PROJECT SUMMARY

Overview:

Bridgerland Technical College seeks funding for the Scaling Up Utah's Automated Manufacturing Technician Pipeline (SUUAMTP) project which aims to design a second iteration of our successful Automated Manufacturing STEM Academy (AM STEM) program and then delivering professional development to allow the program to be scaled to other technical colleges in the state. To reach this end, we plan to: (1) design an improved version of our current program suitable to adaption or adoption at other two-year colleges; (2) revise and enhance the curriculum in order to accurate reflect industry demands and changes to the technology; (3) recruit and retain a cadre of students at the college and high school levels; (4) create and pilot test a professional development model for facilitators at other colleges and high schools so that they will be able to effectively integrate the program into their curriculum; and (5) examine our project with qualitative and quantitative data to make informed decisions about the optimal implementation of our work.

Intellectual Merit:

Utah is experiencing a critical shortage of skilled technicians in advanced manufacturing due, in part, to the abundance of large and small industries which continue to automate their facilitates statewide and the limited number of advanced manufacturing programs which are able to adequately educate and prepare future technicians for the workforce.

In addition to creating an innovative pipeline of high school students into advanced manufacturing to support the economy, this project will provide a refined prepackaged curriculum and programmatic resources that could be easily shared anywhere across the state or nation. The project will serve as a model on how applied technical colleges and secondary schools can collaborate through learning management systems to simultaneously prepare participants with high paying jobs and/or a pathway towards college. We will also develop and implement a professional development model that will reveal the strategies and protocol that will best serve high school and college faculty as they adapt the advanced manufacturing program at their own institutions. We anticipate that the expected outcomes and findings will offer the educational community an insight as to how to build a blended learning environments comprised of learning management systems with high levels of hands-on training.

Broader Impacts:

We are confident that the proposed project will make a significant impact on the capacity and quality of advanced manufacturing technicians statewide. We foresee that this project will directly impact high school and college students, Bridgerland Technical College, the Utah System of Technical Colleges, and our industry partners. The benefits to students will be: (1) improved curriculum, (2) higher retention rates, (3) access to a pathway into a career into automated manufacturing and robotics, and (4) strong connections to local industry leaders. The benefits to the College will be: (1) improved curriculum, (2) new branding of recruitment strategies, (3) enhanced tracking/retention, (4) advanced leadership development in project management/grant writing, and (5) a pathway for the College to become a regional training leader in automated manufacturing. The benefits to the Utah System of Technical Colleges will be: (1) a pilot of curriculum development and collaboration across technical colleges, and (2) a mechanism of how to share and scale best practices across the State of Utah. The benefits to industry partners will be: (1) growing number of students pursuing careers in automated manufacturing, and (2) a curriculum more reflective of industry needs.

PROJECT DESCRIPTION

PRIOR NSF SUPPORT

Bridgerland Technical College has no prior NSF Support. The college is a participant in the Mentor Connect project.

MOTIVATING RATIONALE

Manufacturing is the foundation of the Utah economy, but many Utah manufacturers are having difficulty finding enough highly skilled technicians, putting Utah's economic prosperity at risk. Manufacturing is the fourth largest employment sector in Utah. In 2016 manufacturing accounted for 9% of total employment, approximately 126,000 jobs and $7,000,000 in wages (11% of all wages in the State of Utah). Unlike the first, second, and third largest employment sectors (Retail Trade 12%; Health Care & Social Assistance 11.5%, and Education 10.5%), Utah manufacturing is considered a basic industry and provides goods and services that are sold outside of the region. Instead of just recycling the same monies, manufacturing brings dollars into the state that would not be there otherwise, causing a multiplying effect on all other economic sectors. The Utah Department of Workforce Services (UDWS) calculated this multiplier effect to be 1.3 over a five-year period. This means that for every three manufacturing jobs created, a fourth job is added to the Utah economy. There are three key factors causing a critical shortage in manufacturing technicians in Utah: a strong economy, a robust transition to automated manufacturing, and a small pipeline of high school students.

Utah's economy is one of the strongest in the United States which creates demands upon available labor. Utah currently boasts the 12th best unemployment rate in the United States at 3.5% (BLS, 2017). Often economists equate low wages with a business's inability to find sufficiently qualified personnel, but this is not the case with Utah manufacturing. In 2015 UDWS conducted a survey and found that only two of Utah's employment sectors offered wages above the national average. One of those high wage sectors was manufacturing. Despite offering wages above the national average, Utah companies are struggling mightily to find enough highly skilled automated manufacturing technicians.

