Introduction:
The Learning Factory helps coordinate senior capstone design projects in the College of Engineering that are sponsored by industrial and professional clients. These projects fulfill the senior capstone requirements in Agricultural, Bio, Computer, Electrical, Energy, Industrial, and Mechanical Engineering along with Computer Science. This document describes the projects that are available this semester and provides important general information.

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1. Why Industry Projects?
1. Industry-sponsored senior design projects provide an excellent opportunity to apply your engineering talents to actual problems.
2. You will get to build hardware and do real, hands-on engineering in state-of-the-art facilities.
3. Most engineering efforts involve interdisciplinary teams. This project will give you experience in working in teams with professionals and students from many engineering disciplines.
4. It will help you get a job! Corporate recruiters highly value teamwork and hands-on experience in design and manufacturing. In this competitive job market, you need all the advantages you can get.

2. Project Kick-Off and Showcase Schedule
1/13  1-3pm  Project Kickoff: Lunch and Q/A with industry sponsors at the HUB (Alumni Hall)
1/13  3pm  Project selection forms submitted to Cindy Winkelblech by end of Kickoff (3pm)
1/17  Students will be notified of their project team assignment and section
1/18  Students report to appropriate class location
4/28  1-3:30pm  Design Showcase at the Bryce Jordan Center (Arena)

3. Deliverables
1. Deliverables agreement signed by students and sponsor and given to Cindy Winkelblech, 314 Leonhard, by Thursday, February 10

In addition to what your instructor requires, ON A CD ROM please submit the following to Cindy Winkelblech, 314 Leonhard Building by **Monday, May 2, 2011**. (Note: Your instructor might have a different deadline.)

2. Copy of final report (DOC & PDF versions) for our files and future student reference (in addition to the copies for your sponsor and instructor).
3. A one-page project recap summary of the project (DOC & PDF versions).
4. Final poster (for future display) 32" x 40" size, portrait orientation (PPT & PDF versions). You can see examples from previous semesters on display in the 3rd floor of Leonhard Building and the 2nd floor of Reber Building due at the Design Showcase which will be held on Thursday, April 28, 2011.
4. Awards - Cash awards will be given at the end of the semester in the following categories:
1. Best Project (1st, 2nd, and 3rd places – two awards will be given in each category)
2. Best Poster (1st, 2nd, and 3rd places) (32” x 40” size, portrait orientation)
3. People’s Choice Award

5. Site Visits, Purchases, and Reimbursements
Reimbursements and certain purchases will be processed through Cindy Winkelblech, ckb2@psu.edu, 314 Leonhard Building, 814-863-6380 ph 814-865-9693 fax http://www.lf.psu.edu/students

Below are some quick tips to follow but please refer to the Purchases and Reimbursements Guidelines located on the Learning Factory website to obtain the required forms to request purchases or reimbursements.

Team Budget: Each team will be reimbursed for actual expenses up to $1000.

Site Visits
1. Approval: Students must get approval for the visit from their instructor and provide a list of who will be going on the site visit. Include name, phone #, and emergency contact name and phone #.
2. Hotel: Students should make and pay for their own hotel accommodations and then submit itemized and proof-of-payment receipts. (This is a change in procedure since posting these guidelines prior to 1/13/11.)
3. Meals: Group meals are not permitted. Each student must buy their own meals and request reimbursement. Tips cannot exceed 20%.
4. Transportation: Mileage is reimbursable on personal vehicle. A copy of the directions must be given to Cindy. PSU will reimburse for a rental car but only if a National or Enterprise rental car is used.

Purchases and Subcontractors
1. Purchases under $50: DO NOT spend more than $50 in out-of-pocket cash/credit card per vendor per day.
2. Purchases over $50 must be placed by Cindy and will be made in the order in which they are submitted. Complete a Material Request Form, get instructor's approval, and submit to Cindy. Allow 1 to 2 business days for the item to be ordered.
3. Subcontractors: IMPORTANT: Only Penn State can pay a vendor for providing a SERVICE. (This is different than purchasing an item.) Students cannot pay for services and then get reimbursed. It can take at least 7 business days until the vendor receives payment. If you use a subcontractor (e.g. special welding, sewing, etc.) approval must be given by your instructor, an invoice given to Cindy, and she will process a payment to the vendor. What is required on the invoice? Date, vendor name, address, phone number, contact person, tax exemption number if applicable, social security number if applicable, detailed description of the work performed, hourly rate if applicable, and total amount due.
4. Purchases from vendors outside of the US. In the past, PSU credit cards have been compromised when making purchases from vendors outside of the US. Students may make purchases from vendors outside of the US, however, it will be at their risk and the purchase must be under $50. If the purchase is over $50, please find and use a vendor within the US and follow the Purchase over $50 policy.

Reimbursements
1. All receipts must be original and itemized, submitted within 30 days, contain vendor name and address, date of purchase, description of items, proof of payment, and initialed by the instructor.
2. Request reimbursements as often as possible – do not stockpile your receipts.
3. Cindy has a small ‘petty cash’ fund in which to reimburse for purchases that are $50 or less. Petty Cash should be requested once a week or within 30 days of the purchase. Complete a Petty Cash form.
4. If you are submitting multiple receipts that total more than $75, a check will be processed and mailed to you. These take about 2 weeks to be processed.
5. Travel reimbursements are processed by completing appropriate travel forms.

Non-Refundable Expenses
1. Meals and taxi service in the State College area will not be reimbursed.
2. Postage is not refundable. If you have anything to be mailed give it to Cindy.
Returning Unused or Incorrect Items
Cindy will return items to the vendor. Students must:

1. Research vendors return/exchange policy.
2. Package up the items. (HINT: Keep original packaging until you are sure item is going to work.)
3. Provide Cindy with the return shipping address and any pertinent information that the vendor requires.
4. Credit will be issued to the team’s budget, however, any expenses incurred to return the items will deducted from the team’s budget.

Conference Calls to Sponsors
Telephone calls can be made from the Learning Factory or the conference room in 312 Leonhard Building - see Cindy Winkelblech in 314C Leonhard to schedule the conference room. If you call from your residence, the bills are reimbursable if you submit the original phone bill as a receipt. International teams are encouraged to use SKYPE and other Internet-based solutions and should contact Cindy before placing international calls on any Penn State conference phone.

IMPORTANT:
6. Intellectual Property (IP) Concerns (Far Right Columns in Table 1)
In order to protect their competitive positions, some sponsors may require each team member to sign a confidentiality agreement (see www.lf.psu.edu/lf/confid2.doc) as a condition for working on their project. These projects tend to be on the cutting edge of technology. By signing this document, you are obliged to protect the confidentiality of information provided by the sponsor. If you have any problem with this condition, you must pick another project.

Sponsors may also require that they retain exclusive ownership rights to any intellectual property that is developed during the course of the project. Projects in this category require students to assign their intellectual property rights to the sponsor using the form found at: http://guru.psu.edu/policies/RAG13.html If you have any problem with this condition, you must pick one of the projects that have no intellectual property restrictions.

URL for this complete document:
http://www.lf.psu.edu/Instructors/PROJECTS.pdf
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<th>Project Title</th>
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**Note 1:** See the Key in Table 2 for meeting times of each indicated section.

**Note 2:** This column indicates that there are confidentiality restrictions for this project, see section 6 on page 3. (Students must sign form: www.lf.psu.edu/lf/confid2.doc)

**Note 3:** This column indicates that there are intellectual property restrictions for this project, see section 6 on page 3. (Students must sign form: http://guru.psu.edu/policies/RAG13.html)
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<td>T 11:15-02:15</td>
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<td>L. Engel</td>
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<td>122 Engr Svc</td>
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Project Application Form

Instructions:
1. Review the available projects (Table 1) and apply for your preferred projects. You may apply for any project (in any section) that is compatible with your schedule and which requires the services of your major. The departments have agreed to allow each other’s courses to satisfy the senior project course requirement.
2. Complete and submit this form to Cindy Winkelblech by the end of the Project Kickoff on Thursday, January 13, 2011 (no later than 3:00 pm). If this form is not submitted on time, you will be assigned to a project at the instructor’s discretion.

Team Selection Process - Teams will be selected by instructors using the following priorities:
1. Staffing the industry-sponsored projects
2. Using your preferred choices as a guide (note, depending on the demand for the projects you have chosen, it is possible that you may not get any of your choices)

What will happen next?
1. We will make every effort to give you one of your five choices if your form is received on time.
2. You will be notified by E-mail of your project assignment and where your next class meeting will be.
3. We will take care of changing your registration to the appropriate course and section.

Student Name: (Print): ___________________________ Email address:____________________

Currently Enrolled in (CIRCLE ONE) BE BIOE CMPEN CMPSC EDSGN EE EGEE IE ME
440.1 ME 440.2 ME440.3 ME440.4 ME440.5 ME 441 OTHER _______

Project Preferences (please indicate project number, sponsor, and title from Table 1)

1. Proj #____ Sponsor________________________ Title___________________________
2. Proj #____ Sponsor________________________ Title___________________________
3. Proj #____ Sponsor________________________ Title___________________________
4. Proj #____ Sponsor________________________ Title___________________________
5. Proj #____ Sponsor________________________ Title___________________________

Please indicate all your OTHER scheduled classes:

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This schedule above helps to determine if you have the availability to move from one time to another time.
Tips for Students
Keeping Your Sponsor Happy

Your dealings with your sponsor are an excellent opportunity to learn and practice the skills that will keep your future bosses happy – and get you promotions and raises.

1. Communicate: Keep your sponsor and instructor informed – communicate regularly by phone or email and solicit response. Use E-mail and the Web for posting of information when possible.

2. Visit: Visit the sponsor at their plant as soon as feasible (preferably within the first week after team formation). Be prepared for the visit. Prepare a specific agenda prior to the visit. Have a list of questions and information needs. Bring a camera, video camera or other electronic devices as needed to collect information about products or processes (but be sensitive to their security concerns). Be curious, ask questions, and don’t be afraid to ask additional questions if you do not understand the sponsor’s response to your inquiries. Arrange for a second visit.

3. Have a Positive Attitude: Don’t get frustrated if your sponsor does not answer your calls immediately, or provide requested information instantly. Just be positive, patient and persistent. Keep in mind that they have full time jobs in addition to sponsoring this project. They are offering these projects as a favor to Penn State and to benefit your education.

4. Be Professional – Treat your sponsor as both a valued customer and your future boss. If you give your sponsor only what they ask for, they may be satisfied; if you give them more, they will be delighted. Take pride in the completeness and professionalism of your work. Don’t make excuses. Part of your grade will be determined by your sponsor’s evaluation of your performance.

5. Plan Ahead: Time is short – 15 weeks will be gone before you know it. Keep in mind that it takes time to send out purchase orders and receive parts. Therefore start your project ASAP, develop a plan for its completion and submit regular progress reports to your instructor and sponsor.

6. Expect Change: The project description you were given at the start of the semester may change with time as you and your sponsor delve deeper into the problem. Moving targets are a fact of life, for a number of reasons, including new insights into the problem, changing business environment, or politics. Accept it and learn how to deal with it.

7. Be a Team: Your success depends on how well you can work together. The best teams have a diverse mix of personalities and skills. Often, the human interactions are more challenging than the technical aspects of a problem. All team members must participate. Responsibilities must be divided among team members and each member is held accountable for accomplishing the agreed tasks. Do not let team problems fester, if you cannot solve them, talk to your instructor. It is especially important in dealings with your sponsor to have one consistent voice. Never blame, disagree with or criticize each other in public. This is extremely unprofessional.
Learning Factory Industry Project-Deliverables Agreement

Date: ______________________

Project Title ____________________________________________________________

Sponsor Company __________________________________________________________

Company Contact ____________________________ Phone _______ Email _______

Faculty Coach ____________________________ Phone _______ Email _______

Team Name ____________________________

Student Team (primary contact) ____________________________ Email _______

Problem Statement:

<table>
<thead>
<tr>
<th>Deliverables:</th>
<th>Delivery Date</th>
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<tr>
<td>1) Final Report (copies to sponsor, instructor and Learning Factory)</td>
<td>May 2</td>
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<td>2) Weekly update memos (status reports); delivery method:</td>
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<td>(fill in &amp; Specify agreed-upon day of week and time)</td>
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<td>3) Statement of Work (Project Proposal)</td>
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<td>4) Detailed Design Specification Report</td>
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<td>5) Poster (32 x 40&quot;) for Showcase</td>
<td>April 28</td>
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<tr>
<td>6) One-page Project Recap (submit to instructor)</td>
<td>May 2</td>
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<td>7) insert project-specific items here</td>
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Check below if this project involves:

☐ Non-Disclosure Agreement (attach copy of agreement to this form)

☐ Loan of equipment, materials, documents (see next page)

Signatures: We agree to the deliverables listed above:

Team Members:

Project Sponsor: ____________________________ date ____________

Faculty Coach: ____________________________ date ____________
Sponsor Supplied Items

In support of this project, we (project sponsor) agree to provide the following equipment, materials, or apparatus by the date listed.

The student team is responsible for returning all loaned items. The instructor reserves the right to withhold a final grade if loaned items are not returned, or if a copy of the final report is not delivered to the sponsor.

<table>
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<tr>
<th>Item</th>
<th>Delivery Date</th>
<th>Check one</th>
<th>If Loan, Return Instructions</th>
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</table>

Return signed original by **Thursday, February 10** to Cindy Winkelblech, 314 Leonhard Bldg.
A & P Enterprises

Contact: Mark Antolosky
Address: 315 S. Atherton St., State College, PA 16801
Phone: 814-389-0051
E-mail: mantolosky_magnumbroadcasting@yahoo.com
Project Title: Terrible Tail TM

Description: Product intended to help fans “get into the game” and support their team Device will be hand-held and emit noise Device will be team distinctive; initial design will be produced for PSU Nittany Lion fans but has potential to serve fans of other collegiate and professional sports teams Multiple “styles” will likely be made available to allow fans the opportunity to buy product with more “pizzazz” and obviously these will be sold at a slightly higher price

Requested Dept.: Electrical, Industrial, and Mechanical

Requirements: Confidential, Intellectual
AcousticSheep, LLC

Contact: Wei-Shin Lai  
Address: 179 Jefferson Circle, Bellefonte, PA 16823  
Phone: 814-380-9296  
E-mail: ceo@sleepphones.com

Project Title: Wireless SleepPhones

Description: SleepPhones are unique headphones you can wear for sleeping. Invented in 2007 by Dr. Lai of the Penn State Student Health Center, SleepPhones have now helped over 20,000 well-rested people listen to their favorite tunes in bed. The next step for SleepPhones is to become wireless. There are several requirements for this project. 1. The components to make it wireless must fit inside a small headband and be flexible. 2. The battery must be easily rechargeable. 3. The battery must play for at least 4 hours. 4. The user interface must be so friendly your grandmother can figure it out.

Requested Dept.: CompSci, Electrical

Requirements: Confidential, Intellectual
Project Title: Ethiopian Injera Making Machine - Phase 2

Description: The forest cover of Ethiopia is rapidly declining. Estimates vary widely as to the rate of decline but experts agree that the decline has been dramatic and rapid. Currently, the forest cover of Ethiopia is at less than 5%. The primary reason for deforestation is lack of alternative energy sources for cooking food. Injera, a spongy unleavened bread that is the staple of every meal in Ethiopia, is usually cooked over an open fire. It can be ascertained, therefore, that this practice is contributing to the plight. Other issues include the limited nutrition supplied by traditional injera, which could be dramatically improved using current food manufacturing technologies. The African First Climate Exchange (ACX) seeks to address these problems by eliminating the need to use wood for fuel to cook injera. The Injerama machine will mass produce injera using sustainable energy sources, such as biofuel, solar and wind energy. The nutritional content of injera will also be improved through new formulations. The machine needs to be mechanically simple, free of any superfluous or complex electronics, and require little maintenance. It should have a low cost of operation, a minimum down time, and be designed so that it can be operated using local, Ethiopian labor. The injera will also need to be sold at a reasonable price making it affordable to most everyone. There will be multiple distribution channels to ensure that it will be accessible to everyone. In phase I of this project, the Penn State Team Injera Factory created detailed designs for two concepts: the cylindrical drum and the sliding plates methods. The sliding plates method was determined to be the design to further develop because it best meets the design requirements of simplicity and ability for mass production. The goals for phase II of Injerama, therefore, are as follows: (1) Make the design adaptable to varying batter viscosity by creating a slit for the batter that is variable in width; (2) Make the design adaptable for varying demands in injera size by creating a slit that is variable in length (current demands are for injera that is 55 – 60cm); (3) Develop a mockup using ultra high molecular weight polyethylene for the sliding plates in order to test this material for compatibility with the batter and the stainless steel of which the tank is made; (4) Develop a mockup of a sliding plates unit that can deposit two lanes of injera batter simultaneously, resulting in injera that is 55 – 60cm diameter; (5) Identify all specs for the conveyor belt required; (6) Test the mockup using the appropriately sized conveyor belt; (7) Identify all specs for oven required; (8) Identify the baking temperature(s) needed to cook and cool the injera; (9) Identify the volume of batter needed to produce 1 million injera per day; (10) Identify the specs for fermenting/storage containers for enough injera batter to produce 1 million injera per day; (11) Design the packaging assembly process; (12); Identify the number and types of labor needed to operate all processes in the factory; (13) Design the factory layout from unloading of the inputs (such as teff grain) from trucks to the loading of the delivery trucks with packaged injera. Steps include (but are not limited to) receiving the inputs, mixing, fermenting, loading (batter into machine), producing, packaging, stocking (delivery trucks), cleaning, draining system, quality control, energy supply; (14) Create a detailed step-by-step manual for the operation of the Injerama machine; (15) Create a detailed step-by-step manual for the operation of the injera factory; (16) Do any other design work needed to make this system ready to take to the next steps of manufacturing the machine and implementing the process.

