

# **Design and Manufacturing Technologies**

## **2019-20 Annual Program Review Update**

**Submitted By:** Mike Appio

### **Program Mission Statement:**

The Design and Manufacturing Technologies Department offers broad yet in-depth curriculum that imparts a strong foundation for direct employment and engagement in local industries or transfer to a four-year college. Diversification is the hallmark of the program. The program outcomes are based on skills required to gain or enhance employment by means of program innovation, which focus on critical thinking, peer communication and personal responsibility for career success.

### **Program Description**

The Design and Manufacturing Technologies offers state-of-the art advanced manufacturing instruction in computer aided design (CAD), reverse engineering (scanners), 3D printing (additive manufacturing), laser scanning systems, computer numerical control (CNC) machining, model making/rapid prototyping, materials processing and a new quality assurance program. The curriculum is ideally suited to those who are new to the field, as well as drafters, lab technicians, conventional machinists, machine operators, quality technicians who wish to update their skills and advance in this rapidly changing industry. Certificate of Achievement in CAD-Mechanical, CNC Machinist, Quality Technician and a new Additive Manufacturing certificate are the initial point of entry into the Design and Manufacturing program. Students who complete the program will have a solid foundation in design and manufacturing systems with the opportunity to choose a further specialization in the areas of CAD design and additive manufacturing (3D Printing), advanced CNC set-up, CNC operation, CNC programming and quality assurance.

The program is also a primary choice for many tech, medical, aerospace and automotive engineers, designers, planners and purchasers who wish increase their “hands on” skills and overall knowledge of the design and manufacturing process in order to advance their careers.

Examples of career possibilities include: CAD drafters, Additive Manufacturing Technicians (3D printing) Computer Numerical Control Machinists, Product Model Makers, Computer Numerical Control Programmers, CNC/Research & Development Machinists, Inspection / Quality Assurance, Manufacturing / Engineering and Industrial Engineering Technicians.

De Anza College’s Design and Manufacturing Technologies program offers state-of-the-art classroom and lab facilities. Students have the opportunity to work with CAD/CAM workstations, 3D printers, Laser Scanning equipment, CNC lathes with C/Y axis live tooling, CNC vertical machining centers

with 4th and 5th axis capabilities, as well as a 4 axis horizontal machining center. In 2019-20, a Fanuc Robotics work cell was added to a CNC machine to teach automation, which will have already had an increased presence in manufacturing facilities in the bay area. The students also have access to automated coordinate measuring machines, inspection equipment, conventional machining equipment, 3D printers and three CAD/CAM programming labs. Design and Manufacturing Technologies offers an accelerated day program, designed for those who need to reenter the workforce quickly. Courses are also offered in the evening to accommodate incumbent workers. The program is also approved by the California Department of Apprenticeship Standards, which currently teaches apprenticeship classes for the International Association of Machinists and Aerospace Workers and the California Tooling & Machining Apprenticeship, with current programs at Northrup Grumman, FM Industries and contact vendors, as well as internships at Lockheed Martin, NASA and DuPont. The De Anza DMT program also has the distinguished honor of being one of three community colleges in the state that is a NIMS (National Institute for Metalworking Skills) certified facility. The department chair is a member of the California Manufacturing and Product Development Advisory Committee for the California Department of Education, chair of the 2019-20 Haas Teacher Training Advisory Committee representing community colleges and high schools. He is also the educational board member of the NTMA SF chapter (National Tooling and Machining Association). De Anza is officially the "Gene Haas Center for Design and Manufacturing". The Gene Haas Foundation, which has graciously donated over 2 million dollars over the last 7 years to upgrade CNC labs, student scholarships and teacher scholarships, to ensure the program is teaching cutting edge CNC technology well into the future. To enhance this advanced technology, Siemens Corporation, PTC, MasterCam and other partners continue to support De Anza with millions of dollars of software and support. The DMT department is the only west coast certification center for Siemens CNC controls.

For multiple years in a row, De Anza College earned California Strong Workforce Stars recognition in the Advanced Manufacturing sector for its Design and Manufacturing Technology (DMT) program; 100% of students who participate in this program report securing a job in their field of study.

De Anza college is entering the sixth year of its partnership with HAAS Automation (largest manufacturer of CNC machines in North America) to provide teacher CNC training, which teaches High School and College instructors how to better utilize their CNC equipment in their own classrooms/labs. Haas also entrusts a five axis vertical mills and multiple training simulators valued at over \$250,000. The equipment is not only used to teach instructors throughout the US, it is used by our students on a daily basis in advanced CNC courses. Starting in the summer of 2020, the department will expand summer instructor training. MasterCam, the world largest CAM software company, has partnered with the DMT program to offer teacher training to instructors from around the country.

