Internal Program Review
Self-Study Report

Program Name
Machine Tool/Computer Aided Manufacturing

Credentials Offered
CAS in Machine Tool Technology 39 Credits
AAS Computer Aided Manufacturing 71 credits

Self-Study Completed by:
John McLaughlin and Paul Nicholson

Date Completed:
October 1, 2020

A. Introduction

The computer aided manufacturing (CAM) program 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, precision measurement tools, and surface grinders. The first year students use a variety of manual machines, including engine lathes, and vertical mills, surface grinders, and drill presses. Students work from blueprints and follow exact specifications and apply machining mathematical calculations 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 both HAAS and Fanuc controlled 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, prototype, and production work.

The goals and actions for the previous program review were as follows:

1. Integrate student acquisition of industry-recognized credentials into the curriculum. – Helena College responded to this by having instructors become certified in FANUC and HAAS which in turn results in students graduating the program with valuable industry recognized credentials in addition to their two-year degree.
2. Increase instructor professional development through attendance at national educators' conferences and institutes.- Both instructors received professional development through training to become eligible to certify students in FANUC and HAAS operating systems.
3. Build career awareness by partnering with industry partners, secondary schools and US Department of Labor Job Service. – Over the last five years, Helena College has held a number of events to build career awareness in manufacturing including Women in Gear, Fab Fridays, Manufacturing nights, and junior high and high school tours and shadowing events. Helena College also developed the first internship program with Boeing Helena, which allows four students to be interns at Boeing Helena. The Helena College manufacturing program has also partnered in several events with Helena WINS a local group under the Chamber of Commerce whose mission is to help area employers attract, develop, and retain workforce talent.

B. Alignment with Mission, Strategic Goals and Core Themes

STRATEGIC GOAL #1 – PROMOTE STUDENT SUCCESS AND ACHIEVEMENT

This program has both a one- and two-year option, which allows students to move directly into the workforce. The program is offered in the morning hours four days per week so students can work while attending college to gain field experience and minimize student debt.

STRATEGIC GOAL #2 – ADVANCE ACADEMIC EXCELLENCE AND SCHOLARSHIP

The computer aided manufacturing program is in part governed by an advisory board that provides suggestions for the changing industry as well as employment information and recommendations. The advisory board also reviews our curriculum on an annual basis to ensure our curriculum is meeting industry standard and need.

STRATEGIC GOAL #3 – BUILD COMMUNITY ENGAGEMENT AND PARTNERSHIPS

In addition to the Helena College advisory boards, the faculty have community and industry relationships that they continue to foster and communicate with on a regular basis. These partners provide feedback regarding workforce needs and often come on campus to recruit students into the industry. The students in the CAM program also take on community projects which gives them real-world experience for providing a customer with a product. Collaborative partnerships with business, industry, and the broader community to enhance workforce development and lifelong learning.

STRATEGIC GOAL #4 – MODEL AND FOSTER EQUITY, INCLUSION, AND CULTURAL COMPETENCY

The faculty and students in the CAM program participate in training activities and professional development to ensure a thorough understanding of equity, inclusion and cultural competency. All students are given equal opportunity to succeed in this program.

STRATEGIC GOAL #5 – ENSURE INSTITUTIONAL INTEGRITY

The Executive Director and faculty that oversee the budget process for this program participate in a thoughtful and strategic process for prioritization of equipment and tooling. We are currently working on a long-term budget plan to ensure the program continues to have adequate resources. Through data analysis and assessment, decisions are made to ensure efficacy and sustainability of this program.

C. Alignment with Community Needs

Helena College supports our local industry manufacturers in aerospace engineering, including Boeing Helena and Pioneer Aviation, by providing a pipeline of entry-level workers for their businesses. We have adjusted our academic schedule to meet workforce needs of these businesses and they are often involved in campus events. Helena College students are also hired in many places throughout Montana and the United States. Department of Labor data for 2019 reveals that there are currently 610 job openings for machinists in Montana:

Occupation code	Occupation title	Level	Employment	Employment RSE	Employment per 1,000 jobs	Location quotient	Median hourly wage	Mean hourly wage	Annual mean wage
51-4041	Machinists	Detail	610	13.5%	1.301	0.50	$19.75	$20.68	$43,020

Department of Labor National Estimates

Employment estimate and mean wage estimates for this occupation:

Employment (1)	Employment RSE (3)	Mean hourly wage	Mean annual wage (2)	Wage RSE (3)
383,470	1.0 %	$22.17	$46,120	0.3 %