Requested Dept.: Ag, Industrial, Mechanical

Requirements: Intellectual
Project Title: Ceramic device transport container

Description: Ceramic devices are capable of separating gases into their constituents for applications requiring purified streams. The ceramic devices may be comprised of delicate structures that must be transported from manufacturing facilities to their point of use. As ceramics, the materials are sensitive to applied moments, vibrations, and accelerations. A cost-effective package is desired to enable shipment with high reliability. We would like a multidisciplinary team of mechanical and industrial engineers to design a container that would enable reliable transport of ceramic devices. The devices are approximately 85 cm tall, by 15 x 15 cm, and weigh approximately 15 kg. Each device consists of an array of thin plates supported by a central column. Drop-testing has been used to determine that the maximum allowable g-forces are 0.5 g in all directions. The target cost for the shipping materials is $100. Project scope: 1. Define design criteria and acceptance test protocols. 2. Perform engineering evaluation of up to three potential package designs. 3. Select most promising design and hold design review. 4. Subsequent to design review, build and test prototype shipping container. 5. Develop a life cycle analysis on use of the container to determine if it should be reusable or single use.

Requested Dept.: Industrial, Mechanical

Requirements: Confidential
Air Products and Chemicals, Inc. 2

Contact: He Jianpei / QuQiang
Address: East Wing, 1st Floor, No. 88Lane 887, Zuchongzhi Road, Shanghai, China, - -
Phone: +86-21-38962065 (ph)
E-mail: hej@apci.com ; QuQ@apci.com

Project Title: Liquid Nitrogen Packed Column Distributor Design

Description: Overview and Motivation: In a packed distillation column, vapor is fed from the bottom and flows upwards while liquid is fed from the top and flows downwards by gravity. The vapor and liquid come into contacted in the packing installed in the column. The more evenly the vapor and liquid get contacted, the more effectively the packed distillation column works. The first step for an even vapor/liquid contact is to distribute the vapor/liquid evenly throughout the cross sectional area of the distillation column. This project is targeted at the liquid distribution only. Normally liquid is introduced to the liquid distributor (in the distillation column) via feed nozzle(s). The feed nozzle size ranges from 25mm to 500mm diameter while the column size ranges from 300mm to 6000mm diameter (or even larger). The liquid distributor’s function is to accommodate liquid feed from nozzle(s) as well as evenly spread the liquid throughout the cross sectional area of the distillation column. The purpose of this project is to develop a new type of liquid distributor which can be used to distribute cryogenic fluid (liquid nitrogen). The following guidelines need to be considered when developing the new distributor. • The distributor will work at extreme conditions (-196 C). Proper material must be selected. • The liquid feed momentum needs to be mitigated to achieve even liquid distribution Liquid level gradients throughout the distributor should be minimized to achieve even liquid distribution. • Horizontal flow velocity throughout the distributor/distribution holes should be minimized/killed to achieve liquid even distribution. • The final distribution holes should not be so small as to be blocked by debris. • The dripping hole density should be at least 200 holes /m² and evenly located throughout the cross sectional area of distillation column. • The risers should have enough open area to allow vapor pass through the distributor without resulting in too much pressure drop. The vapor pressure drop across the risers can be calculated for a given vapor property, vapor flow rate and riser open area. As a start, the total cross sectional area of risers should be at least 20% of the cross sectional area of the column. • Simple, reliable and low cost design is preferred. Objectives and Deliverables: The objective is to design a liquid N2 distributor for a ?1.8m packed column. The criterion for a good distributor is defined to be: Flow through all holes should be within a 5% tolerance. The deliverables include all or part of following, depending on the progress and facility availability: a) Schematic drawing of distributor b) CFD modeling and results c) Manufacturing drawing of distributor d) A distributor prototype (optional) e) Distributor test result using water(optional) f) Final project report The following are the suggested steps (may be adjusted according to progress) Project definition 3 weeks o Understand requirements to know the key success factors for the project o Literature research through library or Internet etc. o Brain storming, idea creation and prioritization, design different distributors and select the model that is to be tested or modeled CFD modeling 12 weeks o Software selection and corresponding learning o Distributors model creation and simulation o Results analysis and design modification Build and test 12 weeks (optional) o Manufacturing drawing developing o Distributors manufacturing o Test rig preparation o Test the distributors, analyze the data and design new distributors Final report 1 week o Report preparation and Documentation

Requested Dept.: Chem, Mechanical

Requirements: Confidential, Intellectual
A schematic of a liquid distributor is given in figure below.

Note that the purpose of schematic drawing above is to illustrate the principle of a liquid distributor. A real distributor product can be materially different from the schematic.
Project Title: Planetary Optimization – Phase 2

Description: Background: The planetary gear presents a number of advantages (power density, large reduction in compact volume, pure torsion reactions) that make it an ideal solution for gear reduction applications for Akron Brass products. The current planetary gear sets are extremely cost effective at the sacrifice of the efficiency (80% ~ 50%). Planetary gear sets can be arranged in series to multiply ratios (5:1 x 5:1 = 25:1). When multiple planetary sets are used in series, the efficiency is multiplied as well (80% x 80% = 64%). Some applications require 4 planetary sets in series (41% ~ 6%). The low cost of the current planetary set may be offset by the increased size of motors, increased wire size required for current draw, possibly increasing the number of planet sets required to generate the necessary torque to rotate a joint, reduced life of the gear. State-of-the-art commercially available gear sets are 97% efficient per gear set. This presents an opportunity of 17% ~ 47% improvement of the efficiency of our current gear sets. The challenge of this application is to identify appropriate improvements that will have as little impact on cost as possible (possibly, a dollar amount per % improvement). If $10 added to the gear set improves the product value by more than $10, the product value will increase. First Semester Summary: A test fixture was developed that can measure the planetary gear output speed and output torque. The input speed and torque is measured from the input current and voltage to the electric motor. The total efficiency of the output of the system is measured and calculated from the test fixture. The electric motor efficiency must be known in order to derive the gear set efficiency. The efficiency of the electric motor is then divided out to calculate the gear set efficiency. Issues: 1. The resulting gear efficiency is higher than 100% in some cases. It appears that friction needs to be considered in the torque calculation for power out. This brings efficiency into the 40% range which is believable. 2. The characteristics of the electric motor are not well understood. These characteristics have a large influence on the measured/calculated efficiency of the gear set. 3. The load applied to the gear set uses a prony brake. This configuration may generate some loads that are not accounted for in the measurement of the efficiency. Project Objective: 1. Verify the calculations are correct for the current setup. 2. Evaluate the current test setup and identify improvements to the fixture. Identify errors in the current test setup (measure actual friction coefficient of the brake, consider brake loading errors, improve accuracy of the input power measurement, etc.) 3. Re-measure the efficiency of the planetary gear set. 4. Identify opportunities in the current design to pursue greater efficiency. Strategy: Power is the combination of torque and speed. Efficiency is the ratio of power out divided by power in. Parameters involved: • Torque in • Speed in • Power in (dependant on torque in and speed in) • Torque out • Speed out • Power out (dependant on torque out, speed out, and efficiency of gear set) Deliverables: i) A verified test device that will measure a combination of torque, speed, and power that will result in measuring or knowing all six variables. The device should have the following capabilities: 1. Ability to measure efficiency at varying input speeds. 2. Ability to measure efficiency at varying output loads. 3. Ability to adjust the output load to a known value. ii) An improved planetary gear set (>90%)

Requested Dept.: Mechanical

Requirements: Confidential, Intellectual
APPEK, LLC

Contact: Andrew Herman
Address: 200 Lackawanna Ave., Suite 300A, Scranton, PA 18503
Phone: 814-777-0819
E-mail: andrew.herman@appekapps.com

Project Title: Website to Native Mobile App Generator

Description: Project Overview: APPEK is a Penn State born company focusing on multi-platform mobile application development. Currently, they are serving the public transportation industry with a GPS-based bus-tracking application in several markets. In order to realize the full commercial value of this service, this project will streamline the customer-to-product workflow from its current manpower driven operation to a fully automated web service. This project will take advantage of existing technologies like Google Transit's General Transit Feed Specification (GTFS), common Automated Vehicle Location (AVL) API's, etc. Deliverables: 1.) Complete competitive benchmarking, including copyright and patent considerations. 2.) Financial analysis of any related hardware or maintenance costs. 3.) Design and develop a customer front-end website allowing users to create and manage their accounts. 4.) Design and develop the associated back-end database and web service to store customer information, as well as house application usage feedback information. 5.) Design and develop the associated iPhone and Android apps based upon APPEK's pre-existing technology and specifications.

Requested Dept.: CompSci

Requirements: Confidential, Intellectual
ArcelorMittal

Contact: Rachel Smithers  
Address: 215 S. Front Street, Steelton, PA 17113  
Phone: 717-514-7180  
E-mail: rachel.smithers@arcelormittal.com

Project Title: Test Procurement for Standard Rail

Description: ArcelorMittal produces rail for railroads and transit systems throughout the Americas at its facility in Steelton, Pennsylvania. Rail is produced in a variety of sizes and two families of grades - standard strength and high strength. Each heat lot of rail produced requires mechanical properties testing to assure compliance to industry and customer specifications. For many years, tests for standard strength rail were taken at an in-line hot saw station. That saw uses a high speed steel blade to cut tests at elevated temperature, while the rail is still austenitic. Testing over the last few months has brought to light that the samples procured by this method did not accurately represent the mechanical properties of the finished rail. We have determined that the sampling needs to be done once the transformation is complete. A successful project will deliver: 1. Solutions considered for procuring the test, with a recommendation for the preferred method, including the requirements for purchased hardware, consumables, and utilities. 2. If a permanent (fixed) installation can be made, conceptual drawings of the installed solution. 3. Analysis of the considered solutions, including safety, cost, cycle time, robustness, utility requirements, labor needs, and maintenance requirements.

Requested Dept.: Industrial, Mechanical  
Requirements: none
Armstrong World Industries Inc

Contact: Bill Frantz
Address: 2500 Columbia Ave, Lancaster, PA 17604
Phone: 717.396.5713
E-mail: whfrantz@armstrong.com

Project Title: Develop Optimized Footprint for Marietta PA Ceiling Tile Manufacturing Plant

Description: Company Background Armstrong World Industries Inc is a global leader in the design and manufacture of floors, ceilings and cabinets with a focus on innovation, design and environmental sustainability. Armstrong’s net sales totaled approximately $2.8 billion in 2009. Based in Lancaster, PA, Armstrong operates 35 plants in eight countries and has approximately 9,500 employees worldwide. Project Overview Armstrong operates a ceiling tile manufacturing plant in Marietta PA. As part of a Lean Manufacturing Initiative in 2011, we are re-evaluating the entire 110 acre plant property footprint with the intention of working towards a more rational plant layout. As manufacturing needs change over time, “how and why” things are located as they are may gradually make less sense. This can lead to costly wastes and inefficiencies (scrap, damaged or lost material, excess motion and transportation, waiting). Currently, we have all sorts of material (raw materials, GIP, finished goods, packaging materials, spare parts, stores items, etc.) spread out over the property and across numerous buildings. We believe there are potential savings and waste reduction opportunities if we could optimize our plant layout. Our goal is to completely eliminate the need for two of our buildings (allowing a cost avoidance in roof repairs over the next several years, energy savings, scrap and other savings). We want a Capstone Team to develop a “future state” for us in the first quarter of 2011, which would allow the plant to focus on the execution of the changes over the rest of the year and next year. Project Deliverables 1. Define the current state. Map out our current storage/usage locations of all items, materials and equipment on the Marietta Property (what is located where and why?). 2. Gather data on current movement patterns and material usage (what goes where?, when?, how often?, why?, etc.). 3. Create an optimized property layout that minimizes transportation and motion waste (define what should be where, in what volumes). This analysis should take into account the future vision of the plant in terms of output, product mix, potential major re-designs of the manufacturing lines, etc. 4. Create a “roadmap” to help us get to the “future state” (what order should changes be made?).

Requested Dept.: Industrial
Requirements: Confidential
B Braun Medical, Inc.

Contact: Brian Grafe  
Address: 901 Marcon Blvd, Allentown, PA 18109  
Phone: 610.596.2667  
E-mail: brian.grafe@bbraun.com

Project Title: ISO 80369-compliant design of Medical Device Connectors/standards

Description: Male & female Luer adapters are ISO standardized components that have been used for decades in a variety of medical devices and applications. The advantages of an ISO standard connector are obvious to designers who want to ensure interoperability among potential mating components from various manufacturers. But the application of the Luer adapter across multiple systems and applications has also given rise to a significant and growing problem: the misconnection of medical devices. Such misconnections typically can occur when a patient is connected to multiple systems in a clinical setting, fulfilling different requirements for patient monitoring, feeding, drug delivery, etc. Although the dilemma is by no means new, progress in medical technologies has only exacerbated the problem, resulting in patients being simultaneously connected to diverse systems. In such situations, transposed connections--e.g., a blood pressure cuff inflation line mistakenly connected to an IV line--can and have had fatal results. Consequently ISO 80369, Small Bore Connectors Standards, is currently being developed to identify and standardize the requirements of connectors for six identified applications, while also ensuring the incompatibility of said connectors in the event of attempted "cross-functional" use. Thus, the goal of the standard is that the connectors by design would assist medical practitioners in the prevention of medical misconnections, in the face of ever-increasingly complex clinical settings. The goal for the PSU project team is to design four different male/female connector pairs that satisfy the provided functional performance requirements (based on ISO 594 for the luer connector), while also guaranteeing incompatibility of the connectors in the event of an attempted misconnection between any/all of the different designs. The team shall provide proof of concept achievement via simulation, modeling, and/or physical samples, taking into account the "entire design envelope" of each connector pair design. Design methodology/approach is also of interest. B. Braun is participating in the development of the ISO 80369 standard, and we feel that the process provides an excellent backdrop for students to gain valuable, real world insight into the challenges of standards development and product design. As the team exercises its creativity in problem-solving methodology and design solutions, they will be competing with the best and brightest of the Medical Device Industry in an effort to significantly enhance patient safety, medical device efficacy, and clinician productivity.

Requested Dept.: Bio, Mechanical

Requirements: Confidential, Intellectual
BAE Systems

Contact: Bryan Berical

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Project Title: Thermo-Electric Discrete Cooling

Description: Project Abstract: --------------- In our business of developing Avionics, we often encounter a few "problem" devices which are prone to exceeding their maximum junction temperature. The end result of this is a higher system design cost, so that the excessive heat of these devices may be accommodated. Since normal axial fans have proven unreliable in these types of environments, we want to explore the use of thermo-electric cooling devices to remedy this issue. Thermo-electric coolers are solid-state devices that use applied voltage to create a change in temperature (also known as the Peltier effect). Project Deliverables: - Prototype thermo-electric cooling design - Final report documenting findings

Requested Dept.: Electrical, Mechanical

Requirements: none
Biomass Converters, Inc.

Contact: Herman Wefelmeyer
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Project Title: Construct Prototype OCM Reactor

Description: Biomass Converters Inc. is a startup company whose object is to build, own, and operate chemical processing plants that convert biomass into ethanol for motor fuel. Biomass Converters Inc. is currently developing a gasification process that will be used in these plants. We believe that the cost of the ethanol manufactured by this project could be less than $0.50 per gallon, less than half of the costs of both current processes using corn and those under development using cellulosic feedstock materials. In order to justify funds needed to develop this process, a working prototype is needed to verify the potential profitability of this process. Proposed Reactor Design (1/4 scale) Deliverables: The deliverables for this project are as follows: • A working model of the reactor that converts at least 35% of the methane to ethylene • A mass balance that includes all materials added to the reactor and all materials exiting the reactor • An energy balance that is based on the above mass balance Departments: Chemical Engineering, Energy Engineering, Mechanical Engineering Requirements: Confidential Agreement, Intellectual Property Agreement

Requested Dept.: Chem, Energy, Mechanical

Requirements: Confidential, Intellectual
Boeing 1

Contact: Frann Shore  
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Project Title: FSAE Data System

Description: Using a rigorous systems engineering approach, design and build a complete data acquisition system that will monitor more aspects of the vehicle’s status and performance than ever before. Planned instrumentation includes a 6 DOF inertial measurement unit, linear damper and steering potentiometers, temperature measurements of the turbine inlet and engine coolant, as well as GPS lap timing capability. All of these sensors will be mounted in custom-designed enclosures and communicate with the central control computer in the dashboard of the car. This controller, based on the powerful BeagleBoard C4, will display information on a color LCD screen and also transmit the data wirelessly for pit area monitoring.

Requested Dept.: CompSci, Electrical, Mechanical

Requirements: none
Project Title: Mechanical Energy Storage

Description: Energy storage for small-scale renewable energy generation systems is currently dependent on battery storage. These systems are bulky, heavy, contain toxic chemicals, and are difficult to maintain. In order to make renewable energy on this scale feasible for use in remote areas, a more easily maintainable and inexpensive system is needed. The goal of this project is to design, build and demonstrate a mechanical system that stores energy in a mechanical form and outputs the electrical power, using a systems engineering approach. The received energy could come from a wide variety of sources including solar, hyrdo, and manual (human and animal). The system should be maintainable with locally available skills and materials, so that it can be installed and used with limited engineering support. The system must have good environmental robustness against things like sand, dust, mold, temperature, rain. The design team will need to determine the size and duration of the load they're trying to serve, the availability (level, intermittency) of the energy source, and time period over which energy should be stored / allowable energy loss rate. A complete systems analysis and engineering trade study should be conducted.

Requested Dept.: Energy, Mechanical

Requirements: none
Boeing Helicopters

Contact: Farhan Gandhi

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E-mail: fgandhi@psu.edu

Project Title: Morphing Wing for Compound Helicopters

Description: Compound helicopters have wings attached to the fuselage to provide lift in high-speed flight where the effectiveness of the main rotor decreases. In doing so, they increase the maximum speed capability of the aircraft. However, the presence of the wing in the main rotor downwash in hover and low-speed flight significantly reduces the rotor efficiency in those conditions. A morphing wing that can retract into a compact configuration at low speeds, and expand at high speeds would be highly beneficial from a performance standpoint. Boeing Helicopters in Philadelphia has sponsored this project. The project comprises of the following steps and will extend beyond the duration of a semester. (1) A baseline “nominal” wing will be identified as a starting non-morphing design, to be used as a benchmark. (2) A morphing wing will be designed by the team that will extend to dimensions similar to that of the nominal wing, while having the ability to produce comparable levels of lift. (3) The reduction in planform dimensions in the compact configuration is to be maximized, while keeping in mind the weight penalty. (4) The morphing wing will be fabricated and undergo benchtop testing to demonstrate actuation from compact to extended configurations, and the ability to carry equivalent aerodynamic loading. (5) The morphing wing will be tested in the wind-tunnel in the extended configuration to determine penalties in drag that it may suffer relative to the benchmark non-morphing wing. (6) The weight of the morphing wing will be compared to that of the benchmark non-morphing wing. (7) Scaling issues will be considered (how does the demonstrator scale to aircraft in different weight classes).

