll tube steel from the cart and place it onto the machine for safe, easy manufacturing. The cart features manual brakes that prevent it from moving unintentionally while in use.

Motorized Telescoping Pontoon Ladder Project

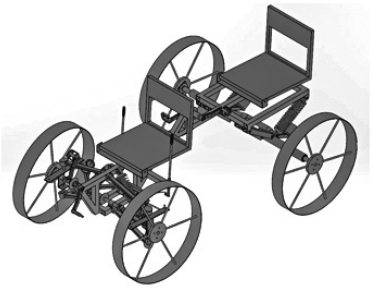
Members: Spencer Brown, David Crowder, Nick Elston and Kyle Holsten
Advisor: Prof. Tom Barkimer
Sponsor: Heartland Global Services, Inc.



Heartland-Global Services, a product developer and distributor in the marine industry, desired to redesign the HM3070 Stainless Steel Pontoon Ladder. The current HM3070 ladder has two parts, a handle component with mounting plates and a ladder section with telescoping rungs. The two parts connect at a single bolt on each side for a hinged operation. The current design issue is that users must get down on the deck of the pontoon for removal and folding of the ladder rungs after deployment. The design team proposed two general motorized solutions to the sponsor. The first design replaces the two bolts in the folding operation with motors where the telescoping rungs remain manual, but easier to access. The second solution proposed was to integrate the telescoping ladder rungs and handles as one part. The single-part ladder was selected and integrates a push-pull cable system driven by a 12 Volt Direct Current motor to extend and retract the ladder with a toggle switch. This system will be compatible with the pontoon's existing power source and will not require any more deck space than the existing ladder. Final concept design bonuses are taller handles and the elimination of water spray from the low bolt and hinge design on the original HM3070 Pontoon ladder.

NASA Rover Human Exploration Project

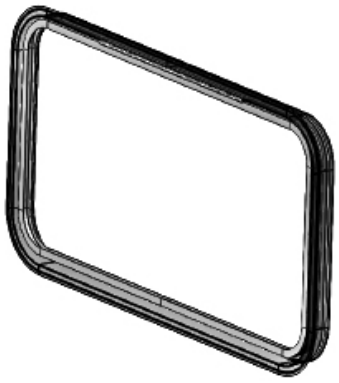
Members: Brodie Bender, Gabe Clarkson, Melissa Grahovac, Noah Gray, Andrew Pelot and Nathan Rea
Advisor: Tim Jenkins, Ph.D.
Sponsor: DET Department – Trine University



The NASA Human Exploration Rover Challenge is a design competition that allows high school and university teams to design a two-person powered vehicle. The university division teams are tasked with creating a vehicle that can transverse over 14 different obstacles within six minutes. The university teams are required to create wheels, frames and a drive train for the rover with a 40% change from the previous year's rover.

The competition was designed to challenge students mentally and physically as well as get them involved with exploring and engaging young students (K-12) through facilitating a STEM activity. For the design project, the team had three concepts: a double bar sliding frame, a single bar folding frame and a double bar folding frame. For the final rover design, the team decided to combine different aspects of the single bar folding frame and the double bar sliding frame. The team plans to create a single bar frame that utilizes four-wheel drive and uses lever steering. The rover design also will have foldable seats with independent front suspension and four-link rear suspension.

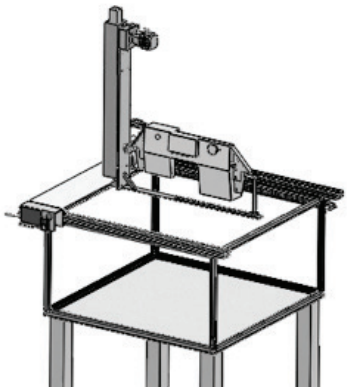
RV Luggage Door Redesign Project



Members: Lazarus Conley, Richard Kranze, Boyang Li and Bryan Mckinzie
Advisor: Prof. Tom Barkimer
Sponsor: Keystone RV Company

Keystone RV creates innovative products that are built tough and provide a better ownership experience while "Building Adventures for the Long Haul." Currently RV luggage doors have a problem of leaking when it is raining, a widespread problem within the RV industry. This can damage valuables in the compartment as well as create rust and rot over time. The purpose of the project is to reduce leaking in the baggage doors for Keystone RV. The team redesigned the frame of the door to create a tighter seal between the door and the frame to eliminate the leak issue. This resulted in a stronger seal against water, keeping the baggage compartment and its contents dry. The team has replaced the original hinge with a new piano hinge to create a more robust design. The team also replaced the current D-seal with a more robust seal. These changes will further protect the interior of the luggage compartment from water.

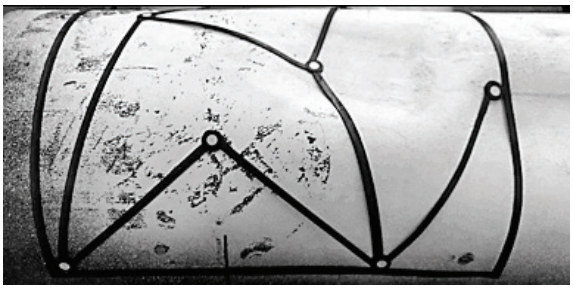
Surge Tank Testing Machine and Tank Project



Members: Kevan Barissi, Chris Habegger, Kendall Miller and Justin Stout
Advisor: Prof. Tim Jenkins, Ph.D.
Sponsor: Triton Metal Products

Triton Metal Products is a custom fabrication shop that serves a diverse customer landscape. One of the challenges for the company is the proper testing of commercial automotive surge tanks. These tanks must be pressure tested to ensure there are no leaks. The current method consisted of a worker manually holding the surge tank underwater. Not only was this unsafe for the worker in the event of a catastrophic failure, it also didn't guarantee workers were testing the surge tanks according to the testing standard provided to Triton by Spartan Chassis. The design problem is to create a new apparatus to allow workers to test the tanks safely and to the established standard. The proposed solution is a test apparatus to improve the process in which the workers pressurize, submerge and test the multiple surge tank models. Triton fabricates multiple tank models and designs, so an easily adjustable special bracket, or brackets, that work in conjunction with the submersion mechanism need to be created. The team needed to be space conscious with the proposed design, as seen here, due to the limited space allotted at Triton.