(RSE: Relative standard error)

Percentile wage estimates for this occupation:

Percentile	10%	25%	50% (Median)	75%	90%
Hourly Wage	$13.43	$16.74	$21.36	$26.88	$32.02
Annual Wage (2)	$27,940	$34,820	$44,420	$55,910	$66,610

Industries with the highest levels of employment in this occupation:

Industry	Employment (1)	Percent of industry employment	Hourly mean wage	Annual mean wage (2)
Machine Shops; Turned Product; and Screw, Nut, and Bolt Manufacturing	99,260	27.07	$21.25	$44,200
Machinery Manufacturing (3331, 3332, 3334, and 3339 only)	37,620	5.00	$22.22	$46,210
Metalworking Machinery Manufacturing	26,280	14.61	$21.74	$45,230
Fabricated Metal Product Manufacturing (3321, 3322, 3325, 3326, and 3329 only)	24,120	4.97	$21.19	$44,080
Employment Services	22,920	0.62	$18.82	$39,140

Source: United States Department of Labor, 2020

Helena College Community Needs Data Summary:

Computer Aided Manufacturing 2014-2019

Program Review Data Summary								
Alignment with Community Needs (CTE Only)								
Data Definition:	Current MT	Projected MT	Current U.S.	Projected U.S.			Program Notes	Source
A. Provide the total number of projected job openings from related occupations for Montana and the U.S.	297	356	24,300	29,200			Projected annual openings MT: 36 Projected annual openings US: 3,200	Montana Research & Analysis Bureau /Bureau of Labor Statistics (2018-2028 Projections). US DOL (2016-2016 Projections)
B. Provide percent change in job openings for related occupations for Montana and the U.S.		+4%		20%				Montana Research & Analysis Bureau/ Bureau of Labor Statistics (2018-2028 Projections). US DOL (2016-2026 Projections)
C. Provide the median hourly wage or annual salary for related occupations	$40,430		$53,190				Starting Salary Range (2013-2017): $33,385-$44,567	Montana Research & Analysis Bureau /Bureau of Labor Statistics (2018-2028 Projections). US DOL (2016-2026 Projections)
Data Definition:	AY1213	AY1314	AY1415	AY1516	AY1617	5 Year Ave	Program Notes	Source
D. 5 years of job placement rates for all program graduates **PI**	100%	100%	100%	100%	75%	95%	% of graduates employed for at least 1 quarter following graduation	OCHE & Bureau of Labor Statistics

Denotes Items that are Core Theme Indicators for Helena College

KPI or **PI** — **K**ey **P**erformance **I**ndicator or **P**erformance **I**ndicator for Program Effectivness under Strategic Enrollment Planning/Management

D. Student Participation and Success

Please see the following data for student participation and success. From this data we can see that course completion is high but degree completion is lower. Our goal is to determine the cause of this lack of completion and address this to increase degree completions.

Computer Aided Manufacturing 2014-19

Program Review Data Summary								
Student Participation and Success								
Data Definition:	AY1415	AY1516	AY1617	AY1718	AY1819	5 Year Ave	Program Notes	Source
A. Transfer rates to 4-year colleges (AA/AS)	N/A	N/A	N/A	N/A	N/A	**N/A**		Institutional Research
B. Program Capacity (Headcount)	30	30	30	30	30	**30**		Institutional Research
C. Annual Headcount Enrollment (Unduplicated)	29	23	31	21	30	**27**		Institutional Research
D. Annual FTE Enrollment **PI**	28	25	34	23	31	**28**		Institutional Research
E. Annual Program Capacity	97%	77%	103%	70%	100%	**89%**		Institutional Research
F. Fall to Fall Retention Rates (FT/PT students) **PI**	100%	67%	81%	60%	56%	**73%**	Fall 2014-2018 Cohorts	Institutional Research
H. Program Course Completion Rate (C- or better)	97%	93%	95%	94%	96%	**95%**	(Fall + Spring Semester)/2	Institutional Research
I. 150% Time Graduation Rate (FT/PT students)	50%	50%	91%	33%	56%	**56%**	Fall 2012-2016 Cohorts	Institutional Research
K. Annual Degree & Certificate Completions	9	16	23	19	15	**16**		Institutional Research
L. Degree Production Rates – *proportion of degrees/certificates granted per 100 FTE* **PI**	33	65	68	84	48	**60**		Institutional Research