In addition to having an expanding base of manufacturing companies, Utah is attracting new business. Utah has been listed by Forbes as the number one state for new business for six of the last seven years (Forbes, 2016). Utah's friendly business atmosphere, population growth, and strategic location is generating significant growth in manufacturing and distribution. UDWS also projects an additional 2,000 manufacturing jobs needed each year for the next 10 years to satisfy demand. For example, Amazon announced a new 855,000 square foot distribution center in Utah, which will generate over 1,500 jobs. Many of these jobs will require automated manufacturing and robotics skills. Niagara Bottling LLC., a water bottling company, has recently completed a new production plant in Brigham City, Utah where they need to fill 111 manufacturing jobs immediately. Amazon, Niagara, and other companies' success will be dependent upon having enough highly skilled technicians in the workforce.

To further exacerbate the gap between employee supply and demand, current manufacturing operations in Utah are quickly becoming more and more automated. JBS, a meat packing plant,

recently invested $100 million in automating the packaging side of their facility. Even small companies like Casper's Ice Cream (200 employees) have recently invested about $35 million in automating their ice cream sandwich lines, allowing them to produce around 400 sandwiches per minute instead of 150. This movement from old manufacturing to automated manufacturing across the state requires a different set of technical skills than the current workforce possesses.

Other companies are expanding automated manufacturing lines. For example, a massive part failure at Takata, the largest supplier of airbags in the world, has led to tremendous growth in Utah. Autoliv, the largest employer in Northern Utah, has seven fully automated manufacturing facilities to supply airbags. During 2016-2017, Autoliv's Tremonton facility had to break ground twice to expand their production to meet the demand for replacement airbags.

In 2016, UDWS conducted a report titled "Career and Technical Education in Utah" that illustrated that Utah is suffering from a skills gap in manufacturing (Schroeder, 2016). UDWS reported that "Production/Manufacturing" was the third largest occupational group with the most job openings with 29,795 manufacturing jobs open in the state in 2016 (Schroeder, 2016). During the same month in 2016, all eight Utah technical colleges graduated a total of merely 22 technicians in Industrial Automation & Maintenance and Manufacturing Operations. Sadly, this immense discrepancy was not out of the ordinary. From 2010 to 2016, the combined yearly total for manufacturing certificates across the eight Utah technical colleges was 20 graduates per year. This significant gap between workforce demand and the modest supply of skilled technicians from all the technical colleges is the foundation of this project.

OUR INITIAL WORK TO ADDRESS THE NEED FOR SKILLED TECHNICIANS

In 2016, Bridgerland Technical College (Bridgerland), a competency-based, employer guided technical college in rural northern Utah, started the High School Automated Manufacturing STEM Academy (AM STEM). Bridgerland's Industrial Automation and Robotics program has been providing advanced technical education to college students and industry for over forty-five years. The goal of the AM STEM program was to design an innovative way for high school students to become advanced manufacturing technicians (NASEM, 2017). By enrolling them into Bridgerland's program while still in high school, students are able to earn an employable certification for employment shortly after graduation.

The AM STEM program established a partnership between Bridgerland Technical College, the four northernmost Utah K-12 school districts (Box Elder School District, Logan School District, Cache County School District, and Rich School District) and our local industry partners (Orbital ATK, Boeing, Autoliv, Pepperidge Farm, Post Holdings, Nucor Steel, Liberty Foods, Schreiber Foods). Together they designed the AM STEM program. School districts shared their resources (classroom space and faculty). Bridgerland provided curriculum and faculty experts. Local industries supplied scholarships, internships, and ultimately, full time jobs for students completing an industrial automation 900 hour or higher certification.

Since the fall of 2016, Bridgerland instructors have been broadcasting their advanced manufacturing curriculum each week day live at 7:00 a.m. over the Utah Education Network to eight participating high schools. In addition to the live interactive broadcast, high school students were added to Bridgerland's custom designed coursework in their learning management system

(LMS) Canvas. Within the Canvas courses, students engaged in supplemental work, formative assessments, labs, and hands-on summative assessments to track their progress and competency. Lab equipment, furnished by Bridgerland, has been placed in each high school. Students complete requisite hands-on labs at their respective high schools on lab equipment designed and built by Bridgerland. Hands-on industry-relevant labs comprise approximately 75% of all curriculum. Students explore the topics of 3D Modeling, Electronics, Microcontrollers, Industrial Robotics, Workplace Safety, Fluid Power Pneumatics, Electric Motor Controls, and Programmable Logic Controllers. The curriculum contains eleven major courses typically covered in a two-year timeframe and when completed will result in 630 college approved course hours toward a 900 or higher certification.