Requested Dept.: Aero, Mechanical

Requirements: none
BP

Contact: Glenn Gesoff

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Project Title: Designing Novel Solids Separation or Particle Size Reduction Devise

Description: BP is regularly faced with potential solids plugging issues around pumps used for removal of liquids in a multiphase natural gas well. Solids of various sizes pass through the pump either creating plugging or abrasion issues inside the pump. In addition, due to the low liquid flowrate & velocity, if the particle sizes are too large they will also accumulate in the discharge tubing and form another plug. The key objective is to keep the pump running as long as possible and reduce the number of times the pump has to be pulled from a plugged or worn condition. Filters or screens may prevent solids entry, but then they plug and BP still has to pull the pump out. A solids separator below the pump can be a better option but there are two downsides. First it limits applications to vertical wells and secondly, the solids will accumulate in the bottom of the well and then have to be cleaned out in other manner. BP is therefore, seeking two novel designs: 1. A non- powered, non- plugging screen or separator to be used in vertical wells. 2. A powered solids grinder that can reduce plugging in the pump and essentially allow solids to be suspended and carried out of the well. This would definitely be needed for a horizontal well. If needed, electrical power is supplied to the pump. Engineering Disciplines: ME, EE, ChemE

Requested Dept.: Mechanical

Requirements: Confidential, Intellectual
Central Pennsylvania SCI Support Group 1

Contact: Keith Parsons  
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Project Title: Bionic Glove for Tetraplegic Man

Description: The Bionic Glove is an ongoing project to develop a device that will make it easier and safer for a C5 tetraplegic man to perform weightlifting. Previous prototypes have addressed the issue of power supply, tight closure and opening, and the ease of donning and removing the glove. The introduction of voice recognition represented a significant advance in the overall control of the glove by the user. Some of the new ideas being proposed for the Bionic Glove are: 1. Moving the power supply off the glove and onto the forearm. 2. Reduce the voice recognition device and move it off the glove onto the arm. 3. Increase the number of commands the voice recognition system can recognize including the ability to pause. 4. Adjust the profile of the mechanism used to open the glove by incorporating actuators to pull the straps that close the glove and modifying the spool that opens and closes the glove. 5. Gripless weights/dumbbells that do not require grip to lift are also considerations in the design of this glove. The design team will have the previous prototypes as references for a new prototype. Copies of the previous two projects final reports can be obtained from Dr. Mary Frecker, Professor of Mechanical Engineering

Requested Dept.: Bio, CompSci, Electrical, Industrial, Mechanical

Requirements: none
Central Pennsylvania SCI Support Group 2

Contact: Everett Hills, MD  
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E-mail: ehills@psu.edu

Project Title: Self-Propelling Walker

Description: The first prototype self-propelling walker was unveiled at last summer's 2010 Iron Lion competition where it won 1st place. The 2010 fall semester design team modified the walker to a tricycle arrangement with power to the front wheel. An attempt to use omni-directional wheels on the rear legs was unsuccessful and were replaced with castor wheels. The speed is controlled by a pressure-sensitive trigger which increases motor speed as more force is applied. There is also reverse speed and neutral by flipping a switch on the hadgrip. Preliminary use of this self-propelling walker has generated very positive feedback from the SCI support group. Everyone who used the walker felt it preserved energy and was practical for community ambulation. Several recommendations were made by these users for consideration in the next version: 1. Make the trigger switch more stable 2. Make the walker handles raise higher for taller persons. 3. Expand the base of support to prevent tipping. 4. Allow the motor to disengage so that the walker can be propelled in the event the battery dies. 5. Have larger anti-tipping caster wheels in the front 6. Use the omni-directional wheels on the rear legs. 7. Devise a breaking system for the rear wheels. There may be interest in using this device for patients with Parkinson's Disease (a neurological disorder of motor control and balance) who have a tendency to fall backwards and have trouble getting their legs to go forward. Pushing a walker tends to be challenging. This self-propelling walker may allow them to ambulate more safely and with less energy consumption. The final report on the Self-Propelled Walker (12/13/10) can be obtained from Drs. Maggie Slattery (Biomedical Engineering) and Mary Frecker (Mechanical Engineering).

Requested Dept.: Bio, Electrical, Industrial, Mechanical

Requirements: none
ChimClean

Contact: Jason Gabler  
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Project Title: Chimney Cleaner

Description: Design a “universal” chimney cleaning system that can be used from the ground without having to go onto the roof to clean the chimney flue. The system will need to be universal for the four different size round flues, four different square and four different rectangle flues. Ultimately having two maybe three different chimney cleaning packages that could be sold off the shelf of large retail stores. The mechanics would be a pulley system that attaches to the top of the chimney (the best design needs to be determined). A cable that goes from the operator on the ground to a spring loaded device in the chimney flue via the pulley. The spring loaded device opens at the bottom of the chimney. The operator pulls the device up the flue to clean it. Once at the top then compresses the spring which contracts the cleaner to allow the operator to lower the device to the bottom of the chimney via gravity.

Requested Dept.: Mechanical

Requirements: Confidential, Intellectual
Consol Energy Inc.

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Project Title: Safety and Efficiency of Magnetite Recovery Process

Description: Process Opportunity: Increase the safety and efficiency of magnetite recovery equipment currently used in heavy media based coal beneficiation processes. Current Process Technology: During the coal cleaning process, waste rock is separated from coal using a media that has a density between that of rock and coal. One media that is commonly used in coal cleaning is a suspension of finely-ground ferrous solids in water. This media can be easily adjusted in density, and the majority of the ferrous solids can be recovered and recycled using magnetic devices. Magnetite (an iron ore) is usually the ferrous material of choice due to its resistance to oxidation, high bulk density, and commercial availability. In the last ten year period, process grade magnetite has more than tripled in price. The current magnetic separator technology uses rare earth magnets exposed to a large surface area in extracting the magnetite from the aqueous suspension. Key Objectives: A more-effective magnetite recovery system will allow tighter control of the media density, resulting in higher process efficiency, and will reduce magnetite losses. Other benefits compared with existing magnetic separators are a small footprint, no moving parts and no stored energy sources. A successful design will consider the safety aspects, capital and operating cost improvements, and the practical application within the entire system. Expected Project Agenda: Research of previous work in the area of magnetite recovery. Identify the governing scientific principles. Field trip to operating Coal Processing Plant. Formulate the best possible approaches and narrow to one plan. Construct a pilot scale model for testing. Evaluate the achievement of the goals.

Requested Dept.: Chem, Electrical, Mechanical

Requirements: Confidential, Intellectual
Project Title: Continuous Passive Motion Machine for Man With Bilateral Hand Transplants

Description: The purpose of this project is to help improve the motor and range of motion recovery to a man who received a left hand and right above elbow arm transplant one year ago. He currently receives daily hand therapy in an effort to obtain the highest possible return of strength and fine motor control to his hands. This therapy is conducted by a hand therapist who performs passive range of motion techniques on the patient's arm and hands. The patient continues his exercises at home as directed. Progress has been slow and steady but a device that flexes and extends the finger and wrist joints would help confer greater recovery while permitting the patient to work on other activities such as fine motor movements of pinching, grasping, and twisting using the fingers. Current devices used to passively move the hand and finger joints are very bulky and not portable. The prototype device being sought in this project will be portable and light weight. It will allow the user to exercise the muscles in his transplanted right arm and allow him to develop his fine motor control of the finger movements. The device will have safety features and be under complete control by the user. Ideally, the patient will be able to use this device at home. The design team will work with the project contact, the occupational therapy hand specialist, and the patient. Additional resources will be drawn from the Penn State Hershey Medical Center's Department of Physical Medicine & Rehabilitation, Department of Physical and Occupational Therapy, and Department of Orthopaedics.

Requested Dept.: Bio, Electrical, Industrial, Mechanical

Requirements: none
Dresser-Rand 1

Contact: Jorge Pacheco  
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Project Title: Cylinder Assembly Rotation Rig

Description: Overview Dresser-Rand is one of the major suppliers of Turbomachinery equipment in the world. Its reciprocating compressors are at work creating products we use every day. In the refining industry, our equipment compresses hydrogen and hydrocarbon gas mixtures, to produce clean gasoline, jet and diesel fuels, heating oils, lubricants and asphalt. Also, our compressors collect and separate toxic gases harmful to the environment. In the petrochemical industry, thousands of products ranging from plastic to shampoo are created by the compression of various gas mixtures, in many different chemical processes. Motivation In order to maintain Dresser-Rand’s position as a technical leader in reciprocating compression, a project was started to develop a cylinder assembly rig that is capable of rotating a process cylinder designed for the oil and gas industry. The cylinders are designed for variety of applications and as such change in size (see figure below). The test rig will need to be fitted with movable elements to facilitate its use on this variety of cylinder envelopes and avoid time consuming retrofits. Objectives The objective of this project is to design a portable, robust and precise system to ensure the cylinders can be rotated accurately, reliably and safely for long-term use. Safety is paramount to our company. Reliability will be crucial as it will be used multiple times a day on a variety of sizes. Accurate positioning of the cylinder openings will aid the fitting of valves and their associated assemblies. Deliverables The team is expected to develop a cost effective rotation system that will meet the reliability and precision of movement requirements. The deliverables will include the layout and drawings for the rotation system and a final report detailing the design process. Also, a working model or prototype is expected. This prototype will be a scale representation that shows the functionalities of the design.

Requested Dept.: Mechanical

Requirements: Confidential, Intellectual
Dresser-Rand 2

Contact: Jorge Pacheco
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Project Title: LNG Development Test Rig

Description: Overview LNG stands for liquefied natural gas. Natural gas is one of the most abundant natural resources on Earth. Geologists say that natural gas reserves are plentiful and will last for several hundred years, long after crude oil reserves have been exhausted. This makes natural gas an extremely attractive energy source to meet ever increasing global energy demand. The only difficulty with natural gas is that it has been economically challenging to transport due to its mass in its gaseous state. However, when chilled to -162º C (-260º F), natural gas converts to a liquid form and takes up only 1/600 the space. Dresser-Rand is one of the major suppliers of large compressors used in LNG trains. Motivation In order to maintain Dresser-Rand’s position as a technical leader in centrifugal compression, a project was started to develop a sub-scale test rig that is capable of testing stages for LNG service and gas pipeline applications. The test rig will be fitted with Movable Inlet Guide Vanes (MIGV) that are used to shift the performance map without causing excess reduction in efficiency. Objectives The objective of this project is to design a robust and precise drive system to ensure the vanes will move accurately and reliably under long-term field application. Reliability is paramount to our clients who could face millions of dollars in operating losses due to down equipment. Accurate position of the vanes determines the aerodynamic performance of the compressor which is directly related to the operating cost for the unit. Deliverables The team is expected to develop a cost effective drive system that will meet the reliability and precision of movement requirements. The deliverables will include the layout and drawings for the drive system and a final report detailing the design process. Also, a working model or prototype is expected. This prototype will be a full scale representation that shows the functionalities of the design.

Requested Dept.: Mechanical

Requirements: Confidential, Intellectual
Project Title: OIL OPERATED STOP & CONTROL VALVE

Description: Overview For more than 85 years, Dresser-Rand GIMPEL has been a world leader in design, construction, and servicing of numerous types of valves. One design in particular is the oil operated trip and throttle valve (OOTTV). These are safety critical equipment used in many diverse applications such as in refineries, ethylene production plants, and for the Navy. The purpose of the TTV is to prevent destruction of a turbine by shutting off steam flow in less than 300 milliseconds. The valve operating system uses an Electro Hydraulic or an Electro Mechanical Actuator (EMA) with an available maximum/steady state force of up to 50,000/20,000 lbs for valve operation and a spring load of up to 10,000 lbs for closing. Typical normal flow rate will be 350,000 lb/hr at 950psig and 950 F. Motivation The TTV steam section can either have a Globe or Offset shape that will encompasses a semi balance disc. The TTV valve can be used as a control valve during turbine start up with no load mode up to 5 to 10% of steam flow rate. During this mode, throttling is done using only the pilot valve. Once the governor valve takes control of the steam turbine the TTV will open and stay open until the trip system initiates shutdown. This concept requires one stop valve and 2 or more control valves. The control valve does not provide positive shut off, therefore the stop valve is required. The maximum operating temperature is 1050 F for our current TTV design and material selection. Objectives Develop a cost effective TTV that can be used as a stop valve as well as a control valve for the full range of steam flow. This will include steam condition temperatures up to 1150 F. The new design will have a positive and fast shut off which will eliminate the need to use a control valve. It is recognized that this concept may not be suitable for all application but our goal is to apply this design to at least 25% of cases. Deliverables -Design internal trim so that valve can be used as a stop and control valve connected to a steam turbine inlet. -Establish material, hard facing, surface treatment of all sliding parts for up to 1150 F operating temperature. -Establish guide lines for limitations on this application as a control valve.

Requested Dept.: Mechanical

Requirements: Confidential, Intellectual
Experimental Designs, Inc

Contact: Colin Darney
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Project Title: Bipedal Machine - Part 3

Description: Experimental Designs is continuing research into the realization of a large, hydraulically-driven bipedal machine that carries a pilot for initial use in construction. The basic structural design of the machine has been completed but requires refinement before continuing with the project. Originally, the design was able to use prefabricated pieces for savings in both cost and manufacturing time. However, it has been identified that those structural members will not be able to support the machine while in motion and under power. Team members will be taking the structure as it stands and redesigning it to meet the requirements of dynamic motion. The past three projects have completed the redesign from the hips through the ankles of the machine. This project will be concentrating on two separate milestones. First, a completed foot design will be finalized. Second, the entire completed design will be analyzed for deficiencies. This project will be heavy in FEA analysis, troubleshooting and product improvement. Student have free reign to change the design in any way to meet project goals. The past project deliverables will be provided to team members for analysis. It is strongly suggested that team members be prepared to study the reports from the past projects as it will save time in understanding and "getting up to speed" with the challenges facing this project. Due to the complexity of this project, it is understood that some objectives may not be met this semester. If this is the case, team members, the team faculty supervisor and myself will have a candid and open discussion about how to prepare the work done in this semester’s project to be completed in following projects. Students applying for this project should prepare themselves for a challenging semester. I am specifically looking for detail oriented people who are creative, self-motivated and can think 'outside the box'. Free and frequent communication between the team members and myself is not only looked for but encouraged. An interest in robotics and/or biomechanics is encouraged, but not required. Skills in troubleshooting and product improvement are a plus. It is the suggestion of past teams that at least one team member have extensive knowledge of Solid Works and above average skill in FEA analysis. Students will be required to attend a meeting on either 1/18, 1/19, 1/20 or 1/21; date to be determined by the team leader and myself. This meeting is mandatory. It was found that team members not able to be at this meeting were unable to "catch up" to everyone else related to the discussion that takes place. This led to many misunderstandings later in the semester that could have been avoided by simply attending the initial meeting. On selection for the project, team members can pick up a “Student CD” from the Learning Factory offices in the Leonhard building. This CD should be reviewed prior to the initial meeting as students will be expected to have a basic familiarity of the prior projects goals and limitations. The CDs are considered property of Experimental Designs and will be collected at the end of the semester. Specific project goals for this semester, along with any comments, questions or concerns that team members may have will be the topic of the initial meeting. This meeting should also be considered a working meeting; teams should come prepared to discuss their initial ideas for changes, observations, problems etc… It is strongly suggested that the team meets with each other prior to meeting with me to collaborate and prepare for the initial meeting.

Requested Dept.: Industrial, Mechanical

Requirements: Intellectual
**Flowserve**

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**Project Title:** Research and Development of Composite Materials for Pump Pressure Vessels

**Description:** Flowserve is continuously seeking ways to improve the products that are provided to our customers as well as ways to remain competitive in a very aggressive market. Most recently Flowserve has begun to explore the application of composite materials in the construction of pressure retaining pump components. Flowserve high energy pumps are manufactured with forged carbon steel or forged martensitic stainless steel casings that provide high strength at high temperatures. Last semester a team of students tried to develop a composite design philosophy that will house a bolted closure for a pressure vessel, but ran into a few roadblocks. This semester a root cause analysis should be performed on the previous work, and that information used to complete a valid design strategy. This strategy should be validated by hydro-testing a scaled prototype. Objectives: This one semester project will require the students to simultaneously investigate the use of composite pressure vessel materials from both an experimental and theoretical approach. Analytical: (1) Perform a root cause analysis, (2) Determine the shortcomings of the previous attempt, (3) Complete a detailed design review of the design from last semester, and (4) Complete a detailed design review of the improved design. Experimental: (1) Manufacture the scaled composite prototype pressure vessel, (2) Hydro-test the prototype to the test conditions provided by Flowserve, and (3) Based on the results develop a design strategy for advanced composite pressure vessels.

