WEEF PROPOSALS

SUMMARY

S2017

Table of Contents on last page

Chemical Dept (CHE)

S17-1128

Flow through Orifice Recirculation Upgrade

Newton, Cheryl
Undergraduate Laboratory Instructor, Chemical Dept (CHE)
cheryl.newton@uwaterloo.ca

Description of Proposal

In everyday life, materials are pumped to move from one place to another. Think about the water that comes out of your sink tap, shower, and gasoline from a gas pump. As well as, discharge of liquid from storage tanks or water towers. In chemical engineering processes moving liquids is a very important part of a processing unit. Being able to measure flow rate directly and indirectly is a key skill engineers must be able to do. An indirect way of measuring flow rate is using devices such as pitot tube, venturi, nozzle or orifice meters which are based on differential pressure across a restriction in flow path.

In the Chemical Engineering Undergraduate labs there are three orifice flow meters. The existing orifice flow meters are set up in series with water feed from domestic water lines. The three orifice flow meters are used simultaneously with water for undergraduate labs. The proposed improvement to the orifice meters is to add a tank and a pump for each orifice meter to allow for fluid recirculation and use of liquid solutions other than water in the equipment. There will be a total of three centrifugal pumps and three plastic storage tanks.

The recirculation aspect of the equipment is very important to promote concepts such as water conservation and process flow to undergraduate students. Currently, there is no water circulation in the units, instead the water is sent to the sewer. Flow from the domestic water line is approximately 20 liters per minute. As a result, up to 33,000 liters per year of water is treated as waste from the current first year experiment.

Adding recirculation units to the orifice meters presents an opportunity to investigate different liquid conditions including type and temperature. The recirculation unit can be used in the existing experimental apparatus for the third year labs in addition to the current use in first year undergraduate labs. For the third year project labs a recirculation system will have students propose an experimental approach to study flow of different liquid types and conditions. The recirculation units will upgrade the equipment to adapt them for project based open-ended laboratories. Project laboratories promote skills in investigation, problem-solving, and self-directed learning which are indicative of real-world engineering projects for students.

Specifically, the proposed accessory will add:
1. Recirculation of liquid used in first year experiment. Less water waste.
2. Increased experimental options for first year laboratory by offering different fluid types.
3. Use of orifice flow meters for traditional third year laboratory experiments.
4. Experimental design options for students in third year project based laboratories.

Proposal Benefits

1. Use of the new equipment will increase laboratory efficiency and reliable data collection.
2. Less water waste compared to current equipment.
3. The operation capability of the proposed new equipment will offer potential for new and innovative laboratory experiments that will enhance student learning and comprehension.

Estimated Equipment Lifetime

The pumps and storage tanks will be purchased from reputable retailers and the equipment should have a useful life of 10 or more years, with appropriate maintenance and care.

Implementation Schedule

The equipment can be assembled and tested in one to two terms and will be ready for the laboratory courses in Winter or Spring 2018.

Additional Information

The department agreed to cover the cost of small accessories such as valves, fittings, and piping and provide any additional funding to fully upgrade the experimental setup. Equipment setup and testing will be done by the department.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Pump Centrifugal ($352.89 CDN each)	$ 1059	$ 706	$ 353	$ 0
Tank HDPE ($412.87 CDN each)	$ 1239	$ 826	$ 413	$ 0
HST 13%	$ 299	$ 200	$ 100	$ 0
Total	**$ 2,597**	**$ 1,732**	**$ 866**	**$ 0**

Chemical Dept (CHE)

S17-1129

Conductivity Device for Chemical Engineering Labor

Newton, Cheryl
Undergraduate Laboratory Instructor, Chemical Dept (CHE)
cheryl.newton@uwaterloo.ca

Description of Proposal

The proposed equipment from Mettler is an upgrade to the existing equipment and includes a bench meter unit with two 4-pole cell conductivity probes that offer a range increase of almost 50 times compared to current sensors and accuracy of +-0.5 %. The current probes used have a range of 0 to 20,000 and accuracy of +- 4%. Also, the Mettler conductivity probe has an epoxy shaft which has high chemical resistivity. The new conductivity probes are 4-cell and are intended to eliminate polarization effects and guarantees high linearity over a conductivity range/ Current in use conductivity probes have visible polarization effects, limited measurement range, and poor chemical compatibility and thus not ideal for a student laboratory experience.
Conductivity is a measurement technique used in multiple years of the chemical engineering undergraduate laboratory curriculum. Current courses that use conductivity sensors include ChE 101 lab (~ 140 students a year) and ChE 490 (~ 140 students a year). Chemical Engineering offers project based laboratories for fourth year students where students propose their own experimental investigation. Replacing the current conductivity devices with a more sophisticated device will give students increased flexibility in their experimental design and promote additional design options for their study. For ChE 101 a conductivity probe with greater range, accuracy and chemical compatibility will allow investigation of additional reactions to introduce batch reactions and reaction kinetics. In particular a greater range conductivity probe will allow a current experiment to be adapted to go through a colour change as the reaction progresses. A visual indication of reaction progression is beneficial for student comprehension and learning.
Specifically, the proposed accessory will add:
1. Conductivity measurement over a larger conductivity range.
2. More experimental design options for students in project based laboratories.
3. Increased experimental options for ChE 101 laboratory including monitoring a reaction by visual colour change as well as conductivity simultaneously.
4. Excellent chemical compatibility.

Proposal Benefits

1. Use of the new equipment will increase laboratory efficiency and reliable data collection.
2. The operation capability of the proposed new equipment will offer potential for new and innovative laboratory experiments that will enhance student learning and comprehension.

Estimated Equipment Lifetime

Mettler equipment has a high reputation for quality and the equipment with appropriate maintenance and care should have a useful life of 10 or more years.

Implementation Schedule

The equipment can be assembled and tested in one term and will be ready for the laboratory courses in Winter 2018.

Additional Information

The department agreed to cover the cost of small accessories and provide limited additional funding to fully upgrade the experimental setup. Equipment setup and testing will be done by the department.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Conductivity Bench Meter SE 2700-K with Inlab 731	$ 3550	$ 3550	$ 3550	$ 3550
Conductivity Module to add multiple sensors (Acces	$ 1300	$ 1300	$ 0	$ 0
Conductivity Probe InLab 731-ISM (0.01 â€“ 1000 mS/c	$ 477	$ 0	$ 477	$ 0
HST 13%	$ 693	$ 631	$ 524	$ 462
Total	**$ 6,020**	**$ 5,481**	**$ 4,551**	**$ 4,012**

Chemical Dept (CHE)

S17-1150

Coffee Club

Grove, Jason
Lecturer, Chemical Dept (CHE)
jason.grove@uwaterloo.ca

Description of Proposal

Although chemical engineering students participate in student teams, there is no team or club that can call chemical engineering "home". We propose the creation of a technical coffee club that would focus on the coffee making process, from roasting to cup, as a technical chemical engineering project. Three capstone project teams are currently working on projects in this area.

Proposal Benefits

The proposal will provide a focal point for a new club/team with chemical engineering as a natural home. This will provide students with experiential opportunities for research and technical knowledge develop in the food and beverage area. This will support future capstone projects and provide opportunities to bridge into the curriculum using club facilities as examples in chemical engineering courses.

Estimated Equipment Lifetime

Long (10 yrs +)

Implementation Schedule

Capstone groups are selecting and specifying equipment this term.

Additional Information

The department will provide space and support some renovation of this space to be suitable for purpose. Equipment to be purchased includes:
- water treatment (likely household RO, but to be specified)
- roaster
- grinder
- variety of coffee brewing equipment

We will match WEEF's contribution at least dollar for dollar from departmental or faculty funding sources

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Water pre-treatment, roast, grind and brew equipmn	$ 5500	$ 4250	$ 3000	$ 1750
Total	**$ 5,500**	**$ 4,250**	**$ 3,000**	**$ 1,750**

Chemical Dept (CHE)

S17-1151

Soap bench scale plant

Grove, Jason
Lecturer, Chemical Dept (CHE)
jason.grove@uwaterloo.ca

Description of Proposal

To support the purchase of equipment for a soap manufacturing plant. This will include:
- water pre-treatment via reverse osmosis
- reaction vessel with impeller (for missing) and air driven motor
- ancillary piping
- instrumentation
- manual bottling unit

Proposal Benefits

This miniature production plant will serve as an experiential education centrepiece for chem eng first-year, allowing students to interact with a significant miniaturised process plant. This plant will address all major theroetical principles of chemical engineering (conservation, heat and mass transfer, reaction, control) and allow students to interact with real process equipment, piping and instrumentation, etc.

There are many opportunities to integrate this equipment into other courses through the CHE curriculum.

In addition, NE instructors have expressed interest in accessing the equipment to explore the design and production of a nano-product (since soap is a colloidal suspension).

Estimated Equipment Lifetime

Long (10 yrs)

Implementation Schedule

Theoretical aspects will be addressed in the ChE100 lab in the Fall. The plant will be purchased and commissioned in the fall for use in the 1B term.

Additional Information

Funding was previously approved for a milk/juice manufacturing plant. It has taken significantly longer than anticipated to develop a workable design (via multiple capstone projects), however we are now at that stage. (Winter/Spring/Fall 2015, total $6250). Project cost is significant (~$20k+) and additional funding will be via the department and IDEAS Clinic.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Soap manufacturing equipment	$ 9500	$ 7500	$ 5000	$ 2500
Reallocation of W/S/F 16 Funding	$ 6250	$ 0	$ 0	$ 0
Total	**$ 15,750**	**$ 7,500**	**$ 5,000**	**$ 2,500**

Civil and Environmental Dept (CEE)

S17-1119

Laboratory Balances

Allen, Anne
Laboratory Technologist, Civil and Environmental Dept (CEE)
anne.allen@uwaterloo.ca

Description of Proposal

To purchase additional balances for teaching lab purposes – students need to use balance/scale(s) to gather data to complete required labs as a part of their course curriculum.

Proposal Benefits

The additional balances would improve “wait times” and lab symmetry would increase – for example CivE/EnvE/GeoE 353 compaction lab, students utilize a moisture analyzer balance to calculate their sample's moisture content. Currently there are only 2 balances, with the addition of a third one wait times would improve greatly and the lab could be completed more efficiently. This balance could also be utilized by other CEE courses/labs beside the geotechnical labs.

Estimated Equipment Lifetime

With proper maintenance, use and as needed calibrations by a trained lab technologist, lifetime could be infinite.

Implementation Schedule

To be purchased by end of spring term 2017.

Additional Information

As always, we the CEE dept. appreciates all the support WEEF has given us. This support continues to make possible the vision of having a positive hands on learning experience in the undergrad labs.
I have been able to update several pieces of equipment in the geotechnical soils lab, while also reducing wait times.

Option #1 - 100% paid by WEEF
Option #2 - 30% of total paid by CEE dept.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Laboratory Balances	$ 7826	$ 5478	$ 0	$ 0
Total	**$ 7,826**	**$ 5,478**	**$ 0**	**$ 0**

Civil and Environmental Dept (CEE)

S17-1145

DS 102 Rotary Vane Pump

Merlau, Mark
Lab Technologist, Civil and Environmental Dept (CEE)
mmerlau@uwaterloo.ca

Description of Proposal

A rotary vane pump is an oil-sealed positive displacement pump that is used to expel gases and vapors from a system. Rotary vane pumps are used for a wide range of applications including electron microscopes, analytical instruments, and mass spectrometry. This proposal is for the purchase of one rotary vane pump, which will be used with a Gas Chromatograph-Mass Spectrometer (GC-MS) system. The pump will be a direct replacement for a unit that is 16 years old and in need of significant repair. The GC-MS is used to characterize contaminants in landfill gas samples during the ENVE 330 course. The pump will be used primarily for this course; however, it will also be available for other students if needed (e.g. 4th year design projects).

Proposal Benefits

The purchase of a rotary vane pump will benefit about 85 students per year by enabling continued analysis of landfill gas samples. This analysis includes quantifying Volatile Organic Compounds (VOCs) and the ability to search for and identify unknown compounds.

Estimated Equipment Lifetime

Approximately 10 years. One-year warranty.

Implementation Schedule

Immediately upon receipt.

Additional Information

The CEE department will provide partial funding up to 20%. The department has also recently purchased a turbo molecular pump for this same system (8K purchase).

Cost Breakdown

Item	Option1	Option2	Option3	Option4
DS 102 Rotary Vane Pump	$ 3229	$ 2583	$ 0	$ 0
Total	**$ 3,229**	**$ 2,583**	**$ 0**	**$ 0**

Electrical and Computer Dept. (ECE)

S17-1132

ECE Design Days: Pitching Machines

Wright, Derek W
Graduate Attributes Lecturer, Electrical and Computer Dept. (ECE)
derek.wright@uwaterloo.ca

Description of Proposal

ECE produces highly competent and competitive graduates, but there is an opportunity to improve the student academic and social engagement with ECE/FoE and give students more opportunities to practice open-ended engineering design. To this end, ECE and Ideas Clinic have initiated the “ECE Design Days” event for 1B students beginning with a successful pilot last W2017 term. This S2017 term will see two streams of 1B students participate in ECE Design Days activities that span the ECE spectrum, including hardware, embedded, software, and robotics. The activities also aim to join the course-level islands of knowledge by integrating knowledge across the curriculum.
This proposal is to fund the in-house fabrication and assembly of Arduino-controlled ping pong ball pitching machines used in the ECE Design Days activities. 35 of these pitching machines were fabricated and assembled for the W2017 event. The students assemble the fabricated pitching machine parts, program the Arduino, control it wirelessly via Wi-Fi or Bluetooth, and even mount it to Tetrix mechatronics kits. Based on the success of the event, the success of the pitching machines as a learning platform, and the plans to scale ECE Design Days, we are requesting the following funding.
Each pitching machine costs approximately $200, and we estimate needing 100 more to meet the needs of ECE, Ideas Clinic, and to begin offering the platforms to other engineering programs. The estimated cost for this development is $20,000 in total. We are asking for $10,000 from WEEF. The Ideas Clinic and ECE will each contribute $5,000 towards the remaining $10,000.

Proposal Benefits

Surveys of student participants and faculty/staff/student volunteers after each event and three weeks later indicate substantial agreement that students both learned and enjoyed the activities. 97.5% of respondents (N = 120) agree that ECE Design Days should become a core part of the 1B curriculum, and this concept has the backing of the ECE Chair and Undergraduate Studies Committee. The pitching machines also expose the students to other engineering disciplines, including mechanical and mechatronics engineering. They gain confidence in their choice of program, and in dealing with the ambiguity present in real engineering problems.

Estimated Equipment Lifetime

We expect a life of 3-5 years from the pitching machines. The platform assemblies will likely last longer, but the problems will get stale for students after about three years.

Implementation Schedule

If funding is granted, we will begin development immediately.