High school Career and Technical Education (CTE) teachers at each location have been hired by Bridgerland for one hour a day to facilitate instruction at each school. High school facilitators are required to attend paid training for two weeks at Bridgerland each summer, where they expand their knowledge regarding the updated curriculum and pedagogy. After the two-week summer training, teacher facilitators receive additional professional development and support via daily broadcast, site visits, and troubleshooting web conferences with Bridgerland faculty.

Upon completion of the certification, students are immediately eligible for internships or full time employment, and have opportunities for additional education. Autoliv, for example, has created a limited internship for students completing a 900 hour certificate with a starting salary of $15.00 per hour. This internship opportunity provides valuable real world experiences in addition to covering full tuition for continuing education in an applicable field. Other local companies also provide tuition reimbursement and actively encourage additional education by tying raises and promotions to education.

The AM STEM Certificate can apply 30 credits toward an Associate of Applied Science (AAS) degree at Utah State University (USU). As of August 2017, there is a direct pathway from the AAS degree to a Bachelor's of Science in Technology Systems with an emphasis in manufacturing control systems at USU. In addition to the 30 transferable credits, upper level industrial robotics and automation courses taught by Bridgerland have been articulated for up to 12 credits towards the USU bachelor's degree. Weber State University also applies 25 credits toward their AAS degree in control systems upon certificate completion. Students have increased levels of opportunity at each of these pathway levels.

The AM STEM program has led to large increases of high school enrollment as well as certification completion. From 2009 to 2015 Bridgerland averaged just 3.3 high school students per year (See Table 1). After establishing the AM STEM program, we have brought that yearly average up to 148 in our first three years (See Table 1). That is over a 4300% increase in high school attendance. What is really exciting is that we are still growing. From the first to second year of AM STEM, Bridgerland grew from 117 to 142 (21% increase) and then from 142 to 185 (30% increase) in the third year.

Table 1. Increase of Bridgerland Automated Manufacturing High School Enrollment

School Year	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018
HS Total	3	5	2	2	0	8	117	142	185

It is important to note that this increased high school enrollment has also led to an increase in certificate completion (900 hour certificate). These students are not only gaining high demands skills in the high demand area automated manufacturing and robotics but they are also persisting after high school to complete Bridgerland industry recognized certificates (See Table 2). For many, they are also continuing their coursework in order to earn an associate or baccalaureate degree.

Table 2. Increase of Bridgerland Automated Manufacturing Certificate Completion

School Year	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017
Total	3	3	3	3	8	9	9	53

While this program has provided many students with a pathway to college and significantly enlarged the pipeline of highly skilled manufacturing/robotics workers, it has not completely fulfilled demand. There are issues with curriculum, retention, and recruitment that need to be resolved in order for Bridgerland to satisfy the current and future demand for automated technicians in Northern Utah.

In April of 2017, the USTC held its annual conference in which a presentation was made about the success of the AM STEM academy. All of Bridgerland's sister institutions have since requested help in establishing the AM STEM Academy at their respective institutions. There have also been many requests made by several rural K-12 school districts and higher education institutions in and out of the State of Utah. We are extremely excited about the prospect of helping other institutions. However, the challenges we have encountered must be resolved before we are able to help others.

OUR PROPOSED PROJECT

Our work on the AM STEM project will serve as a launching pad for our proposed project, *Scaling Up Utah's Automated Manufacturing Technician Pipeline* (SUUAMTP). During the proposed project, we plan to: systematically revise curriculum that best reflects industry needs, create and formalize effective recruitment and retention strategies, develop and test a professional development model so that SUUAMTP can efficiently and effectively make its way to other institutions, and ultimately increase the number of highly-skilled technicians statewide.

GOALS, OBJECTIVES, AND EXPECTED OUTCOMES

The goal of the *Scaling Up Utah's Automated Manufacturing Technician Pipeline* program is to increase the quality, capacity, and, especially, the quantity of the next generation of skilled

technicians in advanced manufacturing. To reach this end, the project plan has the following objectives and expected outcomes (See Table 3).

