Evaluation of Yavapai College's Applied Pre-Engineering Program Expansion

National Science Foundation Advanced Technological Education Grant Evaluation Report



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May 2019

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Acknowledgments

SPR would like to thank Yavapai College staff, students, and employer partners for sharing their observations and insights with us, including John Morgan, James Voska, Linda Brannock, and Stephanie Wiltcher Sproul. Their input allowed us to understand the structure and development of Yavapai's Applied Pre-Engineering programs and supports. We also thank Tom Hughes and Leo Derks for providing data that were critical to tracking the progress of the grant outcomes.

We also thank our colleagues at SPR for their help in preparing this report. In particular, we thank Maureen Sarver for her help with data collection and writing, and Eduardo Ortiz for his help implementing all of our online surveys. In addition, we thank Hannah Betesh for her constructive feedback, Karen Jarsky for her careful and thorough editing, and Yufei Wang for her help formatting the report.

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Executive Summary

In 2016, Yavapai College, in Prescott, Arizona, was awarded a three-year National Science Foundation (NSF) Advanced Technological Education grant to implement its Engineered for Success initiative, which was designed to expand and enhance the college's Applied Pre-Engineering programs. The grant began in fall of 2016 and ended in spring of 2019, though Yavapai has extended it by an additional year. During the grant period, the college created two new certificate pathways for Applied Pre-Engineering students and increased its capacity for providing applied learning experiences via the purchase of new equipment, support for paid internships, and professional development for instructors. Grant funds were also used to support applied learning experiences for third- to ninth-grade students at engineering summer camps on the Yavapai College campus.

Yavapai College selected Social Policy Research Associates (SPR) to evaluate its progress toward the grant's enrollment and completion goals. SPR relied on information from surveys of interns and employers, a focus group with interns, interviews with college faculty and staff, interviews with internship mentors, a site visit, and enrollment and graduation data from the college's student information system. This final report summarizes the outcomes achieved as of spring 2019 and describes the implementation of the initiative, including lessons learned.

The college generally achieved its outcome goals and implemented grant-funded activities as planned. It was also able to develop an additional program that was not part of the initial plans. The key findings from the evaluation were:

- **Ongoing employer engagement has helped Yavapai College adjust its programs to meet industry and student needs.**
    - **The college created the Integrated Systems Engineering Technician (ISET) certificate program**, which serves as an alternative pathway for students pursuing Applied Pre-Engineering, especially those not interested in transferring to a four-year university. The certificate also responds to employers' expressed need for job candidates with general manufacturing skills. As of spring 2019, 63 students had enrolled in the program—fewer than the goal of 80. The ISET certificate is relatively new, however, and enrollments are expected to grow as more students learn about it.
    - **The college created a braided internship program in Additive Manufacturing in partnership with a local 3-D printing company and the City of Prescott.** The Additive Manufacturing program trains students to be production technicians, whose responsibilities include setting up and disassembling custom 3-D printers, connecting machines to a computer network, and

running production jobs. As of spring 2019, 65 students had enrolled in the program.

- **With the addition of two new computer numerical control (CNC) machines, the 5-to-1 ratio of students to CNC machines was reduced to 3 to 1.** This has allowed students to gain more practical experience using the machines on their own and to apply concepts they have learned in class.

- **Students' hands-on learning was enhanced through additional paid internship opportunities and the incorporation of problem-based learning (PBL) into classes.** As of spring 2019, 71 students had participated in internships supported by the NSF grant, including 65 in the braided Additive Manufacturing internship, which exceeded the goal of providing 28 internships. Faculty also participated in professional development training that helped them learn new concepts or enhance PBL they were already using.
- **During the grant period, Yavapai students earned a total of nine Applied Pre-Engineering Associate of Applied Science (AAS) degrees, four ISET certificates, and 183 industry-recognized certifications.** This exceeded the goal of 126 degrees and industry-recognized certificates. Additionally, 26 students transferred to four-year universities. Transfers are considered a success because students are advancing to further education.
- **Employer survey respondents were generally very satisfied with Yavapai student interns and recent Yavapai graduates they hired.** All surveyed employers would very likely (79%) or likely (21%) hire a Yavapai intern. Similarly, all surveyed employers would very likely (67%) or likely (33%) hire a recent Yavapai graduate again.

The primary lessons learned and recommendations that emerged from the evaluation of grant implementation are:

- **The college should offer more work-based learning (WBL) experiences so that more students can gain exposure to real-world work experience, which helps them learn what is expected on the job.** Interview respondents consistently made this recommendation. Their suggestions included adding more internships, more hours for existing internships, and shorter work-based learning experiences, like job shadowing.

- **More resources should be directed toward community outreach and hiring career counselors and/or job developers.** Interview and survey data both support this recommendation, and interview respondents provided several reasons. First, outreach will help identify more internship opportunities and WBL experiences. Second, a few employers

observed that interns needed some soft-skills training, which a career counselor could provide. Third, a respondent suggested gathering feedback from a wider range of employers, beyond those involved in the advisory industry council.

- **The college should continue its practice of on-going employer engagement.** Employer engagement at multiple levels has contributed to the successful development of internships, including braided internships. Yavapai leadership, staff, and faculty regularly engage with the business community, which has helped the college maintain and grow its network of employers, some of whom now serve on the Advanced Manufacturing Industry Council or host interns.

Yavapai College's Applied Pre-Engineering Program Expansion

Exhibit 1. Initiative Overview

Years: 2016–2019

Certificate Programs Created:
*Integrated Systems Engineering Technician (ISET)
*Additive Manufacturing

Enrollment During Grant Period:
*71 students placed in internships
*63 students declared ISET or enrolled in a gateway class
*65 students declared Additive Manufacturing
*178 students declared Applied Pre-Engineering or enrolled in a gateway class

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I. Introduction

Yavapai College, in Prescott, Arizona, designed its Engineered for Success initiative to increase students' opportunities for hands-on learning and to train more students to better meet the workforce needs of local employers. It was designed to expand and enhance the college's Applied Pre-Engineering set of programs. The initiative was funded through a three-year, $900,000 National Science Foundation (NSF) grant that began in fall in 2016 and ended in spring of 2019 (though the college has extended it by an additional year). The grant was part of NSF's Advanced Technological Education (ATE) program, which supports education initiatives that train students for technical fields that are needed by regional employers.

Yavapai College selected Social Policy Research Associates (SPR) to conduct an evaluation of the initiative. The evaluation included an outcomes study and an implementation case study. This report describes findings from both of these components. SPR relied on information from surveys of interns and employers, a focus group with interns, interviews with college faculty and staff, interviews with internship mentors, a site visit, and enrollment and graduation data from the college's student information system. For a more detailed description of data collection methods, see Appendix A.

Initiative Origins

Yavapai College's Career and Technical Education Center, home to the Applied Pre-Engineering programs, was established in 2007 and has 35 degree and certificate programs that train students for jobs or prepare them for further education at four-year universities. The college relies on groups of local employers, called industry councils, for advice on its curriculum. There is usually one council for each program area.

In 2015, the college learned from its industry council on Pre-Engineering and Electrical & Instrumentation Technology that there was a growing need among local employers for job candidates with general training in advanced manufacturing. As the project director described, employers wanted graduates with "a liberal arts degree in manufacturing." In other words, employers were looking for job candidates with a broad understanding of manufacturing.

The college applied for the ATE grant to help it create such a degree—a new Integrated Systems Engineering Technician (ISET) certificate that combines computer numerical control (CNC), robotics, and computer-aided design (CAD). The college planned to create an Advanced Manufacturing Industry Council to advise the new ISET certificate program.

The college also sought to expand its capacity to provide students with hands-on learning activities—through more paid internships, a lower student-to-equipment ratio, and problem-based learning (PBL)—and

Exhibit 2. What is a Braided Internship?

At Yavapai College, a braided internship is a credit-bearing certificate program that pairs an internship with related college classes. The main characteristics of the program are:

Paid Work Experience—Students spend about 10–16 hours a week working at the employer and receive training and guidance from a mentor (an experienced employee at the company).