Additional Information

Options 1, 2, and 3 represent 100, 75, and 50 pitching machines, respectively. Also, these pitching machines will also be used in ECE 105 for the exploration of introductory physics.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Machine Shop	$ 5670	$ 4252	$ 2835	$ 0

Electronics (Arduino + PCBs)	$ 4342	$ 3256	$ 2171	$ 0
Total	**$ 10,012**	**$ 7,508**	**$ 5,006**	**$ 0**

Electrical and Computer Dept. (ECE)

S17-1153

ECE Facture Lab for Microelectronics

Wright, Derek W
Graduate Attributes Lecturer, Electrical and Computer Dept. (ECE)
derek.wright@uwaterloo.ca

Description of Proposal

Hardware-focused ECE graduates are highly competent and globally competitive in areas like digital and analog circuits and embedded design. However, UWaterloo is not equipped to fully develop the skills that ought to accompany the concepts students learn in lectures and labs. For example, students may learn all about devices like ADCs (analog to digital converters), including their uses and characteristics, but few can design, fabricate, assemble, and test a system that incorporates an ADC integrated circuit. Such skills are left to co-ops, meaning that only those students lucky enough to have hands-on hardware design co-op terms develop that critical experience. Also, capstone design projects suffer in quality since there are no in-house resources to prototype such hardware systems.

To begin remedying this situation, ECE has cleared out E2-3351 for the development of The Facture Lab: an electronic prototype manufacturing resource for ECE undergraduate students. The Facture Lab is intended as a place where students can assemble and test their board designs. Therefore, the lab will be outfitted with tools and equipment that can be used to hand assemble state-of-the-art surface mount board designs using solder paste and hot air reflow tools for board assembly. Once a board is assembled, students will be able to bring-up, test and debug their designs with the help of a high-speed oscilloscope outfitted with active and differential probes, logic analyzers, bench meters and multi-channel current-limited bench supplies.

ECE is, therefore, requesting WEEF funding to help offset the high upfront equipment cost. ECE has spent a significant amount on building upgrades to support the lab, including rewiring and moving utilities, and security features like access control and surveillance. Access to the room will be very similar to the WATiMake space, where students must complete online and in-person training to gain access to the lab.

Proposal Benefits

The Facture Lab is a space designed to address that current technologies in electronic circuit design have moved out of the realm where low-cost hobby tools (i.e. soldering iron, hand tools or even a 100MHz oscilloscope) are satisfactory for completing a functional design. Given this evolution in the industry, ECE will benefit from providing the resources to our students that will allow them to not only design state of the art solutions but also have the resources to properly prototype and test them. Based on actual student use, it may be possible to allow other programs to access the Facture Lab.

Estimated Equipment Lifetime

We expect a life of 10+ years from the various pieces of equipment with minimal upkeep fees, like calibration costs.

Implementation Schedule

We are aiming to make the lab available in the W2018 term.

Additional Information

Option 1 includes:
1 x Reflow Oven
1 x Board preheater

1 x Fridge for paste
1 x PCB screen printing rig
2 x Microscope
1 x Small CNC
2 x Hot air rework
2 x Soldering station
1 x High-speed oscilloscope + probes (4 GHz)

Option 2 splits the cost of the high-speed oscilloscope with ECE. Option 3 omits the oscilloscope.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Equipment Totals (see additional details)	$ 56880	$ 32880	$ 8880	$ 0
Total	**$ 56,880**	**$ 32,880**	**$ 8,880**	**$ 0**

Mechanical and Mechatronics Engineering (MME)

S17-1121

Advanced Controls Lab Equipment

Li, Eugene King-Ho
Mechatronics Engineer in Training, Mechanical and Mechatronics Engineering (MME)
eugene.li@uwaterloo.ca

Description of Proposal

The MME and ECE departments have been using equipment from Quanser and National Instruments for the past 15 years of teaching their undergraduate controls courses. This equipment has served us very well and has proven itself as an effective platform for teaching relevant control methods. However, the equipment has started to show its age. In addition, with the increase of digital applications, driven by more small scale electronics, the need for increased capacity in digital control labs is growing. To facilitate this need, negotiations with Quanser and NI have been held to obtain steep discounts and extended product support for new equipment. This equipment will allow for the existing controls courses to be taught, and will expand our capability to teach more complex methods such as vision based control to a greater number of students. The existing labs are currently at 100% capacity, and will more than double starting in Fall 2018. We are seeking WEEF funding for assistance to obtaining the equipment in a timely manner. The courses are predominately aimed at a fourth year level and are open to ME, MTE, ECE and SYDE students. We will also reuse components of these systems to extend the life of existing equipment, to reduce overall costs. The departments will be covering the development costs, as well as the external peripheral costs (e.g. computers, physical setup mounts, platforms, etc.).

Proposal Benefits

The new equipment will allow us to introduce advanced controls courses and techniques to a wider range of students. The existing equipment limits the capacity of the labs, as well as the capability of the lab. The equipment that we are proposing will allow for students enrolled in the courses to learn about advanced controls techniques that are used in industry with minimal barrier to entry. This will make students and graduates more employable and competitive in the job market.

Estimated Equipment Lifetime

Our existing set of ball and beam equipment has lasted us for 20 years with minimal modifications. Given our experience and the robustness of the equipment from Quanser, we expect the equipment to last another 20 years

Implementation Schedule

The MME Department currently has three NI ELVIS boards for other courses. We aim to take the potential funds and purchase two Quanser QNET boards to begin prototype and development. The first class to make full advantage of the ball and beam systems will arrive Fall 2018. If funding is provided we will purchase one of station immediately for development to ensure smooth support for the new systems. The rest of the systems will be purchased in Spring 2018 to obtain bulk pricing discounts. Once the additional systems are setup, we will begin the process of replacing the old ball and beam systems to bring up the capacity of the labs

- Phase 1 (Spring 2017) : Purchase development units
- Phase 2 (Spring 2018) : Purchase the minimum number of units for Fall 2018 for bulk pricing
- Phase 3 (Spring 2019): Purchase remaining units to bring labs up to maximum capacity

Update: At this time we have received $21k from WEEF and $10K savings from suppliers in addition to the MME departmental support in development and other costs such as computers.
With the fixed pricing agreement that we have obtained, with additional funding from WEEF we will be able to immediately order half of the units at the bulk pricing cost, providing a faster return on investment.

Additional Information

Option 1 outlines the total cost of the project. Option 2 outlines the target for phase 2. Option 3 outlines only the existing lab upgrade. Option 4 represents only the QNET development units.
• Departmental Support – MME Department will help with costs for computers
• Looking for cost savings
• Investigating other comparable alternative parts to bring cost down (potentially ~$20 K in savings)
• Negotiated deal with industry partners to provide discount. Can provide large discount even if we don’t order all the units at once
• This mean we can order some units now and provide immediate benefit and the suppliers will still honor the bulk price discount later

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Quanser Ball and Beam System	$ 108759	$ 54380	$ 54380	$ 0
QNET for NI ELVIS II+	$ 7072	$ 7072	$ 0	$ 7072
Total	**$ 115,831**	**$ 61,452**	**$ 54,380**	**$ 7,072**

S17-1124

Cubicon 3D Printers for WATiMake

Rathlin, Jennifer
Clinic Engineer-in-Training, Mechanical and Mechatronics Engineering (MME)
jsfung@uwaterloo.ca

Description of Proposal

WATiMake (DWE 3508/3509) is seeking funding from WEEF to replace 7 old, faulty 3D printers with 7 new 3D printers: 3 Cubicon Single+ and 4 Cubicon Style 3D printers.

WATiMake is a makerspace run by the MME department for students to work on class activities, design projects, personal projects, and prototypes of all kinds. It is equipped with prototyping equipment and tools, including 8 3D printers, 1 laser cutter, 1 desktop CNC machine, 1 injection moulding machine, and 1 thermoforming machine.

When WATiMake began 3 years ago, 7 XYZprinting da Vinci 2.0 3D printers were purchased. Now, they are well past their service lifetime and are malfunctioning often. They can no longer support the large volume of 3D prints with the precision and reliability that students need. As a result, these machines need to be replaced to maintain 3D printing capacity.

The 3D printers selected are the Cubicon Single+ and the Cubicon Style. The Cubicon Single+ has a larger build volume than the Cubicon Style. Both include automatic platform levelling, built-in filtration systems, chamber temperature monitoring, and the ability to 3D print in 11 different materials. A Cubicon Single+ 3D printer was loaned to WATiMake during the Winter 2017 term; student feedback was highly positive because the machine was found to be more reliable and precise than the da Vinci 2.0 3D printers, in addition to a several useful new features.

Proposal Benefits

WATiMake equipment is used for MME class activities as well as by students from all over Engineering and across UW. They provide students with a low-cost option to build their projects, learn to use prototyping equipment, and develop their design skills.

At busy times of the year, like when Fourth-Year Design Projects are being built, almost every single WATiMake 3D printer is in use at all times of the day. During less busy times of year, the 3D printers are still used daily. In 2016, these 3D printers were used for a total of over 2,500 hours. Students use these machines for course projects including design projects (50%), personal projects (15%), design team projects (15%), training (10%), and more (10%).

The da Vinci 2.0 3D printers are well past their expected service lifetime of 1-2 years. In total, they have been used for about 4,000 hours of 3D printing. Demand for 3D printing is increasing at UW so WATiMake needs to replace these 3D printers with machines that can 3D print more reliably, precisely, and with more customizability. The Cubicon Single+ and Style 3D printers will be able to meet these demands.

Estimated Equipment Lifetime

3-5 years

These 3D printers, along with the other equipment in WATiMake, will be managed and maintained by the MME Clinic team. The selected equipment are “pro-sumer”-level 3D printers, and are expected to have a lifetime greater than consumer-level 3D printers like the da Vinci 2.0. Maintenance of the 3D printers will be performed on a regular basis as

recommended by the manufacturer, and all supplies and parts will be purchased by WATiMake.

Implementation Schedule

All 3D printers will be purchased as soon as funding is approved. Students can start using them immediately upon arrival.

Additional Information

WATiMake has already purchased 2 Cubicon Single+ 3D printers in May 2017 to replace 3D printing capacity due to urgent need. WATiMake is looking to obtain funding from WEEF to replace the remaining 5 da Vinci 2.0 3D printers.

With tax, a Cubicon Single+ 3D printer costs $4,068 each and a Cubicon Style 3D printer costs $2,130 each. Ideally, we want to replace all 7 da Vinci 3D printers with Cubicon 3D printers.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Cubicon Single+	$ 12204	$ 8136	$ 8136	$ 8136
Cubicon Style	$ 8520	$ 8520	$ 6390	$ 4260
Cubicon Single+ (purchased May 2017)	$ (8136)	$ (8136)	$ (8136)	$ (8136)
Total	**$ 12,588**	**$ 8,520**	**$ 6,390**	**$ 4,260**

Mechanical and Mechatronics Engineering (MME)

S17-1148

TRON Days - pneumatic kits

Robinson, Mary Anna
Assoc Dir First Year & lecturer, Mechanical and Mechatronics Engineering (MME)
mary.robinson@uwaterloo.ca

Description of Proposal

As part of the IDEAs Clinic initiative to have discipline-specific days with appropriate, hands-on activities, the 1A Mechatronics Engineering teaching team is developing a suite of activities around a pneumatic actuator for the Fall 2017 1A Mechatronics Engineering class. This proposal is for the pneumatics kits for all 200 1A MTE students, in groups of 4, to use as they complete the TRON Days activities, culminating in building a functional pick-and-place robotic arm.

Proposal Benefits

These pneumatics kits will allow the students to build, in groups of 4, a functioning pick-and-place robotic arm. Under the IDEAs Clinic model, students will be applying concepts taught in all 5 of their 1A courses to the design and construction of a working prototype.
This activity is supported by the IDEAs Clinic and we will be obtaining $5000 from them for other materials needed to build the robotic arms.

Estimated Equipment Lifetime

Some small parts, such as the pneumatic hoses and fittings will need to be replaced or supplemented every year and the maintenance costs will be covered by MME. The majority of the kits (the cylinders, valves, gauges, and solenoids) should last for at least 5 years. The equipment will be stored within MME and moved to the Mechatronics Days location as needed.

Implementation Schedule

Kits will be purchased Aug-Sept 2017; TRON Days is scheduled for Oct 5-6, 2017.

Additional Information

None.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
55x pneumatics kits at $90/each (Studica or equiv)	$ 5000	$ 0	$ 0	$ 0
Pneumatic hoses & fittings	$ 1500	$ 0	$ 0	$ 0
Total	**$ 6,500**	**$ 0**	**$ 0**	**$ 0**

School of Architecture (ARCH)

S17-1141

Clay 3D Printer

Correa, David
Assistant Professor, School of Architecture (ARCH)
david.correa@uwaterloo.ca

Description of Proposal

This proposal is for the purchase of a dual extruder clay 3D printer to be used for the fabrication of architectural models and full-scale prototypes. The deposition modeling 3D printer uses high density fluid material like clay, ceramic or other experimental materials to produce fast large-scale prints of up to 45x40x45 cm.

Proposal Benefits

The clay 3D printer will allow for the production of large architecture prototypes and models at a fraction of the cost of conventional plastic filament printers. The proposed printer can produce prints 10 times bigger that is currently possible using the FFF 3D printer. Larger scale prints, lower cost and readily available materials, like clay, will allow a larger group of students to learn and experiment with 3D printing. Moreover, bad prints can also be recycled and reused to create new prints. As opposed to plastic, clay is bio based, highly recyclable and biodegradable.

The proposed equipment will give students direct access to the additive manufacturing process from material preparation, design and fabrication. They will gain new insight into the design and development of their own printing materials. With the support of two student-run digital fabrication groups, MakerLab and the F_RM Lab, this equipment will support ongoing research and fabrication activities to develop new and innovative fabrication projects.

Estimated Equipment Lifetime

The equipment will be supported by the Architecture School workshop manager and technicians. With proper care and maintenance, the equipment should last in excess of 10 years. Maintenance of the equipment will be performed on a regular basis and all supplies and parts will be purchased by the School of Architecture.

Implementation Schedule

Immediate.

Additional Information

The clay printer requires the use of kiln oven in order to allow for the sintering of the pieces. The School of Architecture has agreed to cover the purchase of the Kiln and the facility related costs of equipment installation. To facilitate immediate access to the students, there is an agreement in principle with a Cambridge based artist shop that will support use of their Kiln to students, at a discounted rate, until a permanent solution is established within the school. This will break down the cost of the proposal into 60% WEEF ($12,250) and 40% School of Architecture ($4,000).

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Clay 3D Printer	$ 12250	$ 0	$ 0	$ 0
Total	**$ 12,250**	**$ 0**	**$ 0**	**$ 0**

Management Sciences Dept. (MSCI)

S17-1146

Conveyor System Replacements and Add-ons

Chan, Dayna
Laboratory Technician, Management Sciences Dept. (MSCI)
dayna.chan@uwaterloo.ca

Description of Proposal

The purpose of this proposal is to request assistance in funding for, at minimum, a Fischertechnik robotic arm (similar to Lego, but made for industrial training). This robotic arm will replace the existing arm that is currently integrated with a conveyor and Fischertechnik systems in the Management Engineering Undergraduate Laboratory. The existing robotic arm has undergone significant wear and tear through testing and development by students and through normal lab use. As such, it is prone to malfunction. It is also using lower grade motors than one of the other robotic arms in the lab. In order to improve the performance of the overall system and align it with similar technology to other parts of the system, a new robotic arm should replace the existing arm.

Another issue with the system is that the handheld reader that is used to read RFID tags and program random timings into tool duration is having connectivity issues. It is recommended that this reader be replaced with a more suitable reader for this application that is able to maintain a stable connection. Finally, the last potential upgrade the department is currently looking into is to purchase a second robotic arm to remove parts from the storage warehouse to a location for a drone to pick up. This will also require an I/O module for the PLC system since it is already near the limits for inputs.

