UNIVERSITY OF LOUISIANA AT LAFAYETTE

STEP Committee

Technology Fee Application

Materials and Manufacturing Laboratory Improvements for UL Engineering

Title

Jonathan Raush

Name of Submitter

(Faculty or Staff Only)

Department of Mechanical Engineering

Organization

Title: Assistant Professor Date: July 15, 2020
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ABSTRACT (250 words or less):

This proposal is being submitted to improve the available materials and manufacturing processes training resources in the College of Engineering through the purchase and implementation of a melting/casting system for alloying and casting projects. The upgrades will be integrated into materials, manufacturing processes and design courses offered by the Mechanical Engineering, Industrial Technology, and Chemical Engineering Departments affecting over 2000 students on campus. Funding this project will provide this large pool of students access to state-of-the-art tools intended to improve their instruction and exposure to the necessary skills and knowledge needed to be competitive in the workplace. The project will improve college resources where there is currently a deficiency in the design of these critical methods and processes. Currently, there is NO commercial hardware for melting and casting in the college, a processing method which accounts for a vast majority of commercial materials, and has relevance in advanced manufacturing methods such as additive manufacturing and joining. Industry standard hardware will not only improve student learning but increase the quantity and quality of experiential activity. Students will receive training in methods and processes that will be necessary to remain competitive and relevant.

Instruction Sheet:

1. Complete the cover page.
2. Complete the abstract page.
3. Give a description of your proposal in 12 pt. font, single spaced, addressing the following points:
    a. Purpose of grant and impact to student body as a whole
    b. Projected lifetime of enhancement
    c. Person(s) responsible for
        i. Implementation
        ii. Installation
        iii. Maintenance
        iv. Operation
        v. Training (with qualifications)
    d. The narrative of the proposal must include the purpose and justification for each of the items listed in the Budget Proposal.
4. Complete the Budget Proposal form.
5. Include any additional information relevant to your application.
6. Discuss all previous funded STEP projects (if any).

ONE ELECTRONIC COPY (Microsoft Word or Adobe PDF) OF PROPOSAL SHOULD BE EMAILED TO
stepproposal@louisiana.edu
BY DEADLINE DATE.

For additional submission instructions and deadlines, please visit http://cio.louisiana.edu/step-process

NO HARD COPY SUBMISSIONS WILL BE ACCEPTED!

A. Purpose of Grant

A critical and often neglected component of engineering design is the practice of Concurrent Engineering incorporating materials selection and manufacturing process design along with traditional design (stresses, strains) for the part under consideration. Poor material or manufacturing process selection can lead to a failed component or part – often in a catastrophic manner. These design considerations affect students in chemical engineering, mechanical engineering, civil engineering, and industrial technology. Currently, these Departments cover material and process selection as a limited discussion in design courses, separately from the only required material science course of CHEE 317 (which not all departments require). However, there are currently very limited tools available for training students in process selection or material design concepts and in the analysis of the subsequent effects, such as performance, availability, and costs, which can have huge consequences on project success. The **purpose** of this grant is therefore acquisition and implementation of significant and requisite upgrades in materials and manufacturing training resources. Funding for hardware acquisition of casting and melting equipment for the College of Engineering are therefore requested.

Learning outcomes include:

- Understand the interaction between materials and manufacturing processes, especially melting, and how this affects selection and design.
- Understand systematic selection of materials and processes using constraints and objectives.
- Identify solutions to real engineering problems (i.e. in capstone design projects) using comprehensive materials and process data.

The application will support both introductory courses such as CHEE 317, where resources allow students to explore the relationships between the Processing, Structure and Properties of materials – and advanced courses where the synthesis allows students to explore new and hybrid materials. This application in combination with the ability to melt/cast alloys provides the holistic experience needed for future engineers.

There is currently NO commercial melting and casting furnace available for use in the College of Engineering for student learning and training. Current available hardware includes the use of a custom constructed and adapted furnace whose performance and safety limitations severely inhibits student impact and learning. Industry standard hardware will not only improve student learning, but also increase the quantity and quality of experiential activity. Students will receive training in methods and processes that will be necessary to remain competitive and relevant in the future.