Table 3. Objectives and Outcomes

Objectives	Expected Outcomes
Objective 1: **Increase the amount of formalized instruction embedded in courses from 20% to 100%.**	**1.1** At the end of year 1, create and embed audiovisual lectures and project modeling for five Canvas courses. **1.2** At the end of year 2, create and embed audiovisual lectures and project modeling for six Canvas courses.
Objective 2: **Increase the number of rubrics for hands-on labs to 100%.**	**2.1** At the end of year 1, include well-designed industry-centered rubrics for all lab assignments in five Canvas courses. **2.2** At the end of year 2, include well-designed industry-centered rubrics for all lab assignments in six Canvas courses.
Objective 3: **Increase high school student participation in the Program by 10% each year.**	**3.1** At the end of year 1, ten new high school students will participate in the program. **3.2** At the end of year 2, twenty new high school students will participate in the program.
Objective 4: **Increase underrepresented population participation in the program by 20% per year**	**4.1** At the end of year 1, we will increase female participation by 5 students from the previous year **4.2** At the end of year 2, we will increase female participation by 7 students from the previous year
Objective 5: **Decrease student attrition during the program by 20%.**	**5.1** At the end of year 1, the "within high school" attrition rate of students will be improved by 5% (<15% attrition from beginning to end of school year). **5.2** At the end of year 2, the "within high school" attrition rate of students will be improved by 5% (<10% attrition from beginning to end of school year).
Objective 6: **Increase the number of participants who are retained after high school and complete certificates by 30%.**	**6.1** At the end of year 1, the "after high school graduation" retention rate will be improved to 40 %. **6.2** At the end of year 2, the "after high school graduation" retention rate will be improved to 50%.
Objective 7: **At the end of each academic year, facilitator affective support rating will be at 80%.**	**7.1** At the end of year 1 and 2, all high school teachers will rate professional development support and facilitation at 80% effective.
Objective 8: **Increase Bridgerland's capacity to deliver professional development to current high school facilitators from within and without our area.**	**8.1** At the end of year 1, 75% (6 of 8) teacher facilitators will be able to complete the summative course tasks with 80% accuracy. **8.2** At the end of year 2, 88% (8 of 9) teacher facilitators will be able to complete the summative course tasks with 80% accuracy.

ACTIVITIES

At the heart of this project are four activities that will guide us in our work. They are: Curriculum Revision, Recruitment, Retention, and Professional Development.

I: Curriculum Revision - *Promotes expected outcomes of Objectives 1 & 2*
Upon review of the AM STEM program, it became apparent that the curriculum as designed would inhibit scalability. Issues with specific class curricula such as: lockstep teacher-centered curriculum, limited audio visual demonstrations, and inadequate rubrics, directly influenced significant student attrition during the first year (from 117 to 87 students). The program was initially designed with a morning broadcast lecture over the Utah Education and Telehealth Network (UETN). After the first year, teachers and students reported that this "lockstep" structure was frustrating and ineffective. Students were moving at their own pace which led to inattentiveness during the broadcasted lectures. The lack of recorded lectures left the students with knowledge gaps if they missed a broadcast day. When the high school facilitators were unable to fill those knowledge gaps or handle misconceptions, students began requesting "make-up" lectures from Bridgerland staff, which at this scale was untenable.

For the second year of the AM STEM Academy, teachers at Bridgerland began capturing video for all formalized instruction and models of hands-on labs and then uploading them to the LMS. However, we have only been able to redesign two of the eleven core classes. Students and high school facilitators have been very pleased with the transition to audiovisual lectures which have allowed students to move at their own pace, review or make-up missed lecture work, and watch clear modeling for project-based work. Additionally, high school facilitators are now able to handle more misconceptions with a repository of instruction. However, we have not yet moved all eleven core courses to this new instruction model. We must transform the remainder of the courses in order to effectively deliver the content at scale. We will also move troubleshooting discussion from the broadcast and embed them directly into Canvas using Webex and CirQLive.

Rubrics for hands-on labs have been another curricular challenge inhibiting the potential for scalability. Effective and complete rubrics are comprised of three key ingredients: evaluation criteria, quality definitions, and the scoring levels/strategy (Popham, 1997). Our current rubrics are missing one or more of these essential ingredients. Uniformity and the quality of high school teachers grading of student work continues to be a challenge. We have seen some progress in this area as high school teachers take on more of a facilitator role and are able to address student misconceptions; however, there is still much work needed in this area. With improved rubrics students will be able to navigate different types of problem solving tasks with much more success and teachers will be able to more effectively handle curriculum and technical questions that arise (Andrade, 2000).

Meeting Curriculum Objectives: Under the proposed project, we will redesign the current curriculum so that it is more student-centered and student paced. As in the two courses that we have redesigned already, we will be capturing and uploading formalized instruction into the Canvas LMS courses. Professors Fuller and Danielson (Co-PIs) will bear the major responsibility to revise and update the curriculum. Their expertise along with their strong connections to advanced manufacturing industry leaders will be instrumental in guaranteeing that

the content in the courses is high-quality, industry relevant, and responsive to the pedagogical approaches that are most effective with the target student participants.

We will also hire a part time instructional designer to take on the task of redesigning the Canvas LMS courses so that formalized instruction is embedded into the course content. The instructional designer will work with Bridgerland professors and industry experts to design well-detailed rubrics for each lab that are industry relevant and appropriate. We anticipate that the curriculum developed and implemented during this project will provide students with a deep and rich content, hands-on lab experiences, and a strong connection to their career aspirations.