Denotes Items that are Core Theme Indicators for Helena College

KPI or **PI** — **K**ey **P**erformance **I**ndicator or **P**erformance **I**ndicator for Program Quality and/or Effectiveness under Strategic Enrollment Planning/Management

E. Student Learning Outcomes and/or 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, and employer and graduate surveys.
4. Increase enrollment through recruiting efforts, including: business, industry, government, professional organizations, and high schools

F. Curriculum and Instruction

See attached Degree Planning Sheets for CAS and AAS Degrees in section K. Appendix.
A curriculum review and revisions were completed for all first-year machining classes in 2019. A significant change that happened as a result of the program review was a clean up of many of the learning outcomes that had been in place for a very long time and had not been updated to measurable and concise outcomes. There were also some outcomes that were attached to outdated equipment which is no longer used in the industry and therefore, those were removed. We also amended the curriculum by removing the blueprint reading course and spreading those outcomes throughout the semester in other courses so that content is still covered just in a different way. By doing this we could then add in a specific Solidworks course which is a valuable update to the first year program and allows better preparation of those students who are planning on entering into the second year where they are required to use an advanced program similar to Solidworks. These curriculum changes were reviewed and supported by our advisory board. We plan to review all second-year courses this year and make any needed changes in response to changing industry needs or to update current curriculum.

G. Faculty/Staff Profile

The computer aided manufacturing program has two full-time tenure track instructors who support two cohorts, a first and second-year cohort. Over the past few years, Helena College tried to offer this program as a night program as well, and employed three instructors. It was found that the night program was not sustainable at this time due to not enough enrollment and therefore the night program was discontinued. Helena College will continue to respond to industry needs and enrollment demands as needed and will continue the option of a night cohort if necessary. Current faculty include:

John McLaughlin:

John teaches machine shop at Helena College and has been actively working in the trade since 1994. His experience includes building rifles and designing parts, both of which require precision manual and CNC machining. Before moving to Helena, John taught machine shop and gunsmith metalwork at Trinidad State Junior College and NRA summer courses. Outside of the classroom, John stays active in the industry through his business, McLaughlin Custom Firearms. John's most recent accomplishment was being inducted into the American Custom Gunmaker's Guild. John also completed NC3 Certification Training in Precision Measurement.

Paul Nicholson:

Paul Nicholson is an alumni of Helena College University of Montana who attended the machining program and graduated with an AAS in Machine Tool Technology in 2011. Paul then was hired as a machinist at Elite Iron in Potomac, Montana and was employed in industry there from 2011 to 2019 where he was eventually promoted to shop foreman. Paul joined Helena College in the fall of 2019 as the second year computer aided manufacturing instructor. Since fall of 2019 Paul has earned certifications training in both HAAS and FANUC.

H. Fiscal and Physical Resources

Please see the following collection of data in regard to fiscal and physical resources. The machining program obtained three new manual lathes in the spring of 2020 and is currently in the process of purchasing a new CNC turning center. These purchases were made with a combination of Perkins grant funding and institutional support. Financial resources for this program are adequate to support students but not necessarily adequate to replace the very expensive CNC machines; therefore, the instructors try to use current unrestricted funds for student purchases and maintain fee pot monies to potentially use to update equipment in that area.

Computer Aided Manufacturing 2014-2019

Program Review Data Summary								
Fiscal and Physical Resources								
Data Definition: Instructional costs include program personnel and operating expenses	FY15	FY16	FY17	FY18	FY19	5 Year Ave	Program Notes	Source
A. Program Expenditure/FTE **PI**	$6,169	$6,618	$6,095	$11,138	$9,160	$7,836		Institutional Research /Finance
B. Average HC Program Expenditure/FTE	$4,919	$5,146	$6,827	$6,284	$8,252	$6,286		Institutional Research /Finance
C. Program Expenditure /Completion	$19,192	$10,340	$9,010	$13,190	$18,931	$14,133		Institutional Research /Finance
D. Average HC Program Expenditure /Completion	$17,959	$13,493	$16,601	$17,005	$13,598	$14,101		Institutional Research /Finance
E. Student Program Fees-Fund Balance	$4,033	$6,314	$8,306	$6,075	$7,348	$6,415	H60530	Institutional Research /Finance
F. Student Program Fees-Fund Expenditures	$0	$0	$0	$9,701	$6,613	$3,263	H60530	Institutional Research /Finance
G. Total Program Expense	$173,927	$169,043	$210,400	$250,602	$283,968	$217,588	Personnel + Operating	Institutional Research /Finance
H. Total Program Revenue	$230,478	$277,066	$316,370	$286,608	$301,754	$282,455	State Approp + Tuition	Institutional Research /Finance
I. Program Revenue/FTE	$8,231.36	$11,083	$9,305	$12,461	$9,734	$8,798	Total Revenue/FTE	Institutional Research /Finance