Classes—Students take credit-bearing classes at the college in areas related to their internship. Employers and the college collaborate during the design phase to select classes that are related to the job and that provide foundational knowledge.

College Certificate—Students who successfully complete the internship and classes are awarded a college certificate.

Cohort-Based—Students take their classes together and work at the employer on the same days, which can provide students with peer support.

Temporary—The internship is a temporary job, usually lasting two to four semesters (nine to 18 months). (The Additive Manufacturing program was accelerated and lasted four months.) Sometimes interns are hired after the internship ends.

continued access to a career coach to help with internships, job placements, and employer engagement.

CTEC's aspirational hands-on learning model is a braided internship program, where an internship and related classroom instruction are combined into a college certificate or degree program (see Exhibit 2). Yavapai College created its first braided internship in 2008—a two-year program with a local mining company, where students can participate in diesel technician, electrical instrumentation technician, or advanced manufacturing technician internships.

The typical CTEC braided internship program lasts approximately four months to a year, depending on the program. Students spend three days taking classes on campus and two days working as an intern at the employer. Having the internship last at least two semesters or an accelerated semester allows the college to pair it with a certificate (usually about 20–50 college credits).[1] The availability of funds to pay interns is an important factor in supporting the creation of more braided internship programs. As described in Section II of the report, Yavapai College was able to establish a new braided internship in Additive Manufacturing with a company that hosted an NSF-supported intern.

Leaders at the college also recognized that women are historically underrepresented in the engineering field, including in programs offered by Yavapai. The grant funds allowed the college to offer a robotics summer camp designed for girls ages 11 to 13. College leaders chose this strategy because research has demonstrated that nurturing girls' interest in science helps them persist and pursue science fields later in life.[2] Also, the camp was intended to help the younger generation learn about the program options available at Yavapai College—a long-term recruitment strategy, especially for girls and women.

Initiative Goals

The specific goals outlined in Yavapai College's NSF grant application build upon the needs described above. These goals are to: (a) produce more qualified engineering technicians to meet workforce demand; (b) improve engineering technician education (technical skills and general STEM preparation) and success by implementing new instructional approaches and student support services; and (c) improve engineering technician education by increasing industry engagement.

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[1] An accelerated semester is divided into two seven-week quarters. Students take a different set of classes each quarter.

[2] The study found that girls who participate in STEM clubs and activities outside of school are more likely to say they will purse STEM subjects later in their education. See Microsoft (2018), *Closing the STEM Gap: Why STEM classes and careers still lack girls and what we can do about it* (Retrieved from https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RWvbgX).

As of spring 2019 (the final semester of the six-semester grant period), Yavapai College's Pre-Engineering program had met or exceeded eight of the 12 outcome goals associated with the three main goals.[3] Specifically:

- **Three of five Goal 1 performance outcome goals were exceeded.** The college exceeded its goals related to Applied Pre-Engineering enrollment, summer camp enrollment, and degrees and industry certifications awarded.
    - The two goals that were slightly below the target were the total number of ISET enrollments and enrollment of women. The ISET certificate—which had 63 enrollments, versus the goal of 80—is relatively new and enrollments are expected to grow as more students learn about it. The college has also nearly reached its goal of 20% of Applied Pre-Engineering students being female; the current level is 17%.
- **Four of six Goal 2 performance outcome goals were exceeded.** The college exceeded its goals related to PBL enrollment, internship enrollment, the student-to-CNC-mill ratio, and instructor professional development.
    - The two goals that were slightly below the target level were the portion of students who passed the ACT National Career Readiness Certificate (75% actual vs. 80% goal) and the CNC lab-hours goal. The lab is currently open 12.5 hours per week, versus the 20-hour goal. The primary challenge to keeping the lab open for more hours is that it is difficult to find available staff members to supervise the lab. Staff have made adjustments to minimize the impact of fewer open lab hours, however, including by letting students who cannot attend during current lab hours work with faculty to schedule time.
- **The Goal 3 performance outcome goal was exceeded.** The college has established a new Advanced Manufacturing Industry Council with eight employers, versus a goal of four.

Appendix B provides a detailed summary of all 12 outcome levels as of the spring 2019 semester. Yavapai has extended its grant for another year and will continue to work toward achieving these goals. For example, the college will continue to offer the engineering summer camps and increase community outreach in an effort to enroll more women in Applied Pre-Engineering programs.

[3] The goal related to placement is excluded from this total because data on placements were not available from Yavapai College. The college attempts to collect information from recent graduates but gets very low response rates because it is difficult to reach graduates after they leave. To help fill this gap, SPR conducted a survey of employers, which is described in Section V and Appendix A.

In addition to achieving most of its quantitative goals for the project, the college created new programs and enhanced its hands-on opportunities for students. The remainder of the report describes the implementation of these activities and other grant accomplishments as follows:

- Section II reviews new degree programs created under the grant.
- Section III describes program enhancements implemented under the grant.
- Section IV reports enrollment levels for these new and enhanced programs.
- Section V describes the internships implemented under the grant.
- Section VI summarizes student completion outcomes and employer satisfaction with Yavapai College graduates they hired.
- Section VII concludes the report with a discussion of post-grant sustainability and recommendations.

II. New Applied Pre-Engineering Programs

Both of the certificate programs created under the grant—ISET and Additive Manufacturing—were developed through a collaboration between the college and local employers to meet the employers' needs for skilled technicians in applied engineering or advanced manufacturing[4] and to provide students with additional educational degree pathway choices. While the ISET certificate was part of the grant application, the Additive Manufacturing certificate was an addition created during the grant period (as described in more detail below).

Each new certificate prepares students to obtain industry-recognized credentials (Exhibit 3). In the case of the ISET program, Yavapai is a testing center for FANUC robots, so students' testing fee is waived for the operator test.[5]

[4] Applied engineering and advanced manufacturing used synonymously in this report because both refer to the general process of taking raw materials and processing or engineering them into a final product.

[5] FANUC is one of the largest makers of industrial robots used in manufacturing facilities.

Exhibit 3. New Yavapai College Certificate Programs

CERTIFICATE PROGRAM	CREDIT HOURS	INDUSTRY CREDENTIALS	ASSOCIATED CLASSES w/ Embedded Industry Content
Integrated Systems Engineering Technician	24	HAAS CNC Operator HAAS CNC Tool Setter FANUC Robot Operator	CNC 101 – CNC Machine Operator CNC 102 – CNC Machine Setup CNC 201 – Computer Aided Programming for CNC Machining CNC 202 – 3-D Programming and Rapid Prototyping for CNC ELT 130 – Introduction to Robotics
Additive Manufacturing	19	CompTIA A+ CompTIA Network+	CNT 100– Computer Networking Technologies I CNT 115– Computer Networking Technologies II

Notes: HAAS and FANUC are equipment manufacturers that offer operator credential exams for their machines. CompTIA is an information technology industry association that offers professional credential exams.

ISET Certificate

As described in the introduction, the ISET certificate was created in response to local employers' stated need for job candidates with general training in advanced manufacturing. Another reason the college created the ISET certificate was to provide a pathway for students not interested in pursuing the Applied Pre-Engineering AAS degree. College faculty explained that the AAS degree prepares students to transfer to Arizona State University (ASU), and Yavapai needed another option that was focused on applied skills so that graduates would be prepared to work in industry. Therefore, the college designed the ISET certificate to be closely related to the Applied Pre-Engineering AAS degree.

Curriculum

The set of eight classes in the ISET certificate is designed to provide students with skills that prepare them for advanced manufacturing and mechatronics-related jobs, which require skills in applied engineering, electronics, and computer coding, as well as a general understanding of manufacturing processes. Five of the eight required ISET classes are also part of the Applied Pre-Engineering AAS curriculum.[6] The three additional classes—in CAD , manufacturing technologies, and robotic vision—provide students with practical manufacturing skills. The robotic vision class, which teaches students to use robotics that are visually-enabled, is a new class at the college. Yavapai developed the class to keep up with industry practices, which increasingly rely on vision-enabled robots to do sorting and inspection as part of the production process.