The main strengths of the DMT program are our close ties to industry, as well as ties to high school and four-year college programs. Major companies such as TESLA, NASA, Northrup Grumman, Loral Space Systems, Lockheed Martin, Google, Apple Inc., Stanford Linear Accelerator, Lawrence

Livermore National Lab, DuPont, Facebook as well as other local manufacturing companies are closely involved in our advisory committees. These companies depend on the DMT program to enhance the skills of their existing and future employees in high tech manufacturing. The program also has articulating agreements with a local high school program and the Industrial Technology program at San Jose State.

**I.A.1 What is the Primary Focus of Your Program?** Career/Technical

**I.A.2 Choose a Secondary Focus of Your Program?** Transfer

**I.B.1 Number Certificates of Achievement Awarded:** 36

**I.B.2 Number Certificates of Achievement-Advanced Awarded:** 10

**I.B.3 #ADTs (Associate Degrees for Transfer) Awarded:**

**I.B.4 # AA and/or AS Degrees Awarded:** 18

**I.B.5 Trends in # Degrees Awarded:** Certificate of Achievement and Certificate of Achievement certificates have held steady fluctuating up and down annually approximately 5% over the last 5 years. Unfortunately, there are several individuals annually that don't apply for certificates for various reasons. One area is that over 30% of our students already have a higher degree, such as a BS degree, and do not usually apply for certificates as they are seeking valuable job skills although they have taken the required courses to get a certificate.

AS degrees have increased 50% from 12 to 18 last year with a five year trend of increasing every year. The DMT continues to stress the importance of a degree over a certificate for long-term career success.

**I.B.6 Strategies to Increase Awards:** As mentioned before by many departments, an implement of software that would flag students who finish all the required courses for certificates would be a major asset to the DMT department and De Anza college.

The full time instructors in the DMT department hold sessions in the classroom at the end of the quarter asking students what courses they have finished ( or open Degreeworks). The instructors have the certificate and degree PDF forms on the DMT shared drive in advance and have the students fill them out. If the students do not have the required classes completed, the instructors counsel the students on remaining courses.

The CTE department does not have a dedicated counselor who can assist with GE strategies and some department direction. At this time the DMT instructors are the best counselors when planning core class selection.

**I.C.1. CTE Programs: Review of Perkins Core Indicator and SWP Outcomes Metrics:** DMT faculty will continue with the existing plan of actively providing counseling on course selection and scheduling to students. They hold advising sessions and help students prepare applications for certificate and degree awards. Similarly, DMT faculty will continue to expand their industry

partnerships and connections with professional associations such as SME to help current students and recent graduates connect with employment opportunities. De Anza's DMT program is also expanding its offerings in Additive Manufacturing. With the combined resources of SWP and Perkins funding, the program has acquired state-of-the art 3D printers and scanners and developing advanced courses. A new certificate program in Additive Manufacturing is under development and will expand employment opportunities for students. Expanding our lab times and increasing the amount of tutors/mentors and open lab time for those students who do not have computer access.

The De Anza College DMT Department is accredited by the National Institute for Metalworking Skills (NIMS). Students are encouraged to pursue these industry-recognized certifications at no cost, as the fees are underwritten by lottery funds

Free home versions of software MasterCam, SolidWorks, NX and Autodesk Inventor, and learning tutorials such as Solid Professor have also been added for those with internet access. For those without access, the software can be used in the expanded lab hours. Free SolidWorks associate and professional certifications are offered free at De Anza CAD lab. Perkins funding will be used to offer supplemental instructional assistance and mentoring to help improve DMT students' course-level outcomes.

### **I.C.2 CTE Programs: Labor Market Demand and Industry Trends:**

Employment opportunities for Design and Manufacturing program graduates exist in high tech, research/ development, large manufacturing facilities and small, independent design shops. Individuals with a background in manufacturing technology can also parlay their skills into other related positions in the industry: CAD design, Engineering, Additive Manufacturing, CAD/CAM programmers, CNC set-up operation, PLC programmers, and Rapid Prototyping Quality Assurance. and Cost Estimators

EMSI Program Market Demand (Growth 2020- 2025) - DMT: CNC Machining, Product Model Making, and Quality Control Technician

Machinists +3.98% / Industrial Engineering technicians +6.78% / CNC Programmers +3.06% / CNC Machine Set-up +11.59%

EMSI Program Market Demand (Growth 2020- 2025) - DMT: CAD

CAD Mechanical Drafters +3.48% / Cost Estimators + 5.12%

Percentile Earnings Hourly: 25th percentile earnings \$27.22 / median percentile \$45.97 / 75th percentile Earnings \$72.36

While the above is a sampling of the CNC and CAD career opportunities available, the DMT program serves a variety of other careers. Over the years the program has provided Mechanical Engineers, Industrial Engineers, Program Managers, Manufacturing Planners and Purchasers with career advancing knowledge and skills. These jobs represent a significant number of current career positions, as well as job growth in the Bay Area.