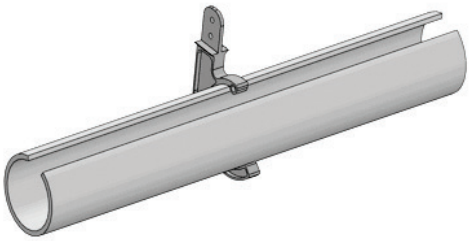
3D Scan Overlay Project



Members: Zane Bierman, Sam Loga, Dominic Peloso and Jordan Stevens
Advisor: Prof. Tom Barkimer
Sponsor: Marathon Petroleum Corporation

Marathon Corporation owns and operates 8,300 miles of pipeline that moves refined products across the United States. One of the system requirements is to inspect the pipes for damage. The current method of placing small target dots on the damaged oil pipe by hand is time consuming, costly and inefficient. The design team's task was to create an overlay to help aid with 3D scanning of damaged oil pipes out in the field, which will save time and money. The 3D scan overlay must meet precise specifications while incorporating repeatability, reusability and ease of application. Through interviews, concept generation, testing and implementation, the design team created a rubber overlay that would adhere to the pipe in all conditions. The design team believes this concept's pattern and application would meet all the requirements and needs set by Marathon. While the concept met the requirements for adhering the targets to the pipe, more research is needed to find a thinner material, since the current material interferes with defect detection. This rubber square overlay is a crucial stepping-stone for future iterations of the design. The team hopes this idea will gain ground and be useful to other oil companies allowing for a faster, more accurate and simpler solution to scanning damaged oil pipes around the world.

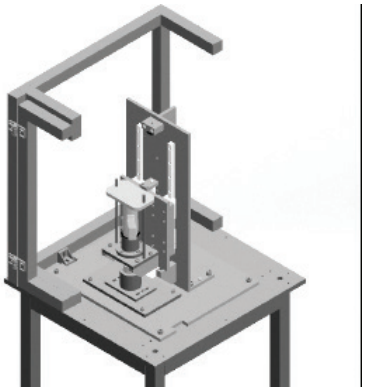
Wire Management System



Members: Kevin Fitzsimmons, Daniel Hogenkamp and Casimir Kromkowski
Advisor: Tim Jenkins, Ph.D.
Sponsor: Halex Co., a Scott Fetzer Company

Through a partnership with Halex Corporation, a manufacturer of various electrical components for both residential and industrial uses, the design team helped solve an issue with wire installation. The design team was tasked to design a system to manage wires and reduce the installation time for electricians. The product also needed to satisfy certain standards involving safety and wire weight, while being modular so installation can be made in a variety of settings. This product allows wires to be hung from building joists in a more efficient manner than the current methods of stapling to or drilling holes through the joists. These methods are less than ideal because wires cannot easily be removed at a later point in time. The team's product mounts to the joists and allows the user to feed wires in and out of a PVC pipe running between each hanger. The bracket also allows for the tray to slide into the bracket underneath the wires if needed.

Carbon Pin Crusher Machine Project



Members: Brice Bauer, Matthew Magliola, Jonathan Toles and Andrew Walters
Advisor: Prof. Tom Barkimer
Sponsor: Metal Technologies, Inc.

Metal Technologies (MTI) is a metal casting company that produces parts from mostly gray and ductile iron. While making parts, a test is run that requires crushing white iron pins to a "salt like" state for carbon content testing of the material. MTI currently uses a pneumatic hammer manually operated by a worker to crush the pins. MTI desires to change the method for completing this task to a more user-friendly process. Potential solutions included using a fixture for the pneumatic hammer, then attaching it to a pneumatic actuator or linear actuator with a stepper motor. The proposed solution involves the same pneumatic hammer that MTI is currently uses, but inserts it into a device that operates the hammer at the push of a button and actuates with a pneumatic cylinder. A guarding is also included that protects the user from noise and debris. With this device, operators will no longer have to worry about flying debris, loud noises, or fatigue. Crushing white pins will be done with ease in less than 60 seconds.

Conduit Installation Tool and Strap Integration Project

Members: Colton Conn, Jalen Grier, Kaethe Henke and Cydney Huey
Advisor: Tim Jenkins, Ph.D.
Sponsor: Halex Co., a Scott Fetzer Company

Halex Corporation is an electrical fittings manufacturer, founded in 1990 as a Scott Fetzer company that supplies products to the contractor and consumer. One of the challenges for electricians is to hold and carry multiple components, while installing conduit overhead in other difficult areas. This organization desires to merchandise a conduit strap with an integrated fastener and a device (tool) to assist in the installation of the strap product. Preventing the screws from falling out with an integrated strap and a tool aid will decrease the manual movement and hazards of installation for any user, but especially professional installers. One requirement for these product designs, to be used commercially, is the ability to meet UL514 and UL2239 pull standards. With these requirements in mind, the design team envisioned multiple strap ideas including polymer-filled holes, grommet and stamped cut out designs; likewise, installation aid ideas including brackets, clips, bags or adapters. Two main factors that drove the decision-making process were costs, which needed to low, and ease of manufacture, leading the team to choose the final two designs here. With these products, electricians now can mount conduit on a ceiling overhead or on a horizontal surface at a faster rate, saving operation time.

DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

Nucor Payroll System

Members: **Zachary Morgan, Zachary Phillips and Sam Stein**
Advisor: **Mahesh Khadka, Ph.D.**

The team developed a web portal to track employee hours for a global manufacturer. In addition to logging hours worked, employees can request vacation days and track projects, and managers can track their employees' work. Sensitive data is securely transported from the user's web browser and stored on the company's cloud servers.