[6] The Applied Engineering AAS degree classes excluded from the ISET certificate are academic-oriented classes needed by students seeking a bachelor's degree in engineering (e.g., Calculus & Analytical Geometry; Physics).

High School Pathway

High school students can also obtain the new ISET certificate through the Career and Technical Education District's (CTED) Pre-Engineering program. Arizona has thirteen such districts, which provide high school students with the opportunity to earn college credit while still in high school. Yavapai College is part of the Mountain Institute CTED.

The Mountain Institute CTED Pre-Engineering program has eight classes, six of which are common with the ISET certificate curriculum. Therefore, students can take two additional classes to obtain the ISET certificate. In practice, many students transfer directly to ASU's engineering program and receive credit for the six classes they have completed. Half of the 10 high school students who were enrolled in the CTED Pre-Engineering program in the 2016 fall semester transferred to a four-year university in the spring 2017 semester.[7] As of fall 2018, no CTED students had obtained the ISET certificate—an outcome that is not unexpected, given that the program is a relatively new option for students.

Recruitment

Students in the ISET certificate program and the related Applied Pre-Engineering AAS program were recruited through the college's usual general outreach efforts, including advertisements, outreach to high school counselors, and an open house. During the annual open house, area high school students toured the CTEC facility, saw the equipment, and had an opportunity to operate some of the equipment.

As described above, high school students have participated in the closely-related CTED program. These students were recruited through the Mountain Institute, which recruits from seven area high schools, charter schools, and home schools. CTED staff conduct outreach annually to area high schools, meeting with guidance counselors to let them know about their 21 available programs (including the pre-engineering program); they also have an information booth open during school lunch hours so students can learn more about CTED programs. Yavapai's NSF grant goal was to enroll 50 high school students and 30 postsecondary students into the new ISET program.[8]

[7]Enrollment in the 2016 fall semester is defined as students who enrolled in the CTED Applied Pre-Engineering class MET 100 (Introduction to Manufacturing Technology).

[8] Students are considered enrolled in the ISET program if they (a) declared the ISET certificate between fall 2016 and spring 2019, *or* (b) enrolled in MET 100 (Introduction to Manufacturing Technology) between fall 2016 and spring 2019.

Additive Manufacturing Braided Internship and Certificate

The Additive Manufacturing braided internship and certificate, which were not part of the original grant plan, were created as part of an economic development effort by a local 3-D printing company and the City of Prescott's Office of Economic Development. The city approached the 3-D printing company in 2017 to offer support to the new business after it obtained a contract with a national retail chain. The company was interested in collaborating with the city to help with expansion, which required additional capital and hiring, as well as training of new production technicians.

Front (left) and back (right) of the custom 3-D printing equipment for the Additive Manufacturing braided internship program. Students learn to set up, network, disassemble, operate, and repair the machines.

The City of Prescott connected the company with professionals who could advise it on business growth and raising capital, and with Yavapai College to help train the new production technicians. The production technician responsibilities included setting up and disassembling custom 3-D printers, connecting machines to a computer network, running production jobs, doing routine maintenance and troubleshooting, and helping with sales as needed.

Yavapai College instructors worked with the company to create a two-semester curriculum for the braided internship. The curriculum trained students in 3-D printing, electronics, and computer networking competencies needed for the job. Students spent three days a week in class and two days a week working for the 3-D printing company (at an hourly wage of $14.75). Yavapai and the company were already familiar with each other because the company had hosted three Yavapai student interns (supported through the NSF grant) in stand-alone (i.e., not braided) internships during the fall 2017 semester.

Curriculum

The two-semester curriculum consisted of classes that were already offered at Yavapai, which allowed for a quick roll-out of the program in spring 2018. Because of the reviews and approvals needed within the college, it took somewhat longer (until fall 2018) to get the additive manufacturing certificate approved and for the program to appear in the academic

catalog. Two classes—3-D Printer Operation & Maintenance and Embedded Systems—were developed in coordination with the employer to ensure the curricula met their needs.

Students in the internship program reported during a focus group that they learned a great deal from classes on topics such as computer networking, electricity fundamentals, and 3-D printing. They also appreciated that there was overlap between the required classes for the Additive Manufacturing certificate and the Applied Pre-Engineering AAS degree (as well as other certificates and degrees at Yavapai). One of the students planned to pursue the Applied Pre-Engineering AAS after completing the certificate. The students also reported plans to get a professional certification in computer networking because their coursework prepared them for the exam.

Recruitment

Yavapai College and the City of Prescott recruited candidates for the braided internship program through advertisements on the college website, social media, and outreach presentations. In the first cohort, 90 applications were received for about 30 slots.[9] Interested candidates attended an orientation where they learned more about the program, completed an application and screening test, and participated in a group interview. The screening test assessed their basic knowledge in areas such as math and reading. One focus group participant described it as an easier version of the Armed Services Vocational Aptitude Battery, a test used by the U.S. military to asses readiness to enter the armed forces. Some candidates applied individually; they took the test and participated in an in-person interview at the 3-D printing company.

III. Enhanced Program Supports

In addition to supporting the creation of two new certificate programs, grant funds were used to enhance hands-on learning in Applied Pre-Engineering AAS classes and to support a career coach who advised students and conducted ongoing employer outreach. These enhancements, and their perceived value from the perspective of faculty and staff, are described in this section.

Hands-On Learning

Yavapai's CTEC programs have a tradition of hands-on learning that existed prior to the NSF ATE grant period and spans the its 35 programs. As one of the program staff explained, instructors are expected to spend about 60% of their instruction time in the lab setting because "the mind

[9]See City of Prescott (2018), *Prescott Economic Development 2018* (Retrieved from: https://issuu.com/raxxdirect/docs/prescott_ed2018-final_52518).

cannot forget what the hands have learned." Through the grant-funded initiative, Yavapai was able to enhance its approach to hands-on learning.

Through support from the grant, Applied Pre-Engineering faculty attended a day-long training that included a review of the key elements of effective PBL and practice sessions for applying these elements. The training helped faculty enhance their PBL approaches and learn new techniques.

Yavapai College purchased single-axis CNC mills with NSF grant funds (above). Students can use the mills to learn how to transform raw materials into tools or machine parts (right).

In interviews, faculty described how they have used PBL in their Applied Pre-Engineering classes. For example, one instructor added problems she learned about during discussions with representatives from local companies who toured CTEC lab facilities (e.g., using a robot to inspect the edges of an object). In addition, adding the Robot Vision class (developed with support from the grant) will allow Yavapai to eventually provide students the opportunity to obtain the associated industry certification. Yavapai already offers the first certification in the series of four. The certification related to robot vision is still in development by the robotics company.[10]

Equipment Enhancements

Through the grant, Yavapai was able to purchase three new CNC machines and thus increase the amount of time students can spend using the equipment during class. Prior to the grant, about five students shared one CNC machine. Now, on average, three students share one CNC machine.[11]

Several faculty members reported that the more favorable student-to-equipment ratio allows students gain more practical experience by using the machines on their own and applying concepts they have learned in class. Students now have more time to learn to make parts,

[10] The FANUC company plans to offer four certifications, and the third level includes robot vision competencies. Certifications 2, 3, and 4 are currently under development. See https://www.fanucamerica.com/CERT/fanuc-nocti-certifications-robotics-education.

[11] These ratios assume 15 students are in the CNC class. The pre-grant ratio was 15 students to three CNC machines; the post-grant ratio was 15 students to six CNC machines.

program the CNC machine (usually from a design they have created), monitor the machining process, and assemble the different manufactured parts. One instructor explained that more time with the equipment means students have more time to prepare for industry certification exams. Another said that having new machines is beneficial to students because they learn the newest systems—in an industry that changes quickly, this is an important advantage.

