CELT Summer Instructional Development
Application Cover Sheet

Applicant(s): Zhuming Bi and Donald W. Mueller, Jr.

Project Title: Incorporating product lifecycle concept, rapid prototyping, and certification in a solid modeling course

1. Professional Information

Academic rank: Associate Professor (Dr. Bi); Associate Professor (Dr. Mueller)

School and Department: ETCS, Department of Engineering

Year of initial appointment: 2009 (Dr. Bi); 2001 (Dr. Mueller)

Year of tenure-track appointment, if applicable: 2009 (Dr. Bi); 2001 (Dr. Mueller)

2. Grant History

Preference will be given to those applicants who have not received previous CELT grant funding.

Previous IPFW, IU, or Purdue summer or other instructional development grants awarded. (Please include year received and project title)

Dr. Bi and Dr. Mueller have not received any instructional development grants from IPFW or IU.

Previous external support received in the past five years. (Indicate year received and whether it is current, pending, or expired.)

SMP: Concentration in Wireless Technology and Systems Engineering. NSF grant 1010908
dates: 8/15/10 – 7/31/2013
amount: $691,000.

amount: $2,939.
Incorporating product lifecycle concept, rapid prototyping, and certification in a solid modeling course

1. Overview

The purpose of this project is to enhance student’s spatial visualization skills through solid modeling, product design, and manufacturing in ME 160—Solid Modeling. The proposed course changes are to (1) develop activities to help students better transition from 2D drawing with AutoCAD to 3D solid modeling with SolidWorks, (2) introduce the product design lifecycle concept by developing new examples and exercises whereby solid models are utilized directly for engineering analysis, motion simulation, mold design, and manufacturing, (3) integrate solid modeling with rapid prototyping by developing new labs and projects using 3D printers, and (4) allow students to take certified SolidWorks Associate (CSWA) exams and count the test results in their grades.

Students will benefit from this proposal in multiple ways: (a) they will appreciate the importance of solid models in the entire product design lifecycle; (b) they will learn to make physical objects via rapid prototyping processes, (c) they will be able to better utilize SolidWorks in junior and senior level courses where the software can be used effectively for course projects or senior design projects; (d) they will gain the formal recognition of their solid modeling skills for career development. In addition, we believe that the innovations in this proposal will improve students’ spatial visualization skills, which has been shown to be a significant factor in retention and important skill for successful practice of engineering.

2. Project Description

2.1 Background

Research shows that “strong spatial visualization skills are linked to success in science, technology, engineering, and mathematics (STEM) fields.” EngageEngineering, an initiative funded by the National Science Foundation, promotes as one if its three key strategies to improve retention in engineering: assessment and improvement of students’ spatial visualization abilities.

Mechanical engineering students at IPFW develop their spatial visualization skills in a two course sequence ENGR 127 – Engineering Fundamentals I (the computer lab) and ME 160 – Solid Modeling. These two courses (see Figure 1) introduce computer-aided-design (CAD) using two popular, commercial software packages, i.e. AutoCAD and SolidWorks. The skills introduced and developed in these two courses are used by our students throughout the rest of engineering curriculum, in required courses, technical elective courses, and senior design projects, as well as by our co-op students and eventually by our graduate engineers working in local industry.

The focus of this proposal is the course ME 160–Solid Modeling. ME 160 is a two-credit hour, required course that meets once a week as a 60-minute lecture and a 100-minute lab. Dr. Zhuming Bi is the course coordinator, and he has taught ME 160 for twelve semesters.

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1 For more information refer to [http://www.engageengineering.org](http://www.engageengineering.org) and the link 2. Improving student spatial visualization skills.
Based on his experiences and formal course assessment, the current version of ME 160 has the following weaknesses:

1. **Student background and preparation**

   The prerequisites of ME 160 are MA 165 (Analytical Geometry and Calculus I) and ENGR 127 (Engineering Fundamental I). Students are mostly at freshmen or sophomore levels, and they have limited discipline knowledge to understand the importance of solid models in product design lifecycles. Typically, a student takes ME 160 for two reasons: (1) ME 160 is a core course in the mechanical program and (2) SolidWorks is a desirable skill that many employers seek. The aforementioned reasons stand well, but ME 160 can also be designed to benefit students in additional ways. For example, the course can be enhanced to help students (a) understand solid modeling methodologies regardless of the software tool, (b) fully utilize the information of solid models for different engineering analysis, and (c) focus on design needs and effectiveness of products rather than product geometries.