Vesper

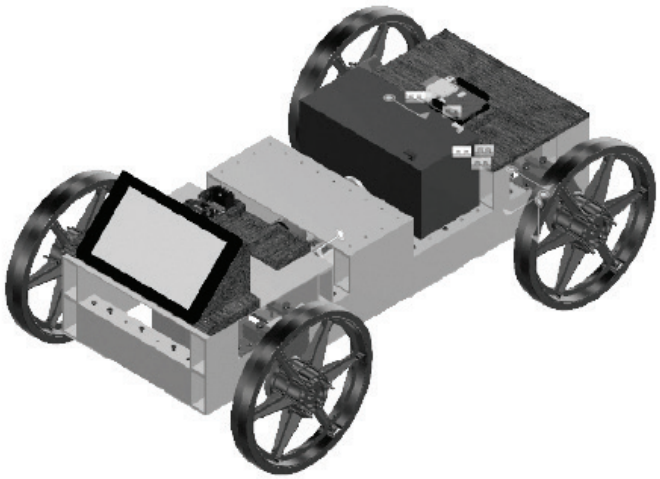
Members: **Chris Bushey, Ryan Griswold, Hank McKnight, Tanner Neeley and Skyler Parrish**
Advisor: **Sameer Sharma, Ph.D.**

Drone racing initially started as a hobby. However, with advancements in technology, drone racing is rapidly approaching recognition as a worldwide sport. In our project ,"Vesper," we have addressed the most important component of drone racing, the race course. Unlike other courses, project "Vesper" does not require additional equipment attached to the drone. The course is easy to set up and will display information such as speed, lap time, and race position of each drone. The course will consist of three smart gates. A smart gate has sensors that will detect multiple drones racing at the same time. Each gate is able to identify up to three drones based on their frequency. The gates are able to transfer data to a central location via wireless signal. Project "Vesper" will allow amateurs to host drone races and practice on their own.

Reveles

Members: **Frank Hittel, Alisha Johnson and Alex Portolese**
Advisor: **Andrea Mitofsky, Ph.D.**

Reveles - (Latin) to detect or discover.
With self-driving cars becoming more of a reality and less science fiction, Reveles seeks to explore, on a small scale, the challenges and different approaches to autonomous navigation. Thanks to a camera and a myriad of sensors, Reveles is capable of both safely maneuvering in its environment and reacting to moving obstacles, namely humans. In combination with its motors and a custom drivetrain, Reveles is capable of moving at the same pace as a human in an effective manner.



EZPZ Parking

Members: **Naif Alshahrani, Ashton Castator, Kelsey Cumberworth, Aaron Dea and Bryce Hernly**
Advisor: **Andrea Mitofsky, Ph.D.**

Finding parking spots on campus often can be extremely frustrating. EZPZ Parking's goal is to ease some of these parking frustrations. In the corner of each set of four parking spots will be a system of four ultrasonic sensors. These sensors detect if the corresponding spot is available or currently contains a parked car. They then send that data to an arduino and to a server to be hosted on the EZPZ Parking web page. Trine students, staff, faculty and even visitors can visit the web page to check the number of available parking spaces within each of Trine University's designated parking lots. For practical testing and demo purposes, we will only be implementing 12 sensors.

NRC Autonomous Vehicle Competition

Members: **Travis Haynes, Miguel Martinez, Josiah Ward and Sarah Westman**
Advisor: **Kevin Woolverton, Ph.D.**

This senior design project consists of building an autonomous robot for the Autonomous Vehicle Challenge (AVC), a contest hosted by the National Robotics Challenge (NRC), in Marion, Ohio. The robot constructed is controlled with a Raspberry Pi microprocessor that drives two DC motors and uses an NPN photoelectric proximity sensor and camera for input to autonomously navigate an established course consisting of four stanchions in a rectangular formation within a five-minute timeframe. Points are awarded for successfully clearing each stanchion, completing the course within the time allowed, and clearing the obstacles (optional). The obstacles must either be navigated or avoided and consist of a 60-inch-wide hoop to go under and an 8-foot ramp to go over. The robot must fit within a 24x24x24-inch space at all times and must be fully autonomous, water resistant, and self-contained. A single physical input must be used to start the robot, and three runs per robot are permitted.

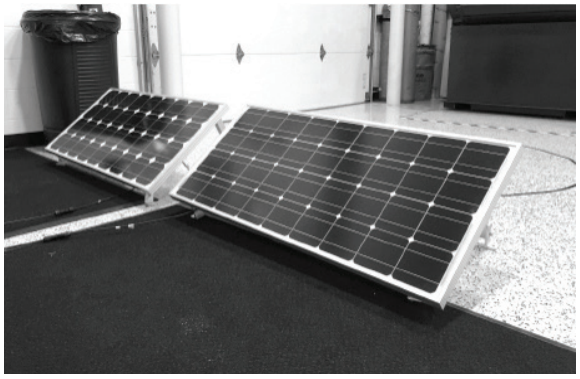
Three-Phase DC-AC Inverter

Members: **John Milostan, Ethan Cavanagh and Gage Tester**
Advisor: **Stephen Carr, Ph.D.**

This design project aims to create a three-phase electrical supply from a solar panel array. The three-phase supply is to be compatible with the requirements of our undergraduate machinery laboratory and so produce a 208 V, line-to-line, sinusoidal supply at 60 Hz. This electrical supply is for application to the laboratory electrical loads.

The energy supplied by the solar panels is stored in a battery bank and the battery is then used as a source for a DC to three-phase AC invertor. For our verification test, the invertor will be loaded with a balanced three-phase load consisting of the three 60 W light bulbs. The invertor operates from the 24 V battery bank and outputs a 48 V peak-to-peak PWM signal. This is filtered and amplified for application to the AC load.

The architecture implemented for the invertor consists of PWM-driven MOSFETs in a three-branch bridge structure. The PWM control signals are generated through a Nucleo microcontroller programmed in the C language. These modulated signals are processed through a power MOSFET driver circuit to control the six power transistors. Smoothing of the transistor-stage PWM output signal is accomplished with an inductance filter for each phase.