To access this equipment, students can take advantage of the open-lab hours. The CNC lab is currently open 12.5 hours per week, which is 7.5 hours fewer than the 20-hour goal. As described earlier, the college had difficulty recruiting staff to monitor the lab for a limited number of hours. One faculty member explained that students who cannot attend during current lab hours can work with faculty to schedule time.

Career Counselors

Grant funds helped support the CTEC career counselor and instructor, whose responsibilities included supporting students' career development, conducting ongoing employer engagement, and managing CTEC's internship and braided internship programs. On average, the career counselor met with four or five students each day and regularly conducted outreach to area businesses to learn about their skill needs. The counselor also taught a class called Career and Personal Development, which covered topics such as goal setting; evaluation of interests, skills, and values; and career planning and job search. The counselor has been an important part of CTEC's internship programs, finding internship slots and intern candidates for the slots (as described further in Section V).

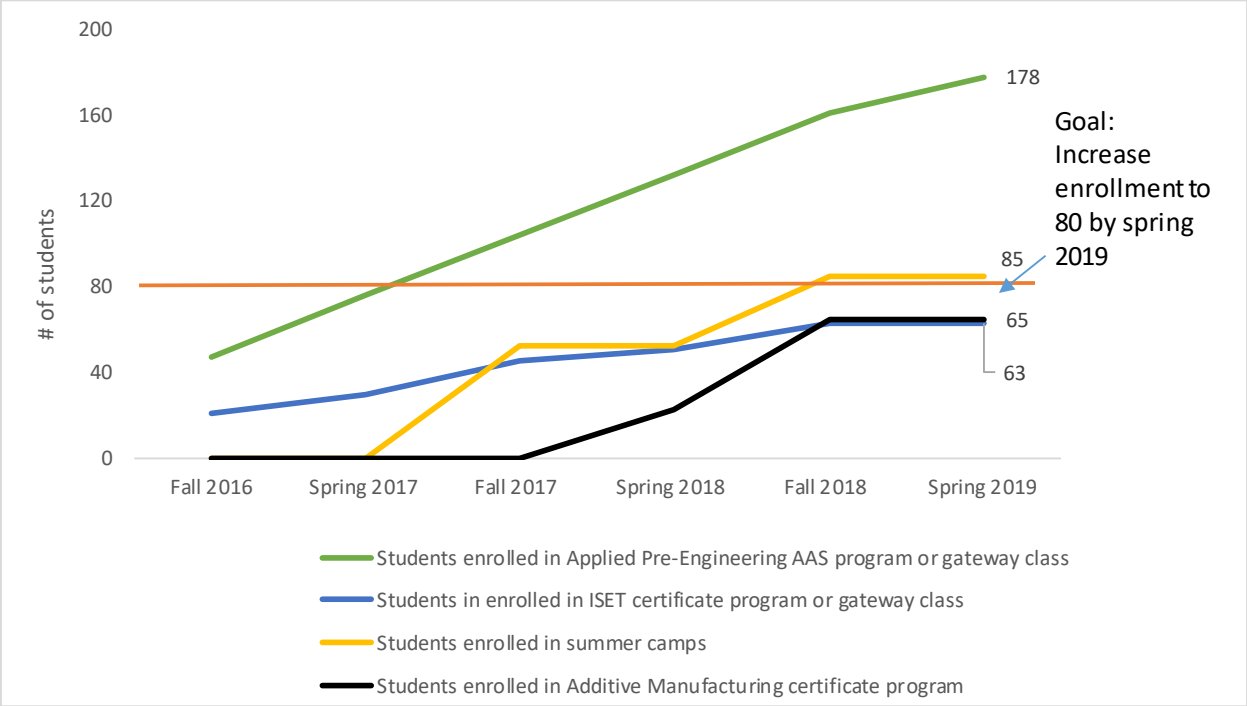
IV. Enrollment Levels

Enrollment in the newly created ISET certificate program and the enhanced Applied Pre-Engineering programs grew over the grant period, between fall 2016 and spring 2019. As depicted in Exhibit 4 below, as of spring 2019, 178 students enrolled in Applied Pre-Engineering programs during the grant period. This is more than twice the goal of 80.[12]

[12] Students were considered enrolled in Applied Pre-Engineering if they (a) declared the Applied Pre-Engineering AAS between fall 2016 and spring 2019 *or* (b) enrolled in ELT 130 (Introduction to Robotics) or EGR 102 (Introduction to Engineering) between fall 2016 and spring 2019. ELT 130 and ENR 102 are both required gateway classes for the Applied Pre-Engineering AAS degree. If we restrict the definition to just condition (a), the total drops to 118—still greater than the goal of 80.

As of fall 2018, student enrollment in the ISET certificate program was 63, or 79% of the goal of 80.[13] Enrollments are expected to grow over time as more students learn about this relatively new program. As of spring 2019, a total of 65 students had enrolled in the Additive Manufacturing certificate program.[14]

Exhibit 4. Enrollment in Applied-Pre Engineering Programs
Fall 2016 to Spring 2019



Source: Yavapai College Student Information System, February 2019.
Note: Totals are cumulative for each semester.

Female Student Participation Levels

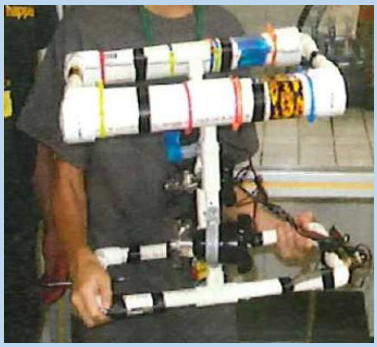
As described earlier, Yavapai is committed to increasing gender diversity in Applied Pre-Engineering. The college is three percentage points away from achieving the grant goal of 20%

[13] Students were considered to have enrolled in the ISET program if they (a) declared the ISET certificate between fall 2016 and spring 2019, *or* (b) enrolled in MET 100 (Introduction to Manufacturing Technology) between fall 2016 and spring 2019.

[14] Students were considered to be enrolled if they declared Additive Manufacturing as their major between spring and fall of 2018.

of AAS enrollments being female students (Exhibit 5). The percentage of female students has fluctuated between a low of 13% in fall 2017 and a high of 17% in spring 2019.

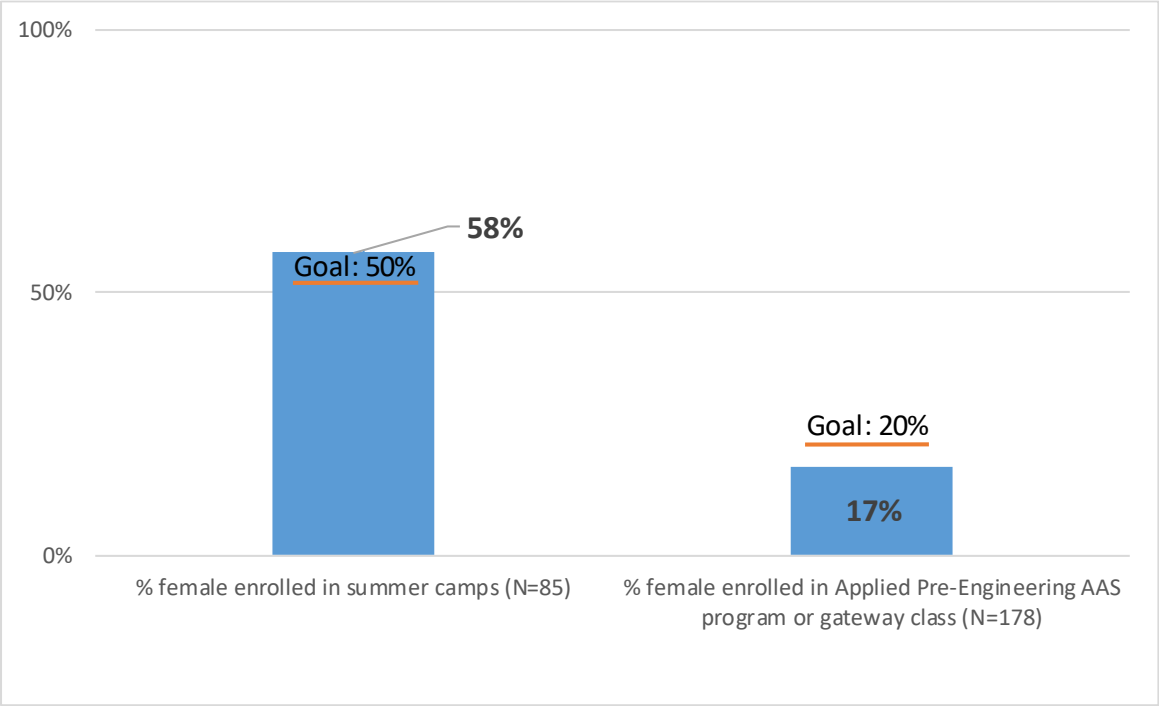
One of Yavapai's long-term strategies for recruiting women to its Applied Pre-Engineering programs is offering youth science summer camps. One is a girls-only camp for third- to fifth-graders called GEEK, or Girls Exploring Engineering Kamp, where campers learn about science and engineering and how to operate an industrial robot. The college offers another co-ed engineering camp for students in seventh to ninth grade called ROV (Remote Operated Vehicles). During the camp, children work in teams to design their own underwater ROV.