The Management Sciences Department is willing to support an equivalent amount to the WEEF funding received, plus any miscellaneous expenses, including student labour.

Proposal Benefits

This system will be used in several Management Engineering courses to promote experiential learning for undergraduate students. Specifically, the robot arms will facilitate the flow of production parts from one subsystem to the next and the RFID reader allows for stochastic processes, which adds complexity for the students to analyse. This system will be and has been used in undergraduate courses (i.e. MSCI 100 – Management Engineering Concepts, MSCI 131 – Work Design and Facilities Planning, MSCI 333 – Simulation Analysis and Design) to demonstrate various manufacturing concepts such as process flow, queuing, material handling, etc.

Estimated Equipment Lifetime

In a typical industrial environment, the expected lifetime for the equipment is 10 - 15 years. This lifetime can be extended in a clean lab environment such as the Management Engineering Undergraduate Laboratory. Some maintenance may be required to replace items such as LED bulbs and motors, as needed.

Implementation Schedule

Once funding is confirmed (estimated August 2017), the purchase requisition will be submitted. It is estimated that delivery will be within 4 weeks. After delivery, the system will need to be configured and programmed, which will take at least a few days with an experienced co-op assigned to the task.

Additional Information

Pricing does not include shipping. Alternate vendors have not been sourced for the Fischertechnik modules, as Studica is the only North American distributor and the units being ordered are pre-made sets. Purchasing individual components to replace

the existing robotic arm was not recommended since significant rework and rewiring would need to be done. The prices for the I/O module and RFID reader are estimates based on past purchases, as current quotes have not yet been received for these items.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Replacement Fischertechnik Robotic Arm (24V)	$ 568	$ 568	$ 568	$ 0
RFID Reader	$ 0	$ 635	$ 635	$ 0
Fischertechnik Robotic Arm (24V)	$ 0	$ 0	$ 568	$ 0
PLC I/O Module	$ 0	$ 0	$ 400	$ 0
Tax	$ 86	$ 157	$ 283	$ 0
Total	**$ 654**	**$ 1,360**	**$ 2,454**	**$ 0**

Nanotechnology Engineering Dept (NANO)

S17-1117

Infrared Thermometers for Nano Undergrad Labs

Saad, John F.
Laboratory Instructor, Nanotechnology Engineering Dept (NANO)
john.saad@uwaterloo.ca

Description of Proposal

This proposal is for purchasing Infrared Thermometers for Nano undergraduate laboratories.

Proposal Benefits

The Infrared Thermometers allow the student to measure the resistivity and carriers mobility of a pinch semiconductor resistor at different temperatures. Also, they will use the new sets to examine the reverse breakdown temperature coefficient of diodes, focusing on the Zener, and Avalanche mechanisms.
Currently, all NE students are sharing 10 of these thermometers, and as the NE program already doubled the throughput of the circuit's laboratory since spring 2016, there is a need to purchase another 12 new sets. Those extra will be used to expand our equipment to fit in devices testing lab for NE 242 course (Electronic devices).

The expected benefits of the proposal are:
1. To provide new units needed for doubling our labs.
2. To provide spare units to enable quick replacement of faulty units during the lab thus reducing inconvenience to the student group at the problem station.
3. These infrared thermometers will be used in engineering undergraduate course : NE 242 (Electronic devices)
4. It will serve about 120 undergrad students.
5. Could be used for capstone design projects

Estimated Equipment Lifetime

10+ years

Implementation Schedule

Fall 2017

Additional Information

It is our expectation that NE will match WEEF Funding.
Option#1 for 12 units while option#2 for 6 units

Cost Breakdown

Item	Option1	Option2	Option3	Option4
FLUKE-561, Infrared Thermometer	$ 3000	$ 1500	$ 0	$ 0
Total	**$ 3,000**	**$ 1,500**	**$ 0**	**$ 0**

Nanotechnology Engineering Dept (NANO)

S17-1118

Variable Temperature Heat Guns for Nano Undergrad

Saad, John F.
Laboratory Instructor, Nanotechnology Engineering Dept (NANO)
john.saad@uwaterloo.ca

Description of Proposal

This proposal is for purchasing Variable Temperature Heat Guns for Nano undergraduate laboratories.

Proposal Benefits

The variable temperature heat guns allow the student to heat up a pinch semiconductor resistor at different temperatures in order to measure temperature dependence of the resistivity and carriers mobility. Currently, all NE students are borrowing 5 of these heat guns from the NE wet labs, and as the NE program already doubled the throughput of the circuit's laboratory since spring 2016, there is a need to purchase another 10 new sets. Those setups will be used to expand our equipment to fit in devices testing lab for NE 242 course (Electronic devices).

The expected benefits of the proposal are:
1. To provide new units needed for doubling our labs.
2. To provide spare units to enable quick replacement of faulty units during the lab thus reducing inconvenience to the student group at the problem station.
3. These heat guns will be used in engineering undergraduate course : NE 242 (Electronic devices)
4. It will serve about 120 undergrad students.
5. Could be used for capstone design projects

Estimated Equipment Lifetime

10+ years

Implementation Schedule

Fall 2017

Additional Information

It is our expectation that NE will match WEEF Funding.
Option#1 for 10 units while option#2 for 5 units

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Varitemp Heat Guns, Master Appliance Model VT-750C	$ 2250	$ 1125	$ 0	$ 0
Total	**$ 2,250**	**$ 1,125**	**$ 0**	**$ 0**

Engineering Student Machine Shop

S17-1112

Power drawbar unit for milling machines

Adair, Graeme
Manager, Serda Student Design Centre, Engineering Student Machine Shop
graeme.adair@uwaterloo.ca

Description of Proposal

We are looking to buy bolt on Power drawbar units for all 5 of the milling machines in the Engineering Student Machine Shop.

Proposal Benefits

Power drawbars will increase productivity as you can perform tool changes in seconds. They will also increase the safety of operation, as students will no longer need to tighten the machine drawbars with wrenches while standing on steps to reach them.
As well as the safety benefits, installing power drawbars will save with repair costs of broken drawbars and collets.

Estimated Equipment Lifetime

10 plus years

Implementation Schedule

Immediate purchase

Additional Information

None

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Maxi Torque-rite Power Drawbar	$ 4280	$ 0	$ 0	$ 0
Total	**$ 4,280**	**$ 0**	**$ 0**	**$ 0**

MME Engineering Clinic

S17-1126

Flow Visualization Apparatuses

Milne, Andrew
Lecturer, MME Engineering Clinic
ajbmilne@uwaterloo.ca

Description of Proposal

Engineers use wind tunnels and water flumes to study the forces and flows around bodies experimentally. As part of various fluid mechanics courses (ME 351, ME 362, ME 562, ME 564, CIVE 280, CHE 211, SYDE 383) students learn about hydrostatics, different types of flow, flow measurement, and fluid forces on moving bodies, but most courses lack adequate experimental setups to allow students to practice the process of constructing a prototype, testing it, and interpreting the results. For example, in ME 351/SYDE 383 (500 students/year) there is currently one flow visualization apparatus used for demo purposes in class. A new class activity is being developed where students can design their own object, laser cut it, and study the flow over it. For this, 7 more flow visualization apparatuses are needed.

The current flow visualization apparatus is very expensive ($10k). Therefore, a cheaper alternative is being designed, tested, and manufactured by MME co-ops. The newly designed apparatus costs $550. Ideally, we want eight apparatuses for classes (the commercially available apparatus plus seven more).

Proposal Benefits

With a flow visualization apparatus, students can study and optimize a submerged shape that is hydrodynamically efficient. This allows students to improve their practical understanding of the course material. The equipment will be used in several courses, including ME 351 and SYDE 383 (500 students per year), with the equipment available for other courses as well (450 students per year).

As well as being used as a class activity, the flow visualization apparatus can be used for design teams, FYDP's, and personal projects where students can model their shape to test the hydrodynamics properties before manufacturing the piece. The flow visualization setups will be located in the MME WatiMake Clinic for students to use.

Estimated Equipment Lifetime

With proper care and maintenance, the equipment will last approximately 10 years. The designs are modular, which should allow parts of the apparatus (specifically the pumps) to be used for other student activities, and to allow repairs/replacement, further increasing useful life.

Implementation Schedule

The flow visualization apparatus will be manufactured in F'2017, validated in W'2018, and used in the upcoming SYDE 383 class, in S'2018. If construction and validation of the devices moves faster than anticipated, it could be used in the W'2017 offering of ME 351 to Mech and Tron students.

Additional Information

The MME department will match funding. As such, the options listed below budget $275 from WEEF for each apparatus. Option 1 is the assembly of seven apparatuses ($2,200). Option 2 is five ($1,375). Option 3 is four ($1,100). Option 4 is three ($825). All parts will be made through the E3 machine shop.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Flow Visualization Apparatus	$ 2200	$ 1375	$ 1100	$ 825
Total	**$ 2,200**	**$ 1,375**	**$ 1,100**	**$ 825**

ENG

S17-1161

Bioplastics IDEAs clinic activity

Gorbet, Maud B.
Associate Professor, ENG
mgorbet@uwaterloo.ca

Description of Proposal

This proposal is for the purchase of equipment to support the bioplastic IDEAs clinic activity. Students synthesized bioplastics based on cornstarch and gelatin on day 1 and then a week later characterize the material properties of their bioplastics and materials synthesized by their peers'. This activity, providing experiential learning in materials science and chemistry, first started in the Fall of 2014 and has been evolving over the years but has experienced some limitations due to the lack of reproducibility in the bioplastics being synthesized. In the summer, molds tend to grow during the drying stage (also referred to as film casting) and in the winter, they may dry too fast and unevenly. This lack of reproducibility in synthesis affects the second part of the activity where students are asked to characterize material properties and has reduced our ability to offer the activity across departments. When the sample is contaminated or not dried properly, no characterization can be performed which affects the outcome of the activity and student's experience. Currently, the bioplastics are synthesized in pots and then air dried in large cookie sheets. While it is important for students to experience the variability that can occur in the synthesis process, the environmental conditions currently affect the synthesis to such an extent that it is difficult to predict the quality of the bioplastics and this in turn hinders the quality and depth of testing that the students can perform on the materials. This proposal aims to acquire equipment that will allow students to synthesize the bioplastics more reliably so that they can be tested and characterized. The following materials are being requested:
- large glass petri dishes, (48), smaller containers with lids for the bioplastic film casting
- thermometers (24), to monitor temperature during synthesis
- two heater panels that can be mounted on a frame to act as our drying system.
- small spring clamps plus clasps (20) to perform the tensile test using the current spring scales

Proposal Benefits

1) The smaller containers for the plastics will allow casting of thicker film of bioplastics and the lids will also protect them from dusts and other contaminants.
2) Having a more reliable outcome in the synthesis process of the bioplastics will allow us to further develop the activity and bring better characterization methods into the second part of the activity.
3) A more reliable synthesis will allow us to reach more students as the impact of additives on material properties will be more effectively demonstrated.

Estimated Equipment Lifetime

10+ years

Implementation Schedule

All equipments will be bought following funding decision so that the frame for the drying system can be built and the activity can be readily available for the Fall term

Additional Information

N/A

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Infrared heater (sweeter heater) panel (2)	$ 550	$ 0	$ 0	$ 0
Large glass Petri dishes	$ 250	$ 0	$ 0	$ 0
Glass thermometers	$ 160	$ 0	$ 0	$ 0
small spring clamps and clasps	$ 150	$ 0	$ 0	$ 0
Total	**$ 1,110**	**$ 0**	**$ 0**	**$ 0**

Engineering IDEAs Clinic

S17-1127

Underwater ROVs (submarines)

Milne, Andrew
Lecturer, Engineering IDEAs Clinic
ajbmilne@uwaterloo.ca

Description of Proposal

A new MTE 380/ME 380 project is being developed. In this existing course students are challenged to create a mechanical/mechatronics device to perform a function (navigate a course, climb a wall, etc). In the new challenge, students will be asked to design and construct an underwater ROV (MTE 380) or to improve on an existing ROV design (ME 380). Students will be required to undertake the design cycle. While doing so, students will also have to perform design analysis, combining and practicing their skills in fluid mechanics, motor specification, and controls.

We are asking WEEF for funds to purchase non-consumable parts for students. Given the water proofing challenges, we anticipate students will require more expensive brushless DC motors. These, along with a selection of propellors, batteries, and controller boards, are the materials we seek WEEF funding for.

Proposal Benefits

This new course project introduces students to a hot field in engineering, (remote operated and/or autonomous drones). Such drones can be used for surveying, data collection, etc. Challenging students to create an underwater drone makes the project more cutting edge, since this field is significantly less developed than aerial drones.

Two offerings each of ME 380 and MTE 380 are given each year. Challenges tend to be repeated for 3 years, meaning that approximately 1200 distinct students would benefit from WEEF funding for this project. Most of the expensive parts (board and motors) are also reusable after the project is retired.

Estimated Equipment Lifetime

With proper care and maintenance, the equipment will last 5-10 years (longer for motors, shorter for batteries). As mentioned above, while the course project will likely be retired after approximately 3 years, the nature of the project is such that the parts themselves will be reusable for other projects/student endeavours (personal projects, FYDP, etc). The course will also be structured so that if students damage WEEF funded equipment in an egregious way, they will be required to fund its replacement.

Implementation Schedule

The new project is scheduled to be rolled out in F2017 to approximately 200 Tron and Mech students. Another 200 would complete the project in W2018.

Additional Information

The MME department will match funding. As such, the totals listed below show only the WEEF contribution. Option 1 is for full funding for 60 groups, including a contingency of 50% for student who damage components. Option 2 is for 75 groups (25% contingency). Option 3 is for 60 groups (0% contingency).

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Battery (1/group, $15 each)	$ 1350	$ 1125	$ 900	$ 0
Motor controller (3-4/group, $15 each)	$ 4725	$ 3938	$ 3150	$ 0
Motor (3-4/group, $15 each)	$ 4725	$ 3938	$ 3150	$ 0
MME/IDEAs Contribution	$ (5400)	$ (4500)	$ (3600)	$ (0)
Total	**$ 5,400**	**$ 4,501**	**$ 3,600**	**$ 0**

Engineering IDEAs Clinic

S17-1139

Tetrix kits for Engineering Days

Rennick, Christopher
Engineering Educational Developer, Engineering IDEAs Clinic
chris.rennick@uwaterloo.ca

Description of Proposal

One important key to students succeeding in the program is to feel a part of the discipline. To achieve this, students need to experience what it “feels like to be an engineer” early in their program. In fall 2016, 3 efforts were attempted to give students an immersive, hands-on, problem-solving experience. MSCI ran their second annual Case Days, Mechatronics ran the first annual Tron Days, and SYDE ran the first annual Design Dayz. In Winter 2017, ECE Days was organized and ran for 4 nights at the end of February. All four efforts were very successful, with positive feedback from both students and faculty. Mech Days was run for the first time in the second week of May, 2017 with the second offering of ECE Days later in the spring term. The fall 2017 term will be full of student activity, with MSCI, SYDE and Tron’s version of the first year events all running, in addition to a pilot of an upper year version of this concept for CIVE.
The Engineering Ideas Clinic is working to expand this concept, which we call Engineering Days to all Engineering disciplines. This event will be organized by the Ideas Clinic, but will rely on the individual programs to steer the content to match their discipline. This event will require the development of over 20 activities, some unique to one program, and some shared between programs.
The most used, and most flexible kit of parts for these events are Tetrix kits. Tetrix kits are easy-to-assemble sets of aluminum extrusions that come with servo motors if motion is required. These Tetrix kits were used in ECE Days, Mech Days, and will be used in Tron Days. Tetrix kits are used in outreach activities, and for in-course activities for the BASE program. They are also used in the final projects in ME 101 in winter and spring, and MTE 100/GENE 121 in the fall terms. An additional 30 kits are required to continue running these events. The Ideas Clinic will purchase 10, ECE will purchase 10, and we are requesting WEEF to purchase the remaining 10 kits that are required.