II. Recruitment - ***Promotes expected outcomes of Objectives 3 & 4***

While recruitment of students has exceeded our expectations, there are still challenges that face us. In Northern Utah we have seen the inequity of the number of students participating in the program from each high school. While our underrepresented/minority population of students matches the Utah population proportion, we have a significant gap in the number of female high school students (see Table 4). Much of our current recruitment happens with teachers who are not as connected with female high school demographics since many of our teachers are CTE teachers whose students are primarily male. The skills gap in industry is so large that if we continue to primarily recruit only half of the population, we will never fill the gap. Our advisory committee has reported that more than half of their workforce is currently female. According to the 2016 Economic Report of the President, 85% of jobs paying less than $20 an hour will be replaced by automation (USP, 2016). A disproportionate number of low skill jobs in manufacturing are currently filled by women.

We are also addressing the misconceptions of students and their families regarding the number of manufacturing jobs in the area, the vitality of a career in advanced manufacturing, and the prestige of a technical college.

Table 4. High School AM STEM Participants by Underrepresented Population

School Year	2015-2016	2016-2017	2017-2018
Total Enrollment	117	142	184
Male Enrollment	108 (92.3%)	133 (93.6%)	160 (87.0%)
Female Enrollment	9 (7.6%)	9 (6.3%)	24 (13.0%)
Minority Enrollment	24 (21%)	17 (12%)	24 (13.0%)

Meeting Recruitment Objectives: We will increase the overall recruitment pipeline by widening the pool of students who are exposed to our program. We will present to targeted groups outside of the CTE programs which could include business, computer science, physics, automotive, and agriculture at local high schools. Presentations will center on career opportunities in one of the largest employment sectors as well as the idea that women make up more than half of that sector but are in lower skill, lower wage jobs. We will partner with local companies to create promotional materials that will include profiles of women in industry. In addition to high school presentations, these tailored materials will presented yearly to Cache

Makers' large population of female "Makers". Finally, these materials will be stripped of Bridgerland branding and uploaded into the AM STEM Facilitator Guidebook to be used as a template to share with the other tech colleges and high schools.

III: Retention - ***Promotes expected outcomes of Objectives 5 & 6***
The retention of students to continue their academic pursuits to a certificate and/or degree remains challenging. Table 5 captures the attrition rates for AM STEM participants for the past two years.

Table 5. AM STEM Attrition during the Academic Year

School Year	2015-2016	2016-2017
Beginning of Year Enrollment	117	142
End of Year Enrollment	87	114
Attrition %	25.6	19.7

We plan to address the retention of high school students during the school year by creating more responsive curriculum and better prepared high school facilitators. Students will continue to remain in the project during their sophomore, junior, and senior years. We also plan to decrease attrition after high school graduation. Even though many completed their Bridgerland certificate, approximately 50% of them took time to fulfill their two-year religious mission experience after high school. Many of these students have expressed their intent about returning to Bridgerland to finish off their certificate but two years is a long time. Our best estimate is that we retained around 15% of the total. It remains to be seen how many will return. We currently have no method of tracking and following up with those who graduate from high school and leave.

Meeting Retention Objectives: In this proposal of increasing "within high school" retention as well as decreasing "after graduation" attrition, we propose the following strategies. First, Bridgerland will extend the employment of one of Bridgerland's current Student Success Coordinators to full time. The extra 20 hours will be used to track students during their high school experience, and follow up with them face to face at least two times during the school year. Second, the Student Success Coordinator will use AspireEdu software to track and diagnose why students are leaving the program and prescribe a solution. Additionally, this tracker will track participant's time out of program and deliver tailored messages to remind students and their parents about opportunities. Third, we will resolve the high school to full time student transition by developing and employing an onboarding (high school to full time) process which includes parents and happens prior to students' high school graduation. This onboarding process will include a Bridgerland enrollment night convention where SUUAMTP students and their parents will be instructed on how to re-enroll into Bridgerland as an adult certificate seeking student, create a plan to complete the Bridgerland certificate, find meaningful employment opportunities (internships), and transfer their Bridgerland certification to local universities (Utah State University & Weber State University). Tracking and consistent follow up from initial enrolment while still in high school through at least two years post high school graduation should allow us to conservatively graduate 10 students in 2018 and 15 students in 2019.

IV: Professional Development - ***Promotes expected outcomes of Objectives 7 & 8***
Currently, supporting local high school facilitators has been manageable, due to proximity and the number of teachers involved. Any expansion of our professional development services in Northern Utah, or across the state, will be contingent upon our ability to resolve two major issues. First, we need professional development which enables faculty to take more ownership over the content. Second, we need strategies for faculty so that they can take a leadership role in building and maintaining instructional materials for hands-on labs.