Advanced curriculum in multi-axis, live tooling automation, quality assurance and advanced 3D printing/ design is being continuously developed with SWP and Regional funds, which will increase enrollment as it is implemented into the DMT department.

In addition to the local EMSI Program Market Demand Data , the Design and Manufacturing program provides training to many other areas. De Anza offers the only Design and CNC program in the surrounding counties. As of 2019 De Anza serves a vast area, such as Monterey, San Benito, Santa Cruz, San Mateo and San Francisco Counties where no existing Design and CNC manufacturing programs exist.

**I.D.1 Academic Services & Learning Resources: #Faculty served: 0**

**I.D.2 Academic Services & Learning Resources: #Students served: 0**

**I.D.3 Academic Services & Learning Resources: #Staff Served: 0**

**I.E.1 Full time faculty (FTEF): 6.5**

**I.E.2 #Student Employees: 0**

**I.E.3 Full Time Load as a %: 42.3%**

**I.E.4 # Staff Employees: 2**

**I.E.4 #Staff Employees: 2**

**I.E.5 Changes in Employees/Resources:** There were no increase or decrease in 2019-20

**II.A Enrollment Trends:** The DMT department enrollment has virtually not changed over the last three years .With a strong economy enrollment has remained strong for the last five years

The department goal is to continue to create new and advanced classes with SWP and Regional funds to retain students to continue their education goals, which will increase their career and wage opportunities, as well as attract new students into the field. New courses in 3D printing /additive manufacturing and quality assurance will create new opportunities and increase enrollment in the future.

The department (facility request / spreadsheet) is currently requesting to expand existing rooms in the E3 building. E35 will become a state of the art 3D printing / Additive Manufacturing lab and E34 and E36 becoming Computer / Lecture Labs. An expanded 3D printing / Additive Manufacturing lab has been a high level discussion with our advisory committee since our first course offerings. This worldwide technology is expanding at a pace never seen before and the DMT department has already set the bar for all community colleges. This expansion would provide the department chair to actively peruse outside interest, such as he did with the Haas \$1 million donation to the CNC lab and other substantial partnerships. The space (lab / classrooms) will allow the department to expand new course

offerings, and offer existing classes during hours that will better serve all students. The DMT department currently has to schedule on Friday evenings and Saturdays to meet demands. Currently some classes have not been offered because of lab availability. The computer labs will not only be used for 3D printing, but for all courses in the DMT program including quality assurance, CAD, CNC programming and other high demand courses.

The lab will contribute to higher enrollment in the DMT department, as well as contribute significantly to our equity plan, institutional metrics and educational goals. Additive manufacturing will be a major contributor to high wage paying jobs of the future. The Silicon Valley is currently the hub of 3D development and De Anza college will be the leader in introducing this technology to new and incumbent workers.

**II.B Overall Success Rate:** Success rate holds steady at 76% - 80% over the last three.

At this time the on line courses and the students who are juggling full work schedules have the most issues with success.

To increase success rates the department has increased student tutors / mentors and added more available “hands-on” labs and special project assignments throughout the quarter.

Utilizing Canvas tools to help interact with on line students will better connect the instructor and the student to stay on target

The department consistently goes over tools, rubrics and other SLOAC developed assessments from beginning to advanced classes to increase success at the introductory level. As we continue our assessments, changes will be implemented to help a higher percentage of students complete the program certificates and degrees.

Extra emphasis will be placed on introductory and on line courses that have a tendency to have lower success rates.

**II.C Changes Imposed by Internal/External Regulations:** There have not been any direct regulations that have impacted our department.

**III.A Program Success:** The DMT program has always a very diverse program. The success has always been the development of hands on, visual learning exercises, as well as department developed curriculum that consists of in class assignments, lab exercises, and other materials. The students can follow by means of visual instructions using common words that don't use slang terminology (which is very common in CNC machining,, CAD / CAM courses and inspection) that would not be easily translated by ESL students.

The DMT department focuses on student teaching assistants and mentors who are bi lingual. Having hired staff over the last three years who are bi lingual have also had a major impact on success in the labs.