Proposal Benefits

Student feedback which has been collected thus far is highly positive, with high demand for more hands-on activities. Engineering Days events allow students to get an exposure to the breadth of Engineering as a whole; they see what the process is like to bring a concept to an executed solution on a very condensed timeline, but which carries a high impact. They gain confidence in their choice of program, and in dealing with the ambiguity present in real Engineering problems. Engineering Days will provide much-needed, and oft-requested, hands-on practice for the students. To provide a hands-on experience to 1500+ undergrads requires a great deal of equipment. As we expand to upper years, we will require even more equipment.

Estimated Equipment Lifetime

These kits will easily last 5 years. The Engineering Ideas Clinic will handle storage and any attrition to kit contents.

Implementation Schedule

These are needed immediately. The first event which will need these kits is ECE Days which is running in the first 2 weeks in July, 2017.

Additional Information

The Engineering Ideas Clinic has previously supported all implementations of Engineering Days events, both in the development, and roll-out phases. The Ideas Clinic’s financial contribution to ECE Days alone was $10,000. WEEF

provided $2500 in Fall 2016 and $10,000 in Winter 2017 towards Engineering Days development.

ECE and the Engineering Ideas Clinic have already committed to purchasing 10 kits each, we are requesting WEEF to cover the remaining 10 that are required.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
10 Tetrix kits	$ 5000	$ 0	$ 0	$ 0
Total	**$ 5,000**	**$ 0**	**$ 0**	**$ 0**

Engineering Orientation (EngFOC)

S17-1138

Tent Sponsorship

Chui, Adele Syt-Fu
FOC member, Engineering Orientation (EngFOC)
aschui@uwaterloo.ca

Description of Proposal

EngFOC is hoping to purchase a tent to expand the Engineering booth's presence during Orientation Week 2017.

Proposal Benefits

All faculties have booths, like Environment's Banana Stand, but Engineering has traditionally lacked the resources to run an overnight booth to provide support in the same way as other faculties.

With the purchase of a tent with walls, Engineering will be able to support first year students, leaders, and other members of the community during Orientation Week by running the Engineering Booth for longer. Some of the services provided by the Engineering Booth during the week include: directions and information about Orientation Week, shelter from the sun/rain, hydration (water provided to refill water bottles), small games to entertain first years, support when needed for lost/in need students during Orientation Week.

During the year when Orientation Week is not running, the tent will be available for use through EngSoc for any student groups or events that require additional shade or a tent (particularly useful during the summer/early Sept when heatstroke may be a problem).

Estimated Equipment Lifetime

90 day warranty, should last 5+ years depending on care taken by those setting up, tearing down, and using the tent.

Implementation Schedule

Once funding is approved, the tent will be immediately purchased for use during Orientation Week.

Additional Information

https://www.aosom.ca/outdoor-living/10-x-20-gazebo-pop-up-tent-with-walls-cream.html
http://www.bestbuy.ca/en-ca/product/outsunny-outsunny-10x20-ft-pop-up-party-tent-outdoor-patio-instant-wedding-canopy-shelter-with-4-walls-cream-01-0284/10487012.aspx?CMP=KNC-GOOGLE%3AShopping%20Campaign%20-%20BBQ%20%26%20Outdoor%20Furniture%20-%20RLSA%3ABBQ%20%26%20Outdoor&gclid=Cj0KEQjwyZjKBRDu--WG9ayT_ZEBEiQApZBFuA_4mFS5V5I9a0-eaWcApaC3W3ezVUzm3FcbXtydJycaAjvX8P8HAQ&gclsrc=aw.ds

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Outsunny 10x20 ft Pop Up Party Tent	$ 215	$ 0	$ 0	$ 0
Total	**$ 215**	**$ 0**	**$ 0**	**$ 0**

4th Year Design Project (FYDP)

S17-1131

Coffee Roasting Equipment

Maclachlan, Brooks
Chemical Engineering Student, 4th Year Design Project (FYDP)
bmaclachlan@uwaterloo.ca

Description of Proposal

To purchase a coffee roaster and auxiliary equipment for the purpose of investigating the coffee roasting process from an engineering point of view. This fourth year design project would serve as a foundation for a future coffee club for engineering students.

Proposal Benefits

A coffee club would be a unique opportunity for engineering students. There are currently few clubs that involve direct application of chemical engineering principles on a familiar process. An engineering club centred around a mainstream product like coffee would be appealing to students looking for extracurricular learning.

In addition, a coffee roaster would provide an example of a common chemical engineering process to show to visitors at the University of Waterloo. Most people should be familiar with the general concept of coffee roasting, unlike other chemical engineering processes like distillation, and thus having this roaster would make it easier for people to relate to and understand what chemical engineering is.

Estimated Equipment Lifetime

The coffee roaster has a one year warranty and should last for a number of years, although filters will need to be replaced once or twice a year, depending on how often it is cleaned.

Implementation Schedule

The project will be finished by the end of April 2018. After that, the faculty supervisors will take over to implement their plans for a coffee club and more coffee projects.

Additional Information

The specific coffee roaster being purchased is suitable because it tracks bean and environment temperature, which is necessary to perform engineering heat transfer analysis.

The purpose of the sieves is to ensure the coffee grounds have a consistent size, to ensure that the only variability between roasts are the roasting parameters.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Coffee Roaster	$ 2303	$ 1727	$ 1157	$ 576
Sieves for coffee grounds	$ 130	$ 90	$ 50	$ 0
Total	**$ 2,433**	**$ 1,817**	**$ 1,207**	**$ 576**

Engineering Society (EngSoc)

S17-1116

E7 Engineering C&D Fridges

Beauchemin, Michael
Vice President Operations and Finance, Engineering Society (EngSoc)
vpfinance.a@engsoc.uwaterloo.ca

Description of Proposal

The new E7 building will be equipped with a brand new, student run and Engineering Society operated C&D that will open in 2018. To serve the students best and offer the quality and variety of food, drink, coffee, and doughnuts, the new C&D requires refrigerators.

Each fridge costs approximately $4000

We require 6-9 fridges
To date, WEEF has funded the Engineering Society for $11 200 to buy fridges

Proposal Benefits

The Engineering C&D that will open in the new building, Engineering 7, will benefit all students and faculty in the vicinity, which includes E5, E6, and E7. This is in close proximity to the student workspace in the E5 Student Design Center, and the new student space in E7.

Estimated Equipment Lifetime

Min. 10 yrs

The similar fridges we have in the CPH C&D have lasted more than a decade and continue to operate. We have only recently needed to replace a fridge that has served longer than 10 years

Implementation Schedule

These fridges will be purchased all at once for the opening of the E7 C&D in September 2018

Additional Information

The cost is an approximation based on average current prices of industry standard refrigerators on the market today.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Fridge - Partial Funding Appreciated	$ 4000	$ 3000	$ 2000	$ 1000
Total	**$ 4,000**	**$ 3,000**	**$ 2,000**	**$ 1,000**

UW Habitat for Humanity

S17-1123

Habitat for Humanity UW WEEF Proposal

Oliveira, Peter John
President & Co-Founder, UW Habitat for Humanity
pj2olive@uwaterloo.ca

Description of Proposal

UW Habitat for Humanity Campus Chapter is a new cross faculty design team that combines philanthropic opportunities with real hands one design experience. A first of its kind, the campus chapter is both a student design team and a community outreach organization looking to realize the vision of Habitat for Humanity. As a new team on campus we are in the initial stages of developing a strong community base within the University sphere. Hosting events and increasing our brand awareness is an essential part of ensuring that the whole campus gets involved.

We have or will be reaching out to industry sponsors, students' societies including Engineering Society and Environment Society as well as WEEF to assist in gathering the necessary funds. We will also be doing on campus fundraisers to further collect funds for Habitat for Humanity and the Campus Chapter.

The proposed funds will be used for a variety of purchases. Most importantly a pull up banner and other necessary equipment that will allow us to attract more students to our events and to our design team. The pull up banner will become on of the identifying factors for the campus chapter, which will be used at events, and competitions that our team attends. As a new team we all need to ensure that we have the essential equipment necessary for the of our team as they perform their different tasks. That is why we are dedicating a large amount of funds for equipment and safety supplies.

Proposal Benefits

Contributing to UW Habitat will not only help the students involved but it will further help bring awareness to the community about the importance of collaboration in creating a better living situation for all. The University of Waterloo is known for their innovation, it is therefore only fitting that the first ever design component to a Habitat Chapter is developing out of Waterloo. Our vision of "building efficient homes, stronger communities and a better future," can only come to fruition with the support of the University community and the knowledge that the current generation of students is gathering through their education. Supporting this program will not only help to promote UW Habitat but also promote the philanthropic opportunities that exist within the Faculty of Engineering and the greater UW community. Very rarely do students get the opportunity to use their education while they are a student to give back to the community, UW Habitat provides that. It should be noted that the tools and equipment requested in this proposal are reusable and will be used for many years to come.

Estimated Equipment Lifetime

10+ years for items including the pull up banner, table, table cloth, bar clamps, hammers and extension cords. 5+ years for safety equipment.

Implementation Schedule

The project is currently being implemented with the accessing of these funds helping to expedite the process so that we can further roll out the programming.

Additional Information

We are a FEDs Club and soon to be Design Team. I have only selected 4YDP because there was no other appropriate field I could file this under.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Portable Speaker	$ 150	$ 150	$ 150	$ 150
Hardware (nails)	$ 150	$ 0	$ 0	$ 0
Personal Protective Equipment	$ 700	$ 700	$ 0	$ 0
Extension Cord	$ 80	$ 80	$ 80	$ 80
Team Banner	$ 300	$ 300	$ 300	$ 300
Folding Table	$ 85	$ 85	$ 85	$ 85
Table Cloth w/ Logo	$ 290	$ 0	$ 0	$ 0
Hammers	$ 300	$ 300	$ 300	$ 0
Bar Clamps	$ 180	$ 180	$ 180	$ 0
Total	**$ 2,235**	**$ 1,795**	**$ 1,095**	**$ 615**

Baja SAE

S17-1125

Summer 2017 Baja SAE Proposal

Dobson, Connor James
Captain, Baja SAE
connor.dobson@uwaterloo.ca

Description of Proposal

We are looking to buy some tools and legacy parts for our car.

There are 4 different things that we are looking to purchase:

1. A new CVT

Our CVT is an integral part of our drive train. These are purchased from Gaged CVT in Arizona and they have worked very well for us.

2. Brake Calipers

As we are trying to build a new car to give the best experience to our members, we need a second set of brake calipers.

3. Brake Cylinders

Similarly to the brake calipers we need a second set, especially since our first set leaks, which could pose a safety issue.

4. Tig Torch

A new tig torch would allow more fabrication to be done in house by students, which is a great way to keep our budget low and give members hands on experience.

Proposal Benefits

See above. Overall these items will help the team meet its goals of building a new 2018 car which will in turn give our members great hands on and design experience.

Estimated Equipment Lifetime

CVT typically lasts roughly 5 years.

Brakes can last anywhere from 3-7 years depending if they get damaged. (There is a lot of crashes and breakdowns in Baja)

TIG torches can last up to 10 years. One of our welders is currently 9 years old.

Implementation Schedule

We would purchase this equipment as soon as possible as we are beginning a build season in the fall.

Additional Information

shoot an email to uwaterloobaja@gmail.com if you have any extra questions!

Cost Breakdown

Item	Option1	Option2	Option3	Option4
CVT	$ 2000	$ 1500	$ 2000	$ 1500
Brake Calipers	$ 500	$ 500	$ 0	$ 0
Master Cylinders	$ 650	$ 650	$ 650	$ 650
TIG Torch	$ 400	$ 400	$ 0	$ 0
Total	**$ 3,550**	**$ 3,050**	**$ 2,650**	**$ 2,150**

Midnight Sun Solar Rayce Car Team

S17-1142

Midnight Sun Solar Cells

Vandenhoven, Clarke Raymond
Sponsorship Lead, Midnight Sun Solar Rayce Car Team
crvandenhoven@uwaterloo.ca

Description of Proposal

Midnight Sun has entered the construction phase of MSXII and has thus began to make purchases.

The most important part to purchase for MSXII is the solar cell.

We are currently asking for financial support to purchase the cells.

Proposal Benefits

The benefits will be very important for the team. Not only will this be necessary for the function of the car, but the set up of the solar cells and the use of the solar cells during the race present huge educational benefits.

Estimated Equipment Lifetime

The equipment will last until the next cycle of Midnight Sun development, so until Fall 2019.

Implementation Schedule

The WEEF contribution represents a portion of the total cost of the solar cells (c. $50000) and will be used in Fall 2017 and Winter 2018

Additional Information

None.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Solar Cells	$ 4000	$ 6000	$ 8000	$ 10000
Total	**$ 4,000**	**$ 6,000**	**$ 8,000**	**$ 10,000**

Nanorobotics Group (UW_NRG)

S17-1133

UWNRG Equipment Funding Proposal

Wang, Jane
Marketing Lead, Nanorobotics Group (UW_NRG)
jane.wang@uwaterloo.ca

Description of Proposal

The University of Waterloo Nanorobotics Group is an undergraduate research and design group made up of members from a variety of engineering programs. Our goal is to research, design, and construct robots at small scales using cutting edge micro design concepts to manipulate matter. Our team competes at the International Conference on Robotics and Automation (ICRA), which is hosted by The Institute of Electrical and Electronics Engineers (IEEE). In our past competitive years, we have participated in the Mobile Micro-Robotics Competition as well as the Micro-Assembly Challenge. We perform well at theses events; just last year, at ICRA 2016 in Stockholm, Sweden, our team finished 2nd for mobility and 1st for micro-assembly.

We are developing new and unique robots to compete at the competition. Some of our exciting robots in development that are expected to compete are Solenoid Actuated Movement (SAM), Micro-Assembly YBCO Apparatus (MAYA), and Surface Acoustic Wave (SAW). Each robot has a unique approach to micro mobility and assembly. We are taking an entirely new competitive approach and are very eager to test our latest designs against the best the world has to offer. UW_NRG will push the boundaries of possibility in mobile micro-technology.

This term, we would like to ask for $50 to purchase an end mill and $100 to purchase neodymium nanoparticles. This end mill will be used to make a copper mould for our robot MAYA. It is essential in order to fabricate our robot. Without it, we would be unable to proceed to the next steps of testing and refining our design. The nanoparticles are necessary because they will form the actual body of the robot.