   Another weakness relates to the software tool (AutoCAD) that students learn in ENGR 127. Students in ENGR 127 are able to create 2D drawings using AutoCAD; however, AutoCAD is not a sophisticated tool to support parametric 3D solid modeling. The 2D drawing techniques learned in ENGR 127 can be an obstacle to fully appreciating the parametric solid modeling techniques introduced in ME 160.

2. **Course content and structure**

   Exercises and assignments in the 100-minute lab sections are to create solid models, drawings, or animations using SolidWorks. Assignments also include design projects where students have their freedom to choose the subjects to be modeled, develop their modeling plans, create parts, and assemble parts into products as needed. Since solid models contribute to design activities at all phases (conceptual design, detail design, manufacturing, and testing) of product design lifecycles, ME 160 can be improved by incorporating lab(s) and projects relevant to manufacturing.

3. **Grading and certification**

   ME 160 students are systematically trained to use SolidWorks. SolidWorks is one of the most popular CAD tools, which are widely used by manufacturing companies, and the majority of design engineer positions require applicants to possess SolidWorks skills. In the
current format of ME 160, students’ grades are based on their performance on exercises, homework, projects, and exams. Employers might be skeptical about students’ actual levels of SolidWorks skills based on their grades. An independent, standardized testing system will reduce that concern.

2.2 Proposed Innovations and Rationale

Four specific activities, described below, are proposed to strengthen the above weaknesses.

1. Develop new CAD exercises to better bridge the gap between 2D wireframe modeling taught in ENGR 127 and 3D, parametric solid modeling taught in ME 160.

The first innovation is to have the coordinator of the ENGR 127 computer lab (Mueller) and the coordinator from ME 160 (Bi) work together develop activities and exercises to help students to better transition from ENGR 127 to ME 160. Both classes teach CAD, but the modeling techniques and software packages are different. With close coordination, the instructors will develop activities and exercises to be used in both classes—specifically at the end of ENGR 127 and at the beginning of ME 160. Development of these activities will be guided and influenced by the spatial visualization resources from EngageEngineering.

Requiring students to work the same problems using to two different approaches, will allow them to compare and contrast and develop a much deeper understanding of the different techniques. This approach is based on one of the overarching implications of Gardner’s Multiple Intelligences Theory, viz. Pluralization.\(^2\) Pluralization refers to the idea that important material should be taught in several ways.

It is expected that this innovation will improve students’ spatial visualization skills.

2. Introduce a new instructional module dealing with the product life cycle concept.

Ideally ME 160 should not only cover sufficient depth and breadth of theory of solid modeling, but also connect solid models to various computer-aided technologies. As shown in Figure 2, ME 160 in the current setting includes three modules: 3D modeling fundamentals, part modeling, and assembly modeling. In this proposal, the new module called solid models in product design lifecycle will be developed. It will consist of a number of new examples and exercises where solid models are utilized for engineering analysis, motion simulations, mold designs, and manufacturing processes. This introduction will be very useful for students in later courses. For example, solid models can be used to define kinematic and dynamic models of mechanisms for ME 361 Kinematics and Dynamics of Machinery and the Simulation package in the SolidWorks can be used as a tool for finite element analysis. The interfaces of solid models with these applications will be introduced in the new module.

By introducing a new module of solid models in product design lifecycle, students will appreciate how solid models can be utilized in the entire process from design to manufacturing to assembly to testing. Adding the new module in ME 160 allows students to use solid models in a wider scope.

\(^2\) See for example https://howardgrrdner01.files.wordpress.com/2012/06/faq_march2013.pdf
3. As part of this new the product life cycle module, introduce rapid prototyping.

Product design lifecycle starts with the creation of product geometries, but the completion of solid model is not the destination of a design process. By incorporating rapid prototyping technique, students can learn to create physical models directly based on virtual models. 3D printers will be used to quickly fabricate a physical part or assembly. Figure 3 shows an example of a product from the rapid-prototyping process. The alignment relations among a set of parts from different designers can be easily verified using printed parts. The rapid prototyping process will allow students to take into consideration of manufacturing factors at design stage and identify design defects at an early time.

