Internal Program Review
Self-Study Report

Program Name
Computer Aided Manufacturing

Credentials Offered
Associate of Applied Science Computer Aided Manufacturing: 71 semester credits
Certificate of Applied Science Machine Tool Technology: 39 semester credits

Self-Study Completed by:
Art Warner, Faculty
Matthew Moyer, Faculty

Date Completed:
September 25, 2015
A. Introduction
Computer Aided Manufacturing prepares students as entry-level machinists in many areas, including aerospace, computer industries, job shop, gun smithing, tool and die making, computer numerical control (CNC) operator, and CNC programmer. Students study machining processes and procedures using lathes, mills, drill presses, cylindrical grinders, and surface grinders.

The first year students use a variety of manual machines, including engine lathes, horizontal and vertical mills, cylindrical grinders, surface grinders, drill presses, and radial arm drills. Students work from blueprints and follow exact specifications and apply practical shop math to accomplish the required tasks. Much of the lab time is used for shop and project work.

The second-year CNC portion of machine shop is devoted to the programming and operation of the CNC machine. Students are prepared to enter the work force as entry level programmers and CAD/CAM technicians. Students program and operate machining centers and turning centers in the lab. Students learn the Mastercam programming system, which allows students to design parts on the computer and manufacture them in the lab. Students work from blueprints and exact specifications that are used in industry. Lab work includes manual and CNC machine use. These machines are used for manufacturing fixtures, project work, and production projects.

B. Alignment with Mission, Strategic Goals and Core Themes

Helena College Mission
Helena College University of Montana, a comprehensive two-year college, provides access to and support of lifelong educational opportunities to our diverse community.

Computer Aided Manufacturing Program Mission Statement
Computer Aided Manufacturing is designed to prepare students as entry-level machinists in many areas, including aerospace, computer industries, job shop, gun smithing, tool and die making.

Helena College 2012-22 Strategic Goals
1. Partner for Student Success Integrate Assessment/Planning
2. Attain Excellence
3. Support the Community
4. Advance the Institution
5. Develop Resources
Computer Aided Manufacturing Program Goals

1. Collaborate with business, industry, and the community as partners to provide a quality learning experience that gives graduates the best opportunity to gain employment
2. Solicit input from our constituents including, students, graduates, advisory board members, business, industry, faculty, staff, and administration concerning the operation and improvement of the program and career tracks which align with industry standards
3. Assess student and program performance through the use of outcomes assessment, Program Review and Evaluation Process, job placement rates, employer and graduate surveys
4. Increase enrollment through recruiting efforts including; business, industry, government, professional organizations, and high schools

Computer Aided Manufacturing Program goals are perfectly aligned with Helena College-UM Strategic Goals and Core Themes. This alignment is illustrated in the Goals/Core Themes crosswalk below:

<table>
<thead>
<tr>
<th>Helena College Strategic Goals</th>
<th>Computer Aided Manufacturing Program Goal Alignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partner for Student Success</td>
<td>Increase enrollment through recruiting efforts including; business, industry, government, professional organizations, and high schools</td>
</tr>
<tr>
<td>Integrate Assessment &amp; Planning</td>
<td>Assess student and program performance through the use of outcomes assessment, Program Review and Evaluation Process, job placement rates, employer and graduate surveys</td>
</tr>
<tr>
<td>Attain Excellence</td>
<td>Solicit input from our constituents including, students, graduates, advisory board members, business, industry, faculty, staff, and administration concerning the operation and improvement of the program and career tracks which align with industry standards</td>
</tr>
<tr>
<td>Support the Community</td>
<td>Collaborate with business, industry, and the community as partners to provide a quality learning experience that gives graduates the best opportunity to gain employment</td>
</tr>
<tr>
<td>Advance the institution</td>
<td>Building connections with local industry and supporting manufacturing growth in our region and throughout the state</td>
</tr>
<tr>
<td>Develop Resources</td>
<td>Collaborate with business, industry, and the community as partners to provide a quality learning experience that gives graduates the best opportunity to gain employment</td>
</tr>
</tbody>
</table>
Helena College-UM Core Theme Alignment with Computer Aided Manufacturing Program

- **Provide Access and Support:** High quality educational activities and programs important to achieving student success
  - Premier Montana 2-year program in Computer Aided Manufacturing
  - The Helena College-UM Computer Aided Manufacturing Program is one of two Associate of Applied Science Degree offerings in Computer Aided Manufacturing in Montana.