Proposal Benefits

(1) Providing Value to the Engineering Undergraduate Community
We are a dynamic team made up from multiple different faculties. UW_NRG has grown considerably since its inception in 2007. We currently have about 30 active members dispersed among multiple faculties.

These programs include:
- Nanotechnology Engineering
- Software Engineering
- Electrical and Computer Engineering
- Biomedical Engineering

We give undergraduate students an opportunity to gain unique and valuable skills as part of a student research team. We have opportunities in the lab, in business, marketing, programming, experiment design and analysis, literature review, etc. As a result, students are well-prepared to be competitive for co-op and gain experience in subjects complementary to their studies.

(2) Community and International Exposure for WEEF
WEEF will have exposure on our team apparel, which is worn in community events and at international competitions, on our website, and on our banners.

Estimated Equipment Lifetime

The drill bit will last us several fabrication procedures. Therefore lasting several months.

The neodymium nanoparticles will last us several years of competition as well.

Implementation Schedule

We will purchase these items as the teams need them. As such both the end mill and the neodymium nanoparticles will be purchased as soon as funding is received.

Additional Information

The support WEEF has given UWNRG in the past is highly appreciated. By supporting UWNRG, WEEF will be enabling us to continue developing our research in this cutting-edge field. We look forward to maintaining our mutually beneficial relationship.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
End Mill	$ 50	$ 25	$ 0	$ 0
Neodymium Nanoparticles	$ 100	$ 50	$ 0	$ 0
Total	**$ 150**	**$ 75**	**$ 0**	**$ 0**

Alternative Fuels Team (UWAFT)

S17-1130

UWAFT WEEF Proposal S17

Catton, John William Albert
Systems Safety Manager, Alternative Fuels Team (UWAFT)
jwacatto@uwaterloo.ca

Description of Proposal

UWAFT is currently participating in the EcoCAR 3 competition to re-engineer a 2016 Camaro into a hybrid and show that hybrid vehicle can be fun to drive. We are doing this by maintaining the Camaro performance while drastically reducing the environmental impact of this iconic vehicle. To achieve the desired performance of our hybrid car, comprehensive vehicle performance driving tests should be taken over the course of year 4 competition. Testing of diagnostics, vehicle handling, and overall safety integrity tests for components and controls will have to be completed at the vehicle course testing site. This has created problems for running equipment as there is no power to plug the trailer into at the site.

Thus, we are requesting funding for the purchase of a generator dedicated to the trailer. While at the track we will be able to plug the trailer into the generator when doing course testing. In having this option we will be able to supply power to our various electrical devices for a much longer period (beyond their single battery charge) and allow testing time to be extended.

Proposal Benefits

The generator will allow us to extend our testing time at the track making it more beneficial for testing vehicle diagnostics. In year 4 there will be a large portion of the competition dedicated to ensuring that the vehicle will be able to function over all potential drive modes, safely, and efficiently. Without adequate testing, the UWAFT team will not be able to meet the requirements of the competition and be able to participate in the dynamic events. These events make up much of the points in the overall score.

Estimated Equipment Lifetime

The estimated lifetime of the equipment is 5-10 years and therefore will be of great use for the EcoCAR 3 competition and future competitions, provided it is properly maintained.

Implementation Schedule

As soon as funding is received we will be able to purchase the generator. From there we will immediately start using it at the track site. It will therefore be used by core team members and ME599 students to successfully complete their projects on the 2016 Camaro as year four will begin to see projects involving more vehicle dynamics and testing.

Additional Information

The team does have a sponsorship package with different sponsorship levels. By contributing to this project, WEEF will be one step closer to achieving the maximum sponsorship level of $10,000 over four years. This will allow WEEF to be a Visionary partner and have a premium logo placement on the Camaro with additional benefits.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Gnerator	$ 1250	$ 1000	$ 750	$ 0
Total	**$ 1,250**	**$ 1,000**	**$ 750**	**$ 0**

Robotics Team (UWRT)

S17-1157

University of Waterloo Robotics Team Mars Rover F

Ho Jin Mok
Team Lead, Robotics Team (UWRT)
hjmok@edu.uwaterloo.ca

Description of Proposal

The University of Waterloo Robotics Team is a participant of the University Rover Challenge (URC), which is a competition focused on building a semi-autonomous Mars Rover robot that undergoes a series of tasks, such as object collection and delivery, soil analysis, and terrain traversal. The design team is comprised of approximately 40 active undergraduate students of all years and programs, which is a gradual increase from previous years. We recently finished our design cycle for URC, where we placed 2nd in Canada and 15th globally. As such, we need to start our next design cycle for the competition.

The team is currently seeking to improve upon the current model of the Mars Rover, especially the robot's arm. There are six items for which we would like to request funding, some of which are for the arm project, the power supply, a portable monitor, and the drive train motor. These components are essential for the team to produce a better model for the competition, because they will allow for more testing and subsequently better performance.

The robotics team also has other subprojects: Intelligent Ground Vehicle Competition (IGVC) and International Autonomous Robot Racing Challenge (IARRC), which are two autonomous robotics challenges. The equipment will be crucial towards the team's success in these subprojects as well.

Proposal Benefits

The UW Robotics team has proven to be a great educational ground for undergraduate students interested in robotics for over a decade as one of the most iconic student teams in Waterloo.

A large number of the team are interested in mechanical design, which is what the arm project focuses on. The arm utilizes various types of gears, motors, and linear actuators, allowing members to heavily experience the design process for a complex mechanical system. Moreover, application of in-class knowledge will be utilized by the members to calculate various stresses and forces applied onto the arm.

The power supply requested has been chosen specifically due to its high amperage, which implies that we can run functional tests with the power supply itself instead of a battery. As a result, the battery's cycles can be used towards actual performance rather than testing, thereby increasing the battery's life cycle.

The portable monitor will be particularly useful during on-field testing. The Mars Rover will be tested during its competition in a secluded area, and so far troubleshooting the robot in any way that requires display output has involved using an extension cord, which has its own limitations. A portable monitor would simplify the process, because it would simply entail an HDMI and a power supply connection.

The team's progress has been made possible due to great financial support from WEEF, and so WEEF's contribution to UWRT will be highlighted on the robotics, website, apparel, and competition events as a gold sponsor.

In terms of storage and maintenance requirements, the items will be stored in normal room environment. The power supply,

portable monitor, and the drive train motor will be used even after the project is completed, and the design of the arm project will likely be modified in the future years. No other team will have access to the equipment in the foreseeable future.

Estimated Equipment Lifetime

The arm project is expected to last for 2-3 years, and its components may possibly last for a longer time. The power supply will last for 7 years minimum with proper use, and should serve the team for several design cycles and projects. The portable monitor will last for approximately 3 years, and will be used after the completion of the project for troubleshooting purposes. The drive train motors should last for approximately 10 years. Lastly, the slip ring and the handheld crimper will last for a minimum of 10 years.

Implementation Schedule

Building the arm will be a term-long project, and so the next revision of the arm is expected to be done by the mid-Winter 2018. The slip ring will be incorporated into the arm project. The power supply, portable monitor, drive train motor, and handheld crimper will be purchased immediately, and will be used definitely by Fall 2017.

Additional Information

For the second item in the Cost Breakdown table, the Power Supply, the team has $271 dollars remaining from our W17-1101 power supply funds. As such, the $271 was deducted from costs breakdown for all the Power Supply option. The new power supply will be a variable amperage power supply, for the purposes of testing and preventing battery cycling. The fourth item in the Cost Breakdown table, the Drive Train Motor, is an exact motor back up and replacement necessary for the Mars Rover. The model is AMP Flow F30-150.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Arm Project	$ 1500	$ 0	$ 0	$ 0
Power Supply	$ 335	$ 404	$ 604	$ 0
Portable Monitor	$ 150	$ 495	$ 208	$ 0
Drive Train Motor	$ 425	$ 0	$ 0	$ 0
Slip Ring	$ 74	$ 0	$ 0	$ 0
Handheld Crimper	$ 160	$ 0	$ 0	$ 0
Total	**$ 2,644**	**$ 899**	**$ 812**	**$ 0**

Robotics Team (UWRT)

S17-1160

University of Waterloo Robotics Team First Year C

Shah, Raj
Team Lead, Robotics Team (UWRT)
r43shah@uwaterloo.ca

Description of Proposal

The University of Waterloo Robotics Team has recently initiated a robotics competition directed towards first years. The goal of the competition is to introduce the participants to understanding the various components and types of tasks towards building a robot. When building the robot, the participants will be exposed to many concepts, such as pulse-width modulation and noise-filtering. Last year, 19 teams registered for the competition, 10 of which managed to successfully complete their robot.

In order to improve the competition, there are several items we would like to request funding: soldering station, motor controllers, oscilloscope probe, sensors, breadboards, and op-amp amplifiers.

Proposal Benefits

The most direct benefit of this competition is providing the first year participants the full design process experience. Not only does this give them exposure of what it is like to be an engineer, it also teaches them how to collaborate their design with different types of engineers. This is because the competition requires mechanical, electrical, and software components, thus allowing for group coordination and design considerations similarly seen in the tech industry.

Moreover, this competition can act as a gateway to other design teams for first years who may have zero design experience. Completing the tasks will be rewarding and a large confidence boosts, thus encouraging participants who complete the tasks to join other design teams to further their knowledge.

The soldering station will allow the participants to learn how to solder electronic components, which is a required skill in electrical engineering. The oscilloscope probe will be used in conjunction with an oscilloscope, and will familiarize the students with electrical troubleshooting.

Estimated Equipment Lifetime

The soldering station, breadboards, and the oscilloscope probe should last for about 5 years minimum, and will be used for multiple years of the competition. The motor controllers, amplifiers, and sensors will have a lifetime of 2-3 years, and will also be used for multiple cycle of the competition.

When the equipment is not being used for the competition, the UW Robotics Team will likely be using them for their projects.

Implementation Schedule

The competition will start within the first month of Fall 2017, and will last for six weeks. We expect to purchase the equipment within the next month, so that they arrive in time for the competition.

Additional Information

None.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Soldering Station	$ 310	$ 200	$ 0	$ 0
Motor Controllers	$ 280	$ 0	$ 0	$ 0
Oscilloscope Probe	$ 30	$ 35	$ 0	$ 0
RGB Sensors	$ 425	$ 310	$ 0	$ 0
Op-Amp Amplifiers	$ 12	$ 0	$ 0	$ 0
Breadboards	$ 112	$ 70	$ 0	$ 0
Total	**$ 1,169**	**$ 615**	**$ 0**	**$ 0**

Rocketry Team

S17-1144

Waterloo Rocketry Team - WEEF S17 Proposal

Gallagher, Ryan
Sponsorship Lead, Rocketry Team
r3gallagher@uwaterloo.ca

Description of Proposal

1. A drop-down extension cord would be installed to provide safe access to electricity in our student design bay. It is intended to cover workspaces where wired electricity is essential but outlets are out of safe reach. The Student Design Center will be taking care of the wiring and mounting of the cords, but it is our team's responsibility to purchase the cords.

2. A run tank stand is intended to replace our existing test stand, used for rocket ignition testing, with a safer, more robust system. The proposed run tank stand will provide greater structural support for our stand, minimize set-up and take-down times, and incorporate a blast shield for increased safety.

3. Sanitation equipment is necessary for the maintenance of our rocket and for the safe manufacturing of its components.

4. Personal protective equipment is vital to students' safety as we execute our projects, as we are frequently required to handle small pyrotechnics and chemicals. Personal protective equipment includes items like respirators, face shields, and safety glasses.

5. RLCS Upgrade - This year we added the capability to launch our rocket from a much greater distance (2000 feet) to comply with competition rules. We're asking for $500 to increase the reliability and robustness of this system, and upgrade the system to comply with future competition regulations and the future needs of the team. Upgrades for future comp regulations include encrypted radios, which are not yet required but judges mention it's likely to be required for next year. Robustness and reliability upgrades include longer range antenna, active cooling, and PCBs for all the boxes. Future team desires include more data acquisition, data logging, and live video.

6. A computer or laptop is intended to serve as a replacement for the no longer functioning computer in our design bay. This computer is to be used for design, research, material procurement, and file management while in the design bay.

7. A variety of tools are needed to ensure that the manufacturing of our rocket is safe, precise and optimal. Our current toolset is not optimized for the processes in which our teams perform, so funding allocated to tools will help improve both the effectiveness and workflow of our team.

Proposal Benefits

1. A drop-down extension cord would aid our team in reducing health and safety hazards in our team design bay. Extension cords ran along the ground provide a significant tripping risk to students on the team. This risk factor is intensified when these hazardous cords are being used to operate power tools.

2. An improved run tank stand offers operational and safety advantages to our team. Reducing the time spent with setup and takedown both reduces physical strain and risk to students setting up, but also allows us to complete testing operations more favourably within granted safe testing windows. The blast shield implemented into the run tank stand will provide an additional barrier between students and the oxidizer tank, which must operate at high pressures and thus poses a significant risk to operators.

3. Sanitation equipment is necessary to keep our rocket and its components operational. We maintain rigorous standards of cleanliness during the testing and storage of components due to the volatile nature of some of the chemicals we work with. These chemicals prove difficult to clean and require specialized cleaning equipment to ensure that our sanitary standards continue to be met.

4. Funding this item will allow us to safely operate both in Waterloo, and in the field during major tests. The item will not only benefit our team, but other teams within SDC. We are open to sharing our supplies to minimize risk for all engineering students.

5. RLCS Upgrade - this system failing means that we would not be able to launch at competition, and a year's worth of hard work would be for nothing. The data logging would allow us to do more post-launch analysis and improve our loading and launching operations. Live video gets us a Realtime view so we know when things go wrong at the rocket, which may not be obvious from 2000 feet away.

6. A centralized computer or laptop for our design bay reduces the risk to personal computing devices of team members. It democratizes the use of team software that we have limited licenses for and allows for a central storage location for important design work.

7. New tools will be used for the safe construction of our rocket and its testing systems. With virtually all of our construction done in-house, having effective tools helps improve team productivity and safety. Funding this category also benefits other student design teams as we are open to sharing both our equipment and our safe handling expertise.

Estimated Equipment Lifetime

1. A drop-down extension cord is expected to last ten years.

2. The run tank stand has been designed for reusability and is expected to last at least five years

3. Sanitation equipment will include items with a timeline lasting from four months to two years.

4. Personal protective equipment is expected to safely last one year. The items for which this funding is sought require replacements to ensure they remain as protective as possible.

5. RLCS Upgrade - Yearly minor upgrades are expected to match each rockets needs, but the core system, which is what we're requesting money for, should last 5 years

6. A Computer or laptop is expected to last five years.

7. Tools are expected to last one year for cheaper items replaced out of necessity to upwards of ten years for larger purchases.

Implementation Schedule

1. A drop-down extension cord is expected to last ten years.

2. The run tank stand has been designed for reusability and is expected to last at least five years

3. Sanitation equipment will include items with a timeline lasting from four months to two years.

4. Personal protective equipment is expected to safely last one year. The items for which this funding is sought require replacements to ensure they remain as protective as possible.

5. RLCS Upgrade - Yearly minor upgrades are expected to match each rockets needs, but the core system, which is what we're requesting money for, should last 5 years

6. A Computer or laptop is expected to last five years.

7. Tools are expected to last one year for cheaper items replaced out of necessity to upwards of ten years for larger purchases.