By integrating rapid prototyping technique in labs and projects, students will learn how to use virtual models to fabricate physical objects and what aspects they must consider make right part geometries. They will gain hand-on experiences of using a 3D printer to mock up design concepts. They will be trained to optimize product designs based on all of the criteria related to design, manufacturing, and assembly. Shortening product development is the key factor to the business success. CAD/CAPP/CAM integration can make a great difference.

It is expected that this innovation will improve students’ spatial visualization skills.

Plus, 3D printing is fun and motivating to students!
4. Implement Certified SolidWorks Associate (CSWA) exams as part of the course grade.

Students will master the competitive skills of using Solid Works for solid modeling. Note that employers usually judge candidates’ skills based on the certificates they possess. Students can benefit greatly if the course offers the opportunities of obtaining the certificates. As shown in Figure 4, the corresponding level of SolidWorks skills is the certified Solid Works Associate (CSWA). CSWA certifications are issued by the Solid Works Inc. To pass a CSWA exam, students must possess the skills to create sketch entities, define relations, use basic and advanced part modeling tools, define assembly models, create drawings, define references, insert annotations, and find physical properties of solid objects. The exams provided by the third party can also be a direct measure of course outcomes and help instructors to identify teaching weaknesses for continuous improvement.

3. Evaluation Methods

The student learning outcomes as documented in the current syllabus will be modified to reflect the proposed innovations. The outcomes of the proposed project will be evaluated through both standardized tests and well-established, direct and indirect assessment procedures of the engineering department.

(a) Student-produced methods

Newly designed exercises, homework, and projects will be used to evaluate and assess the effectiveness of the proposed innovations.

In addition, students in both ENGR 127 and ME 160 will be given the Purdue Spatial Visualization Test (PSVT:R) to directly assess improvements in spatial visualization skills.

(b) Instructor-produced methods

The instructor will document in detail about (1) the introduction of new module in solid models in product lifecycle, (2) using rapid prototyping in labs and design projects, and (3) adopting CSWA exams in the grading system. Short pre- and post-surveys will be developed to evaluate the students’ learning performance. Moreover, the design process and the evaluation results of the proposed innovations will be documented and presented to interested faculty and submitted to educational conferences.

(c) Data track and analysis on results of CSWA exams

CSWA exams are standardized and provided by the third-party. The outcomes of CSWA exams will be used to evaluate the project’s performance. The results of CSWA exams will also be analyzed to identify any aspects to be improved.
4. Timeline and Budget

4.1 Project Timeline

Table 2 shows the project timeline.

Table 2. Project Timeline

<table>
<thead>
<tr>
<th>Activities</th>
<th>Tasks</th>
<th>Beginning</th>
<th>Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>develop the activities and exercises common to ENGR 127 and ME 160</em></td>
<td><em>review the EngageEngineering website</em></td>
<td>05/18/15</td>
<td>6/05/15</td>
</tr>
<tr>
<td></td>
<td><em>select common activities and exercises</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>solve the activities and develop the material</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>develop the module &quot;solid models in product life cycles&quot;</em></td>
<td><em>expand the lecture of drawing to include geometries dimensioning and tolerances (GD&amp;T) concept</em></td>
<td>05/18/15</td>
<td>6/05/15</td>
</tr>
<tr>
<td>(Dr. Bi)</td>
<td><em>expand the lecture of solid models in manufacturing to include mold design concept</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>expand the lecture of engineering analysis to include stress analysis concept</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>expand the lecture of simulation to include four-bar mechanism concept</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>use rapid prototyping technique in labs and projects</em> (Dr. Bi)</td>
<td><em>setup lab facilities for 3D-printing</em></td>
<td>05/18/15</td>
<td>06/26/15</td>
</tr>
<tr>
<td></td>
<td><em>develop lab and project ideas</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>make rules of using 3D-printing</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>adopt certified SolidWorks Associate exams in grading</em> (Dr. Bi)</td>
<td><em>contact the solid works representatives for free usage of CSWA tests</em></td>
<td>06/08/15</td>
<td>07/10/15</td>
</tr>
<tr>
<td></td>
<td><em>schedule tests and adjust grading polices</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>pre- and post- survey design and PSVT:R</em> (Dr. Mueller)</td>
<td><em>pre- and post-survey design</em></td>
<td>06/08/15</td>
<td>07/10/15</td>
</tr>
<tr>
<td></td>
<td><em>develop the method to analyze results of the standardized exams</em></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.2 Budget

The proposed budget for this course improvement project is $2,000.