Further enhancements will include feedback control for the DC to DC convertor stage, which controls the voltage level into the invertor, and hence the peak amplitude at the output of the invertor.

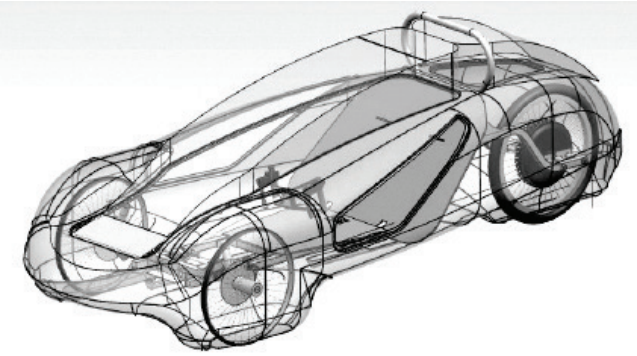
WADE DEPARTMENT OF MECHANICAL & AEROSPACE ENGINEERING

Shell Eco-Marathon Prototype Battery Electric Vehicle

Members: **Caleb Stoffel, Ben Miller, Zach Rowland, Spencer Faull, Jordan Lelito and Christopher Ferguson**
Driver: **Christina Brinkmann**
Advisor: **Pavan Karra, Ph.D.**
Sponsor: **DENSO Foundation**

The purpose of the Shell Eco-Marathon Battery Electric project was to design a super-efficient vehicle to compete in the Shell Eco-Marathon 2018 in Sonoma, California. The goal of the project was to achieve 150 mi/kWh while maintaining the safety of the driver and passing technical inspection at the competition. Various requirements for size, materials used, methods used, and safety were given by Shell. This year's team was tasked with improving on the car from last year, which included minimizing brake rub, reducing vehicle weight, changing the steering design, and improving electrical efficiency.

To achieve 150 mi/kWh, an aluminum frame was added to improve rigidity of the vehicle and eliminate misalignments in the brakes. This minimized brake rub and improved steering alignment as well. Steering was completely redesigned, allowing the wheels to turn without scrubbing. In addition, the weight of the vehicle was reduced by fabricating the outer body of the vehicle out of polycarbonate. Polycarbonate was chosen for its low weight and high impact strength. Lastly, the vehicle's electrical efficiency was improved by choosing a smaller motor, and sizing components to be more efficient.

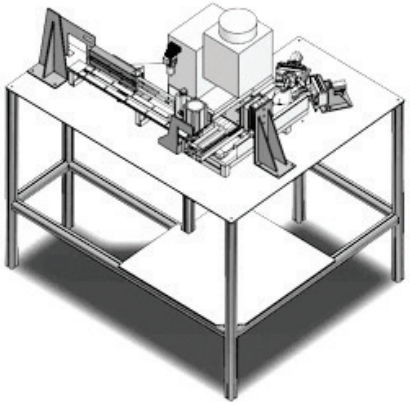


Tower Advertising Ribbon Folding Machine Project

Members: **Ben Blankenberger, Jacob Forsyth, Andrew Hagar, Joshua Jackson and Tony King**
Advisor: **Pavan Karra, Ph.D.**
Sponsors: **Tower Advertising, PhD Inc., and JR Automation Technologies**

The purpose of this project is to design an automated machine that folds awareness ribbons. The sponsor, Tower Advertising in Topeka, Indiana produces various types of ribbons, both with and without printing on them. During its busy season, orders for awareness ribbons can get so large that the company needs to dedicate all production staff to producing them by hand. The machine that was designed would automatically cut, glue and fold printed and unprinted awareness ribbons to free up the production staff.

The finished machine consists of six subcomponents: A feeding mechanism, cutting mechanism, transporting mechanism, glue machine, folding mechanism and ejection mechanism. These mechanisms are mounted to a steel table and encased in a plexiglass safety frame. Each subcomponent is operated by pneumatic cylinders donated to the project by J R Automation. The valves and fittings were donated by PhD Inc. All system motions will be controlled by a PLC, which is housed in the electrical panel mounted to the table. Contrast sensors will control the feed so the ribbon feeds to the proper length. The end user will interface with the system by touch screen display mounted above the electrical panel.



AIAA Design, Build, Fly Project

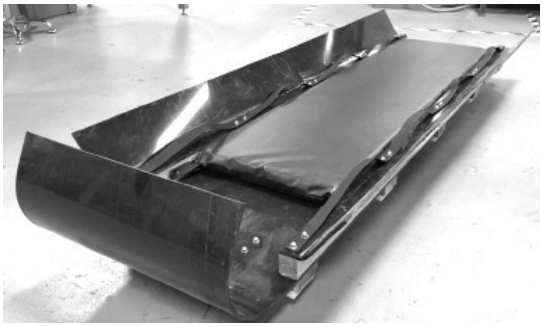
Members: Evan Wyse (CAD design), Nick Maher (Wing Design), Kyle Hoyt (Aerodynamic Analysis), David Schaaf (Propulsion), Josh Breach (Propulsion), Keagan Downey (Tail Design), Cody Verhey (Budget Manager/Score Optimization) and Amanda Mast (Manufacturing/Landing Gear)
Advisor: Pavan Karra, Ph.D.
Sponsor: Indiana Space Grant Consortium

The purpose of this project is to design an aircraft that will be able to complete the missions of the 2017-2018 AIAA DBF competition. The aircraft must follow all rules and regulations specified by this year's competition. The competition involves three flight missions and one ground mission. The first and second flight missions comprise completing three laps of approximately 1900 meters in under five minutes, none and max passengers, respectively. The third flight mission requires the aircraft fly as many laps as possible in 10 minutes, while carrying at least half the max passengers and one payload block. The ground mission is a timed replacement of a randomly selected part of the aircraft.