Student designed robot from the Remote Operated Vehicle summer camp.

As of spring 2019, the college exceeded its goal of having at least 50% female campers overall, with 58% girls. Each year, the college received more applications than they had slots for, according to the faculty camp coordinator. To accommodate everyone, the college created a priority list for the following summer that included the names of campers who had not been admitted. Interviews with faculty suggest the strategy is working: Two former campers (including one who is female) have since enrolled in Yavapai's CTED Pre-Engineering program.

Exhibit 5. Gender Diversity Outcomes



Source: Yavapai College Student Information System, February 2019.
Note: Data are cumulative over the grant period, fall 2016 to spring 2019.

V. Internships

In addition to supporting youth summer camps and the creation of new certificate programs, NSF funds supported the expansion of student internships. Between fall 2017 and fall 2018, a total of 71 students participated in internships with support from the NSF grant, greatly exceeding Yavapai's goal of placing 28 students in internships. Sixty-five of these 71 students were in the Additive Manufacturing braided internship program at the 3-D printing company described earlier. The remaining interns supported by the NSF grant were at four other companies in the region.

Internship Development

Between 2016 and 2018, Yavapai CTEC students—including those supported by NSF grant funds—participated in internships at 24 companies in the region. Establishing these paid internships with local companies was a multidimensional effort. First, the CTEC career counselor used a variety of strategies to identify employers interested in hiring Yavapai student

interns. He reached out to new companies in the region as well as existing contacts, and also attended regional economic development events.

The career counselor asked faculty to recommend students for internship slots and sometimes filled the slots with students who approached him directly. If a student was not a fit for an internship, the career counselor gave feedback about things to improve. Sometimes the career counselor had difficulty finding candidates because students were already working part-time jobs and did not want to work fewer hours (10 to 16 hours) at an often lower wage.

The college pays the interns using grant funds, which helps incentivize employers to host them at their companies. Initially, the college business office set up a process for paying interns directly. Employers reported interns' hours to the college each week, then the college issued paychecks. This process was challenging because of delays in reporting the hours worked. As a result, the college changed to a model where the employer paid interns directly and sought reimbursement from the college. Some employers withdrew from the program because they did not want to have to be reimbursed. Overall, however, the program director feels that the new system is an improvement because it has fewer steps and interns are paid without delays.

Intern Feedback

Interns who completed the survey and participated in the focus group were generally satisfied with their internship experience and valued the work experience gained and skills they learned.[15] They reported benefiting from their internship experience in several ways:

- **Interns valued the work experience because they learned new skills and thought it would make it easier to find a job in the future.** Survey respondents described new skills that included operating different versions of CNC machines, reassembling gear boxes, using spreadsheets to track work processes, and developing workplace communication skills. Some focus group respondents also thought the work experience gained would be enough to help them find a job. In contract, another respondent noted that he thought he would need a college degree in addition to this work experience in order to find a job.
- **Respondents reported that the internship experience helped them improve their problem-solving skills.** All surveyed interns strongly agreed this was the case. Similarly, focus group participants thought the experience of setting up and troubleshooting 3-D

[15] The evaluation team held a focus group with interns participating in the Additive Manufacturing braided internship (in fall 2018) and gathered feedback from interns with other companies via a survey (in fall 2017) and interviews (in fall 2018). The response rate to the survey was 100%. Appendix A provides more detail on the data collection methods.

printers also trained them to handle more generic problems they would encounter in other jobs.

- **Students reported that the internship increased awareness of workplace expectations and the interconnectedness of production processes.** For example, one survey respondent noted, "The workplace was not what I expected it to be, so that helped to prepare me." Similarly, a focus group respondent explained that "internships [are] really important for the coursework to become a reality," which he observed is especially important in less common occupations. Another survey respondent said that the experience helped him think more systematically about how his responsibilities on a given task related to the larger production process and his coworkers' responsibilities.
- **Survey respondents said they benefited from mentors' guidance.** One explained, "My mentors made me more careful and precise in my work." More than one appreciated the fact that mentors held high expectations throughout the internship. Tasks given to interns were relevant to their specific fields of study and made interns feel as though they were "not doing menial labor." In addition to individualized mentor support, interns reported that other workers made themselves available to provide help and answer questions.
- **Interns in the Additive Manufacturing braided internship appreciated the combination of work experience and related classroom instruction.** Respondents valued the intensity and breadth of the program (both the classes and work experience) and thought it made them more confident. They thought the classes were "terrific" and "challenging," and said they learned a lot, especially from the electrical class.

When asked if they had any suggestions for changes to the internship program, interns talked about the hours of the work. Their comments included a desire for "more flexibility in terms of how many hours need to be completed in a week" and a wish to work more hours. One mentor mentioned that additional hours for the internship would be beneficial for both students and companies. Respondents also suggested offering more internship opportunities to students.

Respondents with less prior knowledge of electricity suggested that it would have been helpful if the electrical class that was paired with the Additive Manufacturing internship was longer, because it was a lot of information to compress into a single semester. At the same time, a respondent with more prior knowledge of electricity concepts liked the pace.

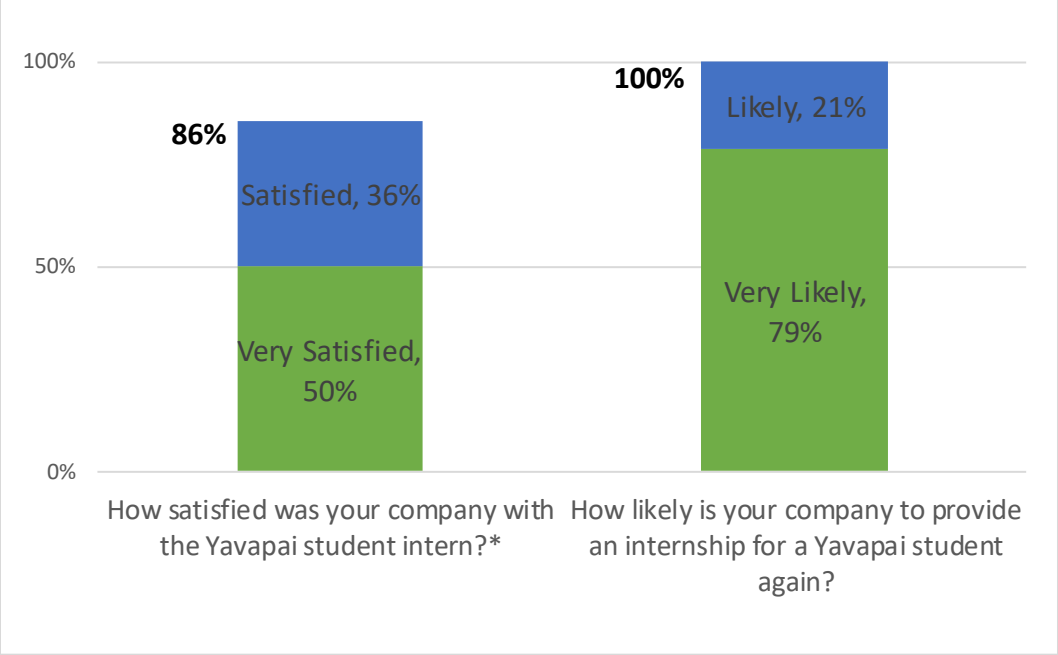
Others suggested that the college should promote internships more, noting that they are so beneficial to students. They also suggested that the college consider short-term (e.g., four-week) internships or a few days of job shadowing so students could get exposure to real-world experience.