Currently the department has one 3D printer and is negotiating to procure another—these two printers will be available for this use in this project.

The funds will be used as follows:

- Compensation for time and effort of Zhuming Bi $1000
- Compensation for time and effort of Don Mueller $500
- Supplies and expenses for rapid prototyping $500

After the activities associated with the proposal are developed and fully implemented, the supplies and expenses associated with rapid prototyping will be covered by the department lab budget and student lab fees.
ME160 Solid Modeling (S1/S2)
Course Syllabus
Department of Engineering, IPFW

Term: Spring 2015
Course Dates: January 12, 2015 – May 10, 2015
Instructor: Dr. Zhuming Bi
Office: 321H, ET
Location:
Phone: (260) 481-5711
Email: biz@ipfw.edu

Course Location: ET 315
Office Hours: M 1:30 p.m. — 4:00 p.m.;
T 6:00 p.m. — 8:00 p.m.;
R 1:30 p.m. — 4:00 p.m.;
Course Times: 6:00 — 8:50 p.m., Thursday (S1)
1:00 — 3:50 p.m., Friday (S2)

Purpose and Objectives

Computer graphics and visualization is the key communication means for engineers to demonstrate design concepts, adopt advanced technologies such as virtual reality, CAD/CAM/CAPP, rapid prototyping, concurrent engineering in their engineering practice. With the rapidly development of solid modeling tools and applications, traditional knowledge on engineering graphics and 2D drawing exposes its limitations to understand complex solid models and master popular solid modeling tools. The possession of knowledge and skills of solid modeling has evolved from 'better to have' to 'must-have'.

The course is an introduction of the solid modeling method and its integrated applications through the use of SolidWorks and engineering related graphical exercises. It will prepare you to identify the design intentions, create and modify part or assembly models productively. It will provide you with the essential skills to use a solid model for advanced engineering design.

Prerequisite

ENGR 127: Engineering Fundamental I.
MA 165: Analytical Geometry and Calculus I

Lecture Materials


2) Handout of lecture notes

Attendance policy

Students are required to attend all of the lectures and exams. The attendances are weighted in final grades based on submissions of in-class exercises (15%).
Course Topics

1. Overview of solid modeling
2. Introduction of SolidWorks
3. Basic part modeling
4. Part drawings
5. Advanced part modeling
6. Parametric modeling
7. Basic assemblies
8. Advanced assemblies
9. Interfaces to other engineering applications

Exercises
Exercises are given regularly. There will be no make-up exercises. They will be collected in class.

Homework
You are expected to work the assigned homework problems individually, although you may discuss the assignments. You may collaborate, but not copy or submit anyone else’s work. If the duplication is found, the penalty is beyond the value of the assignment, and possibly an F for the course. Homework is due at the beginning of the class period after which it is assigned unless otherwise specified. Homework must be submitted before class begins—you may not print homework during class time. **Grade of a late homework will be reduced 20% per day after the due day.**

Projects
Two projects will be assigned during the semester. The first project will be an individual project—all work must be your own. You may not collaborate with others on this project. A brief technical memo will be required. The second project will be a team project, i.e. you will work with at least one other person. A technical report and an oral presentation will be required. Oral presentations will be given on the last day of class.

Exams
There will be a mid-term test and a final-term test, and each test will be worth 25% of your grade for the course. Each test will be given a score from 0 to 100 points and each problem on a test has the same value. The first test will be returned in class.

You will need to make arrangements with the instructor to collect the second test if you would like to have it returned to you. The final test will not be given early and everybody is expected to attend class the last week of the semester.