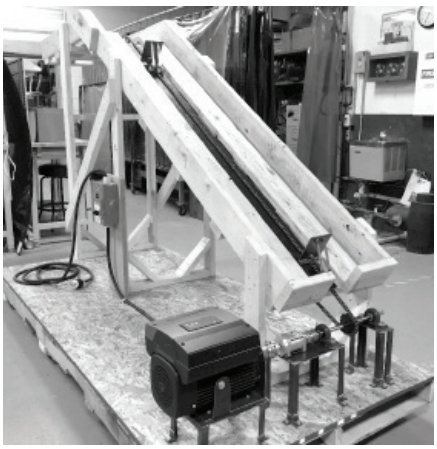
To accomplish this objective, our team reviewed the requirements for the competition, developed a concept and then created a critical design. The aircraft we developed has a carbon fiber fuselage upon which the pieces of the aircraft are attached. The wing and tail are made from polystyrene insulation foam and have been hollowed out to reduce weight. The foam also has been covered by a layer of iron-on plastic wrap to increase structural integrity and improve aerodynamic performance. The control surfaces are made of balsa wood. The passengers (bouncy balls) are housed inside the wing. The passengers are placed into egg carton cells and restrained with rubber bands. The plane is powered by an electric brushless motor and Ni-MH batteries. Finally, the various parts that must be replaced for the ground mission are all easily detachable using zip ties, Velcro and locknuts.

Pokagon State Park Toboggan Sled and Lift System Project

Members: Zach Shepard, Scott McClellan, Taylor Howard and Dylan Hutchison
Advisor: Pavan Karra, Ph.D.
Sponsor: Pokagon State Park

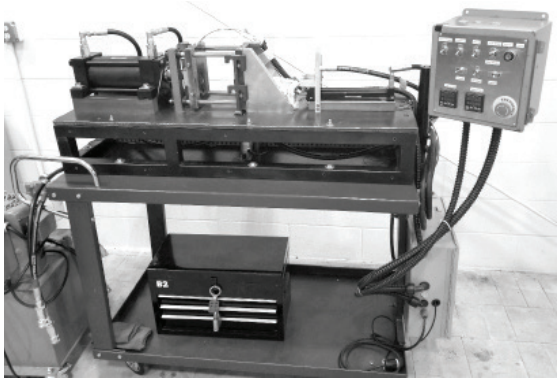


The Pokagon State Park toboggan run consisted of two separate projects, the warm weather toboggan and the toboggan lift system. The purpose of the toboggan project was to design, build and test a sled capable of being used during warmer months when the track is not refrigerated. The goal of this project is to allow year-round enjoyment of the toboggan chutes, increased revenue to Pokagon and the surrounding community, and another exciting attraction for Steuben County during warmer months. The toboggan can carry three adults and is constructed of a plastic body with a wooden skeleton for improved strength and durability. The newly designed sled incorporates sidewalls for increased safety of the riders and is carried down the track by six wheels.



The purpose of the toboggan lift system was to design a structure that would move toboggans from the base of the toboggan run tower to the top. The goal of this project is to eliminate the carrying of toboggans up the stairs at the toboggan chutes, increasing the satisfaction and safety of the customers. A scaled model of the lift was built to provide a visual representation of the full-scale lift and allowed the team to validate analysis techniques for justification purposes.

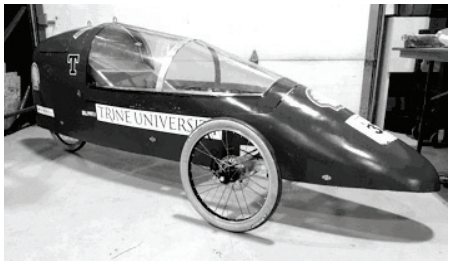
Trine University Die Casting Machine



Members: Landon Pearson and Chris Leary
Advisor: Jamie Canino, Ph.D.
Sponsor: Foundry Educational Foundation

This project challenged the team to complete the die casting machine that has been a senior design project for the last two years. The purpose of the machine is to demonstrate the capabilities and process of die casting to current students, prospective students, and faculty members. The die cast machine will produce a Trine University logoed "challenge coin" cast from tin alloy. The machine also has the ability to change die molds to produce two additional tin-alloy parts: a tensile test specimen and a thickness step block. Trine's die cast machine is cold-chambered, meaning metal (tin) is melted separate of the machine and then poured into the injection tube to be injected into the die cavity. To enhance the learning experience, the injection velocity of the molten metal and temperatures at several positions within the die molds are measured during casting and recorded.

Shell Eco-Marathon Gasoline Prototype

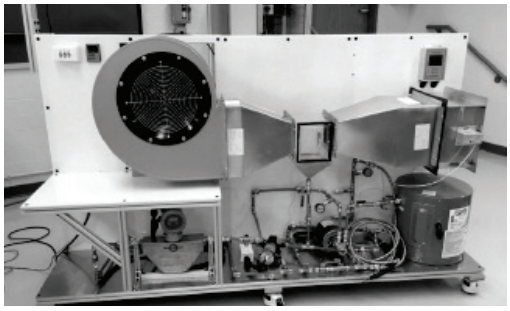


Members: Austin Wendel, Clayton DuVal, Stephen Graham and Chris Krammer
Advisor: Jamie Canino, Ph.D.
Sponsor: DENSO Foundation

The purpose of the project was to design, analyze, build and test a gasoline-powered vehicle capable of 750+ MPG to compete in the gasoline division of the Shell Eco-Marathon competition. The competition was hosted at Sonoma Raceway in California where teams from across the globe competed. The competition spans a four-day period and consists of an official technical inspection, testing and tuning time, and two days for the team to post its lowest fuel consumption on the set track.

The scope of the project required lightening of the existing frame, design of a new steering system and design of a new powertrain. With weight being a major factor in the vehicle's efficiency, many components were analyzed using stress analysis software to reduce their size as much as possible. CNC plasma and laser cutters were two of many essential tools utilized to fabricate the many custom parts for the vehicle. Throughout and after the build phase, each component of the vehicle was rigorously tested to ensure durability and efficiency were maintained.