Additional Information

Drop-Down Extension Cord options breakdown:
1. Option 1 will ensure a high-end, durable cable that is long enough to safely cover all intended areas.

2. Option 2 allows for a lower quality cable of equal length to be bought.

3. With Option 3, less cable will be available for purchase and may result in some functionality limitations.

4. Option 4 would include further functionality limitations and may call for some additional redesign.

Run Tank Stand options breakdown:
1. Option 1 will allow for a full construction of our design with high quality, long lasting parts.

2. Option 2 will allow for a full construction of our design with cheaper parts.

3. Option 3 will lead to the reuse of scrap construction material from our existing run tank stand while still allow for an almost complete construction of the original design.

4. Design rework will be necessary to ensure the maximum effectiveness of the run tank stand.

Sanitation Equipment options breakdown:
1. Option 1 will allow for the purchase of high quality, robust cleaning solutions to help reduce recurring costs while still allowing us to purchase necessary cleaning chemicals.

2. Option 2 will allow for the purchase of a robust cleaning solution that reduces recurring costs, however, it will restrict short-term access to sanitation items.

Option 3 and 4 will limit purchases to short-term, recurring purchases of sanitation supplies.

Personal Protective Equipment options breakdown:
As the options decrease in funding, the amount of personal protective equipment we can purchase for the team decreases. With less personal protective equipment available, fewer members can actively participate in operations at a time.
RLCS Upgrade options breakdown:

1. Live video, more robust boxes, encrypted radios, PCBs, and extensible platform for adding more DAQ sensors and pre-launch capabilities.

2. new boxes and longer-range antennas. With these upgrades, we should have a much more reliable system. We will also add extensibility to add new sensors and pre-launch capabilities, should the need arise.

3. New boxes, active cooling, and PCBs for all our systems. Capabilities would not change, but robustness would increase dramatically

4. PCBs and spare components.

Computer/Laptop options breakdown:
As the options decrease in funding, the processing power of the computer which we hope to procure decreases. Option 1 will allow for the purchase of a reliable computer. Option 4 will only partially fund a new computer for our design bay.

Tools options breakdown:
1. Option 1 will allow for the purchase of high-quality power tools and for all small items we need for the development of our next rocket.

2. Option 2 will allow for the purchase of fewer high-quality power tools while still allowing for small item procurement.

3. Option 3 limits spending on power tools to allow for short term solutions.

4. Option 4 only allows for the purchase of specific items to be used for our upcoming project.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Drop-Down Extension Cord	$ 150	$ 120	$ 100	$ 80
Run Tank Stand	$ 600	$ 550	$ 500	$ 400
Sanitation Equipment	$ 250	$ 200	$ 150	$ 100
Personal Protective Equipment	$ 350	$ 300	$ 250	$ 200
RLCS Upgrade	$ 500	$ 350	$ 200	$ 100
Computer/Laptop	$ 500	$ 400	$ 300	$ 200
Tools	$ 1500	$ 1200	$ 800	$ 400
Total	**$ 3,850**	**$ 3,120**	**$ 2,300**	**$ 1,480**

Waterloo Aerial Robotics Group (WARG)

S17-1162

WARG S17 Proposal

Lenover, Michael
Team Lead, Waterloo Aerial Robotics Group (WARG)
mlenover@uwaterloo.ca

Description of Proposal

The Waterloo Aerial Robotics Group (WARG) is a team of passionate students developing autonomous aerial vehicles that perform various tasks with the slightest amount of human interaction. WARG recently participated in the 7th Unmanned Systems Canada (USC) Competition this past April, with the objective of surveying, analyzing and gathering information for the purpose of wildlife tracking. This is an annual competition, which WARG will be participating in at approximately the same time next year.

As in previous years, the upcoming USC competition will be in two parts: a large-scale aerial surveillance portion, and a smaller-scale probe retrieval/placement section. In prior competitions, we have attempted to modify a single, general-purpose system to complete both these tasks. Unfortunately, experience has shown that this method results in an aircraft that does not perform optimally in either regard. Therefore, in order to more effectively meet the requirements of upcoming competitions, WARG will be designing two systems for the next competition: a fixed-wing aircraft for aerial surveillance, and a general purpose multi-rotor aircraft for precision placement and retrieval of competition probes. For the purposes of this proposal, WARG is seeking funding for the latter of these two aircraft.

A number of parts will need to be purchased in order to complete the project. In particular, the most expensive components will include new lower profile batteries, a frame, motors and electronic speed controllers (ESCs). Backups of appropriate and vital components have also been accounted for. In total, we estimate the total cost of the custom quadcopter to be about $1800.

In order to assemble this system, as well as for future mechanical projects such as the fixed-wing aircraft, WARG is also requesting funding to update its aging toolsets and equipment. While the machine shop is useful for precision machining, specifically involving metal, many of the testings jigs required for aircraft development need to assembled within a very short turnaround time and be easily modifiable. Therefore, the funding for these tools will go towards new woodworking equipment, including a hammer drill, replacement batteries for existing cordless tools, and various other smaller items, such as jigsaw blades, pliers, screwdrivers, etc.. In total, WARG is request $600 for woodworking equipment. In addition, the team’s shop-vac has broken down after many years of use, and as such WARG is requesting funding for a replacement.

Proposal Benefits

WARG’s first priority is student learning, and prides itself in designing and building every aspect of the system from scratch. From the custom designed board that runs the autopilot, the autopilot itself, our image processing suite, our network infrastructure systems including the ground station and tracking antenna and now soon the custom composite airframe, it is sufficient to say that our members get the utmost raw exposure to everything it takes to build an unmanned aircraft. As such we give all our members the opportunity to work on any of the above aforementioned projects, providing them with invaluable, applicable experience.

This proposal includes funding for a multirotor aircraft, a key component of our future competition system. Members working on the project will obtain valuable experience, working from the design phase to the testing phase of the new quadcopter vehicle. They will be able to apply real life engineering practices in making appropriate decisions in terms of

part selection, motor and thrust analysis, and innovative problem solving for completing the competition objectives. The tools that WARG is requesting funding in will facilitate the prototyping process that our members undergo to test our systems, and the shop vac will help keep our working environment safe and clean.

WEEF is currently in our highest sponsorship bracket. This proposal will allow WEEF to continue to be a “High Flyer” sponsor. Being a High Flyer means that a large WEEF logo will be added to our aircraft, website and on team apparel.

Estimated Equipment Lifetime

The estimated lifetime for the multirotor is approximately 3 years. The drill set has a lifetime of at least 5 years. The shop vac in the WARG bay had been functioning for more than 5 years, so it is expected that the new unit will last about the same amount of time.

Implementation Schedule

WARG will be acquiring all purchased items in the Fall 2017 term.

Additional Information

Team Website: www.uwarg.com
Photos: www.flickr.com/photos/uwarg

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Woodworking Tools	$ 600	$ 400	$ 200	$ 0
Shop Vac	$ 175	$ 175	$ 0	$ 0
Multirotor Aircraft	$ 1800	$ 1500	$ 1000	$ 800
Total	**$ 2,575**	**$ 2,075**	**$ 1,200**	**$ 800**

Waterloo Satellite Team (WATSAT)

S17-1152

WatSat Spring 2017 WEEF Proposal

Robinson, Justin David
Team Lead, Waterloo Satellite Team (WATSAT)
jd2robinson@edu.uwaterloo.ca

Description of Proposal

WatSat is a student design team currently competing in the Canadian Satellite Design Challenge (CSDC), a competition that gives students knowledge and experience in space engineering by building a 3U Cubesat. The winning team will be awarded the opportunity to launch the satellite into space for free. Our satellite's mission will be to monitor the arctic sea ice boundary over the course of one year. This task will be carried out using GNSS reflectometry.

GNSS reflectometry is a form of passive remote sensing that analyzes reflected GPS signals. This technology can be used for a variety of applications, and can also penetrate some distance into material. Interest in the technology has increased since its introduction in 2003, with the recent CYGNSS mission from NASA utilizing GNSS reflectometry for its primary mission of cyclone mapping. WatSat is the only team in the CSDC with a GNSS reflectometry payload, and we are trying to use this emerging technology to conduct mapping and ice research in the Canadian arctic.

WatSat is currently looking for GNSS antennas and a GPS receiver development board for our payload equipment. One GNSS antenna will be used to replace an antenna that was damaged during a quadcopter test flight, which was used to demonstrate the feasibility of the GNSS reflectometry mission. The other two antennas will act as a backup, and eventually be used for our flatsat. The GPS receiver dev board will be used in the development and maintenance of our payload module.

Proposal Benefits

Designing a satellite requires knowledge from multiple disciplines. Therefore, WatSat requires students from many different programs to complete this task. Our team consists of students from various faculties in the University including math, science, and most prominently, engineering. Engineering students make up the majority of the team and are equipped with knowledge that allows them to solve interdisciplinary problems involving power management, command and data handling, altitude determination and control, structural and thermal design, and RF communications.

As stated Engineering students are essential to the team's success. These students are applying knowledge learned in class and learning new concepts specific to the space industry. They are gaining knowledge and experience that is difficult to learn without real life applications. This knowledge is paired with remarkable experience in multiple disciplines of Engineering, allowing students to experience certain tasks in a low risk environment. Finally, if WatSat wins the challenge, we will give students the opportunity to successfully launch a satellite into space.

Estimated Equipment Lifetime

The development board and two antennas will stay at the university for the full duration of the project. The last antenna will be launched into space aboard WatSat. If we win this competition, estimated launch date is in 2021.

GNSS antenna (satellite): ~5 years (launch + 1 year)
GNSS antenna (flatsat): ~8 years (launch + operation + further study)
GPS receiver development board: ~8 years (launch + operation + further study)

Implementation Schedule

All components will be purchased immediately. One antenna and dev board will be used during this competition. The other two antennas will be used during the assembly of the flatsat after the competition.

Additional Information

None.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
GPS Antenna (Satellite)	$ 1100	$ 1100	$ 1100	$ 0
GPS Receiver Development Board	$ 761	$ 761	$ 0	$ 0
GPS Antennas (Flatsat)	$ 2200	$ 0	$ 0	$ 0
Total	**$ 4,061**	**$ 1,861**	**$ 1,100**	**$ 0**

UW Formula Motorsports

S17-1158

UW Formula Motorsports

Syed, Mohammad Akmal
Project Manager, UW Formula Motorsports
ma3syed@uwaterloo.ca

Description of Proposal

The proposal requests sponsorship for a suspension damper for the 2017 and 2018 cars. This is to replace an existing damper which lost pressure due to an age-related leakage.

We are also requesting funds to purchase of a quick release system for the steering system. What differentiates this from our existing system is that it has built in connectors to connect the shifter system to the rest of the car during driver egress.

Proposal Benefits

The dampers benefit the team since they are essential to keeping the car running, as well as being on future car suspensions.

The Steering release system allows the driver to egress without damaging the electronics system of the car. This allows the driver to not be concerned with the mechanical safety of the car and to focus all their attention on egressing.

Estimated Equipment Lifetime

Equipment should last longer than any student's lifetime in university.

Implementation Schedule

Dampers will be immediately installed on the car, while the steering quick release system will be implemented on the 2018 cars and onwards.

Additional Information

None

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Ã–hlins TTX25 MkII	$ 980	$ 600	$ 0	$ 0
Spa Tech Electrical Steering Wheel Quick System	$ 700	$ 500	$ 0	$ 0
Total	**$ 1,680**	**$ 1,100**	**$ 0**	**$ 0**

Formula SAE Electric

S17-1166

2018 Formula Electric Vehicle

Wong, Helena
Team Member, Formula SAE Electric
nerissa.wong@uwaterloo.ca

Description of Proposal

Waterloo Formula Electric (WFE) is a student-run electric automotive design team originating as a hybrid automotive team in 2012. Dedicated to designing, engineering, and competing electric vehicles, the team has consistently competed in the annual SAE IEEE Formula Hybrid and, as of 2016, Formula Electric held at the New Hampshire Motor Speedway in Loudon, New Hampshire hosted by Dartmouth College. The team swept 1st Place in Autocross, Endurance, and Overall in Hybrid Category in 2015. However, winning first place did not stop the team from further engineering innovation. In 2016, the team made the decision to push their boundaries and shift focus onto electric vehicles, with the same purpose to create efficient vehicle technology, cultivate skilled and well-rounded engineering students with strong leadership, and develop strong community relations. Despite the challenges to compete in the electric race vehicle domain, in 2016 the team gained recognition by winning 1st place in Design and 4th place Overall in Formula SAE Hybrid's electric class. The team hopes that WEEF will continue to provide support this term to inspire innovation.

Proposal Benefits

Waterloo Formula Electric provides the opportunity for any student to apply academic knowledge to real life; the team is open to any student regardless of educational background or prior knowledge. The team brings critical and innovative thinkers together and inspire new ideas during the entire process of the car's build, cultivating teamwork skills and leadership traits, which prepare them to become future leaders in the engineering fields. The team also provides the opportunity for both team members and the University to network with team sponsors. A handful of sponsors have become regular co-op employers, which opens up opportunities for non-team members as well.

Estimated Equipment Lifetime

Brake system components will last four years.
Simulation computer will last five years.
RIGOL DP831A Power Supply will last ten years.
BK Precision high current supply will last ten years
Vehicle dynamics sensors will last five years.
CANalyzer will last forever.
Organizational bins will last ten years.

Implementation Schedule

All items requested will be purchased in the summer and fall terms of 2017. They will be used for the expected lifetimes or longer.

Additional Information

Brake system components are essential for vehicle functionality and safety. Some of the current brake system components are over a decade old and are difficult to find replacement parts for.
The simulation computer is essential for running FEA studies for the chassis. This analysis is safety critical and a rules requirement for our competition. Currently, using student laptops and/or CAD room computers has led to very slow solve times and frequent software crashes due to memory/processing power limits.

The RIGOL power supply is useful for debugging electrical components and PCBs going into the car. It allows for easy testing in the bay and at competition.
The high current supply is essential for providing shore power to the vehicle (running LV system while parked and with HV inactive). Currently we are using student owned supplies to get this done and the team needs a long term solution.
Vehicle dynamics sensors are essential for vehicle dynamis development and data driven design tasks on the team. It allows us to go a step above previous designs by capturing data about the vehicle such as suspension travel and steering angle while live on track.
The CANalyzer is a tool for debugging the CAN bus we employ on our vehicle. It allows for electronics and firmware debugging during vehicle build and operation.
Electrical organization bins are needed for the large components that the team had amassed over the years. Effective organization is essential for a productive work environment.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Brakes system (calipers, pads, lines, etc)	$ 1000	$ 1000	$ 1000	$ 1000
Simulation computer	$ 2000	$ 2000	$ 2000	$ 2000
RIGOL DP831A Power Supply	$ 1000	$ 1000	$ 1000	$ 1000
BK Precision High Current Supply	$ 700	$ 700	$ 700	$ 700
Vehicle dynamics sensors	$ 1500	$ 1500	$ 1500	$ 750
CANalyzer	$ 1000	$ 1000	$ 0	$ 0
Electrical organization bins	$ 500	$ 0	$ 0	$ 0
Total	**$ 7,700**	**$ 7,200**	**$ 6,200**	**$ 5,450**

Waterloo iGEM

S17-1159

Waterloo iGEM pH Meter

Reed, Paul Maximilian Meiering
Lab and Design Co-Lead, Waterloo iGEM
pmmreed@uwaterloo.ca, uwigem@gmail.com

Description of Proposal

The Waterloo International Genetically Engineered Machine (iGEM) team is a design team that completes yearly synthetic biology projects and competes in the iGEM Giant Jamboree, held in Boston. The projects the team completes vary in aim, but broadly feature the engineering of biological systems to perform a novel function.