For the past two years of the AM STEM program, Bridgerland has been providing two-weeks of required professional development instruction for high school facilitators each summer. The focus of this training has been on a cursory overview of the next year's content and program procedures but not about content mastery or expectations. This has led some high school facilitator teachers to be mere supervisors while other teacher facilitators have played an active role in providing engagement. An increase in the number of students will need to be matched by an increase in high school facilitator capacity. A scaling up will require us to develop and test a professional development model to ensure that the high school facilitators will be able to take more ownership over student engagement, simple misconceptions troubleshooting, and administration of simple checks for understanding.

We are pleased to report that high schools and technical colleges throughout the state are asking us to share our curriculum with them and to prepare their faculty on how to effective implement the AM STEM program. We anticipate that with the professional development model we design, high schools and other technical colleges will be able to successfully implement AM STEM at their respective institutions. Bridgerland faculty will always serve as guides and experts as to ensure that there is a smooth pathway as others implement the program. When we can effectively scale up AM STEM, we anticipate that there will be great progress in meeting the critical demand for highly skilled technicians in advanced manufacturing.

Meeting Professional Development Objectives: We will design a professional development model so that stakeholders will be empowered to build and implement the AM STEM programs at their institutions. The professional development model will support faculty through: (1) summer training, (2) site visits, and (3) ongoing support through a new Canvas course.

The summer training will still be held for two-weeks but instead of just receiving a cursory overview of the next year's content, teacher facilitators will actually complete the summative hands-on labs for each course. Additionally, during the summer training, the newly articulated expectation for faculty will be delivered to the teachers. Each day of the workshop will be divided into three parts – content delivery, hands-on experimentation, and small and group discussions. The content delivery will be the responsibility of Professors Fuller and Danielson, hands-on experimentation will be the responsibility of Fuller and relevant discussions will be held by Danielson.

It is important to realize that no high school teacher facilitator is going to walk away from the summer training with any semblance of mastery of content or instructional expectations. So in addition to just communicating new expectations during the summer professional development, Fuller (Co-PI) will conduct site visits with all participating high school facilitators to model new

expectations directly to participating teachers with respect to sustaining motivation, monitoring comprehension through checks for understanding, and troubleshooting simple misconceptions. Fuller will also take time during these site visits to mentor high school facilitators until they are able to implement the new expectations. Lastly, continued professional development and guidance will be developed and embedded directly into the instruction. Lefler (PI) in conjunction with the instructional designer and Co-PIs will create module overviews for teacher facilitators. These module overviews will be unpublished (invisible to students) but accessible for teachers and will contain the targeted essential learning outcomes, check for understandings, and expectations for engagement for teacher facilitators.

In order to address issues surrounding building hands-on labs, the components for two additional training systems will be purchased to develop instruction on how to purchase equipment and build hands-on labs for each course. Faculty from other colleges (e.g., Tooele Technical College and Ogden-Weber Technical College) will be invited to Bridgerland to be taught by Danielson (CO-PI) on how to build the requisite hands-on labs (including trainer) in preparation for the school year. Additionally, Danielson (CO-PI) will work with Lefler (PI) and instructional designer to build audiovisual instructions for the building of these instructional materials that can be shared in the AM STEM Facilitator Guidebook. The completed training systems will be given to two interested institutions who participate in the summer professional development.

DELIVERABLES

The project plans to develop the three deliverables listed below.

Bridgerland Technical College AM STEM Student Curriculum will contain all eleven of the core courses presented to the students in the AM STEM program. These will be built in Canvas learning management system which has been adopted by all public schools in Utah. Complete courses can be shared easily in just a few minute across Canvas Commons or by exporting and importing Canvas course cartridges.

Recruitment Materials for Students, Industry, and the Community will be used to recruit students, inform the community, and share our work with other professionals both locally and nationally. These materials will be provided with in the AM STEM Facilitator Guidebook in a form which could easily be modified with the logos and branding from other educational institutions.

Bridgerland Technical College AM STEM Facilitator Guidebook will outline the steps and processes required to promote and sustain the AM STEM program in sites and regions outside Bridgerland Technical College's region. This guidebook will include AM STEM implementation plan, recruitment materials, recruitment plan/explanation, retention strategy/explanation, hands-on lab equipment list (w/ costs), and explicit audiovisual instruction on how to build lab trainers. This guidebook will be built in Canvas as an open course and will be disseminated through all ATE Centers that focus on advanced manufacturing.