Final Exam
Date/Time
May 07, Thursday, 6:15—8:15 p.m. (S1)
May 6, Wednesday, 1:00 – 3:00 PM (S2)

Grades

Averages will be calculated using the following point distribution:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercises</td>
<td>15%</td>
</tr>
<tr>
<td>Homework</td>
<td>15%</td>
</tr>
<tr>
<td>Projects</td>
<td>20%</td>
</tr>
<tr>
<td>Midterm Exam</td>
<td>25%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>25%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>
Grades will be assigned in accordance with the following criteria:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&gt;93%</td>
</tr>
<tr>
<td>B+</td>
<td>87-90%</td>
</tr>
<tr>
<td>B</td>
<td>83-87%</td>
</tr>
<tr>
<td>C+</td>
<td>77-80%</td>
</tr>
<tr>
<td>C</td>
<td>73-77%</td>
</tr>
<tr>
<td>D</td>
<td>60-70%</td>
</tr>
<tr>
<td>F</td>
<td>&lt;60%</td>
</tr>
</tbody>
</table>

**Tentative Schedule**

<table>
<thead>
<tr>
<th>Week</th>
<th>Subject</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Overview of 3D Modeling</td>
<td>Lecture Notes and chapter 1.1-1.3</td>
</tr>
<tr>
<td>2</td>
<td>Design Intents</td>
<td>Lecture Notes and chapter 1.4-1.5</td>
</tr>
<tr>
<td>3</td>
<td>Drawings and Layout Design</td>
<td>Chapters 2 and 9</td>
</tr>
<tr>
<td>4</td>
<td>Environment Customization</td>
<td>Lecture Notes and 3.2.</td>
</tr>
<tr>
<td>5</td>
<td>Parametric Modeling I</td>
<td>Chapter 5.2</td>
</tr>
<tr>
<td>6</td>
<td>Parametric Modeling II</td>
<td>Chapter 5.3</td>
</tr>
<tr>
<td>7</td>
<td>Advanced Modeling I</td>
<td>Chapter 4.1.</td>
</tr>
<tr>
<td>8</td>
<td>Advanced Modeling II</td>
<td>Chapter 4.2 and 4.3.</td>
</tr>
<tr>
<td>9</td>
<td>Mid-Term Exam</td>
<td><strong>Lecture Notes and Chapters 1-5</strong></td>
</tr>
<tr>
<td>10</td>
<td>Basic Assembly</td>
<td>Chapter 6</td>
</tr>
<tr>
<td>11</td>
<td>Advanced Assembly</td>
<td>Chapters 7 and 8</td>
</tr>
<tr>
<td>12</td>
<td>Motion Simulation</td>
<td>Chapter 11</td>
</tr>
<tr>
<td>13</td>
<td>Engineering Analysis</td>
<td>Lecture Notes</td>
</tr>
<tr>
<td>14</td>
<td>Solid Modeling in Product Life Cycle</td>
<td>Chapters 12 and 13</td>
</tr>
<tr>
<td>15</td>
<td>Oral Presentation of Projects</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Final Exam</td>
<td><strong>Lecture Notes and Chapters 7-13</strong></td>
</tr>
</tbody>
</table>

**Course Outcomes**

Students who successfully complete the class will be able to

1) use basic/advanced skills for 3D part modeling, create solid 3D model of a part for design concept [k],
2) use basic/advanced skills for 3D assembly modeling [k],
3) create dimensioned drawings and views from a 3D model [g],
4) communicate important aspects of a solid modeling orally and in writing [g],
5) use a solid model for motion simulation or manufacturing [a,g].

**Program Outcomes**

Letters in parentheses refer to the following ABET BSME program outcomes:

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design both thermal and mechanical systems, components, or processes to meet desired needs within realistic constraints such as economic, environmental, social, ethical, safety, manufacturability, and sustainability
(d) an ability to function on engineering and science laboratory and project teams as well as multi-disciplinary teams
(e) an ability to identify, formulate, and solve mechanical engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively in both verbal and written forms
(h) the broad education necessary to understand the impact of engineering solutions in a global and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of and exposure to contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice, including analysis and design

Course Policies

1) You may not submit another student’s electronic file or any portion of another student’s electronic file. Doing so will result in a penalty greater than the value of the assignment and possibly an F for the course. Do not share your electronic files with anyone!
2) You are expected to use your IPFW account to send and receive email related to this course. Please send email only from your IPFW email account.
3) During class time, computers are to be used only for material related to this class. No internet surfing unless the instructor requests, no game playing, absolutely no chatting!
4) Eating and drinking are not allowed in the computer lab. If you do carry a drink, it should have a lid and please be careful.
5) As a courtesy to the instructor and other students, do not be late for class and turn off your cell phone.
6) No late homework or in-class exercise submission.
7) Consult the student handbook for information pertaining to academic honesty, the grade appeal process, or grievance policies.
8) Students with a disability should contact the SSD office at Walb 113 (481-6657) for a description of services available.