Occasionally in the lab we need to control the pH of a solution, but we do not possess a functional pH meter, only pH paper. This makes the task quite difficult. However, it is quite easy to construct a pH meter of decent quality using an Arduino and a pH probe. This solution is much cheaper than buying a pH meter (~$200 vs ~$800).

Therefore, we are requesting $33.13 for an Arduino Uno, and $149.15 for an Atlas Scientific pH kit.

Proposal Benefits

This will help our team perform a basic lab task at relatively little cost.

Estimated Equipment Lifetime

The pH probe has a life expectancy of 2.5+ years.

Implementation Schedule

Equipment will be purchased when/if funding is granted.

Additional Information

NA

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Arduino Uno	$ 34	$ 0	$ 0	$ 0
pH Kit	$ 150	$ 0	$ 0	$ 0
Total	**$ 184**	**$ 0**	**$ 0**	**$ 0**

Concrete Canoe (CNCCC)

S17-1155

UW Concrete Team - Spring 2017

David, Mary Josephine
Finance Captain, Concrete Canoe (CNCCC)
mjdavid@uwaterloo.ca

Description of Proposal

The UW Concrete Team is interested in purchasing software which will be used for the development of the concrete canoe and possibly the concrete toboggan. The two pieces of software are Rhino Educational License, Flamingo nXt and the companion software Orca3D Educational License, Hull Design, Hydrostatics/Stability. The software is critical for the team in order to test the canoe's design and develop the formwork model for CNC. The software would be installed on the team's computer in our E5 work bay so that all team members would have access to the software in order to complete the design. Should we receive the funding for the software, the team will explore different options for modelling and developing the concrete toboggan's ski formwork design as well.

The UW Concrete Team would also like to ask for funding for the canoe's CNC formwork as it is typically done using the CNC machine at the UW Architecture Campus. The machine shop has done our CNC work in the past and we would like to continue partnering with them in the future.

Proposal Benefits

The benefits of purchasing the software would help to secure the longevity of the Concrete Canoe Team. The software is crucial for creating the overall design and it is almost impossible to model accurately otherwise. Another benefit for purchasing the software is expanding the repertoire of skills for the students on the team. Knowledge of these products may help in their future co-ops or other job opportunities. It will also be a beneficial teaching tool for the upper years to teach new and/or lower year members how to take a conceptual design and turn it into reality.

The benefits of using a CNC machine for the canoe formwork include the reliability of the final product and a faster turn around time for the construction process. The UW Concrete Team is the only design team that creates two completely separate products for two competitions within a single year. Any opportunity for efficiency in the construction process means that more time can be allocated to creating a winning design.

Estimated Equipment Lifetime

The license for the software does not expire. Updates are available at an extra cost, but as the software features currently stand, the team does not foresee any reason to purchase an upgraded package.

The formwork for the canoe may be reused for future competitions if it is not inexorably damaged during the de-moulding process.

Implementation Schedule

The team would like to start using the software before the end of this spring term in order to start testing out different design alternatives. We are hoping to be ready to use the CNC machine before the end of the winter 2017 semester.

Additional Information

Currently, team members take turns using a 15-day educational trial in order to create the canoe design. This method is tedious and unreliable and forces students to work under extremely tight deadlines. If something goes wrong with the design after the trial has expired, the team has to find a member who has not previously used the software in the past in order to continue working on the design. Having access to a fully licensed version would give team members the opportunity to fix any design problems encountered without having to rush for a solution.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Rhino Educational License, Flamingo nXt	$ 365	$ 365	$ 0	$ 0
Orca3D Educational License, Hull Design, Hydrostat	$ 235	$ 235	$ 0	$ 0
CNC for Canoe Formwork	$ 650	$ 0	$ 650	$ 0
Total	**$ 1,250**	**$ 600**	**$ 650**	**$ 0**

UW Steel Bridge Team

S17-1167

Steel Bridge Team - TIG Welder & Other Supplies

Gerin, Laurent Marcel
Team Lead, UW Steel Bridge Team
laurent.gerin@uwaterloo.ca

Description of Proposal

The UW Steel Bridge Team is participating in each of the ASCE and CSCE Steel Bridge Design Competitions. This student team provides its members with exposure to many aspects of steel design and fabrication. It also provides the opportunity for networking with industry professionals and students from other Canadian and American universities during the competition. The entirety of the project including the management, marketing, design, fabrication and construction is carried out entirely by the students, giving each of them a strong sense of ownership over the final bridge. The fabrication process is integral to the success of our team because it provides members with practical skills such as grinding, welding, drilling and cutting steel.

This term, we are looking to purchase a TIG welder for the team. We have found at competitions that most teams now deal with extremely thin materials and exotic steel alloys in order to save on weight. We currently have a MIG welder that we've used quite successfully but we have run into quality control issues when welding very thin material. A TIG welder would allow us to have more control over the heat input during the process which is the main source of our problems. We are looking at the Miller Maxstar 210 which comes from a reputable manufacturer and allows welding extremely thin steel.

We're also going to buy a few inexpensive items that will be a big help, namely clamps and drill bits.

Proposal Benefits

We believe that a TIG welder is key for us to move up into the rankings. This year, we became quite competitive but still suffered due to the increased weight of our bridge as our thicknesses of materials were limited by our welding abilities.

The team has approximately 20 core group members who are all passionate. We are one of the few civil-oriented teams and provide a unique opportunity to learn structural steel design and apply it.

Estimated Equipment Lifetime

We estimate this equipment to last as long as the team - we have had a MIG welder for 4 years now and it still looks brand new with no signs of deterioration.

Implementation Schedule

Our main fabrication occurs in the Winter term. If money is allocated this term, we will immediately buy the welder and begin training our members on it.

Additional Information

You can visit the Steel Bridge Team's website at www.uwaterloosteelbridge.com

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Clamps (30$ per 4-pack)	$ 60	$ 30	$ 0	$ 0
Cobalt Drill bits (15$ each)	$ 60	$ 45	$ 30	$ 15
TIG Welder (Miller Maxstar 210) + accessories	$ 4100	$ 0	$ 0	$ 0
Total	**$ 4,220**	**$ 75**	**$ 30**	**$ 15**

Waterloo Submarine Racing Team

Hall, Sasha
Team Lead, Waterloo Submarine Racing Team
s24hall@uwaterloo.ca

Description of Proposal

The Waterloo Submarine Racing Team (WatSub) is currently the only underwater student design team at UWaterloo and the first submarine racing team in Ontario. As we enter our third year as a team, we continue to grow in both number of members and amount of submarine building equipment. There are certain items that we have found to be crucial to the productivity and safety of our team members while working in our bay, such as wall mounts to secure our SCUBA air tanks when not in use, containers for small parts such as nuts & bolts, and better, more ergonomic chairs for working at the high tables in the bay. In addition, our team rarely purchases anything of the shelf, and sometimes requires specialized services from the E3 machine shop for building parts.

Proposal Benefits

Thanks to previous WEEF funding, we have been able to purchase our own scuba air tanks. To safely store these tanks, we need wall mounts for which in total will cost $70.

Within the last year we have also moved into a bay and now need to buy chairs to allow for team members to do design and manufacturing work within the team’s bay. As a start the team hopes to purchase 4 new chairs for a total cost of $450.

To help with manufacturing of our submarine we need to purchase a parts rack to keep our small parts and screws organized as we share the bay with another team and having two teams working out of one bay requires very good organization.

Finally, we need to purchase machine shop time to help manufacture some of our more complicated and bigger submarine parts that can't be made in the student machine shop.

Estimated Equipment Lifetime

Air tank wall mounts - 10 years
Chairs - 5 years
Containers for parts and screws - minimum 3 years
Machine shop services - parts will be used for minimum 2 years

Implementation Schedule

Bay items would be purchased between now and the winter term. Machine shop services would be used between now and the end of next spring, for the production of the current and next submarines.

Additional Information

None.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
E3 Machine Shop Services	$ 100	$ 150	$ 200	$ 300
Air Tank Wall Mount	$ 70	$ 70	$ 70	$ 70
Chairs	$ 450	$ 450	$ 550	$ 550
Parts rack	$ 150	$ 150	$ 200	$ 250
Total	**$ 770**	**$ 820**	**$ 1,020**	**$ 1,170**

UWHyperloop

S17-1165

Waterloop Team WEEF Proposal

Pan, Jason Chun-Zhen
Administrative Lead, UWHyperloop
jcpan@uwaterloo.ca

Description of Proposal

Building a fully functional hyperloop pod isn't easy, and it certainly isn't cheap. Over the past two years, our team has put thousands upon thousands of hours into designing and fabrication a hyperloop pod. We've come across enormous challenges along the way, but have always been able to persevere.
Waterloop is a team unlike any other. For our members, it's an incredible learning experience that rivals a full time co-op position. With sufficient resources, we are able to create exceptional opportunities for our team members that bring us one step closer to reaching our goal.

Proposal Benefits

When it comes to building a POD for an international competition, it is important to realize that it takes a lot of energy physically, mentally, and electrically. In order to get the energy we need, it is important that we purchase a powerful yet safe battery. This proposed battery will not only provide us with power for all our electronics, especially magnetic wheels, but also our electrical fail-safe systems. Additionally, in order for our POD to race we would need some type of propulsion. This is where our unique design of magnetic wheels spin into motion. Furthermore, in order to keep vital components of the POD safe during it is important that we have shock absorption available. Lastly, in order to perform tests on a normal basis and provide air for our levitation system at events, we would like to purchase a CSA approved air compressor.

Sponsoring Waterloop comes with a number of benefits. For WEEF, it means you get a large logo on our pod, social media coverage, and participation in our launch and unveil events. All together, these opportunities will allow you to reach well over 50,000 people.

For engineering students, your support provides life-changing opportunities to participate in an incredibly interesting, exciting field.

Additionally, Waterloop is one of the few design teams that have team members from every single UW faculty. With WEEF's support, we will be able to expand our team into gathering more people from different faculties around campus.

Estimated Equipment Lifetime

2+ Years for Magnetic Wheels
3+ Years for Shock Absorbers
4+ Years for Battery
4+ Years for Air Compressor

Implementation Schedule

Magnetic wheels are currently being prototyped and tested in a small scale. The shock absorbers and batteries will be implemented upon arrival of equipment, approximately July to August.

Additional Information

None.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Highoutput LFP Battery	$ 4500	$ 3000	$ 1500	$ 0
2x 120 HV 50.4V 120 Amp	$ 550	$ 400	$ 250	$ 0
4x Motor Contactors (SC-E4G-24VDC)	$ 500	$ 350	$ 200	$ 0
Air Venturi Electric Air Compressor 4500psi	$ 2200	$ 1800	$ 1000	$ 0
Fiberglass Rings (CCI)	$ 1150	$ 800	$ 400	$ 0
FOX FLOAT DPS FACTORY SHOCK 2017	$ 2200	$ 1500	$ 1000	$ 0
Total	**$ 11,100**	**$ 7,850**	**$ 4,350**	**$ 0**

Autonomous Sailboat (UWAST)

S17-1168

UWAST Spring 2017 WEEF Proposal

Liang, Ruoyu Jessen
Mechanical Design Lead , Autonomous Sailboat (UWAST)
rjliang@uwaterloo.ca

Description of Proposal

The University of Waterloo Autonomous Sailboat Team (UWAST) is one of the newest design teams at the University of Waterloo. The team designs, builds, and programs autonomous wind-powered vessels to compete in the International Robotic Sailing Regatta (IRSR).

In June 2017, the team competed for the first time at IRSR 2017 in Annapolis Maryland, ranking 6th out of a field of 11 teams and the highest of all first year teams.

For IRSR 2018, the team aims to design and construct a new, 2m vessel from scratch. Goals for the new boat include increasing the length to 2m and an increase in speed. On the software side, the team will be implementing autonomous path planning as well as obstacle detection.

For Spring 2017, UWAST is asking for the following items from WEEF: a gelcoat spray gun ($212), a jigsaw ($160), a 64GB MicroSD card ($35), a Dualshock 4 controller ($70), and kevlar scissors ($50).

- The gelcoat spray gun will allow UWAST to coat moulds in gelcoat faster than by brush. The even surface finish also reduces the amount of sanding required, saving many hours.

- The jigsaw will be used for a variety of tasks on the boat, including cutting hatches, bulkheads, and cuttings for rigging.

- The microSD card will be used for data logging on our on-board computer, as well as additional storage space.

- The Dualshock 4 controller will be used to control the boat in RC mode through our custom developed RC control system.

- Kevlar scissors will allow us to cut our composite fabrics more quickly, and reduce the amount we waste by producing a cleaner cut.

Proposal Benefits

We are the University of Waterloo’s first autonomous aquatic vessel team, and offer a unique combination of skills not found in any other student design team. As wind-powered vessels, sailboat dynamics are unique and challenging. We provide students with exposure to hull design, hydrodynamics, and aerodynamics through the design and manufacturing of custom hulls. This is in addition to exposure in power electronics, electric motors, and sensor integration.

Navigating on land is hard, but there’s no other student design team at UW who autonomously navigates on the sea. Students on UWAST are exposed to path planning, location recognition, embedded programming, machine learning, and computer vision.

Estimated Equipment Lifetime

All equipment is estimated to last over five years.

Implementation Schedule

All items will be purchased immediately after funding is granted.

Additional Information

None.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Gelcoat Spray Gun	$ 212	$ 212	$ 212	$ 212
Jigsaw	$ 160	$ 160	$ 160	$ 160
Dualshock 4 Controller	$ 70	$ 70	$ 0	$ 0
Kevlar Scissors	$ 50	$ 0	$ 50	$ 0
64GB MicroSD Card	$ 35	$ 0	$ 0	$ 0
Total	**$ 527**	**$ 442**	**$ 422**	**$ 372**

UWMCC

S17-1143

UWMCC Fall 2017 Events

Maronowski, Robert Martin
Finance Director, UWMCC
rmmarono@edu.uwaterloo.ca

Description of Proposal

The University of Waterloo Management Consulting (UWMCC), serves as a liaison between the management consulting industry and the student body of UW. We foster the leaders of tomorrow, through our workshops, office tours with industry leaders such as BCG (Boston Consulting Group), networking events, and our annual Case Competition, which attracts interest from numerous firms across Canada. We want to showcase the talent that UW has to offer, while shedding light on the rapidly growing industry that is Management Consulting. Please feel free to visit our club's Facebook page at https://www.facebook.com/uwmcc to get a better sense of what opportunities we offer for our students.

UWMCC will be hosting a series of consulting workshops and office visits in Fall of 2017. The goal of these events is to acquaint UW students with the consulting industry, prepare them for the consulting interview process, and connect them with top professionals in the industry. The consulting industry is very much a people business, and these events provide an unparalleled opportunity for Waterloo students to network with professionals and thus break in to the industry.