Heat Exchanger Testing Apparatus



Members: Rebecca Thornsen, Mitch Leahey and Adrea Ayres
Advisor: Jamie Canino, Ph.D.
Sponsor: DENSO Foundation

The purpose of this project is to create an apparatus that will be capable of testing the effectiveness of 3D-printed heat exchangers. Every semester, the Thermo-Fluid Component Design (TFCD) class at Trine University is tasked with designing and analyzing a heat exchanger. Until this semester, there was no way to test the designs. With this project, those designs will be 3D printed and the apparatus will be used to test each group's design. This will allow students to see how well their analyses match the experimental results.

For this project, the decision was made to test using two different media- hot water and room temperature air. Concepts for testing area and data collection were considered. In the end, it was decided the testing area would be a small, clear acrylic box, capable of holding a 5x6x8-inch heat exchanger. The heat exchanger will be held by small notches. A blower will blow room-temperature air over the exchanger, while hot water will be pumped through the heat exchanger. The heat exchanger will be printed out of a plastic-copper filament. Temperatures will be taken before and after the heat exchanger for both the water and the air system. Mass flow rates also will be measured for both fluids. This data will be collected using a Lab-view DAQ and analyzed to calculate the total heat transfer and heat exchanger efficiency.

This project will allow students to have a more hands-on experience in the TFCD class, which allows them to be better prepared for real-life application of engineering.

FCAOS (Fuel Cooled Air-Oil Separator)

Members: **Austin Glynn, Doyle King, Victor Riedman, Kyler Bolen and Mason Pelphery**
Advisor: **Jamie Canino, Ph.D.**
Sponsor: **Rolls-Royce**

Synthetic oil is used to lubricate bearings in Rolls-Royce turbine engines. When the oil is removed from the bearings it is aerated, and the air needs to be removed. Additionally, the fuel needs to be heated before it enters the engine to maintain optimal properties. The project explored the combination of the air-oil separation component with the fuel heating component. The combined part was coined a fuel cooled air-oil separator (FCAOS). The goal of combining the parts is to reduce the total weight and volume taken up by the existing components and to reduce the manufacturing cost of the two components. The FCAOS was built using additive manufacturing. Separation efficiency and heat transfer models were utilized in designing and sizing of the FCAOS. An apparatus was designed and built to test the performance of FCAOS. The apparatus pumped a mixture of air and heated canola oil into the FCAOS at one entrance, and pumped water through another entrance. Canola oil substituted for the synthetic motor oil, and water substituted for the jet fuel.

Hydro-Body Mount (HBM) Testing

Member: **Donald Shockley**
Advisor: **Jamie Canino, Ph.D.**
Sponsor: **Tenneco Inc. Clevite Elastomer Division – Angola, Indiana**

The purpose of this project is to create a standardized process/procedure for all current and future Hydro-Body Mounts (HBM). A HBM is a cab mount for General Motors crew cab and extended cab trucks. The mount softens impacts found on every day roads and dissipates the force so occupants in the vehicle do not experience those impacts. The project originated with the new launch of the 2019 GM T1XX program and will continue for all other HBM Programs.

The standardized process/procedure will allow Tenneco to test rubber compound coming into the facility and determine if the compound is acceptable. This procedure also outlines the desired spring rates for each component (after molding) and defines the testing procedure for each component to verify each component meets specification, as well as that the final assembly meets the customers' specification. Tenneco would be able to minimize the scrap percentage of HBMs during the launch of the part, and continue to adjust parameters as required through the program to meet product specifications. This project would span across one full year due to the reaction of natural rubber to different seasons where the natural rubber is harvested/sold. With the initial correlation completed, the process/procedure will continue across all seasons and will be completed at Tenneco after the completion of the project.

Trine University Basic Utility Vehicle (BUV)

Members: **Russell Hazelet, Collin Butler and Drew Palmer**
Advisor: **Jamie Canino, Ph.D.**
Sponsor: **DENSO Foundation**

The "Institute for Affordable Transportation" is an organization based around improving lives in Third World countries by providing people with affordable vehicles in an effort to help communities grow. The purpose of this project is to design an affordable vehicle able to transport water, farm equipment and people long distances. The designed BUV will run in a competition that tests the hauling capacity. It will carry 165 gallons of water through heavy mud as well as wooded areas, all of which will test the durability of the design. This year the scope and main focus of the design was to redevelop the hydraulic drivetrain and make changes to the front end of the vehicle for a more comfortable ride as well as a lighter design. In order to improve the drivetrain, a larger engine was installed with a 10 percent increase in size from last year. Thirty-six-inch tires will be used that are an optimal size for the new torque motors selected for the vehicle. The last improvement to the drivetrain included upgrading to 5/8-inch lines instead of ½-inch lines to decrease pressure drop throughout the hydraulic system. The new front end allows for more leg room when driving as well as greater ease of steering due to a larger moment arm.

PROFESSIONAL SOCIETY – STUDENT CHAPTERS

American Institute of Aeronautics and Astronautics (AIAA)

Advisor: **James Canino, Ph.D.**
President: **Nick Maher**

The American Institute of Aeronautics and Astronautics (AIAA) is dedicated to the advancement of the aerospace sciences. Membership is open to all engineers, scientists and other professionals who have an interest in aerospace. The Trine University Student Branch of AIAA has been continuously active since 1940, when Dr. James Doolittle and Maj. Leslie Green visited campus to approve the aeronautical program for membership to the Institute of Aeronautical Sciences (IAS).