Comments

1) Graphical communication is very important for engineers, and this class is important.
2) If you work hard and are organized and well-prepared, you will do well in this class.
3) Please feel free to stop by in my office hours if you have any comments or suggestions. Any suggestions that will benefit the class are appreciated, and I will try my best to address any concerns that you might have.
4) If you do not feel comfortable discussing matters with me, feel free to speak to the department chair Dr. Nashwan Younis. He can assist me to address your concerns.

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AGREEMENT

In signing this application, the applicant(s) agree(s) to:

1. Participate in a half-day Instructional Development Institute in May prior to beginning work on the project.

2. Obtain approval or exemption of your research protocols from the Institutional Research Board. (If you do not already have CITI certification and/or Principal Investigator status please contact IRB representative Abe Schwab, Associate Professor, Philosophy.)

3. Attend a mid-semester progress report meeting with CELT Board members in the Fall semester, and submit a short written report.

4. Make public on the Internet by the beginning of the Spring semester the outcomes of the project in a written or visible form in one of the three ways listed below:
   - A written report. For examples see the Past Winners page on the CELT website linked from the Grants page.
   - A virtual poster. Click here to see an example at CELT can assist you.
   - A course portfolio. See examples at University of Nebraska Lincoln’s site. CELT can assist you.

5. Present the results of the project to the IPFW community in the following Spring semester in a “Faculty Showcase.”

6. Teach the course at least twice in the next three years.

7. Include the following acknowledgment in any publication resulting from the work funded by this grant:

   “This work was supported by an Indiana University-Purdue University Fort Wayne Summer Instructional Development Grant.”

8. Because this grant is intended to support you directly and foster professional and academic development at IPFW, it requires a continuing commitment to IPFW. The award of this grant carries the expectation that you will continue teaching at IPFW for at least one year. If you fail to comply with this condition, you will reimburse the university for all compensation paid under the grant.

9. Seek approval from the CELT Advisory Board prior to initiating significant changes in the project as proposed.

Applicant(s)

Date

03/13/2015

Applicant(s)

Date

3/13/2015
Appendix B

Proposal Evaluation Form

This form is to be completed by the applicant’s chair or dean. Please provide a signed digital copy as part of the application packet. Please note that the award of this grant carries the expectation that the awardee will continue teaching at IPFW for at least one year. Visiting Instructors are ineligible.

Title of project: Incorporating product lifecycle concept, rapid prototyping, and certification in solid modeling course

Names of applicants: Zhuming Bi; Donald W. Mueller, Jr.

1. Briefly describe the ways in which the proposed project supports the mission and goals of your department, division, program, or school.

   Our department’s mission is to support the needs of Northeast Indiana through education, scholarship and service. Drs. Bi and Mueller proposed to integrate product lifecycle concept, use rapid prototyping in classes, and adopt standardized CSWA exams in grading systems. These enhancements will definitely strengthen students’ abilities and skills in defining engineering problems, and finding right solutions effectively. The proposal aligns in our mission and goals seamlessly.

2. What do you consider to be the most significant features of this proposal, and why?

   All three features are very significant to me. In particular, adopting CSWA exams in the grading system seems extremely attractive to local employers. Students not only can learn solid modeling theory, but also get recognition of the skills for product designs. Employers can evaluate students’ performances based on industry standards. Moreover, students can be well motivated to learn Solidworks.

3. Given the stated purposes of the IPFW Instructional Development Grant Program, why do you think CELT should fund this project?

   The main purposes of CELT grant program are to enhance the effectiveness of existing courses, incorporate experiential learning, and develop innovative curricular lab experiences. This proposal has innovative components to achieve all these purposes. I strongly feel that CELT should fund this project.

