College/Dept *or* Associated Students Priority: ____

Student Technology Fee – AY 2016

Tech Initiatives Abstract Form

***STUDENT* Due Date (to AS): January 19, 2016** **_EMPLOYEE_ Due Date (to STF Committee): January 14, 2016**

Project Title: Dynamic Force Sensor for Computer Numerical Control (CNC) Mill Machining

Project Abstract Applicant(s)

Principal Contact:

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☒ Student ☐ Faculty ☐ Staff

~~Name:~~ ~~MS:~~ ~~Email:~~ ~~Phone:~~

~~☐ Student~~ ~~☐ Faculty~~ ~~☐ Staff~~

IMPORTANT NOTE

Student Tech Fee project funding is not allowed for:

- *Computer lab upgrades – Existing computer labs are upgraded on a rolling schedule with a separate pool of Student Technology Fee funds.*
- *Software related to maintenance and/or serial payments*

INSTRUCTIONS

1. Would this project involve the check-out of equipment to students?

   No ☒ Yes ☐

2. What is your estimate of project cost? $15,000
   (Provide a very rough dollar amount only; no budget or other background information at this point.)

3. On the following page (Arial 10-point font, single spaced, ½-inch side margins), please:

   a. Provide a succinct description of your project idea.

   b. Describe the scope/reach of the potential project (e.g. campus wide, a specific department, etc.).

   c. Conclude with a strong statement of how the project would fulfill one or more of the objectives in the STF mission as stated below.

      STF Mission:

      The Student Technology Fee provides Western students with adequate and innovative technology experiences by:

      - *Broadening/enhancing the **quality** of the academic experience*
      - *Providing additional student **access** to technology*
      - *Increasing **integration** of technology into the curriculum*

4. Submit abstract electronically (no cover page) for prioritizing:

   a. Employees: Submit abstract per internal due date, which must be before abstract is due to STF Committee on January 14.

b. Students: Submit abstract by January 19 to AS VP for Academic Affairs at asvp.academics@wwu.edu. Your abstract will be prioritized and submitted to the STF Committee by the January 22 due date.

Project Description

This project would allow implementation of a force measurement system (FMS) in a CNC milling machine. A FMS utilized by student and faculty would enhance the future manufacturing engineering (ME) program at Western Washington University (WWU). When removing material to generate engineered parts a variety of factors can affect the outcome of the part. Material quality, tool wear, feeds and speeds, depths of cut and width of cut, and even external factors such as temperature can affect the dimensions of a final part while machining; because of this machine forces are inherently complex. Conventional methods for optimization rely on operators experience to dial in programming to meet engineered tolerances. These trial and error methods can take large amounts of time from production in industry and require experience that students simply do not have. Materials in the engineering world are becoming more and more complex, while machining continues to become faster through technologies such as high speed machining (HSM). Demand for accurately machined parts is increasing. To achieve these increasing tolerances and the level of repeatability required in industry today it has become essential to monitor these complex process forces while machining. Knowledge of these forces, which are more accurately obtained empirically than theoretically, augments a machine's capabilities, allowing the quality desired by design with less iteration. FMSs can improve machine efficiency, reduce waste, and increase tool life by allowing dynamic adjustments to maintain process forces within known material and tool limitations. Understanding the forces can also improve safety for operators (students and faculty), and for the machines themselves. Optimizing a process by analyzing the forces can allow a more efficient and accurate removal of material that is now vital in today's industry. Another industry goal is to reduce changeover times. Adapting a FMS to CNC machines can allow in tolerance parts with little to no iteration so that different programs can be run on the same machine instead of optimizing one machine for one part. In an educational setting the machines are used for a variety of programs already, therefore a FMS would allow us to adapt the machines to their current environment more appropriately. Using one machine for one part requires large changeover times for a new program, and moving away from this method increases overall equipment effectiveness. Funding obtained for the project would be put towards the purchase of materials for machining and assembly of an in-house dynamic force sensor at a fraction of the cost for a commercial one.

Scope/Reach of the Project

This project has a large, but manageable scope encompassing the design, development, and testing of a FMS. After the FMS is developed and tested documentation can be generated to allow student and faculty use of the equipment with ease. Designs for table mounted dynamometers and lathe based tool posts are available in numerous articles eliminating the necessity for a novel design from concept. It would be appropriate to follow the design process while incorporating a variety of methods proven to work in different machining environments coupled with academic learnings. Designs should also be tested with available finite element analysis in engineering computer labs through modal analysis and stress testing before pursuing any development. Development capabilities are limited to the various machines and tools available in the plastics and machine engineering labs. Stephen James as well as other lab technicians available within the engineering department may have access to tools, materials, and machines outside of WWU if needed, however design should be based around WWU resource capabilities. Materials can be purchased from outside sources for the project. Force sensors, amplifiers, data acquisition (DAQ) devices, and other materials should be purchased to minimize the amount of in-house manufacturing. Overall development of the measurement system should mostly be spent assembling the device from parts and testing. Little time should be spent manufacturing components. Testing will involve calibration of the system and data analysis to verify accuracy and precision of the measurements. Purchasing of software would likely be unnecessary with current engineering resources, however peripherals would likely need to be purchased. The FMS would enhance experiences obtained through the engineering department at WWU as a whole, while specifically targeting the new ME program.

How would the project fulfill one or more of the objectives in the STF mission?

Completion of the project would enhance the engineering experience at WWU. There are no FMSs currently being used in the engineering labs at WWU, however, there are a variety of machines that would benefit from one. The ME program has a number of classes involving the machining of parts while other programs still touch on machining to provide a broad engineering curriculum. Parts machined in the curriculum are optimized through methods of the past, trial and error. Integration of force measurement technology to the curriculum would provide students with more industry-like experience, which would be invaluable to their future careers. Machining of parts with a FMS allows visualization of machine forces to enhance the learning experience of the students and increase understanding. Although this project would specifically target enhancing the ME program it would prove to be beneficial to all engineering programs and the engineering department as a whole.