**Requested Dept.:** Mechanical

**Requirements:** Confidential, Intellectual
Project Title: Secondary Hood Release Handle

Description: (1) Overview: The hood release on current vehicles consists of two stages. A primary release typically located in the passenger compartment near the driver, and a secondary release located at the front of the hood opening. The purpose for this two stage release is to ensure that the hood does not inadvertently open while driving the vehicle thereby obscuring the driver’s vision. Typically, this secondary hood release is found by feeling "blindly" in the small opening at the front of the hood created by the primary release. Finding the secondary hood release can be difficult and or inconvenient. (2) Component Description: The secondary hood release is typically a simple lever that is pushed to one side. This releases the hood from the latch and allows it to be opened fully. The component is typically a simple stamped part that operates on a pivot and is spring loaded against the release motion to hold the hood shut until manually released. (3) Fundamental Issue with current design: The current design requires users to find the hood release in a partially opened hood. The hood opening is approximately 30mm which leaves a minimal amount of room for users to move their hands and fingers to search for the secondary latch. Additionally, users may bend down and attempt to visually locate the latch, but it can be difficult to see (4) Design Challenge: Create a cost effective, minimum weight latch handle that deploys out of the 30mm gap created by the primary hood release so users can easily locate the secondary release and open the hood. Additionally, the secondary release must self store when the hood closes. (5) Design Considerations: The deployable hood release should be easily accessible and visible when standing in front of the vehicle. It should not increase the force required to release the hood when compared to the current design. When deploying and storing, the handle should not swing into (or through) the hood as it closes. Additionally, the design must accommodate some amount of hood "overslam". Overslam occurs when the hood is closed and continues to travel beyond its closed position due to the inertia of the hood. The hood then returns to the standard closed position as the hood bumpers and hood itself react to the loads placed on it. Finally, the design should be tolerant of debris as these parts are exposed to the open underhood environment. Typical debris can include dirt, grease, snow, water or other items left on the roadway. (6) Mechanization Thoughts: The concept can be actively or passively actuated meaning that it can be activated electrically in some manner, or purely mechanically. Typical hood release systems are purely mechanical, but electrification of the device is not excluded as a possibility. Because the current release is recessed under the hood, either a slide out or rotating device to present the release to the user is assumed to be a potential solution.

Requested Dept.: Mechanical

Requirements: Intellectual
General Motors 2

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Project Title: Variable Height Vehicle Air Dam

Description: (1) Overview: Energy costs are rising and the automotive industry is looking for cost effective fuel economy initiatives. Future improvements aim to reduce mass, improve vehicle drag, or reduce parasitic losses. This project will focus on reducing aerodynamic drag with a minimum impact to cost and mass. The proposed solution needs to consider potential failure modes to deliver a robust design. (2) Component Description: Many vehicles today are equipped with a front fascia that is wrapped around the front bumper system that offers a stylized aerodynamic surface. Just below the fascia is a rubber or plastic air dam component. This part is typically swept in the plan view to channel air away from a path that would have it travel under the vehicle. Due to its relatively low position, the part is designed to manage occasional ground and curb contacts. (3) Fundamental Issue with Fixed Air Dam Geometry: A fixed static air dam creates a fundamental conflict between two important vehicle needs. The bottom edge of the air dam needs to be high enough to meet defined vehicle ground clearance and front approach angle criteria. In addition, the bottom edge needs to be low enough to impact highway speed air flow away from the underside of the vehicle to meet fuel economy / aerodynamic drag requirements. (4) Design Challenge: Create a cost effective, minimum weight dynamic air dam that supports two vertical positions. At low vehicle speeds the bottom edge is at the same height as today’s part. A high speeds the bottom edge is 50 mm lower to improve on highway aerodynamics. (5) Design Considerations: Vehicle’s can travel over a multitude of road surfaces: dirt, two track, highways, and partially flooded roads. The surfaces can be dry, wet, snow covered or rough. Parking lots contain curb stones which air dams can override causing a scraping noise when the vehicle is reversed. The most effective location will be just under the front fascia creating a smooth downward extension to conform to the overall surface. The vertical displacement will be set at 50 mm. The initial low speed position will be in the carryover original position of the base air dam. This will maintain the vehicles low speed ground clearance and front approach angle capability. The design should maintain this position up to 35 mph. The on-highway lower position will not compromise the vehicles utilitarian capability. Faster moving vehicle have significantly less suspension articulation due to the time dependence of the suspensions ability to react to potholes and irregularities in the road surface. The lower position should be targeted at speeds above 45 mph. (6) Mechanization Thoughts: The concept can be actively or passively actuated. Most vehicles will have a source of electricity, vacuum, and events with fore / aft and vertical inertia. When vehicles are traveling forward at elevated speed a fore / aft pressure will be subjected to the foreword face of the vehicle. Your creativity needs to balance cost, complexity, robustness, and effectiveness.

Requested Dept.: Mechanical

Requirements: Intellectual
General Motors - Variable Height Vehicle Air Dam

Air dam position at or below 35 mph

Air dam position above 45 mph

Fascia

Fixed Air Dam

Variable height (Up position)

Variable height (Down position)
General Motors 3

Contact: Matt Monden

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E-mail: matt.monden@gm.com

Project Title: Rear tail lights embedded in rear glass

Description: Problem: Develop a rear glass construction concept that houses the rear tail lamp function. Examples of previous concepts are included in accompany figures. The benefit is potential mass reduction as well as exceptional styling freedom, but all safety limitations and requirements must still be met. Deliverables: System design and analysis and functioning proof-of-concept

Requested Dept.: Electrical, Mechanical

Requirements: Intellectual
GinzVelo

Contact: PZG5018@psu.edu
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Project Title: Velomobile

Description: Project Title: Tilting Electrically-assisted Velomobile Description A velomobile (velo) is a common name for a partially or fully enclosed human powered vehicle (HPV). Most velos are three wheeled recumbent bicycles with two wheels in the front and one in the rear with a sleek teardrop shaped body shell for weather protection and aerodynamics. Riders can pedal all year long through inclement weather and temperature in a comfortable reclined position. Velos can reach more than 50 mph on level ground due to good aerodynamic properties, and some velos are equipped with regenerative electric drivetrains to boost the riders speed. Only a few thousand velos exist in the world, with almost all of them existing in Europe. Demand in America is rising for these machines as more biking enthusiasts understand the advantages of the weatherproof and aerodynamic velomobile. Tasks and Deliverables Design a tilting electrically-assisted three-wheeled velomobile (velo) capable of reaching 60 mph on electricity alone. The velo will be a monocoque design that needs to be engineered and built from the ground up. The project is split into 4 segments that need to be engineered and assembled: frame, front suspension, drivetrain, and body shell. The rear suspension will be a production unit. First, the team designs, refines and runs simulations on each of the sections, and the entire model. Next, the team builds high quality molds for the frame and body, then uses fiberglass to attain a final product from the molds. The suspension and steering segments will also be built out of lightweight materials, and a compact drivetrain will be built and coupled with electric assist. Finally, all four segments of the design are assembled into a working prototype to be the first tilting velomobile in the world. Requested Departments/Skills: Mechanical (3) and Electrical (1) Some team members should have good Solid Works skills. Requirements: Confidential, Intellectual

Requested Dept.: Electrical, Industrial, Mechanical

Requirements: Confidential, Intellectual
Halare Inc 1

Contact: Kyle Goldschmidt
Address: Three Gateway Center, Suite 2400, 401 Liberty Avenue, Pittsburgh, PA 15222
Phone: 610-213-3854
E-mail: khg116@psu.edu

Project Title: Halare Product Development - Development of a Headset to Aid Child with Breathing Problems

Description: Project 1 Last year this course developed a prototype headset designed to train adults in the Buteyko breathing method, targeting adult asthma patients. The senior design team developed a working prototype running off of Labview software running on a PC and using two off the shelf sensors for the hardware. It appears that there is a substantial market for breath training for k-12 children for whom the previously developed headset is not optimal. In this case, the headset must fit the various sizes of children’s heads, be comfortable to wear for the full extent of the 20 minute exercise and collect the heart rate and breathing data similar to the previous unit. For children, a modified training protocol exists whereby under the guidance from parents or trainers the child completes simple physical exercises while doing breathing exercises. The project deliverables are: 1. modify the current design to fit the various children’s head sizes 2. identify the appropriate sensors to record heart rate and breathing patterns 3. add an accelerometer(s) to detect child movement such as jumping, walking etc. 4. create a working prototype of the device

Requested Dept.: Bio

Requirements: Confidential, Intellectual
Halare Inc 2

Contact: Kyle Goldschmidt  
Address: Three Gateway Center, Suite 2400, 401 Liberty Avenue, Pittsburgh, PA 15222  
Phone: 610-213-3854  
E-mail: khg116@psu.edu

Project Title: Halare Product Development - Novel Pulse Rate Sensor

Description: Project 2 The goal of this project is to develop a novel pulse rate sensor for use with the previously developed head-set to replace the existing ear-lobe clip, which has problems with comfort and reliability. The team is to research the various methodologies of monitoring heart rate and identify a unique technology that can be incorporated into the headset design, allowing for heart rate to be monitored in the local vicinity of the ear. The project deliverables are: 1. research existing heart rate sensor technologies and identify a methodology for recording heart rate that meets the headset design requirements 2. design a unique heart rate monitor to be used in the vicinity of the ear 3. Create a working prototype that could be taken further to a manufacturable design.

Requested Dept.: Electrical

Requirements: Confidential, Intellectual
Harris Corporation 1

Contact: Melissa Dempsey, Christopher Feuerstein
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E-mail: mdemps02@harris.com, cfeuerst@harris.com

Project Title: Intruder Detection Sensor System

Description: OVERVIEW Military and homeland security forces are faced with the ever-increasing challenge to provide security for troops and important assets. Their effectiveness can be greatly increased with a network of remotely located sensors that detect the movement of personnel and vehicles. At home, you can secure a perimeter around valuable items, important rooms, or the entire house to assure the safety of your family and belongings. Sensors can be used in various forms to detect anything from acoustics and seismic motion to infrared and magnetic detection. Sensor system designers must overcome challenges to achieve low-power, highly sensitive systems that are capable of filtering out false alarms before sending an alert for detected intrusions. PROJECT OBJECTIVE Design and build a working system that will detect intruders and transfer the sensor data to a remote location using a low-power wireless technology such as ZigBee. Detection sensor methods could include IR proximity sensors, optical sensors, or ultrasonic range finders. The system must contain at least two transmitter nodes with one or more sensors attached to each node. The sensor data must be transmitted to a remote base station receiver that interfaces to a PC to display the data in a readable format. Displayed data should include when the intruder was detected, distance from sensor/location, and an estimate of the number of intruders. The sensor system will be responsible for detecting human-sized intrusions within a 15' x 15' x 8' tall area. The system should be able to ignore false alarms from small animals wandering through the sensor field. PROJECT DELIVERABLES The project deliverables should include: 1. Definition of problem and proposed solution 2. Block diagram of system and any circuits built 3. Software code developed 4. Prototype of system and demonstration of its functionality

Requested Dept.: CompSci, Electrical

Requirements: Confidential
YOU DON'T EXPECT TO BE A VICTIM OF INTRUDERS IN YOUR OWN HOME

SENIOR PROJECT OVERVIEW

Military and homeland security forces are faced with the ever-increasing challenge to provide security for troops and important objects. Their effectiveness can be greatly increased with a network of remotely located sensors that detect the movement of personnel and vehicles. At home, you can secure a perimeter around valuable items, important rooms, or the entire house to assure the safety of your family and belongings.

Sensors can be used in various forms to detect anything from seismic and acoustical motion to infrared and magnetic detection. Sensor system designers must overcome challenges to achieve low-power, highly sensitive systems that are capable of filtering out false alarms before sending an alert for detected intrusions.

PROJECT OBJECTIVE

Design and build a working system that will detect intruders and transfer the sensor data to a remote location using a low-power wireless technology such as ZigBee (802.15.4). Detection sensor methods could include P-proximity sensors, optical sensors, or ultrasonic rangefinders. The system must contain at least two transmitter nodes with one or more sensors attached to each node. The sensor data must be transmitted to a remote base station receiver that interfaces to a PC to display the data in a readable format (such as a graphical map).

Displayed data should include when the intruder was detected, distance from sensor location, and an estimate of the number of intruders. The sensor system will be responsible for detecting human-sized intrusions within a 15' x 15' x 8' tall area. The system should be able to ignore false alarms from small animals wandering through the sensor field.

The main project components include:
- Sensor hardware
- Intruder detection software algorithms
- Wireless network with two transmitters and one receiver
- Software to display intrusion events on a PC

PROJECT DELIVERABLES

The project deliverables should include:
1. Definition of problem and proposed solution
2. Block diagram of system and any circuits built
3. Software code developed
4. Prototype of system and demonstration of its functionality
Description: SENIOR PROJECT OVERVIEW Consider the following scenario: A mother is enjoying a day at the park with her child until she loses visual contact. Thankfully, she has placed a wearable personal locator and communication device on the child beforehand. The personal locator will allow her to not only locate her child via GPS, but also communicate to ensure the safety of the child. Most GPS Personal Locator Beacons (PLB) operate with the device containing a GPS receiver. The device transmits the GPS data over a GSM/GPRS (cell phone) system. Depending on the system, the location data can be accessed by a second device, on a website, or transmitted to a control center, which then contacts the appropriate people (first responder units). Many of these systems allow the user to see the GPS location in real-time on a moving map. The Personal Locator and Communication Device (PLCD), unlike most current personal locators, would allow the transmission and receipt of audible feedback to be communicated between two users. The person or child wearing the device and the user receiving situational awareness and audible data, both have the option to activate the device (meaning it can be activated from either user). The idea is that the person wearing the device might not be capable or unable to activate the device. Therefore, the person accessing the location of the first user should have remote control of the device as well. PROJECT OBJECTIVES The objective of this project is to produce a wearable prototype for users such as a child or an adult in need. The device, once activated by either the wearer or the user tracking the wearer, should enable communication, pick up surrounding noise data, and send GPS data back to the control center used by the user concerned about the location of the wear. The control center in this scenario can be a laptop. Wearable device capable of transmitting situational awareness (GPS coordinates) and surrounding sound environment. Also capable of receiving audio feedback. 1. Device should be a portable lightweight design and easy to put on and take off. 2. The device should be a dual activation mode meaning that either user has the capability to activate the GPS signal and audio communication. 3. Once activated, the PLCD transmits an identification GPS signal. 4. Once activated, the PLCD should enable speaker and microphone functions immediately. 5. GPS signal and audio feedback is transmitted back to control center (laptop). 6. Wearable device should have mechanical feature that prevents accidental activation/transmission. 7. Antenna automatically springs into place when deployed. When not in use, antenna remains hidden from view and protected against rough handling. 8. PLCD transmits position updates every 20 minutes. PROJECT DELIVERABLES: The project deliverables should include: 1. Demonstrate communication between device and main receiving unit or control center (laptop user). 2. Demonstrate that device has easy installation or placement on individual. 3. All relevant documentation used during project. 4. Detailed design documentation including a diagram of the hardware setup and functional components and depiction of the design of the wearable device. 5. Software code developed. 6. A prototype of the device and a demonstration of its functionality.

Requested Dept.: CompSci, Electrical

Requirements: Confidential
EVERY SECOND IS PRECIOUS WHEN A LOVED ONE IS MISSING.

SENIOR PROJECT OVERVIEW

Consider the following scenario:

A mother is enjoying a day at the park with her child until she loses visual contact. Thankfully, she has placed a wearable personal locator and communication device on the child beforehand. The personal locator will allow her to not only locate her child via GPS, but also communicate to ensure the safety of the child.

Most GPS Personal Locator Beacons (PLB) operate with the device containing a GPS receiver. The device transmits the GPS data over a GSM/GPRS (cell phone) system. Depending on the system, the location data can be accessed by a second device, on a website, or transmitted to a control center, which then contacts the appropriate people (first responder units).

Many of these systems allow the user to see the GPS location in real-time on a moving map. The Personal Locator and Communication Device (PLCD), unlike most current personal locators, would allow the transmission and receipt of audible feedback to be communicated between two users. The person or child wearing the device and the user receiving situational awareness and audible data, both have the option to activate the device (meaning it can be activated from either user). The idea is that the person wearing the device might not be capable or unable to activate the device. Therefore, the person accessing the location of the first user should have remote control of the device as well.

PROJECT OBJECTIVES

The objective of this project is to produce a wearable prototype for users such as a child or an adult in need. The device, once activated by either the wearer or the user tracking the wearer, should enable communication, pick up surrounding noise data, and send GPS data back to the control center used by the user concerned about the location of the wearer. The control center in this scenario can be a laptop (continued on next page).
Harris Corporation 3

Contact: Melissa Dempsey, Christopher Feuerstein  
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Project Title: Automated Solar Charging Station

Description: SENIOR PROJECT OVERVIEW: Consider the following scenario: A major disaster just occurred in your town. There is no power available and generators are scarce. Instead, solar panels are used to charge minor devices needed by first responder units. However, these solar panel devices are not as efficient as they could be. A portable solar panel device that tracks the Sun to efficiently use all solar power available will allow first responders to keep in contact with other emergency services. PURPOSE: The purpose of this project is to design a piece of equipment that is portable and light-weight that will track the Sun's rays efficiently in order to recharge a handheld device (Cell phone, walkie-talkie, etc...). The idea is to provide a source of power to recharge essential scenarios: an expedition in the wilderness for long periods of time, disaster relief efforts, a family camping for several days with no power or battery vehicle to use, and outdoor activities and festivals. OBJECTIVE: There are a few products on the market that utilize solar technology to charge handheld devices. These products are used by outdoor enthusiasts and those who want the ease of recharging their devices wherever and whenever. The idea is to expand on this concept and design a solar charging station that would optimize the solar panel direction and angle to maximize charging by adjusting itself along two axes (rotation and angle). The station should be capable of recharging a handheld device such as a cell phone, iPod, or lithium ion battery. DELIVERABLES: The project deliverables should include: 1. Definition of problem and proposed solution 2. Detailed design documentation of solution, including a diagram of the hardware setup and functional components 3. Software code developed 4. Prototype of device and demonstration of functionality

Requested Dept.: CompSci, Electrical, Mechanical

Requirements: Confidential
DISASTER RELIEF IS NEVER FAST ENOUGH IN THE WAKE OF A STORM.

SENIOR PROJECT OVERVIEW

Consider the following scenario:

A major disaster just occurred in your town. There is no power available and generators are scarce. Instead, solar panels are used to charge minor devices needed by first responder units. However, these solar panel devices are not as efficient as they could be. A portable solar panel device that tracks the Sun to efficiently use all solar power available will allow first responders to keep in contact with other emergency services.

PROJECT PURPOSE

The purpose of this project is to design a piece of equipment that is portable and lightweight that will track the Sun’s rays efficiently in order to recharge a handheld device (cell phone, walkie-talkie, etc.). The idea is to provide a source of power to recharge essential handheld communication devices where power is not readily available. Other possible scenarios: an expedition in the wilderness for long periods of time, disaster relief efforts, a family camping for several days with no power or battery vehicle to use, and outdoor activities and festivals.