Employer Feedback

SPR obtained feedback from internship mentors at employers hosting interns through interviews in fall 2017 and fall 2018. In addition, in March 2019, SPR conducted an online survey of 24 employers that had hosted a student intern from one of CTEC's programs between 2016 and 2019. Fourteen employers responded, yielding a 58% response rate. Four of these internships were supported by NSF grant funds; the other paid internships were supported by other grant funds. SPR decided to survey all employers that had recently hired interns in order to learn about general employer satisfaction with interns.

As shown below in Exhibit 6, surveyed employers reported positive experiences hosting internships. The vast majority (86%) were very satisfied (50%) or satisfied (36%) with Yavapai student interns they hired. All of the respondents (100%) said they would be likely or very likely to hire a Yavapai student for an internship again.

Exhibit 6. Employer Satisfaction with Yavapai Student Interns
N=14



Source: Employer Survey, 2019.
Notes: N=14; survey response rate was 58% (14/24)
*The remaining 14% (two responses) said they were "neither satisfied or dissatisfied" because the intern ended up not being a good fit for the company or dropped out of college.

SPR interviewed mentors who supervised interns supported through the NSF grant to learn why they had hired interns and to ascertain their perceptions of the interns' skill development.[16]

- **The primary reason local businesses chose to offer internships was to find well-trained job candidates.** As one mentor described, it's difficult for the company to find qualified candidates, and the internship served a recruitment and vetting process for hiring people. Employers liked recruiting interns from Yavapai because the related classroom training they received before starting the internship was very helpful.
- **Local businesses hired interns because of their expected contributions to the company**, and these expectations were generally met. As one mentor explained, the intern "has been a big help. We've been busy, and he's at a point now where he's able to help get the work done. He's become a valuable intern and employee." Another explained that the interns are energetic and enthusiastic, like to learn, and are fast learners.
- **The mentors all observed an increase in interns' knowledge and skill levels because of participating in the internship.** They saw improvements in the areas of soldering, assembling machines, building printers, and managing production using spreadsheets. This is consistent with the intern survey findings, where respondents described how the internship experience helped improve their technical skills.[17]

> "There is nothing better than having an [intern] that you can help shape and develop to your company's needs. It helps both the employee and the employer. Also getting someone with some basic knowledge makes it invaluable."
>
> —Employer

We also asked employers and mentors if they had any suggestions for improvement of the program. When suggestions were offered, they were less about changing the program and more about seeking to hire more interns, having them work more hours, and publicizing internship opportunities to more employers. Also, a few employers suggested that interns be provided with some soft-skills training in areas like attendance, punctuality, and professionalism.

[16] The evaluation team interviewed three mentors in late 2017 and two in October 2018. One of the 2018 interview respondents was the director of human resources who had some experience working with the interns. (The mentor originally scheduled for the interview was unable to attend.)

VI. Completion and Employer Satisfaction with Yavapai Graduates

As of spring 2019, Yavapai College had exceeded its goal of Applied Pre-Engineering students obtaining 126 degrees and industry-recognized credentials by the end of the grant period. These credentials are listed below in Exhibit 7. The majority (93%, 183/196) were industry certifications because they take less time to complete than a degree or certificate. Students usually obtain industry certifications after completing the relevant class. For example, after completing CNC 101 and CNC 102, students are prepared to take the exam for the CNC Operator and CNC Tool Setter certificates.

Exhibit 7: Applied Pre-Engineering Degrees and Industry Certifications Awarded Fall 2016 to Spring 2019

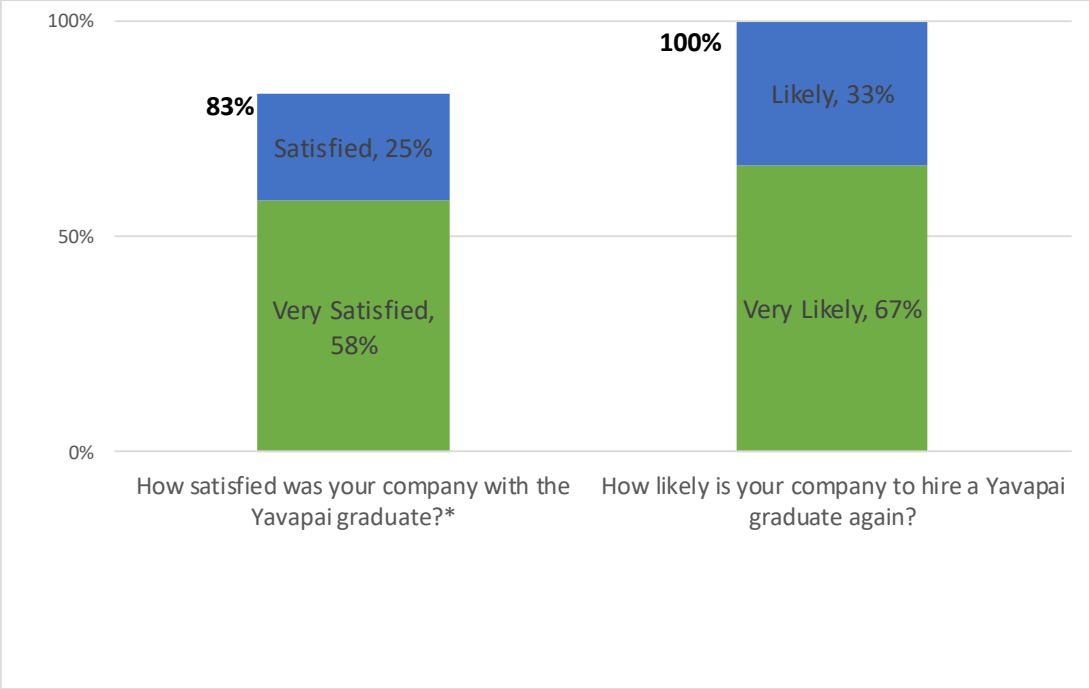
Outcome	Spring 2019 (Cumulative)
# of Applied Pre-Engineering AAS degrees awarded	9
# of ISET Certificates awarded	4
Subtotal degrees and certificates	13 (7% of 196)
# HAAS CNC Operator certificates	65
# of HAAS CNC Tool Setter certificates	44
# Electronic System Associate 1 (DC)	6
# Electronic System Associate 2 (AC)	6
# Electronic System Associate 3 (Semi-conductor)	4
# Electronic System Associate 4	31
# FANUC Robot Operator	19
# of Solid Works Associates	8
Subtotal industry certifications	183 (93% of 196)
Total number of degrees and industry-recognized credentials awarded	**196**

Source: Yavapai College Student Information System, May 2019.

Employer Satisfaction with Yavapai Graduates

Data on post-graduation employment were not available from Yavapai College because it was challenging to reach graduates after they leave the school. Therefore, as an alternative, in March 2019 SPR gathered feedback from area employers who hosted interns about their satisfaction with Yavapai CTEC graduates they hired between 2016 and 2019. As depicted in Exhibit 8, the majority of employers that hired graduates were very satisfied (58%) or satisfied (25%) with the graduates they hired, and 100% said they would hire a Yavapai graduate again.