**III.B Enrollment Trends - Equity Lens:** Overall enrollment for this group of students is 35% college and 26% department.

Although the difference is a small percentage, it does follow the pattern of the college as a whole. Location of the college and the ever changing location of manufacturing from the south bay to the east bay over last 20 years has changed the diversity of the design and manufacturing department. Cost of living has also changed the diverse population in the bay area due to relocation and other financial issues.

The department attends high school career fairs, in class guest lectures and other events at high schools and career centers in the bay area., The focus is on students who would not be familiar with our CTE program. We focus on high schools that are extremely diverse with many students who are in this student group and looking for a great career who might not have an opportunity to attend a four year university or choose to go straight to a high demand career learned at a community college.

Our female total enrollment has increased over 100% (99-227) from 15-16 to 18-19 and from 6% to 15% of our total department enrollment during the same time. Although this is a lower percentage in our program, we are making great strides in the department to recruit females into rewarding design and manufacturing careers.

**III.C Success, Non-Success and Withdraw Rates:** Success rates are as follows Foster youth 100% Individuals with disabilities 63% Veterans 72% Low income 70% Overall DMT program 76%

The overall differences in the report are not so much the success rates, but the overall sampling of students, which consist from 3 (foster youth) students to 412 (low income)

Observation n the DMT courses: Low income students are observed as having to work full time while taking courses...This has led to missed classes, late arrivals and early departures, which has an impact on lab participation and missed lectures, or the worst scenario of getting behind so far that they stop showing up. Many veterans do well with assistance of government education funds, as well as more time available to attend extra lab times and other benefits the DMT has to offer.

The DMT faculty will continue with the existing plan of actively providing counseling on course selection and scheduling to students, as well as increased exposure of the De Anza Design and Manufacturing program. Expanding our lab times and increasing the amount of tutors/mentors and open lab time for those students who do not have computer access.

Free home version software, MasterCam, SolidWorks, NX and Autodesk Inventor, and on line learning tutorials have also been added for those with internet access. For those without access, the software can be used in the expanded lab hours. Free SolidWorks associate and professional certifications are offered free at De Anza CAD lab

NIMS ( National Institute for Metalworking Skills) skills / project certificate tests are now available at no charge to the students. These certificates are part of a national accredited training program that is provided by the DMT department, which is an accredited training program. The cost is covered with lottery funds and is major benefit when applying for employment.

**III.D Equity Planning and Support:** Equity work has generated a need for resources. These funds would target economically disadvantaged, limited English speakers and students with disabilities. Additional mentors / tutors have already been added to classes , but with more funds with we could add more tutors and mentors for individual assistance outside of class hours. This practice has shown to be effective during our day program. At this time the department has a professional industry mentor who works specifically with various small groups depending on needs.

My request for the department would be 2-3 more tutors/mentors to help with day and evening courses. At this time funds limit the amount, but will be added to SWP, Perkins etc. request.

**III.E Departmental Equity Planning and Progress:** Increase speaking engagements at career days at High Schools, as well as an articulation agreements, will open up more career opportunities to underrepresented populations, which will help the department attain our goal of lowering the equity gap.

Continued efforts to make software and on line educational tools no charge to help low income students will increase success rates

Collaboration between basic skills, such as Math and English. Tutors are needed to help student success. Many students entering the program as well as existing show very poor math skills to advance their careers. Increase success rates

Increased open lab / tutorial time - Increase staff employee to twelve months employment to help individual students in the machine tool lab. Increased time would allow the staff to plan out their other duties over a longer time and allow more time to help students with hand on lab projects...This would definitely help with success rated of the student groups that need the most assistance.

**III.F Assistance Needed to close Equity Gap:** Yes

**IV. A. SLOAC Summary:** Adjusting course outlines during 5-yearreview process. The major changes occurred in matching assignments, methods of evaluations and adjusting objectives when needed.



**IV.B Assessment Planning:** DMT 70, DMT 80, DMT 82, DMT 84A, DMT87J, DMT 87N, DMT 89A DMT 90 and DMT 92...All listed courses taught by part time instructors.

**V.A Budget Trends:** Planning, implementation and assessment are major parts of training highly skilled students for the current workforce. When lack of funds becomes an issue within the program, one or more of the areas will be affected. The result would be students finishing the program without the necessary skills to compete for high wage employment. Fortunately, there have been and continue to be generous external donations and consignments, which have allowed the department to implement “hands on” training and assess student needs to become extremely desirable employees.