See more details about this project continued on the reverse side.
**Project Title:** Handcycle for Craig Deitz

**Description:** The team will be tasked with developing a handcycle which a man with no arms and no legs can operate (not motorized). Craig Deitz, a man from St Mary's PA who was born with no legs or arms, and would like to compete more fully in triathlon racing. Currently he can only do the swim portion (see videos here: http://www.craigdietzspeaks.com/video.html). He is considering participating in the IM ABLE Got the Nerve 2011 triathlon race this May. Working with Craig Deitz and the IM ABLE Foundation, you will modify a hand cycle (donated by IM ABLE foundation founder Chris Kaag) to be usable by Craig - he would need to be held in and able to pedal with his upper extremities. Along with pedaling and steering the bike, braking and shifting will be necessary.

**Requested Dept.:** Bio, Mechanical

**Requirements:** Intellectual
Jersey Shore Hospital

Contact: Erin Welsh  
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E-mail: ewelsh@jsh.org

Project Title: Improving Workflow, Patient Flow, and Paper Flow at Jersey Shore Hospital

Description: (1) Overview: As we prepare to utilize a third Operating Room at Jersey Shore Hospital, we would like to have our current workflow, patient flow, paper flow, and work motions streamlined and redefined for maximum efficiencies. (2) Objectives: - To streamline and improve how the Surgical and Same-Day Surgical Departments schedule patients, creating efficiencies in patient flow. - To assess how to best utilize surgical staff and physician time. - To create more efficient paper flow and work flows in Surgical and Same-Day Surgical Departments. (3) Background: - Currently, Jersey Shore Hospital utilizes two operating rooms and one endoscopic room for patients. We are interested in beginning to utilize three operating rooms (it is currently unfurnished, but available for use). Before doing so, we would like the abovementioned objectives assessed. It is also important to note that currently, surgeons are scheduled block times on a regular basis in which to schedule their patients. (4) Metrics: - Determine the adequate number of surgical staff to successfully run three operating rooms and one endoscopic room. - Monitor improvement in patient time from arrival/recovery. - Measure number of patients able to be treated with a more sophisticated scheduling system versus our current system.

Requested Dept.: Industrial

Requirements: none
Keystone Nano

Contact: Mylisa Parette  
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E-mail: mparette@keystonenano.com

Project Title: Nanoparticle prototype reactor

Description: Keystone Nano, a State College – based company, develops nanoparticles for applications in the medical, agricultural and industrial fields. Keystone Nano focuses on the production of nanoparticles composed with calcium phosphosilicate matrix materials due to high biocompatibility, low toxicity and pH-dependent dissolution of these compounds. Encapsulants such as chemotherapeutics or fluorophores are incorporated into the nanoparticle matrix during the precipitation synthesis to achieve protection and targeted delivery of those compounds. Biological data indicate that these nanoparticles are more effective than conventional cancer treatments when designed to deliver chemotherapeutic drugs to tumor sites. Development of effective nanoparticle prototypes involves the optimization of the nanoparticle size, loading and surface chemistry, which is achieved by varying specific parameters during synthesis. This project involves further improvement to a precipitation reactor system to allow high throughput prototyping for nanoparticle development. The current liquid handling reactor, developed as part of a previous Learning Factory project, is capable of mixing multiple inputs with independent control of flow rate for each input. Improvements are desired to a) incorporate low volume sample collection collection and storage, b) be controllable and programmable to allow creation of multiple samples with minimal operator input and c) have software capable of collecting analytical measurements to create standard sample reports. Key Features:  
• automated low volume sample collection in standard plate and tube formats  
• sample storage to minimize solvent evaporation  
• ability to program and create multiple samples using LabView software  
• output of standard sample reports  
Deliverables:  
• Concept design (including feasibility, required components and equipment)  
• Engineering drawings and specifications  
• Prototypes and preliminary hardware  
• Computer programs  
• Presentation & demonstration  
• Final technical report, poster, and one-page summary  
• Progress reports (weekly)  
• Progress update conference calls or meetings (bi-weekly)

Requested Dept.: Chem, CompSci, Mechanical

Requirements: none
KYDEX, LLC 1

Contact: Mark Sneidman
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E-mail: SneidmanM@kydex.com

Project Title: Capping Controls

Description: Capping enhances KYDEX LLC’s thermoplastic sheet both aesthetically and physically. Caps range in design from enhancing chemical resistivity to simply applying decorative patterns. Though while enhancing the KYDEX® sheet characteristics – caps also provide more challenges for the operator which resulted in $66K in customer complaints and, in part, contributed in a loss of $6M dollars of business this year. The root-cause for returned capped material often stems from the lack of controlling mechanisms for the applied stretch the cap undergoes while being applied to the KYDEX®. The goal of the project would be to provide a means for controlling the desired “stretching” of the cap by integrating technology dependent on a small number of variables available to the operator. Sometimes a minimal amount of stretch is required while other caps may require a higher stretching to enhance yields.

Requested Dept.: Electrical, Mechanical

Requirements: Confidential, Intellectual
Project Title: Extrusion Embossing Roll Change Time Reduction

Description: KYDEX, LLC uses large steel rolls with engraved textures to emboss an extruded sheet in their manufacturing process. KYDEX currently offers eight different textures; this requires the texture rolls to be frequently changed. Changing these rolls takes an average of 131 minutes and occurs around 33 times a month. This down time cost KYDEX over $170,000 per month. This project will evaluate the most effective and efficient method for changing the embossing rolls while maximizing employee safety in the process. The goal is to reduce the roll change time by 50% to 65 minutes.

Requested Dept.: Industrial, Mechanical

Requirements: Confidential, Intellectual
LivingWell Integrative Solutions

Contact: Mark Potts  
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Project Title: Mobile Medical App

Description: Mobile Medical App Project Overview LivingWell is a three dimensional approach to integrative care that provides people with the means to connect to a network of resources necessary to achieve whole person health. We educate and empower individuals to take responsibility for their physical, mental and spiritual health. Lack of a simple intuitive method for accurately monitoring and recording daily health status has created a significant limitation in patients’ health self-awareness. The resulting incomplete communication with and between healthcare providers has constrained their ability to provide effective and efficient care. LivingWell has developed specifications for a mobile device application that patients can use to accurately record basic daily health status and generate a summary report that will give their provider an at-a-glance view of their recent health status. This project will provide a true and near-real-time 3-dimensional view of a patient’s health status and trends - both to the patient and to the patients healthcare providers. Project Deliverables 1. Design and develop a mobile patient app based on LivingWell specifications. Initial development will be for the iPhone. 2. Design and develop a mobile provider app based on LivingWell specifications that will synchronize patient data with the patient app, giving the provider an up-to-date view of the patient’s medical history and health status. Initial development will be for the iPad.

Requested Dept.: Bio, CompSci, Industrial

Requirements: Confidential, Intellectual
Lockheed Martin 1

Contact: Paul Mittan  
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Project Title: Design Showcase Electronic Scoring System

Description: A portable electronic scoring system (DSESS per the title above) is envisioned recording the evaluations of student projects at the Learning Factory Showcase. A version of the DSESS was tested last fall and the response from users was positive. The system allowed a new category of judging, the People’s Choice Award, it allowed the judges to record their scores in real time and, perhaps most important, streamlined the presentation of the results of the various scoring categories.

One of the areas where the system clearly needed improvement was in quickly finding the student team to be evaluated among the crowd of teams on the floor. The purpose of this project is to provide a solution to this problem that can be integrated into the web-based DSESS. Several technologies exist that might provide this function, including systems for identification of particular tables (RFID, magnetic strips) or systems for independent position location (GPS, motion sensors). Students should perform a study of the various approaches before committing to a particular solution.

Additionally, students should define solutions for portability and usability of this system. All equipment for this system should be easily transported and the user software applications may be improved for simpler setup and administration.

This project may be applicable for EE and CSE students or a combination thereof.

Requested Dept.: Electrical

Requirements: none
Lockheed Martin 2

Contact: Paul Mittan
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Project Title: X-Plane Flight Simulation Upgrade

Description: Background: Currently we have a flight simulator (sim) that uses X-Plane for the flight model on one computer and Diamond Visionics image generation software for the Out The Window (OTW) displays on three computers. The X-Plane sim uses both Common Image Generator Interface (CIGI) and Distributed Interactive Simulation (DIS) messaging to communicate with the systems and other simulators on the network. The goal of this project is to establish the environment where multiple simulated objects (aircraft, munitions, etc) may interact with one another. Project description: The student team should define what capabilities will be provided as part of this project. They may include any or all of Part 1 and/or Part 2 outlined below. LM will provide the hardware necessary to setup this flight simulation environment. Part 1 -> Upgrade and expand X-Plane DIS and CIGI outgoing messages Phase 1) Rewrite the DIS and CIGI interface code to be in one plug in used by X-Plane Phase 2) When a weapon is fired from the X-Plane sim have either or both CIGI and DIS messages created and put out for this weapon. Phase 3) If the weapon is steerable guide the weapon to a designated entity. Phase 4) If the weapon strikes an entity generate and send out a impact message Part 2 -> Add X-Plane DIS and CIGI incoming message processing Phase 1) Monitor the CIGI and or DIS environment for other entities and populate them into the X-Plane environment. Phase 2) Monitor environment to determine if the X-Plane flight model has been hit and if so determine damage. Phase 3) Develop code to enable counter measures. For example with the A10 if it dispenses chaff or flares determine if an incoming missile will hit the A10 if it won’t temporary move the A10 ID to the counter measures and after the incoming missile impacts the counter measures move the ID back to the A10. References: Diamond Visionics: http://www.diamondvisionics.com/ X-Plane: http://www.x-plane.com/ The following will be the interface formats to be coded to. CIGI: http://cigi.sourceforge.net/files/CIGI_ICD_3_2.pdf DIS: http://usl.sis.pitt.edu/wjj/otbsaf/IEEE1278.1a-1998.pdf

Requested Dept.: CompSci

Requirements: Intellectual
Project Title: Green Solutions

Description: Overview: Widespread use of dimming solutions to provide energy savings has been growing recently as everyone attempts to move towards green solutions in all aspects of their life. Reduced use of electricity not just makes economical sense, but allows individuals and companies to contribute towards lowering their carbon footprint. Lutron Electronics has been the leading innovator in providing these solutions that not only saves the user energy but also with features like theme based lighting, allow for a comfortable and luxurious experience. Innovating equally for residential and commercial applications our products provide benefits to all customers from lighting design to central energy solutions. Just recently we installed Quantum at the New York Times building in New York saving them 70% of energy costs a year. As we pursue new frontiers, we would like to investigate new product possibilities as well as implement better tools to understand the customer needs. We would like to provide the flexibility of a scalable system that can work with other third party devices offering energy saving solutions. Project Objectives: The group that undertakes this project will be designing an iPad application to download a large-scale database from our GUI application and calculate essential energy usage information, comparison charts to pre and post-system energy usage and other applicable information for the user to make an informed decision regarding our product. Deliverables: The final product for this project will be a functional iPad application designed as per approved specification documents and a list of known issues. Extensive testing and viability arguments will be provided describing the different applications the utility can be used in. Departments: Computer Science Confidentiality Concerns: Students will have to sign over the Intellectual property and a Non-Discloser Agreement with Lutron Electronics Co., Inc. Reporting Requirements: Weekly Number of Groups: 1 (3-5 students, CS)

Requested Dept.: CompSci, Electrical

Requirements: Confidential, Intellectual
Save energy with unparalleled total home control
Manitowoc

Contact: Jeff High
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Project Title: Truck-Crane Configuration Project – Phase 2

Description: Overview and Motivation: The Manitowoc Crane Group is the global leader for lift solutions in the crane industry. Manitowoc produces crane products that are mounted on commercially available truck chassis. Due to the wide variety of chassis available from truck manufacturers, each truck-crane configuration that is built in the factory requires preliminary engineering analysis to calculate weight distribution and crane stability. Due to the nature of the crane business, customized truck-crane configurations are frequently required by crane owners and operators. Preliminary truck-crane configurations are developed based on a first guess proposal of truck and crane components chosen by a particular customer. After review of the initial proposal, several iterations are often required of the engineering analysis until a desirable truck-crane configuration is developed to suit the customers’ needs. These iterations consume a lot of engineering time and resources that could be utilized doing other projects. The proposal is to develop a single laptop computer based application to develop truck-crane configurations. This application would allow truck data to be entered and a crane model to be selected. Using this information, the truck-crane configuration would be automatically generated by running calculations in the background of the software to develop the weight and stability analyses. Eventually, this application could be migrated to the internet for remote availability using a password.

Objective and Deliverables: The objective of this project is to develop a laptop computer based application that will automatically generate truck-crane configurations, weight analyses, and crane stability analyses after inputting key truck and crane data. The first phase of this application was developed during the Fall 2010 semester IE 480 class at the Penn State Learning Factory using Microsoft Excel workbooks and VBA code. The deliverables for the second phase of this project will be to develop an organized data storage system for this application and to develop an enhanced output interface for the truck-crane configurations created by the application. The data storage system should include an organized data structure for building in additional crane model information and a method of creating output files for completed truck-crane configurations that have been analyzed. The enhanced output interface should include a pictorial representation of the truck-crane configuration using geometry taken from CAD data.

Requested Dept.: CompSci, Industrial, Mechanical

Requirements: Confidential, Intellectual
Maximus V

Contact: Tim McCorry  
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E-mail: tmccorry@maximusv.com  
Project Title: Total Tone

Description: Maximus V LLC through a strategic alliance with Progressive Sport Technologies of the UK (http://www.progressivesports.co.uk/) look to bring an International collaborative to the Learning factory of Penn State University. The project goal is to produce a market ready deliverable for the rehab and conditioning markets globally. Exercise should be balanced and complete. total tone is a holistic approach to training providing all the elements you need for the best look of your life. cardio, tone, balance, power, flexibility and strength. **Product features:** 15’ recoil cables, 360 degree training area, infinite air resistance system, power unit step, and fat burn data logger. **Product Concept and Overview:** Group exercise, home training or physical rehabilitation have moved to a place where dynamic and whole body movement is the bedrock of the training method. Terms like Core, Open Chain, Sport Specific have all affected how exercise is performed in the modern mode. The total tone exercise system concept provides a platform for full body training, strength, cardio, balance, core, polymetrics etc The system works by providing resistance through the 15’ foot long cables, allowing the user to work on, off and around the central resistance and recoil unit. Units can also be combined for 3D resistance work. **Engineering challenge:** The total tone product presents a number of engineering challenges that we wish to solve:

1 - Recoil of long 15’ inelastic cables
2 - Provision of low to medium resistance against cable extension
3 - Fixing of main unit by addition of mass or alternative means
4 - Electronics, monitoring and feedback of performance

Deliverables:

a - Further development of concept, additional detail on engineering solutions
b - Engineering of working prototype - engineering proof of principle
c - Consideration of product marketing and business planning i.e product family

Requested Dept.: Bio, Mechanical  
Requirements: Intellectual
Muncy Valley Hospital

Contact: Anne Holladay

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Project Title: Evaluation and improvement of meal delivery process for new dining facility

Description: Project: Process improvement in meal delivery for residents of the 1st floor Skilled Nursing Unit because of relocation of resident dining room and evaluation of culture change initiative of open or flexible dining times Overview: The Muncy Valley Hospital Skilled Nursing Unit is a 138 long term care nursing facility. In the Spring of 2011, the facility will begin a 1.6 million dollar addition. The project will take approximately 6 months. When the project is completed the resident dining room on the first floor will be relocated from a central location on the floor to the end of the 1st South Hallway. Approximately 85% of all residents currently eat their meals in the dining room. The new space will be reconfigured differently, so staggered dining time will need to initiated, as all residents can not dine in the new space at one time. The relocation of dining services will require an evaluation of: (1) evaluation of dining times to meet resident needs and regulations; (2) evaluation of nursing staff hours – including break and meal times for staff, staff to serve residents and staff to provide care for residents not dining in the dining room; (3) development of efficient processes for meal delivery including evaluation of dietary processes with new pantry serving area; and (4) exploration of possibility of “Open Dining Service” rather than a fixed dining schedule to allow residents more choice and flexibility

Requested Dept.: Industrial

Requirements: none
NAVAIR

Contact: Thomas Cook  
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Project Title: SEGMENTED SEAL HOUSING INSERTION TOOL

Description: United States citizenship is required for any faculty or student associated with the Project. Proof will be checked at the beginning of a project. . .

Background:...... The steam catapult uses two rows of power cylinders to transmit the steam pressure from the steam accumulator to the launching engine. In these two rows of cylinders are the piston assemblies which transmit the launching forces to the aircraft. The rows are connected via a shuttle assembly, which connects to the piston assemblies via a “connector” that exits the power cylinders through a cylinder cover. To seal the power cylinder pressure area, each cylinder employs a cylinder cover. A segmented seal housing consisting of three (3) sets of spring loaded seals rides on the piston assembly and seals the pressure inside the launching engine as the piston assembly passes. . . Issue:..... During assembly, a mechanic is required to load the seal housing and its seals into the piston assembly and under the cylinder cover. This task is difficult and time consuming for the mechanic as the seals attempt to “jump” from their seats as a result of the spring force acting on them. Insertion and Removal of the Segmented Seal Housing, with segments and springs installed, is difficult and dangerous due to the manual holding of the segments while the piston assembly is being installed in the catapult. Personal injury to hands and fingers has occurred in the past. . . Design Challenge:...... A special tool needs to be developed to aid in insertion of the segmented seal housing and its spring loaded seals into the piston assembly and under the cylinder cover as a complete unit . .