- **Demonstrate Academic Excellence:** Integrity, quality and reliability in all academic and non-academic programming
  - Rigorous Program of Study
  - Curriculum aligns with industry standards

- **Strengthen the Community:** Meeting regional workforce needs, strengthening employee knowledge and skills, providing a bridge to additional educational attainment, and serving as a facilitator for cultural enrichment
  - The Computer Aided Manufacturing Program strengthens the community by preparing students to meet local, regional, state and national workforce needs.

C. Alignment with Community Needs

**Potential employers**

According to the Bureau of Labor Statistics employment of metal and plastic machine workers is projected to grow 6 percent from 2010 to 2020, slower than the average for all occupations. Employment will be affected by advances in technology, changing demand for the goods these workers produce, foreign competition, and the reorganization of production processes.

One of the most important factors influencing employment growth in these occupations is the use of labor-saving machinery. Many firms are adopting new technologies, such as computer-controlled machine tools and robots, to improve quality, lower production costs, and remain competitive. The switch to computer-controlled machinery requires computer programmers instead of machine setters, operators, and tenders. The lower-skilled manual machine tool operator and tender jobs are more likely to be eliminated by these new technologies because the computer-controlled machinery does the work more effectively.

The demand for metal and plastic machine workers also is affected by the demand for the parts they produce. Both the plastic and metal manufacturing industries face stiff foreign competition that is limiting the orders for parts produced in this country. Some U.S. manufacturers have recently sent their production to foreign countries, limiting jobs for machine setters and operators.

Despite slower than average employment growth, a number of these jobs are expected to become available for highly skilled workers because of an expected increase in retirements, primarily of baby boomers, in the coming years.
In addition, workers who have a thorough background in machine operations, certifications from industry associations, and a good working knowledge of the properties of metals and plastics should have the best job opportunities.

The CAM program is advised by local and statewide constituents. The advisory council includes: Boeing Helena, Pioneer Aero-Structures Helena, S and S Machine Billings, Apex Machine Billings, Flying M Helena, Montana Hydraulics Helena, Neptune Missoula, and Elite Iron Potomac. The advisors meet bi-annually and discuss changes to the curriculum and program. Recently we reviewed the course offerings and updated courses to fit industry needs. The manual machining and the CNC (computer numerical control) portions are to be continued and remain unchanged. Solidworks was reviewed and will be continued to be offered in the first semester. The council agreed this would strengthen the blueprint reading skills of the machinist. The council was asked to keep us informed when they are in need of machinists. Overall the council has kept the program in step with industry and continues to keep the College in tune with industry.

D. Student Participation and Success

Helena College-UM enrolls 1,627 students with a full-time equivalent of 1,066. 789 of our students are full-time (48%); 277 of our students are part-time (52%). The breakdown of General Education to Technical to Trades and non-degree seeking is:

General Education Students: 623 (38% of headcount)
Technical Students: 453 (28% of headcount)
Trades Students: 181 (11% of headcount)
Non-Degree Seeking Students: 89 (5% of headcount)

Our students enroll from Lewis & Clark County at the rate of 75%; and from adjacent counties 12% (Broadwater, Jefferson, Cascade, Powell, and Meagher). The remainder of student enrollment comes from the rest of Montana (11%) and out-of-State/Western Undergraduate (2%).