The new furnace will employ rapid cycle times of 6 minutes after initial preheating of 40 minutes (Figure 1). The current method for melting involves a heating time of 3-4 hours, limiting melting activity to just one day per semester. The controlled atmosphere system will also aid in improved material quality such that casted parts could be utilized in applications (senior design, research, etc.), whereas currently casted parts are useful for demonstration only. The furnace will also allow alloying of different elements in line with material design applications – especially useful for graduate student applications – and will add experiential value to simulations. The use of the furnace will facilitate advanced materials research and application, in line with the University and statewide emphasis on advanced manufacturing and materials.
Advanced manufacturing applications in aerospace, automotive, healthcare, and consumer product

sectors are forecasted for 20-30% annual revenue growth. In order to utilize advanced manufacturing to its fullest potential, engineers and designers must be trained. Such courses are offered by top universities. The **goal** of this equipment acquisition then is to provide UL students the opportunity to receive proper training in conventional as well as the emerging fields of advanced manufacturing. The commercial grade furnaces from MTI will provide the capability to conduct high quality melting, alloying, casting, and heat treating of engineered materials and parts, upgrading students learning experience and opportunities.

With the help of these tools, our students will be able to optimize the materials and processes within a Concurrent Engineering paradigm. The proposed hardware can be implemented into current materials, manufacturing processes, and design courses. Both will expose students to the effects of materials and processes on the design of parts and systems. The successful implementation of this training will prepare UL engineering students for the workplaces of the twenty-first century. In addition, this training supports and improves outcomes relative to ABET accreditation.

Impact on Student Body

This initiative will impact students in the following ways:
1. Students currently have limited to no experience with several manufacturing processes such as melting, casting, alloying, and heat treating. This project will improve experiential learning activity with these processes, learning outcomes, and research opportunities. The many departments within the College of Engineering that utilize this training will benefit from the improvement.
2. Students will be expected to have a level of proficiency in the workplace when entering with an engineering degree. They need the exposure to the tools of the future workplace, especially with developing and advanced manufacturing materials and processes.
3. Students will have an advantage over those from other colleges when entering the workplace, making them more competitive for future design or advanced manufacturing jobs.
4. Students will value leaving a program having experienced cutting-edge technologies which they can bring to businesses and other educators.

B. The Projected Lifetime of Enhancement

The hardware has an expected lifetime of 10-20 years for the application proposed.

C. Person(s) Responsible for Project

a. Implementation: Jonathan Raush, College of Engineering
b. Installation: Jeff Guidry, Mechanical Engineering
c. Maintenance: Jeff Guidry, Mechanical Engineering
d. Operation: Jonathan Raush, College of Engineering
e. Training: Jonathan Raush, College of Engineering

Qualifications:

Jonathan Raush is currently an Assistant Professor in the Department of Mechanical Engineering and Associate Director of the Institute of Materials Research and Innovation. He has held this position since 2016. He holds a Ph.D. from Louisiana State University in Mechanical Engineering. He specializes in advanced manufacturing of metal alloys and advanced materials design.

Jeffrey Guidry is the Machine Shop Supervisor in the Department of Mechanical Engineering. He has held this position since 2000. He has a Bachelor of Science in Industrial Arts Education, from the University of Louisiana at Lafayette. He has assisted with MCHE 365 Manual Machining Labs (including casting), assisted Senior Design student projects and competition projects in machining and welding lab, and assisted Graduate Research Students and research professors in customizing research equipment campus wide.

Budget Proposal

1.	**Equipment**	**$16,521**
2.	**Software**	**$0**
3.	**Supplies**	**$2,000**
4.	**Maintenance**	**$0**
5.	**Personnel**	**$0**
6.	**Other**	**$0**
TOTAL:		**$18,521**

Timeline:

Year 1:

Order equipment.

Install equipment, implement into course modules in MCHE, ITEC, CHEE

Year 2:

Further implement into course modules, maintenance as needed. It is anticipated that following Year 1, maintenance costs for the hardware will be allocated from existing student laboratory fees.

Year 3:
Maintenance
Year 4:
Maintenance

Budget Proposal

Length of Implementation (In years)	1	2	3	4
1. Equipment	$16,521	$0	$0	$0
2. Software	$0	$0	$0	$0
3. Supplies	$2,000	$0	$0	$0
TOTAL:	$18,521	$0	$0	$0

Previously Funded STEP Grants

Jonathan Raush has one previously funded STEP grant project:
Implementation of Virfac® (Virtual Factory) Software Package for a total cost of $27,000. The purpose of this grant was the acquisition and implementation of a virtual factory simulation environment. Commercial packages are used by engineers around the world to simulate welding, additive manufacturing, machining, heat treatment and damage resistance in various industries including aeronautics, automotive, naval and nuclear. Additive Manufacturing is a latest software addition. The grant facilitated software acquisition and implementation in this regard.

D. Hardware Images and Examples

Figure 1. Melting and casting furnace with controlled atmosphere from MTI. Cost quotation from MTI: $16,000