LOGIC MODEL

SUUAMTP Logic Model

Inputs	Outputs		Outcomes - Impact		
	Activities	Participants	Immediate	Intermediate	Long Term
What We Invest	*What We Do*	*Who We Reach*	*Expected Short Term Results*	*Expected Medium Term Results*	*Expected Ultimate Impacts*
• AM STEM Curriculum • AM STEM Recruitment Strategy & Materials • Mentor Connect Program • Instructor Expertise • Facilities • Activity Coordination • Instructional Design Interns • Industry Connections	• Develop Shareable Content • Share Recruitment Resources & Strategy • Build & Share Retention Strategy • Develop & Deliver Professional Development • Support Local Colleges and Teacher Facilitators	• Multiple Utah Technical Colleges Leadership and Faculty • Multiple Utah School District Leadership • Multiple High Schools Leadership and Instructors • Sophomore, Junior, & Senior high school students (rural and urban) • Underrepresented populations	• Distribution of Expertise in Automated Manufacturing across Utah • Increased HS Enrollment in Automated Manufacturing and Robotics • Improved Retention Rate • Improved Curriculum and learning outcomes	• Transfer of Responsibility from Bridgerland to Tech Colleges. • Bridgerland Expands AM STEM Program to all other USTC Colleges. • All USTC Automated Manufacturing Programs Continue to Collaborate to Build and Share Knowledge.	• Distribute AM STEM Curriculum across United States. • Bridgerland Becomes a National Leader in Automated Manufacturing • Utah's Economy Continues to Grow and Become a Leader in Manufacturing

PROJECT TIMELINE

The following table captures the activities that will take place during SUUAMTP.

Activity	Sum 2018	F 2018	Sp 2019	Sum 2019	F 2019	Sp 2019
Hire instructional designer, expand Student Success Coordinator Role	X					
Acquire and integrate AspireEdu and CirqLive software into Canvas	X					
Develop course curriculum, instructional material and labs	X	X	X	X	X	
Develop deliverables (guidebook and promotional materials)				X	X	
Professional development workshop	X			X		

On-going professional development activities	X	X	X	X	X	X
Implement recruitment plan			X	X		
Implement retention plan	X	X	X	X	X	
Evaluation data collection, analysis, and findings	X			X		X
Dissemination			X	X	X	X

MANAGEMENT PLAN

The proposed project will be housed at Bridgerland Technical College. Lefler (PI) will manage the project with both Co-Principal Investigators, Fuller and Danielson. This team consists of faculty, staff, instructional designer, and program manager. The team will meet weekly to coordinate the completion of the project activities and the creation of the deliverables.

PROJECT TEAM: EXPERTISE, ROLES AND RESPONSIBILITIES

The following individuals will be comprise the leadership team for this project.

Mason Lefler (PI) is the Senior Instructional Designer at Bridgerland. As the senior instructional designer he is the Canvas administrator, course designer, instructional coach, and professional development committee chair. On this project Lefler will be responsible for: (1) establishing a common course template (i.e., rubric standard, formalized instruction video standard, etc.), (2) managing the part-time instructional designer, (3) coordinating the sharing of LMS Canvas course content the other schools, (4) acquiring and integrating AspireEdu and CirqLive software into Canvas, (5) creating the Facilitator Guidebook, and (6) supervising the project.

Matt Fuller (Co-PI) is an Instructor of Industrial Robotics and Automation at Bridgerland. Fuller has designed and managed the current AM STEM program for the past 2.5 years. He also has expertise marketing (recruitment), and management. He will be responsible for: Collaborating with Lefler and part-time instructional designer in redeveloping curriculum for three courses (Objective 1 and 2), directing the marketing, recruitment (Objectives 3, 4), and managing student success coordinator and retention strategies (Objectives 5, 6), and running the teacher facilitator two-week summer professional development workshop (Objectives 7, 8).

Scott Danielson (Co-PI) is an Instructor for Programmable Logic Controls at Bridgerland. Danielson has helped create the current AM STEM program content. He was the first teacher to embed formalized audiovisual instruction and also has expertise marketing (recruitment), and management. He will be responsible for collaborating with Lefler and part-time instructional designer in redeveloping curriculum for eight courses (Objectives 1, 2), and running the teacher facilitator two-week summer professional development workshop (Objectives 7, 8).

Instructional Designer (part-time and to be hired), will have experience in curriculum design, rubric writing, and audiovisual recording. This individual will be responsible for: (1) working with Lefler, Fuller, and Danielson to redesign the current curriculum with embedded video

formalized instruction, (2) conduct a task analysis of local employers to employer branded rubrics for all summative tasks, (3) create LMS Canvas instances for participating schools, and (4) work with Lefler to design LMS Canvas course for the Facilitator Guidebook.