Exhibit 8. Employer Satisfaction with Yavapai Graduates
N=12



Source: Employer Survey, 2019.
Note: N= 12 employers who hired a Yavapai graduate between 2016 and 2019; survey response rate was 58% (14/24).
* Remaining two responses were "neither satisfied or dissatisfied or dissatisfied" because the new hire left for a job that paid more or was not a good fit for the company.

The primary reasons these employers hired recent Yavapai graduates were their technical skills (75%, 9/12), knowledge about the industry (58%, 7/12), and non-technical attributes, like work ethic (42%, 5/12). Two respondents indicated that the candidates' experience in the industry was also a reason. The most common combination of qualities was technical skills and knowledge of the industry (4/12).

VII. Lessons Learned, Recommendations, and Next Steps

Both certificate programs created with support from the NSF grant—ISET and Additive Manufacturing—will continue beyond the grant period. However, the Additive Manufacturing program will eliminate the braided internship component because the 3-D printing company encountered some financial setbacks in late 2018 and can no longer host interns. The college also plans to offer youth summer camps for another season and will continue to fund paid internships using other grant funds, such as an Ethel Marley Foundation grant.

Key Lessons Learned

Key lessons learned by the college during the implementation of the grant activities include:

- **Partnerships with newly formed businesses can be risky.** Because of their experience with the 3-D printing company, which encountered financial difficulties and had to discontinue the braided internship program, the college will consider more carefully the financial health of a company before committing to a substantial project with an employer.
- **Intern payment should be streamlined.** Because it was challenging to pay interns in a timely fashion due to delays in obtaining information on the hours they worked, the college changed from paying interns directly to reimbursing the companies for what they paid interns. Shifting to reimbursing companies eliminated delays and reduced the amount of paperwork and correspondence for college staff.
- **The local municipality can be a valuable partner.** Collaborating with the City of Prescott's Office of Economic Development to identify companies interested in creating braided internships or other customized training solutions was a key factor in creating the Additive Manufacturing braided internship, and the college will continue its partnership with the City of Prescott.
- **Creating additional hands-on learning opportunities sometimes requires creative thinking about logistics.** The staffing of the CNC lab was a challenge during non-class hours because of difficulties finding qualified staff who will work a few hours a week. The college is considering options for creating a staff position to cover the lab and thus keep it open for longer.

Recommendations

With respect to continued expansion of Applied Pre-Engineering programs, a synthesis of recommendations from interns, employers, and Yavapai College staff suggests the following priorities:

- **Offer more WBL experiences.** Students valued real-world work experience that helped them learn what is expected on the job. Specific suggestions for WBL include providing more internships, including those with more hours, as well as internship-like opportunities (e.g., a few days of job shadowing or short-term internships). Also, job shadowing would allow CTED students (younger than 18) a chance to see what working in occupations is like.
- **Direct more resources toward community outreach, career counselors, and/or job developers.** Interview respondents perceived this was an area of need for several reasons. First, outreach will help identify more internship opportunities (including

braided internships) and WBL experiences. Second, a few employers observed that interns needed some soft-skills training in areas like attendance, punctuality, and professionalism, which could be provided by a career counselor. Third, one respondent suggested gathering input from the local business community—that is, organizations not on the industry council—to learn what skills they want for entry-level jobs and to supplement the feedback the college gets from the council. As he explained, "that balances the input from the active employers with ones that are not aware of the program."

- **Continue the practice of ongoing employer engagement at multiple levels**, which has contributed to the successful development of internships and braided internships. Yavapai College leadership, staff, and faculty regularly engage with business community, which has helped the college maintain and grow its network of employers, some of whom now serve on the Advanced Manufacturing Industry Council or host interns.

What's Next?

Yavapai College's commitment to ongoing employer engagement, which has been a key factor in its continued success in creating new programs, will continue beyond the grant period. For example, the college recently re-organized its Industrial Machine Mechanic AAS and converted it to the Advanced Manufacturing Technology (AMT) AAS. This change was motivated in part by the college's experience developing the ISET certificate, where they learned about the importance employers place on having a general manufacturing degree. The new AMT AAS includes several CNC and electrical classes, which employers identified as an important component to a general manufacturing knowledge base. The additional CNC machines purchased with NSF grant funds will enhance the newly created AMT AAS because the lower student-to-machine ratio will also benefit these students.

The college also has plans to further engage local employers about internship opportunities by hosting an internship conference in the Prescott region, like the one the Verde Valley Campus hosted in August 2018. It is designed to introduce employers to internships, internship candidates, and the process for having the college pay interns. Additionally, the college is exploring another partnership with the City of Prescott and a company that is considering opening a new manufacturing facility in the region. Finally, the college plans to continue its efforts to obtain grant funds to help with internships. Together, these efforts are expected to continue Yavapai College's tradition of providing hands-on learning experiences and to prepare students to work in advanced manufacturing jobs and/or transfer to four-year universities.

Appendix A:
Methodology

Research Questions

The primary research questions that guided this evaluation were:

1. To what extent did the initiative meet its 12 outcome goals, including enrollment and education attainment goals?
2. How were the components of the initiative implemented?
    - How were the new certificate programs (i.e., Integrated Systems Engineering Technician and Additive Manufacturing) implemented?
        - How were (secondary and postsecondary) students recruited for these new programs?
    - How were the hands-on learning experiences of students enhanced?
    - How were internships and braided internships developed during the grant period?
3. What lessons were learned during the initiative's implementation?

Data Collection

The evaluation team collected data from three groups—program staff, employer partners, and students—using interviews, surveys, and a site visit to learn about how grant activities were implemented. The evaluation team also obtained student-record data about enrollments and completions from the college to measure the extent to which the college was achieving its target outcome goals (listed in Appendix B).

Interviews

The evaluation team interviewed the project director, college faculty who were involved in teaching Applied Pre-Engineering classes and/or developing classes for the new certificate programs, and career counselors. A total of 12 faculty interviews were conducted—seven by phone in 2017, and five during a site visit in 2018. Four of these faculty were interviewed twice. All invited faculty participated in their interviews, except one who could not attend the second interview because of a scheduling conflict.

The evaluation team also conducted five interviews with internship mentors at companies where interns were being supported by the NSF grant. In 2017, SPR conducted phone

interviews with all three companies hosting NSF supported interns. During a 2018 site visit to Yavapai College, SPR staff interviewed representatives of two companies that hosted Yavapai interns. One company was supported by the NSF grant; the other was selected by Yavapai College staff because of its proximity to the college. All invited mentors agreed to participate in the interviews.

SPR also invited two project partners to participate in an interview: (1) the Mountain Institute, which oversees the Yavapai Pre-Engineering program for high school students, and (2) the City of Prescott's Office of Economic Development. However, the City of Prescott did not respond to the request for an interview. Therefore, SPR staff relied on information from a City of Prescott annual report.

Surveys

SPR conducted three surveys during the three-year grant period. In May 2017, SPR conducted an online survey of faculty who participated in the PBL professional development training. The response rate to the survey was 33% (3/9). In December 2017, SPR conducted a survey of student interns. The survey was distributed in person by college staff and yielded a 100% response rate (6/6). Because of the small number of responses to these surveys, results are not reported quantitatively, but the responses to open-ended questions were analyzed to supplement the interview and focus group data.

In March 2019, SPR conducted an online survey of all 24 employers who had hosted Yavapai student interns between 2016 and 2019. SPR decided to survey all employers who hired Yavapai interns in the three-year period (not just the four that hosted interns supported by NSF) to learn about general employer satisfaction. Fourteen employers responded to the survey, yielding a response rate of 58%.

Administrative Data

SPR requested student-record data from Yavapai College to measure the outcomes outlined in their NSF grant application. Broadly speaking, the outcomes are related to enrollments and degrees awarded in the ISET certificate program, the Applied Pre-Engineering AAS program, and the Additive Manufacturing certificate program. Staff at Yavapai College provided SPR with data each semester during the grant period, and SPR produced an outcomes report each semester so the project director could assess the extent to which the college was meeting its goals.