KPI or **PI** — **K**ey **P**erformance **I**ndicator or **P**erformance **I**ndicator for Program Effectiveness under Strategic Enrollment Planning/Management

I. Recommendations and Preliminary Implementation Plan

In reviewing the program review data summary the following can be noted:

1) A comprehensive review will be done of the second year program and any significant changes made in response to industry need and advisory board recommendations.
2) New equipment will be purchased in both the manual machining and CAM areas in order to update old equipment with new technology.
3) Course completion is high in this program is high, but degree completion is low; therefore, we will investigate the possible causes of this and look for solutions to increase degree completions in this program.
4) All students will be advised to take all of their related requirements in addition to their machining curriculum in the first year and then apply for a CAS even if they suspect that they will be moving into the second year. This will ensure that the College has completions for all first year students.

J. Program Review Data Summary – See data tables in section C, D, and H

K. Appendix Degree Planning Sheets for CAS and AAS

Certificate of Applied Science – 39 credits Machine Tool Technology		
Name:	**Date of Entry:**	**Advisor:**
Dual Major With:	**Academic Plan Advisor:**	
Transferred From:		
Credit Hours Transferred In:	Must complete 1/3 of degree through Helena College	

Course #	Course Title	CR	Pre - Requisites	SEM	Grade	Comments
First Semester (18 credits)						
MCH 240	Metallurgy	2				
MCH130	Machine Shop	3	M 111T (co-req)			
MCH132	Introduction to Engine Lathes	5				
MCH134	Introduction to Mills	5	MCH 130 (co-req)			
M111T	Technical Mathematics	3	MCH 130 (co-req)			
Second Semester (21 credits)						
MCH136	Advanced Lathes	5	First semester MCH courses and M111T			
MCH137	Advanced Mills	5	First semester MCH courses and M111T			
MCH139	Grinding Applications	2	First semester MCH courses and M111T			
DDSN 135	Solidworks	2	First semester MCH courses and M111T			
MCH245	Shop Practices	2	First semester MCH courses and M111T			
WRIT 121T	Intro to Tech Writing	3				
COMX 106	Communicating in a Dynamic Workplace	2				

Associate of Applied Science – 69 credits Metals Technology		
Name:	**Date of Entry:**	**Advisor:**
Dual Major With:	**Academic Plan Advisor:**	
Transferred From:		
Credit Hours Transferred In:	Must complete 1/3 of degree through Helena College	

Course #	Course Title	CR	Pre - Requisites	SEM	Grade	Comments
First Semester (18 Credits)						
MCH 240	Metallurgy	2				
MCH130	Machine Shop	3	M 111T (co-req)			
MCH132	Introduction to Engine Lathes	5				
MCH134	Introduction to Mills	5	MCH 130 (co-req)			
M111T	Technical Mathematics	3	MCH 130 (co-req)			
Second Semester (19 Credits)						
MCH 136	Advanced Lathes	5	First semester MCH courses and M111T			
MCH 137	Advanced Mills	5	First semester MCH courses and M111T			
MCH 139	Grinding Applications	2	First semester MCH courses and M111T			
DDSN 135	Solidworks	2	First semester MCH courses and M111T			
MCH 245	Shop Practices	2	First semester MCH courses and M111T			
WRIT 121T	Intro to Tech Writing	3				
COMX 106	Communicating in a Dynamic Workplace	2				
Third Semester (17 Credits)						
WLDG 107	Industrial Safety	2				
WLDG 112	Cutting Processes	3	WLDG 107 (co-req)			
WLDG 135	GMAW Theory and Practical Appl	5	WLDG 107 (co-req)			
WLDG 181	SMAW Theory and Practical Appl	5				
Fourth Semester (15 Credits)						
WLDG 137	Blueprint Reading, Layout, and Beginning Fabrication	7	3rd semester WLDG courses and M111T			
WLDG 141	GTAW Theory and Practical App	4	3rd semester WLDG courses and M111T			
WLDG 151	Shop Practices	3	3rd semester WLDG courses and M111T			