Computer Aided Manufacturing Program student enrollment history 2009-2014

<table>
<thead>
<tr>
<th></th>
<th>2009-10</th>
<th>2010-11</th>
<th>2011-12</th>
<th>2012-13</th>
<th>2013-14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>20</td>
<td>27</td>
<td>30</td>
<td>24</td>
<td>24</td>
</tr>
</tbody>
</table>

Computer Aided Program Student Retention

<table>
<thead>
<tr>
<th></th>
<th>FY 2009/10</th>
<th>FY2010/11</th>
<th>FY2011/12</th>
<th>FY2012-13</th>
<th>FY2013-14</th>
<th>Five Year Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100%</td>
<td>75%</td>
<td>40%</td>
<td>58%</td>
<td>71%</td>
<td>69%</td>
</tr>
</tbody>
</table>

From 2009 through 2014, the Computer Aided program capacity has been an average of 83%. With a five-year average of 9 student completers, program completion rates are at 98%. 
### E. Student Learning Outcomes
Upon successful completion of this program, a student will be able to:
- Perform machining operations to exacting tolerances common in industry.
- Prepare and demonstrate cutting tool applications.
- Prepare, setup and operate precision manufacturing equipment

Assessment of student learning outcomes occurs within individual program courses and all student learning outcomes are assessed through an end-of-program assessment.

### F. Curriculum and Instruction (Academic Programs Only)
Length of Program: 4 Semesters  
Type of Program: Associate of Applied Science  
Semester of Entry: Fall

#### FIRST YEAR
- **Fall Semester**
  - MCH120 Blueprint Reading and Interpretation for Machining  
  - MCH130 Machine Shop  
  - MCH132 Introduction to Engine Lathes  
  - MCH134 Introduction to Mills  
  - M111T Technical Mathematics

  Total Semester Credits: 18

- **Spring Semester**
  - MCH136 Advanced Lathes  
  - MCH137 Advanced Mills  
  - MCH139 Grinding Applications  
  - MCH240 Metallurgy  
  - MCH245 Shop Practices  
  - WRIT121T Introduction to Technical Writing

  Total Semester Credits: 19

#### SECOND YEAR
- **Fall Semester**
  - MCH230 Tooling and Fixtures in CNC  
  - MCH231 CNC Turning Operations Level 1  
  - MCH232 CNC Turning Programming Operations 2  
  - MCH234 CNC Milling Operations Level 1  
  - MCH235 CNC Milling Programming Operations 2

  Total Semester Credits: 16
Spring Semester
MCH233 CNC Turning Programming Operations 3 3
MCH236 CNC Milling Programming Operations 3 3
MCH237 CAD/CAM CNC Turning Center 5
MCH238 CAD/CAM CNC Machining Center 5
HR100T Human Relations 2

Total Semester Credits 18
TOTAL CREDITS 71

Length of Program: 2 Semesters
Type of Program: Certificate of Applied Science
Semester of Entry: Fall

Fall Semester
MCH120 Blueprint Reading and Interpretation for Machining 2
MCH130 Machine Shop 3
MCH132 Introduction to Engine Lathes 5
MCH134 Introduction to Mills 5
HR100T Human Relations 2
M111T Technical Mathematics 3

Total Semester Credits 20

Spring Semester
MCH136 Advanced Lathes 5
MCH137 Advanced Mills 5
MCH139 Grinding Applications 2
MCH240 Metallurgy 2
MCH245 Shop Practices 2
WRIT121T Introduction to Technical Writing 3

Total Semester Credits 19
TOTAL CREDITS 39
G. Faculty/Staff Profile

Warner, Arthur*
Metals - Computer Aided Manufacturing
A.A.S., Helena College
At Helena College since Fall 1989

Moyer, Matthew
Computer Aided Manufacturing
A.S. M. E. Tech; Penn State University
Makino Certified Application Engineer
HAAS Certified Applications Technician
At Helena College since Summer 2012

H. Fiscal and Physical Resources

College current fund support of the Computer Aided Manufacturing program has been stable over the past five years. Infusions of budgetary support for Computer Aided Manufacturing Program occurred when equipment maintenance and repair and purchase of new equipment was required.

Cost per Completion

<table>
<thead>
<tr>
<th></th>
<th>FY2010/11</th>
<th>FY2011-12</th>
<th>FY2012-13</th>
<th>FY2013-14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost per Completion</td>
<td>33,220.00</td>
<td>29,193.00</td>
<td>34,780.00</td>
<td>34,148.00</td>
</tr>
</tbody>
</table>

I. Recommendations and Preliminary Implementation Plan

Based upon our program evaluation it has been concluded that the following recommendations are critical to the future of the Computer Aided Manufacturing program. Partnerships with industry are critical to staying on the forefront of this ever developing technological program. Manufacturers, Machine Tool builders and Software Developers are constantly redeveloping and improving their products which requires our program to remain completely engaged and constantly in the learning mode.