Deliverables:....Periodic meeting minutes and any other relevant information, in a timely manner. At the conclusion of the Project, submit a Final Report to the(3 copies bound, 1 unbound) and present their findings on site at NAVAIR Lakehurst. Presentations will be coordinated with Lakehurst in advance and held between the months of April and May, depending on final exam schedules; and will be approximately 60 minutes in duration

Requested Dept.: Mechanical

Requirements: none
NSWCCD

Contact: Thomas Fu
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Project Title: Hydrodynamics Testing Facilities

Description: Increasing competition from foreign hydrodynamic test facilities and increasing economic pressure has made it ever more imperative that the US Navy rationally examine its need for state-of-the-art hydrodynamic test facilities. While certainly the case can be made that in the interest of national security the nation needs some domestic testing capability, the question being asked is, to what level and how does the nation pay for this type of infrastructure. The project is focused on developing a strategic business plan for the Navy's hydrodynamic test facilities. This effort would include a survey of domestic and foreign hydrodynamic testing facilities, their capabilities, and rates, and an assessment of the market need and future growth/decline. From this data develop a business assessment of the naval hydrodynamic testing industry and develop a strategic business plan.

Requested Dept.: Aero, Mechanical

Requirements: none
Pittsburgh Corning

Contact: Pete Atherton
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Project Title: Glass Block Solar Collector

Description: I would like to explore an exciting opportunity to turn architectural glass blocks into solar energy collectors. Such products could be creatively used in fenestration, garden walls, solar panels or whatever a set of glass blocks might be used for. It would involve the integration of PV technology into our glass blocks including methods for gathering electricity outputs from each block and feeding them into a building or utility electrical system. Ultimately this project would result in a collaboration with an existing PV supplier/integrator who would like to work with us to get a product to market, and would leverage creative designs and applications produced by students. I would certainly support student publication of the work, but want the option to retain patent rights.

Polymics

**Contact:** Tim Hsu  
**Address:** 2215 High Tech Road, State College, PA 16803  
**Phone:** 814-357-5860  
**E-mail:** thsu@polymics.com  
**Project Title:** Oil Field Spill Containment System

**Description:** Polymics is a Global Engineering and Materials Company, which has expertise in developing and manufacturing materials to address critical application requirements. One of several markets that Polymics serves is the Oil and Gas Industry. Polymics is motivated to provide a design and required materials / components for an Oil Field Spill Containment System. This project is desired to be focused on the mechanical design that is compatible with certain material constraints and application requirements. Some functional criteria are: 1. Installed with typical construction equipment (backhoe, small crane, etc.) at drill site on leveled dirt or gravel surface. 2. Design must be composed of interlocking sections that can be transported and moved easily to and from site, say 12 X 20 feet maximum. Sections should readily interlock. Joints must provide seal against leakage of production fluids to soil and provide mechanical joint strength to accommodate loads exerted by site production equipment and materials being staged and used on sections. Total typical containment area would be 300 to 500 sq. ft. 3. The design requires the accommodation of a containment perimeter for the assembled pad, as well. 4. Assume that the material of choice is required to resist mechanical loads and chemical exposure and will be similar to a chemical resistant thermoset polyester with long glass fiber and/or continuous woven glass fiber reinforcements. Typical industry terms for this type of material are Vinyl Ester SMC or Vinyl Ester Impregnated Fiberglas Composites. The design of the mat and joint must be compatible with the mechanical properties of this material. A typical overlapping joint design that is unacceptable from the aspects of ease of assembly, mechanical capability and sealing is attached for perspective. The deliverable for this project is the mechanical design and a prototype joint that can be tested for mechanical and installation capabilities. Polymics shall provide technical assistance is fabrication of the prototype joint(s).

**Requested Dept.:** Mechanical  
**Requirements:** Confidential, Intellectual
PSU Architecture 1

Contact: Marcus Shaffer
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Project Title: A Portable and Cost-Effective Motion Capture System

Description: A group of Penn State faculty in Architecture, Landscape Architecture, Dance, and Engineering have received a grant to work with Diavolo, a L.A.-based dance company (http://www.diavolo.org), to create a new performance piece as part of a project entitled, The Secret Life of Public Spaces. To help with this project, we want the team of engineering students to help design a portable and cost-effective system to capture people’s motions through different public spaces (e.g., Old Main Lawn, Penn State Arboretum, Sunset Park). The system should capture the gross/macro-level movements of people through a large open space, not necessarily the fine/micro-level movements of individuals, be easy to set up, move, calibrate, and analyze the recorded data. To create this system, the team should: (1) Review and catalogue the pros/cons of existing motion capture systems; (2) Visit the three venues (i.e., Old Main Lawn, Penn State Arboretum, Sunset Park) and examine the topography and general motion of people through these spaces; (3) Develop 10+ concepts for motion capture systems that could be used in these venues; (4) Meet with relevant faculty in Architecture, Landscape Architecture and Dance to review these ideas and down-select to 2-3 ideas for further development; (5) Refine and prototype 1-2 ideas and review them with relevant faculty in Architecture, Landscape Architecture and Dance to the most promising concept; and (6) Create a working prototype and demonstrate its use in at least two of the venues. Students will also be encouraged to participate in 1-2 project reviews with the entire team over the course of the Spring semester. Finally, we anticipate that one engineering student from the team will have the opportunity to travel to L.A. to visit Diavolo in June 2011 to help present the team’s ideas and its capabilities. At the end of the semester, the team should deliver the working prototype along with a detailed report of their findings, ideas, and design process; detailed part specifications are also required.

Requested Dept.: CompSci, Electrical, Industrial, Mechanical

Requirements: none
PSU Architecture 2

Contact: Dave Celento

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Project Title: Improving the Manufacturability of the DIGI-NET Kiosk

Description: Penn State offers a variety of tools and equipment to support digital design and fabrication on campus; however, these capabilities are distributed among the departments and colleges, and many students (and faculty and staff) are not aware of the range of equipment that is available or how to access it. To overcome these limitations, faculty in engineering, architecture, and graphic design have been working to catalogue the prototyping, manufacturing, and digital fabrication equipment that is available on campus, starting with seven buildings spanning three colleges (Engineering, Arts & Architecture, and Information Sciences & Technology). As part of this project, students in engineering and architecture designed and prototyped a kiosk (see photo) that would stand in each of these facilities. The purpose of the kiosk is two-fold. First, its presence identifies a building/facility that is part of DIGI-NET, the Design Innovation and Group Inquiry Network. Second, it provides a flat panel touch-screen for students to search the catalogue of digital fabrication equipment available through DIGI-NET. The objective in this project is to improve the manufacturability of the kiosk so that it remains aesthetically pleasing while also being cost effective to produce. The overall shape and functionality of the kiosk should remain unchanged; however, material choices, fabrication techniques, and assembly methods should all be scrutinized to reduce the production costs of one kiosk to less than $500, excluding the flat panel touch-screen. Our goal is produce 10 kiosks to cover the buildings in DIGI-NET for less than $5000.

Requested Dept.: Industrial, Mechanical

Requirements: none
PSU AutoMATE

Contact: Khanjan Mehta  
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Project Title: AutoMATE

Description: A group of Penn State faculty in Architecture, Landscape Architecture, Dance, and Engineering have received a grant to work with the Diavolo, a L.A.-based dance company (http://www.diavolo.org) on a project titled “The Secret Life of Public Spaces.” As part of this project, a student team in the (EDSGN 497EF) Sensor and Controller System Integration class conceptualized, designed and prototyped a movement tracking system called AutoMATE (Automatic Movement Assistive Teaching Equipment). AutoMATE is an intuitive, user-friendly device that users can (ideally) strap on their wrist and accurately monitor the movement of their hand through a pre-programmable path. The users can now use the device to learn a specific dance move or do a physiotherapy exercise accurately. AutoMATE’s basic functionality occurs in four basic stages. Initially, a computer-based program (ideally developed in LabVIEW) is used to chart the desired movement and the program is loaded to the memory of the device (over USB). After activating AutoMATE, six LEDs pertaining to the basic axial directions light up in the programmed order, guiding the user through a routine. The movements of the user are then measured for accuracy. If the movement is not within the acceptable limits from the programmed trajectory, AutoMATE provides vibration feedback to the user. The success of AutoMATE is going to hinge on the ability of the technology to accurately track movement and successfully choreograph dance routines. Dance instructors, other types of choreographers, and anyone aspiring to learn how to dance will find AutoMATE to be an ideal tool for their instruction needs. The target mass-manufacturing price-point for the device is $20. The goal in this project is to design and create an accurately working prototype for the AutoMATE system. Specifically, the team should: 1. Meet 2-3 times with the AutoMATE team to discuss the needs of the system, work done so far and team expectations. They should also review other directly related (WiiFit, Kinect, etc) and (seemingly) unrelated product concepts (http://www.ted.com/talks/pranav_mistry_theThrilling_Potential_of_SixthSense_Technology.html). This is a fairly open design problem. The team should be willing to explore questions like: a. How can AutoMATE enhance human expression through dance? b. How can a technology product like AutoMATE help people think differently of physical space…or shared physical space? 2. Brainstorm and further develop the AutoMATE concept and develop 3-5 fully functional prototypes. 3. Conduct beta-testing of the system with dancers. The team will be expected to meet with dance instructors, dancers and other professionals to Students will also be encouraged to participate in 2-3 project reviews with the entire team over the course of the Spring semester. Finally, we anticipate a university-wide demo in the HUB lawns (or similar location) to do a public flash mob kind-of ad-hoc dance performance. At the end of the semester, the team should deliver the working prototype(s) along with a detailed report of their findings, ideas, and design process; detailed CAD drawings of each prototype are also required as part of this report. Disciplines involved: CSE, EE, ME, IE (4-5 students from any/all of these disciplines)

Requested Dept.: CompSci, Electrical, Industrial, Mechanical 
Requirements: Intellectual
PSU BIOE EEG

Contact: Maggie Slattery  
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Project Title: Development of a Low Cost EEG for at home applications

Description: Students will be tasked with beginning the development of a low cost EEG system with several potential applications but beginning with ADHD applications. A at-home device for biofeedback is desired as it is useful for some therapies to connect brainwave frequency with the user's state of consciousness. For example, a beta wave state generally indicates a waking alert mind, alpha state corresponds to daydreaming, and theta/delta states usually are found during sleep. This could have applications in treating attention deficit by training the user to remain in a beta state and not slip into an alpha state. The main challenges with this project will be acquiring a high quality signal, as the brainwave signals are a very low in magnitude, so the design will need to amplify the signal and reduce noise with a low pass filter. Assessment of the minimum number of scalp electrodes will be required; clinical systems have a large number of electrodes that will not be feasible for an "at-home" version. Electrode design and placement will be a critical component to maximize signal fidelity. A proof of concept prototype is desired at this stage while an friendly user interface will the topic for future projects.

Requested Dept.: Bio

Requirements: none
Project Title: Baobab Fruit Pulp Processor

Description: Overview Benin is located in West Africa, and covers a long stretch of land perpendicular to the Coast of the Gulf of Guinea. It is bordered on the north by Burkina Faso and the Republic of Niger, on the east by the Federal Republic of Nigeria and on the west by the Republic of Togo. It is about two-thirds the size of Portugal and a fraction smaller than Pennsylvania. Thirty percent of the population of Benin is rated poor while sixteen percent are reported to live in extreme poverty. Presently, the main enterprise activity is agriculture. The village of Pingou is located in the north of the country near the western border with Togo and Burkina Faso. Baobab trees are prolific in this north-west part of the country. Baobab trees can grow up to 80 feet tall and 40 feet in diameter. Adansonia digitata is the only species that produces flowers, and these flowers give rise to the baobab fruit. The fruit of the baobab has a hard shell with pulp and seeds inside. It is comparable to a coconut, but the inside pulp is dry and fibrous with small, hard seeds similar in shape to a kidney bean but about half the size of one. Baobab seeds are used as a coffee-type drink and also used as feed for livestock. Although covered with a hard shell, baobab seed endocarp is rich in protein and nutrients. Locally, baobab pulp is used for a tart drink similar to lemonade, and also medicinally as a cure for fevers and diarrhea. The first step in using the baobab fruit is opening the shell and separating the seeds from the dry pulp. In industry, this has been done partly mechanically; for example the Baobab Fruit Co. in Senegal has a large mechanized process. The contents of the fruit are transferred into a sieving machine. The pulp is powdered and the entire mixture (pulp, fiber, and seeds) is spun at high speeds. Due to the differences in densities, the constituents of the mixture are separated. Human labor in the form of mortar and pestle is the most common separation technique found in rural villages. It may take about 1 hour for 1 person to process 1 kg of pulp. In the village of Pingou baobab is a critical economic resource; the sale of pulp is the primary economic driver of the community. The Coopérative Agricole "Le Baobab" would like to mechanize the processing of baobab pulp while also not disrupting the balance of work between members of the association. Mechanization will allow the association to increase production quality and quantity, standardize production, and allow association members more time to devote to the preservation of baobab species. Deliverables The goal for the capstone team is to decrease the current level of manual labor associated with baobab pulp processing (i.e. mortar and pestle), increase the process efficiency (e.g. reduce product loss) as well as increase the quality of the final processed product (e.g. reduce contaminants). This will be accomplished through appropriate mechanization of the process. Because energy and resources are scarce in Benin, elements of both appropriate and sustainable design must be considered. In addition, consideration must be given to social factors; a single-machine fully mechanized process while increasing efficiency will eliminate jobs in the village. Pulp processing prototypes were developed by students in the Engineering Leadership Development Program in 2008, 2009 and 2010 and can be used for benchmarking. The specific deliverable is a viable human-powered (e.g. hand cranked, bicycle powered, etc.) pulp processor design approved by the association and the construction of 3 processors. One of the processors will go to the association in Pingou, one will be delivered to the Faculty of Agronomy in Cotonou, Benin and one will stay at Penn State, University Park. The association currently processes ~300kg of mixed seeds and pulp (extracted from the fruit shell) each day resulting in 40 kg of processed baobab pulp powder and 135 kg of seeds. The powdered pulp is packaged into 5 kg and 10 kg bags. Their goal is to increase production quality and quantity. The processor should be able to process ~400 kg of pulp each 8-hour day, packaging high quality powder (i.e. free of impurities and powdered to ~100 microns) into 5 and 10 kg bags. Ideally the two viable products from the baobab fruit exit the machine in an organized fashion: the powdered pulp directly into plastic packaging bags, and seeds into another container; in this way workers avoid handling the pulp product by hand before it is packaged and seeds are saved for further processing as a food source. Baobab fruits will be available
for the design team to use in testing. The association in Pingou has assembled a technical team (Jeanne d’Arc, Brice Valentin, Aurélie Ahouansou, George Godonou) which will communicate with the design team via email and Skype. Representatives from Pingou will visit Penn State the week of March 14, 2010 to inspect the prototype and offer design suggestions.

**Requested Dept.:** Industrial, Mechanical

**Requirements:** none
Project Title: geoPebble Companion Board Design

Description: The effects of global warming on the melting of ice sheets and subsequent sea level rise are based on predictive models. But, ice sheet models and predictions of sea-level change are hamstrung by a lack of knowledge about the englacial and subglacial conditions of the Antarctic Ice Sheet, the Greenland Ice Sheet, and the ice streams that drain them. To allow glaciologists to carry out distributed measurements on the ices sheets, Penn State is developing a network of wirelessly interconnected geophysical sensors (called “geoPebbles”). These parameters can be determined by (1) seismic reflection and refraction imaging, and (2) by dense arrays of continuously operating GPS receivers. This sensor web will provide an entirely new way of imaging the ice sheet that is not possible with current instruments. The sensor web will ultimately consist of a network of 150-200 geoPebbles, which will be inexpensive, low-power, lightweight, field-rugged units. Geophysical field work in Polar regions is logistically challenging. With this sensor web, the cost of doing today's experiments (low-resolution, 2D) will be significantly reduced, and the cost and feasibility of doing tomorrow's experiments (integrated seismic, positioning, 3D, etc.) will be reasonable. This project will involve working with Penn State scientists and engineers in the development effort for a companion board that will allow additional sensors to be connected to the geoPebble node. This will involve developing the set of requirements, researching options for the types and capabilities of sensors that scientists would be interested in including, and prototyping and testing the board.

Requested Dept.: CompSci, Electrical, Mechanical

Requirements: none
PSU Geosciences 2

Contact: Sven Bilén

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Project Title: goePebble Packaging Design

Description: The effects of global warming on the melting of ice sheets and subsequent sea level rise are based on predictive models. But, ice sheet models and predictions of sea-level change are hamstrung by a lack of knowledge about the englacial and subglacial conditions of the Antarctic Ice Sheet, the Greenland Ice Sheet, and the ice streams that drain them. To allow glaciologists to carry out distributed measurements on the ices sheets, Penn State is developing a network of wirelessly interconnected geophysical sensors (called “geoPebbles”). These parameters can be determined by (1) seismic reflection and refraction imaging, and (2) by dense arrays of continuously operating GPS receivers. This sensor web will provide an entirely new way of imaging the ice sheet that is not possible with current instruments. The sensor web will ultimately consist of a network of 150-200 geoPebbles, which will be inexpensive, low-power, lightweight, field-rugged units.

Geophysical field work in Polar regions is logistically challenging. With this sensor web, the cost of doing today's experiments (low-resolution, 2D) will be significantly reduced, and the cost and feasibility of doing tomorrow's experiments (integrated seismic, positioning, 3D, etc.) will be reasonable. This project will involve working with Penn State scientists and engineers in the development effort for the packaging of these geoPebbles. This will involve developing the set of requirements, researching options for packaging to meet these requirements, and prototyping and testing the packaging in analog environments, i.e., for ruggedness and extreme cold.