Proposal Benefits

UWMCC is an exceptional club which allows engineers to broaden their horizons. Many engineering students are interested in consulting as it is a promising career, and due to the top-notch problem-solving skills that engineers possess, many recruiters are eager to have them enter the field. Moreover, many of our Engineering students have recently secured co-op positions at leading consulting firms such as Oliver Wyman and Capco. We have seen that the various training and networking opportunities which our club provides helped these students become successful. With increased resources to attract more engineers into the club, we will continue to build up the reputation of Waterloo Engineers in the consulting industry.
UWMCC's workshops and office tour events provide opportunities for Engineering students to gain knowledge about the field of consulting and break into this highly rewarding industry. The soft skills training from workshops and networking opportunities with consultants are opportunities Engineering students would not get in the classroom. This help the students become leaders in the industry, which in turn, will build a strong reputation for management consulting in the Engineering Faculty.
Approximately 15 Engineering students expressed interest in last year's CEO Factory, our flagship Spring term event, representing over 20% of all students who attended. While the composition of attendees varies by term and by event, Engineering students typically represent about 20-30% of the students who attend our events.

Estimated Equipment Lifetime

Not applicable – we are requesting funding for food, drinks, and transportation costs.

Implementation Schedule

We plan to host 5 workshops throughout the Fall term, as well as 2 office visits to consulting firms (most likely in the Toronto area). We have not yet set any firm dates for these events.

Additional Information

None.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Consulting Workshops: Food and Drinks	$ 500	$ 0	$ 250	$ 125
Office Visit: Bus Fee	$ 0	$ 500	$ 250	$ 125
Total	**$ 500**	**$ 500**	**$ 500**	**$ 250**

UW ACI Team

S17-1156

UW ACI Team Spring 2017 Proposal

Yang, Shelley
Financial Lead/Team Representative, UW ACI Team
s255yang@edu.uwaterloo.ca

Description of Proposal

The newly born UW ACI team requires financial funding and support in order to compete in various structural and concrete design competitions, hosted by the American Concrete Institute (ACI).

The UW ACI team exists to provide opportunities to engineering undergraduate students to challenge themselves in simple and complex designs and construction, per competition theme, as well as to experience conferences and the competitive atmosphere among the other design teams. The designing stage requires out-of-the-box brainstorming and integration of theoretical and practical knowledge and skills.

Being founded in the USA, the ACI hosts two competitions on an annual basis, occurring at an interval of six months, each occurring in different cities across North America. The competitions encourage and challenge students to design and construct concrete elements or structures for a specified function or purpose, ranging from the Egg Protection Device Competition to FRC Bowling Ball Competition to the Art of Concrete Competition.

The team's current focus is on the design and construction of a high-impact-load resistant reinforced concrete Egg Protection Device (EPD) for the upcoming Fall 2017 Egg Protective Device Competition, which will take place in Anaheim. The competition is evaluated based on the durability, impact-load resistance and aesthetics of the device. Having just started, the team requires funding for purchase of tools and equipment needed to carry out preparation, testing and construction of prototypes to reach a satisfying, success-guaranteed final product. Such includes specifically a Dewalt 18V ½ in. heavy duty compact hammer drill kit, at an tax-excluded cost of $230CAD; Stanley 94-248 65-Piece Homeowner's Tool Kit, at a cost of 85CAD; a set of flat-head screws, at the cost of 50CAD and 5 plywood sheets, at total cost of about 250CAD.

Proposal Benefits

The funding and sponsorship contributions function as ingredients that are required for the final result of development and broadening of the student members' theoretical knowledge on the material properties and role of reinforcement in concrete, as well as their practical skill sets associated with the testing and structural design fields. Access to the tools and materials allow team members to better their hands-on experience working with concrete, such as assembly of formwork, concrete mixing, casting and finishing techniques, preparation of test samples and testing SOPs, such as that for compression and air void testing.

The contributions of the funding will allow for the students to further enhance their abilities such that not only do they personally gain advanced knowledge and experience, uncommon in the classroom or laboratory practicals, but the chances of victory, thereby creating a well-known name for the University of Waterloo, at the participated conferences and competitions, are increased.

Estimated Equipment Lifetime

With proper care and storage of the tools and equipment of such high quality, shelf life is expected to be at least 5 years. Therefore, the team members of the following generations, including that of a decade from now, will benefit from the team's personal ownership of such handy tools and equipment for their design testing and construction endeavours.

Implementation Schedule

During the design process, construction of prototypes for trial and error tests to determine the best final product, is expected. In addition, construction of the final product is a necessity. The team's ownership of such tools and the plywood material will facilitate such activities. The tools will also come in handy for the preparation and construction procedures of future ACI competitions.

Additional Information

Additional information will be provided, if necessary.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Stanley 65-Piece Homeowner's Tool Kit	$ 85	$ 79	$ 0	$ 0
Zinc-Plated Flat-Head Square Wood Screws [1.5inch]	$ 48	$ 25	$ 0	$ 0
Plywood Sheet (5)	$ 250	$ 0	$ 0	$ 0
Dewalt 18V 1/2 inch Compact Hammer Drill	$ 230	$ 179	$ 0	$ 0
Total	**$ 613**	**$ 283**	**$ 0**	**$ 0**

BioMechatronics (Powered Arm Team)

S17-1140

Powered Arm Student Team Proposal

Ravindran, Taran
Mechanical Team Lead, BioMechatronics (Powered Arm Team)
t6ravind@uwaterloo.ca

Description of Proposal

As a fully undergraduate team within the BioMechatronics team the Powered Arm Team works on a wide range of things in the BioMechatronics field. Later this year the team will be participating in the “Powered arm Cybathlon” wherein the goal is to design a fully actuated prosthetic hand. We intend to design a 4 Degree – of – Freedom prosthetic hand which is actively powered by Linear Servo Motors with the ability to exert a range of forces on different object shapes. Our prosthetic hand is in the late stages of design with most of part sourcing and selection having already been completed. This proposal is essentially a request for material goods that will be necessary to fabricate the prosthetic hand. These include linear servo motors, raw material, screws, fasteners, ball bearings, tubes and cables.

Proposal Benefits

Our group provides numerous benefits to team member be it through hands on experiences, education, or possible career opportunities. In the field of engineering it is imperative to acquire hands on experience to learn the intricacies of engineering design through trial and error. What sets the Powered Arm team apart from other student design teams is predicated around the fact that prosthetic engineering is such a new growing field and in fact very little is known about prosthetic design. The field is growing as there are very few reasonably priced prosthetic devices on the market today. In the coming years the field of prosthesis engineering will bloom with countless jobs being created, leaving the field ripe for the taking of Waterloo undergraduate engineering students. By providing students with the opportunity to gain experience in the field before these jobs have even been conceived we can guarantee that students will be the first to be hired at new prosthesis design companies. This will allow Waterloo to pioneer the field of prosthesis design and have a lasting impact on the lives of countless people in need of cheap, and functional prosthesis. On the powered arm team, we delve deep into graduate research studies and reports extracting information and mechanisms that are being invented and tested for the first time as we speak. This gives student the opportunity to read, learn, and apply their knowledge about prosthesis engineering – something that very few professionals, let alone students get to do.

Estimated Equipment Lifetime

A large majority of these materials are metal components like bearings, screws, and pipe fittings which will last approximately 15 years. The four motors and the components necessary to drive them should have a lifetime of 5-10 years if used correctly. The raw materials will have a lifetime of 3-5 years as they will tend to degrade over time.

Implementation Schedule

As soon as we receive funding approval, parts and materials will be purchased. Parts should arrive within 2-3 weeks of purchase and at that time we will begin manufacturing parts from raw materials. 2-3 weeks after raw materials are received we should finish in house manufacturing. Assembly should take approximately one week and programming of the system should take 2-3 days. A full prototype should be completed by about mid-august.

Additional Information

WEEF has provided the BioMechatronics team with support since its conception 3 years ago and we are grateful for any further support that we may receive to create our first fully actuated prosthetic hand. For more information feel free to contact:

Name: Taran Ravindran
Position: Mechanical Team Lead
Email: t6ravind@uwaterloo.ca
Phone Number: 647 688 6706

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Linear Servo Motors	$ 404	$ 404	$ 404	$ 404
Raw Plastic Materials	$ 102	$ 102	$ 102	$ 0
Metal Fasteners	$ 106	$ 106	$ 106	$ 0
Ball Bearings	$ 182	$ 182	$ 0	$ 0
Wires and Tubing Material	$ 92	$ 0	$ 0	$ 0
Total	**$ 886**	**$ 794**	**$ 612**	**$ 404**

WATonomous Spring 2017 WEEF Proposal

Ella Rasmussen
Team Captain, WATonomous
erasmuss@edu.uwaterloo.ca

Description of Proposal

WATonomous is a new student design team founded in Spring 2017 and is 1 of 8 schools selected to participate in the Society of Automotive Engineers' (SAE) AutoDrive Challenge competition. This is the newest form of collegiate design series that SAE has to offer, having followed from Formula SAE and Baja SAE. WATonomous will compete in the SAE AutoDrive Challenge competitions annually over the period of three years, with the first one being in April 2018 in Yuma, Arizona. The goal of the competition is to compete against teams across North America to develop a fully autonomous electric vehicle. Similar to UWAFT (EcoCAR), WATonomous will receive a donated Chevrolet Bolt Electric Vehicle, a set of LiDAR and RADAR sensors, and initial funding for a GRA and other start up costs. We will be receiving all competition sponsored material in the Fall 2017 term. Our team is required to fundraise with no donated property for the Spring 2017 term, and will continue to fundraise for additional competition materials in future terms. This proposal is to request funding to help support WATonomous. The funding will go towards the following required materials for the Spring 2017 term, and will last throughout the remainder of the competitions, and possible successor competitions:

Two Simulation/Development Computers: These are absolutely essential for Spring 2017 and successive terms. Two is the minimum number of computers required for a large student design team of 140 students, currently the largest design team at UW, to begin simulation. Simulation is the first stage in developing an autonomous electric vehicle. It is mandatory to run all software through strenuous simulated tests to assure that the software we run on our vehicle does not malfunction.

One Simulation Software License: This license is to be installed and is required to use with each of the simulation computers. We currently have one license sponsored.

One Camera: For year one competition objectives, computer vision is a requirement for detecting road signs, as well as animal, car, and pedestrian cut outs. Additionally, we will not have sponsored funds available until the fall term. We would be able to progress at a much faster rate if we had sensors, such as a camera, to work with this spring. This camera will be in use for the duration of the competition (3 years), after which it can be used in possible successor competitions or used by another student design team that requires computer vision.

Inertial Measurement Unit (IMU), GPS: In order to determine important information about our vehicle, such as location and speed, an automotive grade IMU/GPS system is required. Almost all of our software subteams require information from an IMU/GPS system, so having access to one this spring will greatly benefit our team.

Safety Equipment and Tools: Safety goggles, soldering irons, screwdrivers, wrenches, ratchets, and multimeters are all standard equipment that a student design team should possess.

Proposal Benefits

All funding and sponsorship contributions to our team allow for our student members to gain extensive knowledge in the field of autonomous vehicles, which brings together students from a large variety of engineering disciplines. The experience gained through competing as part of the SAE AutoDrive Challenge Team will further enhance engineering students' knowledge on software, electrical, mechanical, systems design, technical report writing, communication, and competition

skill sets. The interest in WATonomous has been overwhelming; 140 students (and counting) have signed up for WATonomous within 1 month, deeming it the largest student design team in the University of Waterloo's SSDC, and the only one of its kind. Funding from WEEF will be able to help fulfill the high level of needs for the large volume of students that are engaged in the team.

Estimated Equipment Lifetime

3 - 4 years; longer if there is a successor competition. These materials would also be highly desirable to other student design teams, and could thus be donated to them if there is no successor competition.

Implementation Schedule

Equipment is to be purchased immediately. It will be used to fulfill the needs of our 140-student team and tested on the Chevrolet Bolt EV in the Fall 2017 term, which competes in April 2017.

Additional Information

For clarity, some of the options listed in the cost breakdown are described below in more detail.

Simulation/Development Computers: GPUs and CPUs will be the most expensive components due to the need for heavy processing power. Options 1 - 3 request two simulation/development computers with a cost of $2500 each, including all hardware components and peripherals. Option 4 requests one simulation/development computer at $2000, sacrificing some processing power.

Simulation Software License: Options 1 - 2 request one PreScan simulation license. One license is sponsored, however we would greatly benefit from running simulation on two computers due to the size of the team and the need to test all software before implementation on the vehicle.

Cameras: One global shutter, high frame rate camera with high heat tolerance is required to complete competition challenges. All options request one camera at $1500.

Inertial Measurement Unit, GPS: A consumer grade GPS, as in most cell phones and cars, gives a resolution of about 20m. This is not adequate for autonomous vehicles. Using a differential GPS system that also takes signals from ground stations maintained by the Coast Guard brings the resolution down to around 1m. Option 1 requests a high resolution IMU/GPS system for $1000. Options 2 - 3 request an IMU/GPS system for $750 with lower resolution.

Safety Goggles: All options request six pairs of safety goggles at $5 each.

Tools: Basic tools will greatly benefit our newly founded team. Options 1 - 2 include screwdriver, wrench, and ratchet sets with a large variety of sizes and types. Options 3 - 4 include screwdriver, wrench, and ratchet sets with fewer sizes and types.

Cost Breakdown

Item	Option1	Option2	Option3	Option4
Multimeter	$ 35	$ 35	$ 0	$ 0
Tools (screwdrivers, wrenches, ratchets)	$ 70	$ 70	$ 50	$ 50
Soldering iron	$ 20	$ 0	$ 0	$ 0
Safety goggles	$ 30	$ 30	$ 30	$ 30
Inertial Measurement Unit, GPS	$ 1000	$ 750	$ 750	$ 750
Camera	$ 1500	$ 1500	$ 1500	$ 1500
Simulation Software License	$ 2500	$ 2500	$ 0	$ 0
Simulation/Development Computers	$ 5000	$ 5000	$ 5000	$ 2000
Total	**$ 10,155**	**$ 9,885**	**$ 7,330**	**$ 4,330**

Table of Contents

48	WP-1144	Waterloo Rocketry Team - WEEF S17 Proposal	$ 3,850
52	WP-1162	WARG S17 Proposal	$ 2,575
54	WP-1152	WatSat Spring 2017 WEEF Proposal	$ 4,061
56	WP-1158	UW Formula Motorsports	$ 1,680
57	WP-1166	2018 Formula Electric Vehicle	$ 7,700
59	WP-1159	Waterloo iGEM pH Meter	$ 184
60	WP-1155	UW Concrete Team - Spring 2017	$ 1,250
62	WP-1167	Steel Bridge Team - TIG Welder & Other Supplies	$ 4,220
64	WP-1154	Waterloo Submarine Racing Team	$ 1,170
66	WP-1165	Waterloop Team WEEF Proposal	$ 11,100
68	WP-1168	UWAST Spring 2017 WEEF Proposal	$ 527
70	WP-1143	UWMCC Fall 2017 Events	$ 500
72	WP-1156	UW ACI Team Spring 2017 Proposal	$ 613
74	WP-1140	Powered Arm Student Team Proposal	$ 886
76	WP-1164	WATonomous Spring 2017 WEEF Proposal	$ 10,155
		Total	**$ 69,234**