4. Please state the semesters in which this course will be taught in the next three academic years and the anticipated enrollment. Will faculty other than the applicant teach this course? If so, how will the implications of the course re-design be communicated to them?

   This course will be offered every semester in next three academic years. Anticipated enrollment in each semester is 20 to 24. Dr. Zhuming Bi is the course coordinator, and he is the only instructor available to teach this course. He will be responsible to the changes made in the course.

5. Other comments:

   Due to its popularity, I am exploring the possibility of creating an online course for ME-160 Solid Modeling, the proposal will increase the possibility of success for this initiative greatly.

Chair/Dean’s Signature: [Signature]

Title: Professor of Mechanical Engineering

Date: March 13, 2015
BILOGRAPHICAL SKETCH
ZHUMING BI

PROFESSIONAL PREPARATION
Harbin University of Science and Technology, China  Manufacturing Engineering  BSME 1987
Harbin Institute of Technology, China  Mechanical Engineering  MSME 1991
Harbin Institute of Technology, China  Mechatronics  Ph.D. 1994
University of Saskatchewan, Canada  Mechanical Engineering  Ph.D. 2002

APPOINTMENTS
Associate Professor  Department of Engineering, Indiana University  Purdue University Fort Wayne, U.S.A.  August 2014 – present
Assistant Professor  Department of Engineering, Indiana University  Purdue University Fort Wayne, U.S.A.  August 2009 – August 2014
Senior Project Engineer  Northern Ireland Technology Centre, Queens University Belfast, U.K.  May 2008 – July 2009
Research Officer  Integrated Manufacturing Technologies Institute, National Research Council, Canada  January 2005 – March 2008
Associate Professor  Department of Manufacturing Engineering, Nanjing University of Science and Technology, China  June 1996 – June 1999

PUBLICATIONS (most closely related)

PUBLICATIONS (selected others)

SYNERGISTIC ACTIVITIES
• Memberships. Senior Member, IEEE; Licensed Professional Engineer; a member of Technical Committee on (1) Distributed Intelligent Systems of IEEE-SMC and (2) TC8-WG 8.9: Enterprise Information Systems for International Federation for Information Processing (IFIP)
Conf. on Systems, Man, and Cybernetics (SMC 2013, 2014), the 2nd Int. Conf. on Enterprise Systems (ICES 2014), Int. Conf. on Robotics and Biomimetics (ROBIO 2014), Int. Conf. on Computer Engineering and Information Science (2013), The 1st Int. Conf. on Enterprise Systems (ES 2013), 2013 and 2012 Spring World Congress on Engineering and Technology (SCET), Session Chair of Advanced and Adaptive Manufacturing Systems, ASME-MSEC2012, and 2011 World Congress on Engineering and Technology (CET); a Technical Committee member of a series of international conferences including IEEE- ICMA, CSE, CAA, CW-CN, ASME-DETC, and ISFA.

- **Editorial works.** Editor Board member for *Industrial Robot* (Emerald), Associate Editor for *Int. J. of Robotics Applications and Technologies* (IGI-Global) and J. of Intelligent Systems and Applications (Columbia International Publishing); a member of the editorial board for *Industrial Robot* (Emerald); *J. of Conference Papers in Engineering* (Hindawi Publishing Corporation); a Leading Guest Editor of Special Issues for *J. of Robotics: Advanced in Accuracy Improvement of Robots and Mathematical Problems in Engineering*: Multidisciplinary Design Optimization in Engineering; a Guest Editor of the Special Issue in *Advances in Mechanical Engineering*: Medical Robotics (Hindawi Publishing Corporation).


### COLLABORATORS & OTHER AFFILIATIONS

1. **Collaborators and Co-Editors (9)**
   - Wang, Ian L., KTH Royal Institute of Technology, Sweden.
   - Higgins, C., Northern Ireland Technology Centre, UK.
   - Xu, L., Old Dominion University, USA.
   - Yan, J., Queens University Belfast, UK.
   - Chen, I-Ming, Nanyang Technological University, Singapore.
   - Guan, Y., Guangdong University of Technology, China.
   - Jiang, J., Harbin University of Science and Technology, China.
   - Wang, J., University of New South Wales, Austria.
   - Zhang, D., University of Ontario Institute of Technology, Canada.