Requested Dept.: Electrical, Mechanical

Requirements: none

Figure: Photographs of the versions one and two of the geoPebble. Above: guts of the first generation geoPebble. Upperright: the enclosure (bottom) and connectors on the unit. Right: Second generation with custom circuit board and custom firmware.
PSU IE Dept

Contact: Dr. Paul Griffin
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Project Title: IE Course Scheduling Simulator

Description: Undergraduate enrollments in IE have been steady for many years: 100-120 new students annually enter the program in their junior year and take the required courses, electives, and labs in a fairly predictable way. That changed drastically two years ago as interest in industrial engineering increased and other departments started implementing enrollment caps on their programs. First, 150 new students enrolled in IE, then it was 190, and next year may be even more. These increased enrollments are making course scheduling very difficult, particularly courses that have limited seating and/or are resource intensive (e.g., labs). We seek a team of students that will create a simulation model that will help the IE department with its course scheduling each semester. In particular, the team will: (1) Talk to relevant course administrators, faculty, and staff (e.g., Dr. Griffin, Dr. Chandra, Mrs. Joshi, and Mr. Immel) to learn how courses and labs are currently scheduled in the IE department; (2) Identify all constraints (e.g., room size, room availability, enrollment controls, pre-requisites) that impact course scheduling and the required frequency of IE course offerings for all of the department’s required courses, labs, and electives. Make sure to include 'service' courses that IE offers regularly for non-IE majors (e.g., IE312, IE424) as these will impact room availability in some cases as well as required non-IE courses as this will impact the allowable times that courses can be scheduled; (3) Develop a simulation model that will allow the IE department head, faculty, and staff to easily evaluate tradeoffs between different course scheduling options. This model should allow for wide variation in student enrollments (as an input) and take into account the % of students that are on co-ops and internships in Fall and Spring as well as the % of students that fail and/or do not satisfy the 'minimum C requirement' and retake courses. Outputs should include the average time take to complete the degree requirements, average enrollments per course, and other metrics identified during the discussions with the IE department head, faculty, and staff; and (4) as time permits, the simulation model should include summer course offerings as well.

Requested Dept.: Industrial

Requirements: none
PSU Institute for Diabetes and Obesity

Contact: Lorraine Mulfinger, PhD
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Project Title: Ecological Momentary Assessment of Foot Self-Care for DIabetes Patients

Description: Foot ulcerations and amputations are devastating end-stage complications of diabetes, and are a major public health concern due to their substantial socio-economic consequence. It has been estimated that the cost of care for these problems was $9 billion in 2001 in the U.S. The annual incidence of foot ulcers in people with diabetes is 2%, with a lifetime risk as high as 25%. Foot ulcers are part of the causal pathway to amputation in most cases, with 70-80,000 diabetes-related amputations performed in the U.S. each year (CDC). While progress has been made, this has been slow. Thus the Healthy People 2000 goal was to reduce the 1990 amputation rate by 50%, but even by 2005 (last available data) the decrease was only 36% (CDC). It is well accepted that foot-self-care is a key component of prevention of ulceration and amputation in high-risk patients. This is because the primary cause of most foot ulcers is an injury that is not recognized as painful because of diabetes-related nerve damage – and avoiding or at least recognizing such an injury are matters of patient behavior. Most foot-self-care interventions have focused on increasing knowledge, but while knowledge may be a necessary condition for behavior change, it is rarely a sufficient condition. The two types of behavioral recommendations that are usually made to diabetic patients at high risk for foot problems: avoiding ‘normal’ behaviors that could cause injury (such as barefoot walking), and adding new protective behaviors (such as manually checking the inside of shoes). Central among these behaviors is the daily self (or significant other) foot-exam. This is central to self-care because injury is at some point likely despite of all efforts to avoid it. Thus early detection of an injury and early treatment is the “last line of defense.” Many patients do not have the flexibility to examine the plantar aspect of their feet, and thus a long-handled mirror is recommended. We have equipped the bedside holder for such a mirror with a time-stamp recorder that is activated by each removal and return of the mirror (see Figure 1 attached. Time-stamp data can be downloaded to an Excel file via a USB connector. It is recognized that self-report of self-care may overestimate actual self-care due to social desirability effects etc, yet to date only self-report tools existed for assessing foot self-care. Thus this device will not only enable physicians to monitor patient compliance with recommended prevention practices, it will create an incentive for patients to become “compliant” because they will know that this practice is being documented. The next step in development of this device will be to replace the magnetic date/stamp trigger with a triggering system that works based on the handle serving as a dampening system for electrical conductance such that small changes in current due to increased resistance or “grounding” caused by grasping the handle will create a change in current/resistance that triggers the date/time stamp. The datalogger will need to be miniaturized, but this would then allow the entire datalogging system to be self-contained in the footmirror, eliminating the need for stand. The concept could then be applied to a toothbrush, or any other daily- or routine-use item with a handle that is grasped for use. To our knowledge, this device if the first of its kind that is able to document footcare by patients at risk for foot disease and injury. Drawing a parallel with the onset of seatbelt usage in the U.S., it is well-accepted that adopting practices to safeguard one’s on health and safety, no matter how brief or unobtrusive, requires incentives. In the case of seat belts, the incentive has been legislation. In this case, the incentive will become knowledge of the ability of physicians to monitor compliance. As the U.S. healthcare system moves toward pay-for-performance incentives for prevention, it can be anticipated that devices enabling documentation of patient compliant behaviors will have a sizable market for providing documentation for individual rate discounts and physician incentives.

Requested Dept.: Bio, Electrical

Requirements: Intellectual
Ring Magnet
• Acts as hanging rest stop to sit on positioning bracket
• Triggers date/time stamp with removal or replacement

Date/Time Recorder
• Magnetic trigger
• Velcro mount for removal
• Mounting frame for proper repositioning
• USB port for Download to Excel

Figure 1: Compliance Monitoring Footmirror
PSU Learning Factory

Contact: Tim Simpson  
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Project Title: Enhancing an Algorithm for Assigning Students to Capstone Design Project Teams

Description: The Senior Capstone Design Program has grown substantially in the past few years - nearly 600 students in as many as 12 different departments in the College of Engineering work on over 120 semester-long, industry-sponsored capstone design projects each year. At the start of each semester, these projects are assigned to a particular section in a particular department based on the disciplinary needs of the project and faculty expertise. Students often transfer to different sections to work on projects that interest them, and team assignments are done to maximize students’ project preferences, which are captured during the Project Kickoff. As more departments become involved with these capstone design projects, the process of assigning students to teams based on their top-five preferences and schedule availability has become more and more time-consuming. As an example, last spring it took over 4 hours for the 18 faculty teaching the Senior Capstone Design sections to sort and assign 360 students to their projects (see accompanying photo). In Spring 2010, a team of IE students developed a LINGO-based algorithm to help assign students into teams based on preferences entered via Angel and projects listed in Excel. This algorithm was tested in Fall 2010, and several improvements are needed. The goal in this project is to enhance the sorting algorithm along with student project preference capture to make assignment process more robust. In particular, the team should: (1) Review the report and algorithm from the IE team from Spring 2010; (2) Implement the algorithm using the Fall 2010 data to become familiar with its operation; (3) Automate the interaction between Excel and LINGO or find alternative methods to assign students to teams; (4) Enhance the algorithm so that it can (i) minimize student transfers in addition to maximizing student preferences and (ii) minimize number of assignments not based on preferences; (5) Identify, prototype, and test 2-3 new methods for capturing students’ project preferences during the Project Kickoff (the current system uses Angel, which has several drawbacks); (6) Develop and test a method to capture students’ scheduling constraints when entering their project preferences; and (7) Improve overall system integration, namely, the flow of data from students entering their project preferences to final team assignments. The algorithm should be capable of assigning 100-400 students into teams of 3-5 students for each of 30-100 projects in a semester. The algorithm should also provide flexibility for faculty to specify team assignments, overriding the algorithm’s recommendations when interest in a project is low (e.g., only 1-2 students show interest in it) or there are too many projects being offered (e.g., companies offer more projects than there are student teams).

Requested Dept.: Industrial  
Requirements: none
PSU MNE Dept. 1

Contact: Leland Engel

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Project Title: Trailing Dynamometer

Description: There is a need to test HPV, small hybrid, small electric, and small IC engines on small vehicles in ME452, ME597D and ME597F classes. Objective: Design and build a trailing dynamometer that is operable up to ~30mph and can be easily attached to the back of an HPV or small vehicle. The associated parameter measuring range needed is from 1/4HP up to 16HP.

Requested Dept.: Mechanical

Requirements: none
Project Title: Micro dynamometer

Description: There is a need to measure torque and HP on micro-motors and generator set-ups in ME340.
Objective: Design and build a calibrated eddy current or similar type of micro-dynamometer that would be suitable for small 1.5V-24VDC micro-motor systems. Expected torque range is from 10 g-cm to 300 g-cm and the expected speed is up to 20,000RPM.

Requested Dept.: Mechanical

Requirements: none
PSU Open Design Lab

Contact: Chris Garneau

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Project Title: PosaBill, posable digital manikin

Description: Designing for Human Variability requires consideration of the physical space requirements of human users to optimally configure products and environments. Traditional tools for the task have included two-dimensional paper manikins and templates for which the designer would configure the position of the manikin to determine the space required for a design task (e.g., sitting in an office chair, driving a car, etc.). These traditional tools have been largely migrated to virtual environments wherein a designer manipulates three-dimensional posable manikins to interact with a CAD prototype of the device being designed. In addition to physical space requirements, assessments of vision and reach (particularly for automotive applications) are facilitated by the digital environment. While such tools are common in industry, there has been little effort to digitally link the physical and digital mediums for manikins; the current project aims to accomplish this. The project objectives are: (1) create a two-dimensional quarter-size human figure with posable segments, (2) develop a mechanism for digitally capturing a given pose (e.g., electromechanical sensors or optical capture), (3) interface the data with a computer to enable on-screen dynamic rendering of the pose, and (4) provide output in a standardized format that may be exported to digital CAD packages. The result of the project may find application in both education and industry--students and designers alike would benefit from intuitive and straightforward physical manipulation of body posture in the design of products and environments. Deliverables include the physical manikin and capture hardware and the software code for interfacing the manikin with the on-screen digital representation and export capability.

Requested Dept.: CompSci, Electrical, Industrial, Mechanical

Requirements: none
Contact: Dr. Robert Evans  
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Project Title: Lubrication and Tool Wear in the Machining of Powdered Metal Valve Seats

Description: Valve seat inserts for intake and exhaust of gases in an engine’s internal combustion chamber, operate under severe work conditions. The materials suitable for such applications must have good thermal stability at high temperatures, good corrosion resistance, high thermal conductivity and a degree of machinability. The use of powdered metals as materials for engine valve seats has become common. Powdered metals provide the necessary physical and mechanical properties while also allowing the production of parts at low costs with a high level of flexibility. A current target and need in industry, is to achieve improved tool life in the machining of powdered metal valve seats. The tools required for machining powdered metals are typically specialized and expensive, and therefore extending the service life of the tools can have significant economic impact within industry. This project will focus initially on the development of a machining test and conditions necessary to carry out the machining of M2 steel and high nickel steel valve seats, to produce the 45 degree contour cut which is critical to actual valve seat machining. Following method development the testing and evaluation of the performance of lubricating fluids with regard to cutting insert wear rates and machined surface quality will be performed. Specific objectives of this project will be the following: 1. Develop a machining test with conditions useful for machining multiple 45 degree contoured angles in powdered M2 steel and high nickel valve seats. 2. Utilizing the machining test developed, assess the relative performance of three lubricating fluids with regard to cutting insert wear rate and machined surface finish and microstructure, in the machining of both M2 steel and high nickel valve seats.

Requested Dept.: Industrial

Requirements: Intellectual
Project Title: Fluid Performance in the Machining of Compacted Graphite Iron

Description: Compacted graphite iron (CGI) continues to gain use within the automotive and heavy vehicle industries. The material is being used for the manufacture of brake disks, exhaust manifolds, cylinder heads, as well as diesel engine blocks. The higher strength properties of CGI, compared to those of gray iron, enables the manufacture of engines with higher pressure operating combustion chambers, yielding more efficient engines with reduced emissions levels. In addition, the use of CGI enables the production of thinner walled parts, generating lighter engines, and a subsequent further increase in fuel efficiency. Current limitations associated with the use of CGI lie in its lower machinability properties relative to gray iron, with subsequent higher tool wear rates. Recent studies have identified various factors responsible for the lower machinability associated with CGI. These include graphite structure effects, the titanium content in CGI, as well as the levels of sulfur alloyed in the metal. This project will focus on the study of the capabilities of lubricating fluids to compensate for the above mentioned factors and improve the machinability of CGI. Project Objectives 1. Assess the impact of cutting speeds and feed rates on the performance of two lubricating metalworking fluids in the drilling and reaming of Grade 400 and Grade 500 CGI. Performance to be assessed via measurements of cutting insert wear rate and machined surface finish. 2. Investigate microstructural changes and morphology of machined surfaces using microscopic techniques. 3. With both fluids containing sulfur based lubricating additives, investigate and determine if a sulfur based film is formed during cutting and serves to enhance machining performance.

Requested Dept.: Industrial

Requirements: Intellectual
Shell 1

Contact: Buddy Bealer
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Project Title: Shell EcoMarathon 1

Description: The Shell EcoMarathon is a race for the highest fuel mileage. Penn State has competed in these contests with great success and the 2011 race will take place in Houston TX. Penn State will enter two cars in the 2011 race, an all electric vehicle and a diesel vehicle. The two cars need to be modified and prepared for race conditions. They need to be shipped and a crew sent to Houston to drive and support the cars in the three day event. Two Learning Factory projects will make the required mechanical, electrical, and aerodynamic designs and modifications to the cars to prepare and race them in the competition.

Requested Dept.: Electrical, Mechanical

Requirements: none
Shell 2

Contact: Buddy Bealer  
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Phone: 484-632-7955  
E-mail: leroy.bealer@shell.com

Project Title: Shell EcoMarathon 2

Description: The Shell EcoMarathon is a race for the highest fuel mileage. Penn State has competed in these contests with great success and the 2011 race will take place in Houston TX. Penn State will enter two cars in the 2011 race, an all electric vehicle and a diesel vehicle. The two cars need to be modified and prepared for race conditions. They need to be shipped and a crew sent to Houston to drive and support the cars in the three day event. Two Learning Factory projects will make the required mechanical, electrical, and aerodynamic designs and modifications to the cars to prepare and race them in the competition.

Requested Dept.:  

Requirements: none
Project Title: Cryogenic Temperature Calibrator

Description: The challenge will be to design and build a portable cryogenic temperature calibrator that will be used to calibrate temperature switches and transmitters that utilize either RTD (resistance temperature detector), thermocouple, or capillary tube detection elements at temperatures as low as minus 300 deg. F. There are currently no commercially available calibrators capable of operation below minus 50 deg. F. The suggested design concept involves machining a cylinder of aluminum, approximately 8" OD x 8" high, to include a central cylindrical reservoir, approximately 4" ID x 6" deep, that will be filled with either a dry ice/alcohol slurry mixture or liquid nitrogen, depending on the desired calibration temperature. In the remaining ring of aluminum around the central reservoir, six holes will be drilled of varying diameters from 1/4" to 3/4" to a depth of 5" to accept the temperature elements to be calibrated. In addition, two RTD's of known calibration will be imbedded in the peripheral ring of aluminum to measure the temperature of the aluminum block, which will serve as a heat sink, during operation. The outer circumference of the aluminum block will be wrapped with electric heating elements and insulation to avoid personnel injury. The output of the heating elements will be regulated with a PID single loop controller to balance the cold energy derived from the cryogenic fluid contained in the reservoir such that the temperature of the aluminum calibration block can be maintained at any fixed temperature between ambient and the temperature of the cryogen. The engineering team must develop the detail mechanical, electrical and controls design for this device, purchase the basic components and raw materials required, and fabricate a working prototype of the calibrator. The finished product may be eligible for patent protection and should be commercially saleable. Appropriate documentation should be maintained throughout the project to support a patent application.

Requested Dept.: Mechanical

Requirements: Confidential, Intellectual
SpeeCo, Inc

**Contact:** Michael Marino  
**Address:** 15000 W. 44th Ave, Golden, CO 80403  
**Phone:** 720 4972897  
**E-mail:** mmarino@speeco.com

**Project Title:** Improved Packaging for Imported Steel Log Splitter Beams

**Description:** SpeeCo (Special Products Co.) Contact: Paul Streets  
Address: 15000 W 44th Street, Golden, Colorado, 80015 USA  
Phone: 720-880-2062 Fax: 303-278-343a2 E-mail: pstreets@speeco.com  
Project Title: Improved paint and packaging for imported steel beams.  
Background: SpeeCo imports parts and materials used to supply the agricultural industry. The parts are either sold as individual items or are part of larger pieces of equipment that are assembled at our factory here in Golden CO. The beam in question is used in a log splitter which is used to split up sections of a tree for firewood.  
Description of Problem: The beam is an integral part of the log splitter and is manufactured in China and is shipped via container to our factory for assembly. The beam is fabricated and coated with a fused powder coat epoxy in a variety of colors. They are currently bundled in packs of 12 using a basic spacing frame, banded and then wrapped in stretch plastic. Each beam weighs about 180 pounds. There are many opportunities for the coating to be cosmetically damaged from packing and loading at the factory in China, being transported over the ocean, being unloaded in the container from the ship, transport by rail, by truck and being unloaded at SpeeCo. Additionally when the pack of beams are taken to the assembly area and unwrapped the pack typically falls apart allowing the individual beams to rub and impact each other resulting in a damaged product that requires some degree of remedial attention to make it usable.

Objectives: To come up with a packaging method that efficiently packs beams in a configuration that will occupy minimal space to optimize container space used while protecting the beams and maintain the integrity of the package during transport. The package must be stable when unpacked in production with the beams correctly oriented so that they can be loaded directly onto the line in the correct orientation without the need to rotate them.  
Deliverables: Drawing(s) of beam stack configuration, drawing(s) of beam stack configuration to include packing materials used), drawing(s) of any framing used to stabilize the package, packing procedure and unpacking procedure (if necessary).  
Requested Department: I.E.  
Requirements: None.

**Requested Dept.:** Industrial, Mechanical

**Requirements:** Confidential, Intellectual
SpeeCo, Inc 2

Contact: Michael Marino  
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Phone: 720 4972897  
E-mail: mmarino@speeco.com

Project Title: Log Splitter Tank Quality Improvement

Description: SpeeCo (Special Products Co.) Contact: Paul Streets  
Address: 15000 W 44th Street, Golden, Colorado, 80015 USA  
Phone: 720-880-2062 Fax: 303-278-3432 E-mail: pstreets@speeco.com  
Project Title: Log splitter tank quality improvement. Background: SpeeCo imports parts and materials used to supply the agricultural industry. The parts are either sold as individual items or are part of larger piece of equipment that is assembled at our factory here in Golden CO. The tank in question is used as a component in a log splitter which is used to split up sections of a tree for firewood. The tank is the base or chassis to which the splitter beam assembly, engine, pump, towing tongue and wheels are attached. It is also used for the storage of hydraulic oil.