1. Integrate student acquisition of industry-recognized credentials into the curriculum.

2. Increase instructor professional development through attendance at national educators’ conferences and institutes.

3. Build career awareness by partnering with industry partners, secondary schools and US Department of Labor Job Service.
J. Program Review Data Summary

See Program Review Data Summary in Section K.

K. Appendix (Additional data or exhibits)

Program Review Data Summary

<table>
<thead>
<tr>
<th>Data Definition</th>
<th>Current FY</th>
<th>Projected FY</th>
<th>Current FY</th>
<th>Projected FY</th>
<th>Program Notes</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. Provides percent change in job openings for related occupations for Montana and the U.S.</td>
<td>4.2%</td>
<td>4.2%</td>
<td>4.2%</td>
<td>4.2%</td>
<td>Program Notes</td>
<td>Source</td>
</tr>
<tr>
<td>C. Provides the median hourly wage or salary for related occupations</td>
<td>$12.57 hourly</td>
<td>$12.57 hourly</td>
<td>$12.57 hourly</td>
<td>$12.57 hourly</td>
<td>Program Notes</td>
<td>Source</td>
</tr>
<tr>
<td>D. Provides 3 years of in-state job placement rates for all program graduates</td>
<td>77%</td>
<td>77%</td>
<td>77%</td>
<td>77%</td>
<td>Program Notes</td>
<td>Source</td>
</tr>
</tbody>
</table>

Student Participation and Success

<table>
<thead>
<tr>
<th>Data Definition</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Program Notes</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Provides 5 years of transfer rates to 4-year colleges (AA/AS)</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>Program Notes</td>
<td>Source</td>
<td></td>
</tr>
<tr>
<td>B. Provides program capacity (enrollment)</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>Program Notes</td>
<td>Source</td>
<td></td>
</tr>
<tr>
<td>C. Provides 3 years of enrollment (enrollment/graduated headcount)</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>Program Notes</td>
<td>Source</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. Provides 3 years of enrollment (pass rate)</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>Program Notes</td>
<td>Source</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. Program success rate of students completing degree or certificate within 5 years</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>Program Notes</td>
<td>Source</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F. Provides 5 years of completion rates for part-time students</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>Program Notes</td>
<td>Source</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G. Provides 5 years of completion rates for full-time students</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>Program Notes</td>
<td>Source</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H. Provides 5 years of successful program course completion rates</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>Program Notes</td>
<td>Source</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Fiscal and Physical Resources

<table>
<thead>
<tr>
<th>Data Definition</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Program Notes</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Provides 5 years of instructional cost/student (FTE)</td>
<td>$4,473</td>
<td>$4,473</td>
<td>$4,473</td>
<td>$4,473</td>
<td>Program Notes</td>
<td>Source</td>
<td></td>
</tr>
<tr>
<td>B. Provides 5 years of institutional/operating costs/student</td>
<td>$26,879</td>
<td>$26,879</td>
<td>$26,879</td>
<td>$26,879</td>
<td>Program Notes</td>
<td>Source</td>
<td></td>
</tr>
<tr>
<td>C. Provides 5 years of institutional/operating costs/credit hour</td>
<td>$32,879</td>
<td>$32,879</td>
<td>$32,879</td>
<td>$32,879</td>
<td>Program Notes</td>
<td>Source</td>
<td></td>
</tr>
<tr>
<td>D. Provides 5 years of student program financial aid balances</td>
<td>$3,500</td>
<td>$3,500</td>
<td>$3,500</td>
<td>$3,500</td>
<td>Program Notes</td>
<td>Source</td>
<td></td>
</tr>
<tr>
<td>E. Provides 5 years of student program non-fund balances</td>
<td>$3,500</td>
<td>$3,500</td>
<td>$3,500</td>
<td>$3,500</td>
<td>Program Notes</td>
<td>Source</td>
<td></td>
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