American Institute of Chemical Engineers (AIChE)

Advisor: **Majid Salim, Ph.D.**
President: **Roger Chase**
Vice President: **Cameron Orr**
Secretary: **Ryan Kosek**
Treasurer: **Elijah Brandt**
Student Gov't Rep: **Ian Fahrenkrog**
Junior Class Rep: **Nate Buening**
Sophomore Class Rep: **Noah Weston**

AIChE is a global professional association of more than 50,000 members that provides leadership in advancing the chemical engineering profession. Its members are creative problem-solvers who use their scientific and technical knowledge to develop processes and design and operate plants to make useful products at a reasonable cost. AIChE fosters and disseminates chemical engineering knowledge, supports the professional and personal growth of its members, and applies the expertise of its members to address societal needs around the globe. This past year, members of Trine's AIChE student chapter attended the Regional and National Conferences to compete in both AIChE Jeopardy and Chemical Engineering Car Competitions. In addition to organizing plant tours and hosting guest speakers on campus, the Trine student chapter sponsored fall and spring picnics for the Chemical Engineering Department. As a part of our commitment to encouraging the pursuit of chemical engineering and strong community relations between the student body and the community, the local chapter has participated in college visit days, the Steuben County Regional Science Fair, and Introduction to Engineering Day.

American Society of Civil Engineers (ASCE)

Advisor: **Prof. TJ Murphy**
President: **Alex Duran**
Vice President: **Taylor Eash**
Treasurer: **Ben Bellestri**
Corresponding Secretary: **Morgan Sapara**
Recording Secretary: **Robert Morehouse**
Sophomore Representative: **Katelyn Tedder**
Freshman Representative: **Trevor Szelis**

The American Society of Civil Engineers is America's oldest national engineering society, having been chartered in 1852. Trine University's Chapter has been in existence since 1965, supporting the aims of the national organization – to "develop leadership, advance technology, advocate lifelong learning, and promote the profession." In the pursuit of these goals, ASCE student members participate in a wide range of activities. Signature projects include the steel bridge and concrete canoe competitions. Additionally, service projects such as designing wheelchair-accessible ramps for the Christian Campus House allow the organization to promote civil engineering while giving back to the community. ASCE also strives for professional development via guest speakers with local professionals, and field trips such as the Ohio Contractor for a Day event and yearly ASCE Indiana Section meeting.

American Society of Mechanical Engineers (ASME)

Advisor: **Kevin Molyet, Ph.D.**

With 120,000 mechanical engineers and mechanical engineering students as members, ASME offers quality programs and activities in mechanical engineering, enabling its practitioners to contribute to the well-being of humankind. Originally chartered by the national governing body in 1971, the Trine University section has a current membership of approximately 50 students. The section usually meets once a month and attends two regional conferences per year. In addition, the section sponsors miscellaneous activities such as design competitions, special speakers and plant tours throughout the year.

Biomedical Engineering Society (BMES)

Advisors: **Maria Gerschutz, Ph.D.**
President: **Erika Kasen**
Vice President: **Jensyn Garrow**
Secretary: **Jessa Crites**
Treasurer: **Sumayah Algaradi**

The vision of the Biomedical Engineering Society (BMES) is to serve as the world's leading society of professionals devoted to developing and using engineering and technology to advance human health and well-being.

The mission of the BMES is to build and support the biomedical engineering community, locally, nationally and internationally, with activities designed to communicate recent advances, discoveries and inventions; promote education and professional development; and integrate the perspectives of the academic, medical, governmental and business sectors.

Chi Epsilon (Civil Engineering Honor Society)

Advisor: **Bill Barry, Ph.D., P.E.**
President: **Adam Ciszewski**
Vice President: **Ethan Price**
Treasurer: **Rebecca Plantz**
Secretary: **Mariah Fenimore**

Chi Epsilon is the national civil engineering honor society for the top civil engineering juniors and seniors in the department. The Trine chapter has been involved in community service projects including Plank-a-Palooza, Canstruction and a surveying project for Pokagon State Park.

Engineers Without Borders (EWB-USA)

Advisor: **Tim Tyler, Ph.D., P.E.**
President: **Brad Whitehead**
VP of Projects: **Eric Romanowski**
VP of Membership: **Brooke Johnson**
VP of Finance: **Madison Hatkevich**
Secretary **Frankie Perez**
Treasurer: **Braydon Poulson**

Our vision is a world in which the communities we serve have the capacity to sustainably meet their basic human needs and that our members have enriched global perspectives through the innovative professional educational opportunities the EWB-USA program provides. Our mission supports community-driven development programs worldwide by collaborating with local partners to design and implement sustainable engineering projects, while creating transformative experiences and responsible leaders. We are currently working on a water supply project with a small community in Ecuador, with a construction trip planned for September 2018.

Eta Kappa Nu (HKN)
(Electrical and Computer Engineering Honor Society)

Advisor: **Sameer Sharma, Ph.D.**
President: **Samantha Stensland**
Vice President: **Travis Riddle**
Treasurer: **Adam Griswold**
Secretary: **Alex Lewis**

The Zeta Phi chapter of Eta Kappa Nu (HKN), the honor society for Electrical and Computer Engineering students, was established at Trine University on 1975. The chapter is dedicated to encouraging and recognizing individual excellence in education and admirable work in professional practice, and in any of the areas within the electrical and computer engineering fields of interest.

Institute of Electrical and Electronics Engineering (IEEE)

Advisor: **Sean Carroll, Ph.D.**
President: **Miguel Martinez**
Vice-President: **Joe Ward**
Secretary: **Justin DeClark**
Treasurer: **Andrew Heller**

The IEEE promotes the engineering process of creating, developing, integrating, sharing and applying knowledge about electrical and information technologies and sciences for the benefit of humanity and the profession. The student branch tutors, travels, listens and competes to sharpen the interests and skills of Trine electrical, computer and software engineering students through interaction with industry and between more-and less-experienced students.