Unfortunately, the "B" budget has been the same for the last ten years and is lower than it was twelve years ago. With increased funds the donated and entrusted equipment can be used to its full potential.

The addition of SWP and Regional Workforce funds have advanced the program tremendously. These funds have allowed the department technology to keep pace and in some cases move ahead of some of the manufacturers in the bay area.

In the DMT department budget has a direct impact on student success rates and the continued effort of teaching with state of the art equipment, as well as keeping the equipment maintained.

**V.B Funding Impact on Enrollment Trends:** These coming years will be extremely important for funding sources. The department is currently out of lab space for machining and especially 3D printing / additive manufacturing lab. 3d printing / additive manufacturing is one of the fastest advancing technologies in the world and the department is more advanced than any other community college in the state.

The current college funding over the past three years (“B” and CTE) has allowed the program to keep up with its current demand of enrollment, but at the same time limiting growth in other advance manufacturing areas will be limited due to limited space and classrooms in the department.

The HAAS \$1million dollar external donation and ongoing SWP and Regional Workforce funds has allowed the DMT program will to better serve students in advanced manufacturing. These additional funds have allowed the program to serve a new population of manufacturing students, adding new enrollment in advanced technology courses. In a recent department survey over 50% of the students who received certificates would come back and take new advanced CNC classes. Incumbent workers, who never took introductory courses at De Anza also have expressed interest in advanced manufacturing courses.

As we can see the DMT department has done well with increasing enrollment over five years and has stable over the last three years. With additional converted lab space and added classroom space the DMT department could grow significantly in the areas of manufacturing robotics and 3D/ Additive manufacturing.

**V.C.1 Faculty Position(s) Needed:** Replace due to vacancy

**V.C.2 Justification for Faculty Position(s):** Faculty justifications based on advisory meetings, increased enrollment, building a state of the art 3Dprinting / Additive Manufacturing program.

CAD / 3D Additive Manufacturing Replacement – Six years ago the department lost a CAD instructor to retirement...As you can see in enrollment numbers were significantly lower in 14-15 after losing that instructor. Over the last 5 years the department has increased enrollment 47% with part time instructors, but over the last 3 it has fluctuated a few percent and will not be sustainable over time.....Design and Manufacturing part time qualified instructors are very hard to find and many time do not last long due to their work commitments.

A more important part of the justification is the quality assurance and 3D printing / additive manufacturing program. The department has developed 8 new courses in quality assurance, robotics and 3D printing. Many of these classes can only be taught once a year or haven't even been offered yet because there is not an instructor available. Many of our advisory including Apple, Google, Northrup Grumman and other Silicon Valley powers are inquiring about these programs and lack of offerings. 3d printing is the fastest moving technology in the world and De Anza has one of the top community college programs in the state...In order to grow at the pace of the silicon valley a full time instructor is desperately needed.

Enrollment and certificate / degrees would substantially increase with an added full time instructor. We have increased the department 47% since 2014-15 and believe we can increase another 25% with an added (replacement) instructor.

**V.D.1 Staff Position(s) Needed:** None needed unless vacancy

**V.D.2 Justification for Staff Position(s):** N/A

**V.E Equipment Requests:** Equipment resource requests listed on spreadsheet

**V.F Facility Request:** See Spreadsheet

**V.G Other Needed Resources:** Resource requests listed on spreadsheet

**V.H.1 Staff Development Needs:** Continuous training and professional development in multi axis mill, live tooling, Y axis lathe, and manufacturing robotics.

Continued allocations of Perkins, SWP and regional funds will support staff development.

Resources needed for staff development located on spreadsheet

**V.H.2 Staff Development Needs Justification:** After looking over SLO / PLO assessments from the department, it has become apparent that some instructors (large amount of part time instructors) need development in order to prepare assessments that align with the current need of the student. This will ensure we are providing the training to prepare students for employment.

Our advisory group continuously reminds us that if we don't continue to develop the skills of our staff

we cannot help them maintain a steady flow of students / employees who will lead their companies in the future.

**V.I Closing the Loop:** Over the last several years the assessments were established by the resources received. Naturally we are able to asses at a higher level as resources became available. SWP and Regional funds have played a major role and will allow the department to asses at a higher level that was previously imaginable. Evaluating assessments and outcomes will change dramatically over the next five years. When you add resources you add outcomes and assessments methods that were not possible in the past. Students can be assessed on more advanced curriculum and equipment. The assessments can be “hands on” like they would experience in the workplace. The cycle will forever improve as a result of the generosity of SWP/Regional funds the college has awarded the DMT department The results will increase the success of new and incumbent students in the workforce.

**Last Updated:** 02/03/2020

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