Document Review

SPR staff reviewed Yavapai's NSF grant application, Yavapai's academic catalogs, and other program-related documents, such as recruitment materials, the Additive Manufacturing recruitment presentation, and de-identified summer camp attendance records.

Site Visit

A member of the evaluation team conducted a one-day site visit to Yavapai College in 2018 to learn about the grant implementation. The site visit included:

- A tour of the CTEC facility, including observing the CNC equipment, the Additive Manufacturing 3-D printing equipment, and other related equipment;
- Interviews with the project director, career counselors, and faculty who teach Applied Pre-Engineering classes and/or who developed classes for the new certificate programs;
- Interviews with internship mentors who were selected by program staff because they were involved in the Additive Manufacturing braided internship or their facility was close to the CTEC facility (to minimize drive distances for the evaluation staff); and
- A focus group and interview with five interns who were selected by the career counselor.

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Appendix B: Goals of Yavapai College's Engineered for Success Grant

Exhibit B1. Goal 1 Outcomes

Goal 1: Yavapai College will produce more qualified engineering technicians to meet workforce demand.							
Objective	Description of Goal	Outcome	Fall 2016 (cumulative)	Spring 2018 (cumulative)	Spring 2019 (cumulative)	*Goal*	*% of Goal Met as of Spring 2018*
1.1	Increase enrollment in Applied Pre-Engineering by an additional 20 students by spring 2018	**# enrolled in Applied Pre-Engineering AAS program or gateway class**	**47**	**132**	**178**	***80***	***Goal exceeded (223%)***
1.2	Establish new ISET certificate program, with 80 students (50 secondary and 30 postsecondary) by fall 2018	**# enrolled in ISET certificate program or gateway class**	**21**	**51**	**63**	***80***	***79%***
		# of CTED students enrolled in ISET or gateway class	10	15	22	*50*	*44%*
		# of non-CTED students enrolled in ISET or gateway class	11	36	41	*30*	***Goal exceeded (137%)***
		% of female students enrolled in ISET or gateway class	9% (1/11)	6% (3/51)	5% (3/63)	*na*	*na*
		# enrolled in Additive Manufacturing certificate program or gateway class	na	23	65		*na*
1.3	Provide two robotics camps each summer for 20 middle school students each, with at least 50% female participation.	**# enrolled and % female in summer camps**	**na**	**48% (25/52)**	**58% (49/85)**	***50% (40/80)***	***Goals exceeded (116%, 58/50, and 106%, 85/80)***

Exhibit B1. Goal 1 Outcomes (Continued)

Objective	Description of Goal	Outcome	Fall 2016 (cumulative)	Spring 2018 (cumulative)	Spring 2019 (cumulative)	*Goal*	*% of Goal Met as of Spring 2019*
1.4	Increase the number of total industry-recognized credentials, certificates, and degrees awarded to Applied Pre-Engineering students by 20%, to 126 (baseline is 105)	**# of degrees and industry-recognized credentials awarded**	**2**	**96**	**196**	***126***	***Goal exceeded (155%)***
		# Applied Pre-Engineering AAS degrees awarded*	2	8	9	*na*	*na*
		# of ISET certificates awarded	0	4	4	*na*	*na*
		# HAAS CNC Operator certificate awarded	na	30	65	*na*	*na*
		# of HAAS CNC Tool Setter certificates awarded	na	34	44	*na*	*na*
		# Electronic System Associate 1 certificate (DC)	na	3	6	*na*	*na*
		# Electronic System Associate 2 certificate (AC)	na	3	6	*na*	*na*
		# Electronic System Associate 3 certificate (Semi-conductor)	na	4	4	*na*	*na*
		# Electronic System Associate 4 certificate	na	1	31	*na*	*na*
		# FANUC Robot Operator	na	1	19	*na*	*na*
		# of Solid Works Associates	na	8	8	*na*	*na*
1.4	Alternative measure to degrees awarded	**# of transfers to four-year institutions, and not awarded an AAS or certificate**	**1**	**23**	**25**	***na***	***na***

Exhibit B2. Goal 2 Outcomes

Goal 2: Improve engineering technician education (technical skills and general STEM preparation) and success by implementing new instructional approaches and student support services.							
Objective	Description of Goal	Outcome	Fall 2016 (cumulative)	Spring 2018 (cumulative)	Spring 2019 (cumulative)	*Goal*	*% of Goal Met as of Spring 2019*
2.1	Increase the relevance of engineering technician education by incorporating PBL into ISET courses; at least 60% of students will participate in PBL each semester	**# of students enrolled in Additive Manufacturing classes.**	*Data collection for this measure began in spring 2018*	42	65	*48 (60% of 80 ISET enrollments)*	***Goal exceeded (135%)***
2.2	Increase student's experiential learning through participation in internships	**# of Applied Pre-Engineering and ISET students placed in internships**	na	32	71	*28 (7 per semester for 4 semesters)*	***Goal exceeded (253%)***
		# of available internships.	na	32	71	*na*	*na*
		# of businesses providing internships for Applied Pre-Engineering and ISET students	na	3	5	*na*	na
2.3	Increase students' experiential learning through increased access to equipment	**Student-to-CNC-mill ratio**	na	2.5 to 1	2.5 to 1	*3 to 1*	***Goal exceeded: There are 6 CNC mills to be shared among 15 students (ratio = 2.5 to 1).***
		CNC open-lab hours	na	12.5 hours per week	12.5 hours per week	*20 hours per week*	***63%***

Exhibit B2. Goal 2 Outcomes (continued)

Goal 2: Improve engineering technician education (technical skills and general STEM preparation) and success by implementing new instructional approaches and student support services.							
Objective	Description of Goal	Outcome	Fall 2016 (cumulative)	Spring 2018 (cumulative)	Spring 2019 (cumulative)	*Goal*	*% of Goal Met as of Spring 2019*
2.4	At least 80% of students will obtain a Platinum or Gold rating on the ACT National Career Readiness Certificate (NCRC)*	**% of students earning Platinum or Gold NCRC certificates**	*Data collection for these certificates began in spring 2018*	67% (4/6)	75% (6/8)	*80%*	***94%***
		% earning Platinum or Gold on applied math		100% (6/6)	100% (8/8)		
		% earning Platinum or Gold on locating information		100% (6/6)	100% (8/8)		
		% earning Platinum or Gold on reading for information		67% (4/6)	75% (6/8)		
2.5	At least three instructors per academic year will participate in professional development activities, and all will make changes to teaching practices or curriculum as a result	**# of faculty participating in professional development and making enhancements to teaching practices and/or curriculum**	0	12	12**	*9 (3 per academic year for 3 years)*	***Goal exceeded (133%)***

*These scores are as of fall 2018 because spring 2019 scores were not available in time to include in the final evaluation report.

**Six Applied Pre-Engineering or ISET instructors participated in PBL training on May 10, 2017; In spring 2018, three instructors participated in creating the customized courses for the 3-D printing company, and another three will participate in summer 2018.

Exhibit B3. Goal 3 Outcomes

Goal 3: Improve engineering technician education by increasing industry engagement.							
Objective	Description of Goal	Outcome	Fall 2016 (cumulative)	Spring 2018 (cumulative)	Spring 2019 (cumulative)	*Goal*	*% of Goal Met as of Spring 2019*
3.1	Yavapai College will match applied engineering and advanced manufacturing training to industry needs and improve student job placements by 16% by end of grant period	**Job placement rate among Applied Pre-Engineering and ISET enrollees**	na	0	na	*na*	*Data not available to estimate goal*
3.2	Yavapai College will develop an industry council consisting of at least four local businesses to provide input into engineering technician and advanced manufacturing training	**# of employers on the industry council**	na	7	8	*4*	***Goal exceeded: The industry council has been established with 8 employers.***