Institute of Transportation Engineers (ITE)

Advisor: **Ryan Overton, Ph.D.**
President: **Rick Perry**
Vice President: **Bradley Whitehead**
Treasurer: **Alex Duran**
Secretary: **David Gaff**
Student Rep: **Austin Gurley**

The Institute of Transportation Engineers is an international educational and scientific association of transportation professionals responsible for meeting mobility and safety needs. ITE facilitates the application of technology and scientific principles to research, planning, functional design, implementation, operation, policy development and management for any mode of ground transportation. Trine University's ITE student chapter was established in 2013 and aims to draw attention to the importance and excitement of the transportation engineering field. Every spring the ITE members compete in the annual Traffic Bowl competition, in which they answer transportation Jeopardy-style questions against other students from Indiana, Michigan and Ohio. The student chapter attends several conferences each year including the Purdue University Road School and the ITE Great Lakes District Annual meeting, in which they attend technical sessions and collaborate with professional engineers.

Omega Chi Epsilon (Chemical Engineering Honor Society)

Advisor: **John Wagner, Ph.D.**
President: **Blake Trusty**
Vice President: **Cameron Orr**
Treasurer: **Roger Chase**
Secretary: **Ayasha Faria**
Mugmaster: **Cameron Orr**

Omega Chi Epsilon is the national chemical engineering honor society for the top chemical engineering juniors and seniors in the department. The Trine chapter (Alpha Nu) hosts the McKetta birthday celebration and department homecoming activities.

Society of Automotive Engineers (SAE)

Advisor: **Pavan Karra, Ph.D.**
President: **Jacob Stout**
Crew Chief (VP): **Clayton Ayers**
Secretary: **Alexander Garcia**
Treasurer: **Bethany Blumer**
Marketing Manager: **Daria Frame**
Public Relations: **Andrew Barrett**

SAE International is "the premier society dedicated to advancing mobility engineering world-wide." SAE provides many student competitions including Aero Design, Clean Snowmobile Challenge, Formula SAE Series, Mini Baja Series, Supermileage, Robot Systems Challenge and the Micro-Truck Baja. SAE's magazines, such as *Automotive Engineering International*, *Aerospace Engineering* and *SAE Off-Highway Engineering*, are other terrific opportunities to keep up-to-date with the latest in vehicle technology and breakthroughs.

Society of Manufacturing Engineers (SME)

Advisor: **Tim Jenkins, Ph.D.**
President: **Matthew Seasor**
VP/Student Gov't Rep: **Vacant**
Treasurer: **Jessa McClara**
Secretary: **Devin Kershner**

SME has a rich, evolving heritage spanning more than 80 years. We serve the manufacturing industry as a nonprofit by promoting advanced manufacturing technology and developing a skilled workforce. Since its inception in 1932, SME has worked to make engineers, companies, educators and others successful in their quest to advance manufacturing industries in the United States. The Trine University SME student chapter, S280, currently has 13 student members. Chapter members attend plant tours and expert presentations from local manufacturing companies. Some of the field trips have included visits to GM Powertrain (Defiance, Ohio), Steel Dynamics (Butler, Indiana) and Caterpillar (Lafayette, Indiana). The chapter also co-sponsors Foundry Night each semester in the Bock Center foundry lab.

Society of Women Engineers (SWE)

Advisor: **Andrea Mitofsky, Ph.D.**
President: **Sarah Tiedemann**
Vice President: **Ashley Hale**
Secretary: **Kaethe Henke**
Treasurer: **Ayasha Faria**
Student Senate Rep: **Heather Fritz**

The Society of Women Engineers (SWE), founded in 1950, is a not-for-profit educational and service organization. SWE is the driving force that establishes engineering as a highly desirable career aspiration for women. SWE empowers women to succeed and advance, and to be recognized for their contributions and achievements as engineers and leaders. The Trine University student section of SWE provides networking opportunities for students pursuing degrees in engineering, technology and science. Activities include guest speakers, attending career fairs, plant trips, and outreach activities to encourage K-12 students to pursue technical degrees.

Tau Beta Pi – The Engineering Honor Society (TBP)

Advisor: **Ryan Overton, Ph.D.**
President: **Jonathan Phillips**
Vice President: **Erika Kasen**
Corresponding Secretary: **Brittani Smith**
Recording Secretary: **Erin Boles**
Treasurer: **Spencer Graf**

Tau Beta Pi is the only engineering honor society representing the entire engineering profession. It is the nation's second-oldest honor society, founded at Lehigh University in 1885 to mark in a fitting manner those who have conferred honor upon their Alma Mater by distinguished scholarship and exemplary character as students in engineering or by their attainments as alumni in the field of engineering, and to foster a spirit of liberal culture in engineering colleges. To be eligible for membership, one must be in the top one-eighth of the junior engineering class or the top one-fifth of the senior engineering class at their university. There are now collegiate chapters at 241 US colleges and universities, 32 active alumni chapters in 15 districts across the country, and a total initiated membership of approximately 545,000. Trine University's Indiana Epsilon chapter was founded on February 22, 1975. Each year, the student chapter hosts Engineering Futures sessions – professional seminars focusing on the "soft" skills engineers need to succeed in their career. As a community service, TBP also organizes a series of fundraising events called Creating Christmas where all proceeds go to purchasing hats, gloves and candies for local elementary students. Additionally, students are encouraged to travel to regional and national conferences to expand their professional networks as well as polish their leadership skills.

Trine University Materials Society

Advisor: **Darryl Webber, Ph.D.**
President: **Landon Pearson**
Vice President: **Zachary Shepard**

The Trine University Materials Society is a combined student chapter of the American Foundry Society and Material Advantage, which incorporates membership in the Materials Information Society (ASM); the Minerals, Metals, and Materials Society (TMS); American Ceramic Society; and the Association for Iron and Steel Technology (AIST). These professional organizations seek to promote research and knowledge in the area of material science and engineering design. Student members actively participate in meetings with their professional counterparts, host technical presentations from working engineers and scientists, as well as open the foundry laboratory to the Trine community for foundry nights. Many students in the Materials Society are also involved in FEF, which was established to assure a continuing supply of engineers for the metal casting industry through scholarship programs. FEF acts as an interface between students and industry to promote internships, cooperative educational opportunities and full-time employment and provides funding for laboratory equipment as well as travel to professional meetings and industrial tours.