2. **Graduate Advisors (3)**
   - Zhang, Chris W. J., Ph.D. Advisor (1999-2002), University of Saskatchewan, Canada
   - Cai, Hegao, Ph.D. Advisor (1991-1994), Harbin Institute of Technology, China
   - Li, Guixian, M.S. Advisor (1988-1991), Harbin Institute of Technology, China

3. **Postdoctoral Sponsors (3)**
   - Lang, Sherman Y. T., 2003-2005, National Research Council Canada, Canada
   - Gruver, William A., 2002-2003, Simon Fraser University, Canada
   - Zhang, Youliang, 1994-1996, Nanjing University of Science and Technology, China

4. **Thesis Advisor and Postgraduate-Scholar Sponsor (8)**
   - Qian, Zhiqin, Visiting Scholar, East China University of Science and Technology, China.
   - Wang, B., Ph.D., Nanjing University of Science and Technology, China.
   - Liu, Z., M.S., Motorola Mobility LLC, Chicago, USA.
   - Emodi, T. C., M.S., CNH Industrial, Saskatoon, Canada.
   - Meruva, K., M.S., Ph.D. Inc. Fort Wayne, USA.
   - Liu, H., M.S., East China University of Science and Technology, China.
   - Huang, J., M.S., East China University of Science and Technology, China.
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A. Professional Preparation
Missouri University of Science and Technology\(^1\) mechanical engineering BSME 1988
Missouri University of Science and Technology mechanical engineering MSME 1997
Missouri University of Science and Technology mechanical engineering PhD 2001

States in which registered: Indiana, License Number PE10505102

B. Appointments
2008-2012 Chair, Department of Engineering, IPFW
2007- Associate Professor, Mechanical Engineering, IPFW
2007-2008 Director of Graduate Program in Engineering, IPFW
2007-2008 Program Coordinator Mechanical Engineering, IPFW
2001-2007 Assistant Professor, Mechanical Engineering, IPFW
2000-2001 Adjunct Assistant Professor, Mechanical Engineering, University of Missouri-Rolla
1996-2000 Teaching Fellow/Lecturer, Mechanical Engineering, University of Missouri-Rolla
1992-1996 Teaching Assistant, Mechanical Engineering, University of Missouri-Rolla
1990-1991 Teaching Assistant, Mathematics and Comp. Science, University of Missouri-Rolla

C. Products

Five Products Most Closely Related to the Proposed Project


3. SMP: Concentration in Wireless Technology and Systems Engineering. NSF grant 1010908


\(^1\) Formerly the University of Missouri-Rolla
Five Other Significant Products


D. Synergistic Activities
Don Mueller served as chair of the IPFW engineering department for four years (2008-2012). During that time he, with the assistance of the faculty and students, successfully

- managed a department with 19 faculty, over 420 students, and a $2M annual budget,
- headed a department that offers four bachelor of science engineering degrees (civil, computer, electrical, and mechanical), a first-year engineering program, and a graduate program,
- obtained full ABET re-accreditation for three undergraduate engineering programs (CmpE, EE, and ME) and initial accreditation for the civil engineering program,
- secured (as PI) and managed a $691K grant from the National Science Foundation to establish and support a graduate program in wireless and systems engineering, and
- established nine focused, research groups and a curriculum-embedded research experience for undergraduate students

Don is interested in engineering education from the first-year to graduate-level. He has taught many courses in the thermal-fluid sciences, including a course entitled Sustainable Energy Sources and Systems. Don is the author of over 45 technical publications and is currently working on modeling solar collectors and heat exchangers. He is a licensed professional engineer and is a member of the American Society of Mechanical Engineers, the American Institute of Aeronautics and Astronautics, and the American Society of Engineering Education.

E. Awards and Honors
2014 Sigma Xi (IPFW chapter) Teacher of the Year Award
2013 Selected to attend the Center for Sustainable Engineering Workshop at Georgia Tech
2007-2008 ETCS Excellence in Service Award
2004-2005 ETCS Excellence in Research Award
2005 IPFW Summer Research Grant
2005 IPFW Undergraduate Research Funding (Advisor)
2003-2004 Excellence in Teaching Award
2002 IPFW Summer Research Grant