Description of Problem: The tank is an integral part of the log splitter and is manufactured in China and is shipped via container to our factory for assembly. The tank is fabricated and coated with a fused powder coat epoxy in a variety of colors. There are several problems that need to be overcome: 1. The tanks can leak due to poor weld integrity. This can be further aggravated because the wheel spindles are welded to the tank and the stresses of being pulled along both on the highway and on bumpy roads can cause welds to fail allowing the hydraulic oil to leak out. 2. The tanks can have rust internally to varying degrees and there is often weld slag / spatter and other foreign material left in the tank which causes the premature failure of the pump and other hydraulic components.

Objectives: 1. To improve weld integrity / strength and leaking. 2. To solve the rust issue and come up with a method to remove or eliminate weld spatter from the tank before it is shipped. Deliverables: Processes to improve: 1. Weld integrity / strength and leaking. 2. Effectively removing unwanted foreign material from the tank. 3. Should time and resources permit, provide a conceptual approach to improving the leak testing procedure. Requested Department: I.E., M.E. Requirements: None.

Requested Dept.: Industrial, Mechanical

Requirements: Confidential, Intellectual
Project Title: Speedcap Novelty Hat

Description: The objective of the Speedcap project is to determine the most cost effective manufacturing techniques to produce a high quality, flexible foam core novelty hat. The finished product should represent the quality standards of Nascar racing souvenirs with high quality graphics and finished packaging. Most of all, the hat should represent the form of a modern Nascar-style Sprint Cup race car. The final fit of the hat must take into account a variety of head sizes, so adjust-ability will be a requirement. The current prototype is a carved flexible foam core with a sewn graphic covering. Although the overall quality is what I would like to see in the final product, the sewing is labor intensive, therefore driving up cost. At the end of the semester, my goal is to know exactly how the hat will be manufactured. I need to have all costs for the final product: from raw materials to final packaging. At the April Showcase, I would like to have 4 individual novelty hats on display. These hats will each have different graphics packages. I can supply CAD drawings for the foam core, and patterns for the sewn product, IF that is the direction that we, collectively, choose. I would like to have a solid plan for marketing and distribution, with contact information for executives in each venue. As with any start-up company, a well written business plan is a must, and will be required to be available at the April Showcase. Additionally, there should be a spectator voting opportunity for the best of 4 designs at the April Showcase. It remains to be seen if the 4 hats will be of the same material make-up. Regardless, the final packaging should accommodate any of the 4 hats (dimensionally). The required expertise for this project will range from Industrial Engineering, to Mechanical Engineering, and graphic arts. The Business Department will have to be involved to write the business plan and help with marketing and distribution. This project will take a massive amount of work to achieve the goals set forth above. I am confident that the Penn State Seniors will handle this project professionally and in a timely manner. Best of luck, and I look forward to our future communications.
St. Marys Box Co. Inc.

Contact: Bill Pistner

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Phone: 814-834-3819

E-mail: bill.pistner@stmarysbox.com

Project Title: Lift™ Pallet Distribution System

Description: St. Marys Box Co. produces a patented corrugated pallet, the Lift™, that offers many advantages over standard wooden pallets. Lift™ pallets come in multiple sizes and are easily customized to a product’s load, size, and weight. The pallets are lightweight (the standard 48 in. x 40 in. pallet only weighs 9 lbs) yet are able to withstand up to 10,000 lbs in static load tests. Finally, because they are made from 100% corrugated cardboard, they are fully recyclable and repulpable; however, they are durable and strong enough to be reused for multiple jobs. St. Marys Box Co. has customers throughout the United States. The problem that we consistently run into is the cost of shipping the product to the customer increases the cost of the pallet to a point where our price becomes non-competitive. We would a team of students to create a model that will allow us to find good solutions to our logistical problems. In particular, the model should enable us to study and make comparisons as follows. At what distance does transportation make sense? Is it better to ship on our Truck or use a common Carrier? (We currently only ship locally on our trucks, and use common carriers for long distances over 150 miles.) What should be our economic target regions in the United States? Common Threads - Properties that our customers like in the Lift™ Pallet System Shock Absorbance, (50% shock reduction over wooden and plastic), Air Freight (lightness), Overseas shipments, The Green Factor (fully recyclable), and Customizability.

Requested Dept.: Industrial  Requirements: none
Star Cutter Co.

Contact: John O'Neil
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E-mail: jononeil@starcutter.com

Project Title: Near-net cutter form milling

Description: A multiple pitch/form High Speed Steel milling cutter is currently rough flute and form milled on a Haas VF4 VMC using Mastercam software and standard ball-nosed end mills. After milling the form is completed in a form relief lathe. The current practice leaves significant stock for the finishing process, particularly where straight sides and small radii are required. The primary goal of the project is to achieve a closer milled form to substantially reduce the finishing process time. Secondary goals include identification of additional standard or special end mill specifications to minimize the milling process tool and machine time cost and improvements in modeling and milling practices. Deliverables include evaluation of current modeling and machining practice, documentation of improvements including cost analysis, tool specifications, cutting parameters.

Requested Dept.: Industrial

Requirements: Confidential, Intellectual
Project Title: Wind Tunnel Automation - Automated Bike Turret Mount

Description: Background Information Synerge LLC is engaged with Aerofit LLC to provide engineering design and prototype development of a portable wind tunnel to be used for aerodynamic drag measurement and optimized bike fit adjustment for competitive cycling. At this time the prototype wind tunnel has been completed and is located at the Aerofit operations center in Rehoboth, Delaware. The next phase of the development involves three elements: redesigning existing bike dynamometer to provide: yaw capability, additional force measurement for multiple load points, and combining Phase I - PSU Learning Factory Fall 2010 prototype design seat and aerobar adjustment automation. Aerofit will provide a comprehensive bike fitting service to customers looking to improve power output, aerodynamics, and comfort. Currently there are only three locations in the country that allow competitive cyclists to complete a fitting that concentrate on the same critical factors. Aerofit will bring the fitting to the riders via a complete mobile application. The final fitting solution, which this project is based upon, will automate the fitting process by significantly reducing the fitting time that rider has to endure. Project Description The following paragraphs will provide background for the three design elements for the Phase II – automated bike turret mount: The current bike dynamometer/mount is a fixed position mechanical design that aligns the bike directly 180 degrees to the wind stream (facing the wind). The position of the bike relative to the wind cannot be changed. The first design element would modify the existing bike dynamometer/mount to allow a +/- 20 degree yaw capability to the position of the mounted bike in the tunnel. The operator of the tunnel would be able through a series of controls automatically yaw the bike while the rider is mounted and peddling during the fitting process. The second design element would provide additional load/force measurements during the fitting process. Currently the existing platform uses one load cell to measure horizontal drag induced by the conditions of the bike, rider, and wind speed during the measurement trial. The new design would evaluate all significant loads exerted during the fitting process and develop a new load sensing methodology to measure the respective forces. Essentially multiple load cells would be implemented to accomplish the overall measurement. Because the existing dynamometer/mount design is changing to accommodate the other design elements the new solution must be simultaneously developed in the new turret design. The last design element is incorporating the Phase I prototype developed during the Fall 2010 semester by a senior capstone Learning Factory team. The previously developed prototype was focused on automated controls and mechanical design to allow the seat and aerobars of the bike to be manipulated while the rider is on the bike during the wind tunnel testing. The prototype consists of a stinger (cantilever) adjustment system for the seat and a ram adjustment for the aerobars. This prototype must be integrated into the overall mechanical design to allow combined movement with the proposed yawing turret as well as applicable forces to be measured with the new load/force measurement design. The net result of the three aforementioned design elements would be a new bike turret mounting solution that would replace the existing working system. The current working system, design drawings, electrical/control specifications, and Phase I prototype are available to the assigned team. Synerge LLC would be the main point of contact for the project and can provide day to day project management and facilitation with the team of student engineers from Penn State. Synerge will also provide electrical and control engineering support to the project as it is being developed.

Requested Dept.: Mechanical

Requirements: Confidential, Intellectual
The Goodyear Tire and Rubber Company

Contact: Asli Sahin-Sariisik
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Project Title: New Approach to Process Layout

Description: To enable growth, the Goodyear Tire and Rubber Company strives for minimizing its capital expenditure and product cost. Its high capital expenditure is primarily due to large capacity production equipments, and inflexibilities and complexities in the manufacturing processes. Balancing smaller spends for capital expenditure with improved process flexibility and efficiency; Goodyear’s objective is to streamline the process layout to support small scale production facilities with smaller equipments for limited focus production and simplified production routings and timings. Expectation from this project is to develop a decision making support method to simulate and compare alternative manufacturing process layouts, routings, and timings. The method should support the comparison of the alternatives against the current state. Deliverables include simulation model validated on current plant production tickets and alternative new process layouts and production tickets,and production schedule, source code, and instructions for use.

Requested Dept.: Industrial

Requirements: Confidential, Intellectual
The Vitamin Shoppe

Contact: Rich Tannenbaum  
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Project Title: Store Receiving Optimization

Description: Dedicated to helping people fulfill their health and wellness needs, The Vitamin Shoppe is a rapidly growing specialty retailer and direct marketer of nutritional products ranging from vitamins and minerals to nutritional supplements, herbs, sports nutrition formulas, homeopathic remedies, and health and beauty aids. The Vitamin Shoppe offers 20,000 items and will have shipped 46 million units of product to its 484 stores over the past year. The Vitamin Shoppe’s Supply Chain and Distribution Centers “each” pick single items (individual bottles of vitamins) and combines many different items in a carton to ship to its retail stores. Once those cartons of products arrive at the Stores, Vitamin Shoppe Health Enthusiasts (store associates) open each carton and “pre-sort” products based on its shelf location around the store. The Vitamin Shoppe believes there is an opportunity to reduce the time, handling and labor involved in opening, sorting and stocking items onto the retail shelves. A store receives approximately 2 deliveries per week and each delivery can include up to 100 cartons and 2,000 units. With 480 stores nationwide, the labor redeployment opportunity is tremendous if the team can reduce sorting and stocking time by even a few minutes for each carton. The project team should use a combination of time studies, best methods, and operations research sorting algorithms to most efficiently stock items onto the retail shelves. A store receives approximately 2 deliveries per week and each delivery can include up to 100 cartons and 2,000 units. With 480 stores nationwide, the labor redeployment opportunity is tremendous if the team can reduce sorting and stocking time by even a few minutes for each carton. The project team should use a combination of time studies, best methods, and operations research sorting algorithms to most efficiently stock items onto the retail shelves. Recommendations should include methods, tools, processes and a data analysis tool which carefully considers the mix of the items in each carton to recommend the best stocking methods. The team should carefully consider the item composition in the cartons to determine which type of sorting methodology is most efficient for each carton and/or the entire delivery shipment. The Vitamin Shoppe expects the team will apply Operations Research analysis along with concepts and methodologies like 5S, Lean and Best Methods to optimize the receiving and stocking process at retail stores. Final delivery by the team through a presentation and data handoff should include a clear decision-making tool which directs Store Health Enthusiasts when to apply each sorting and stocking method based on the item mix and composition of the carton. The team needs to calculate the expected annual improvement by implementing the recommendations. If a new report or additional data is needed to accompany a delivery to the store, then a mock-up prototype should be provided.

Requested Dept.: Industrial

Requirements: none
The Vitamin Shoppe 2

Contact: Rich Tannenbaum
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Project Title: Damage Reduction Design

Description: Dedicated to helping people fulfill their health and wellness needs, The Vitamin Shoppe is a rapidly growing specialty retailer and direct marketer of nutritional products ranging from vitamins and minerals to nutritional supplements, herbs, sports nutrition formulas, homeopathic remedies, and health and beauty aids. The Vitamin Shoppe offers 20,000 items and will have shipped 46 million units of product to its 484 stores over the past year. The Vitamin Shoppe’s Supply Chain and Distribution Centers “each” pick single items (individual bottles of vitamins) and combines many different items in a carton to ship to its retail stores or its direct-to-consumer web/catalog customers. Throughout the in-transit process to stores and customers many items become damaged in the carton. Due to the nature of those damaged products (liquids, oils, creams) there are often “collateral” damages to other items packed in the same carton which also become ruined. Damages cause extra expense in the supply chain, offer a bad customer buying experience and hurt sales. The project team is being asked to reduce the amount of in-transit damage for the Retail, Web and Catalog business channels. To accomplish the reduction the team must design some universal packaging components which could be applied in the packaging and shipping processes to protect the product and virtually eliminate the potential for damage to the item. The Supply Chain is looking for the fewest number of interchangeable solutions that will protect 30 of the top 50 most damaged items during transit. • The solutions must be practical to implement in the Supply Chain. • The team needs to build an economic equation to determine the maximum amount which could be spent on the designed packaging components and still offer a positive return on investment (ROI). The economic factors should include; the value from reduced damages, avoided replacement costs, incremental costs of packaging components and assembly labor. • Practical – The solution must be implemented and absorbed into the existing packaging and shipping processes at the Vitamin Shoppe. Applying the solutions should not create any throughput bottlenecks. The maximum amount of time it should take to implement any solution for each item is 25 seconds, but the actual time to implement should be factored into the overall economic ROI recommendation. The team will subject their solutions to industry standard stress tests to determine the success and failure rates based on industry standards for similar packages. • Pairings - The Vitamin Shoppe would consider a recommendation from the team which offers a “zero damage tolerance” solution and a “cost effective” packaging solution for each of the targeted products. The “zero damage tolerance” solution will cost more money but will virtually eliminate damages while a “cost effective” solution will be a more economical solution used for typical shipments. The Supply Chain envisions having the practicality of pairings will depend on whether the cost, damage reduction and worthwhile circumstances to provide a substantial economic impact such as international web orders or orders that have already been damaged once during transportation. Final delivery by the team through a presentation and data handoff should include (a) a financial result which includes all of the savings and costs from the proposed solution stated in terms of ROI and annual savings, (b) the design concept and prototypes of the packaging components, (c) a tool to dynamically recommend when to utilize which set of packaging solutions, by item, (d) an implementation plan to start using the proposed solutions in the distribution center environment.

Requested Dept.: Industrial, Mechanical

Requirements: none
Tyco Fire Protection Products

Contact: A.J. Capowski
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Project Title: Redesigned Speaker Baffle

Description: Tyco is redesigning its notification appliance product line, including the speaker and speaker/strobe appliances. The present ceiling mount speaker and speaker/strobe (images below) have been criticized as being unattractive, especially given building owner’s experiences with commercial sound offerings. This project is to design a speaker and speaker/strobe pair that are more attractive relative to the commercial sound market. The units should be cost competitive. Some key requirements are to insure that the mounting screws are not visible, to offset the strobe so it does not block the sound output of the unit (a problem with the previous generation), to minimize the depth of the unit so it is low profile on the ceiling, and to incorporate a previously designed reflector in the strobe portion of the unit. The two units (speaker and speaker/visual) should be variants of each other so if they are mounted together on ceilings it is apparent that it is one family of appliances. They should be able to mount a 4” speaker behind the baffle (details to be provided), and to minimize the speaker projection into the electrical box behind the unit. This is a conflicting requirement with minimizing the extension of the unit from the ceiling. Baffle technical requirements (hole sizing, spacing, etc) will be provided as part of the kickoff package.

Requested Dept.: Mechanical

Requirements: none
Project Title: Security Tag for Eyeglasses

Description: A new security solution is needed for eyeglasses and sunglasses, which are some of the highest retail theft items. The eyeglass tag will have two distinct functions: 1. The new eyeglass tag will attach to a wide range of eyeglass products. The eyeglass tag will be removed from the glasses after purchase at the point of sale. The locking mechanism will be released by magnetic detacher. 2. The tag will have an integrated electronic article surveillance (EAS) marker, which will cause an exit detection system to alarm whenever a tag is moving through the detector’s surveillance zone. The EAS marker is pre-defined, and will not require development. The scope of this project is to develop a new locking mechanism, and overall tag design, that is suitable for application to, and provides strong protection for all types of glasses sold in retail stores. 1. The EAS marker is pre-defined, and the internal tag geometry to contain it pre-defined. 2. The tag housing is made from a low cost, yet durable plastic, like ABS. 3. The tag internal locking components are made from magnetic steel, that can be moved from the lock to unlock position by a 5.2 kGauss magnetic detacher. The magnetic detacher will be provided by Tyco. 4. The tag should be small and lightweight. 5. The tag should not interfere with customers who are trying on the glasses. 6. The tag locking mechanism should be adjustable to accommodate the large range of glass frame sizes found in retail stores. 7. The locking mechanism should provide good resistance to defeat. 8. The locking mechanism should provide at least 25 kg or 55 lbs of pull force resistance. 9. The tag should be simple to manufacture and made from the minimum number of components. 10. The components should be designed for fabrication for high volume production of more than 5 million parts per year. An example of a similar product is shown.

Requested Dept.: Mechanical

Requirements: Confidential, Intellectual
Volvo Powertrain North America

Contact: Sam McLaughlin
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Project Title: Advanced Diesel Engine Combustion System Analysis: Split Cycle Engine

Description: Overview: Volvo Powertrain North America, an industry leader in diesel engine efficiency, is interested in increasing expertise of advanced diesel engine combustion processes. Students are to investigate split cycle technology, where the typical four stroke combustion process is broken into two paired cylinders each performing two of the conventional four strokes in a diesel combustion process. Split cycles options are to be summarized in a literature study, followed by an in-depth analysis of one cycle. The split cycle to be studied in detail is a liquid nitrogen cycle that includes nitrogen generation and storage, iso-thermal compression, and exhaust heat recovery. Students, through simulation and if possible experimentation, are to explore this split cycle and report on its feasibility and efficiency in a truck application. Deliverables: Literature review of existing split cycle technology and theory Analysis/Simulation report: Nitrogen generation and storage, both onboard and off-board Analysis/Simulation report: Efficiency of Nitrogen split cycle Analysis/Simulation report: Recuperator design criteria

Requested Dept.: Mechanical

Requirements: none