Student Success Coordinator (currently working part time at Bridgerland and will become full time) will support the recruiting and retention aspects of the program (Objectives 3, 4, 5, 6). The Coordinator will identify the best strategies for tracking, retaining, and recruiting students in this program, conduct a training workshop at our pilot school, and attend team meetings and recruiting activities such as job fairs and high school visits

EVALUATION PLAN

Full evaluation of SUUAMTP effectiveness in meeting the objectives for this proposal requires a comprehensive approach to ensure its processes are effective and its intended outcomes are realized. Toward this end, we will apply Kirkpatrick's (1996) 4-level model of evaluation, which separately examines stakeholder reactions, learning, behavior, and results. It is necessary to examine success at each of these levels, as success on one may not entail success on another. The evaluator, Dr. David Feldon of Empirical Basis, LLC, is an expert in STEM learning and assessment with specific expertise in instructional design and performance-based assessment (e.g., Feldon, 2007; Feldon et al., 2010; Feldon & Stowe, 2009; Feldon et al., 2015). He is also the prior recipient of an ATE project award (NSF 1340239).

Reaction. To assess stakeholders' reactions to the program, formative and summative data will each be collected from program students, CTE faculty, and Bridgerland faculty. At the end of each semester, students will complete anonymous course evaluations and surveys that elicit their opinions on the value of their learning experiences within the program, the extent to which their skills are developing toward their professional goals, and which facets of the program they find to be most and least helpful. The surveys will also assess intent to complete the program, attain 900-hour certification, and enter the advanced manufacturing workforce. Similarly, participating teachers and Bridgerland instructors will complete surveys to elicit their perspectives on the strengths and weaknesses of the program as implemented with the goal of refining the program to better meet its articulated goals. The evaluator will develop, deploy, and analyze the surveys to ensure that participants have an opportunity to communicate their reactions openly.

Learning. Learning assessment within the program will take place at two levels of performance. At the level of high school students, student performance on summative projects will be assessed using the developed rubrics, and supplemental assessment information will come from instructor observations of collective proficiency with regard to the development of students' process knowledge. CTE faculty learning will be assessed through survey-based measures of familiarity with the aspects of the curriculum and equipment.

Behavior. Curricular materials and assessment rubrics to be created by the project will be evaluated formatively during their iterative development by the external evaluator, leveraging his expertise in cognition, instructional design, and performance-based assessment. CTE faculty

performance will be assessed by Bridgerland faculty through observation during summer trainings and site visits. These observations will be reported to the external evaluator.

Results. Ultimately, the purpose of AM STEM is to prepare the next generation of Utah's STEM workforce to enter advanced manufacturing positions. To attain this goal, we must effectively recruit more students and more diversity into the program, retain them to completion, and increase the rate at which their participation converts to certification. Target metrics for these goals are articulated as formal objectives, and the data for evaluating their attainment are collected through enrollment and completion data in the CTE courses and the Bridgerland program. The evaluator will review these numbers and provide quantitative analyses of growth.

DISSEMINATION PLAN

We plan to widely disseminate this project locally, statewide, and nationally.

Dissemination with a Local Audience
Project progress and final outcomes will be shared locally with industry and the school districts. Dissemination to industry will take place through Bridgerland's biannual advisory committee meetings. This will take place during two advisory committee meetings with our Automated Manufacturing and Robotics program and two advisory committee meetings with our Electronics program. Dissemination to local school districts will take place each fall during our meetings with counselors at each local high school. Additionally, we will report project progress and final outcomes during Bridgerland's Quarterly CTE Directors Meeting with the four participating school districts.

Dissemination with a Regional Audience
Regionally we will disseminate our project with the other six technology colleges not participating in this proposal during our yearly at Utah System of Technical Colleges (USTC) conference in summer of 2019, and 2020.

Dissemination with a National Audience
We will present our work nationally in four ways in order to make sure that we are reaching the various interested parties (NSF/ATE, Other tech/community colleges, and Canvas users). First, we will present our work at the NSF-ATE-PI meetings. Second, we will also share an overview video of our project on atecentral.net with our contact information for those interested in partnering with us. Third, we will present our work at the HI-TEC conference.

SUSTAINABILITY PLAN

The Bridgerland Technical College, along with the leadership of the Utah System of Technical Colleges, is committed to continuation of this project after the end of NSF funding. In order to sustain this project after the initial NSF grant period, we have designed a comprehensive plan for sustainability. Financially, there are associated costs that need to be planned for after funding such as: technology upkeep, replacement of expendables, professional development costs, and the cost of high school teacher facilitators.

As a result of three years of implementing the AM STEM program, we have estimated the cost of replenishing usable educational materials and to replace broken materials to be $75.00 per student. In order to meet this cost, Bridgerland students pay a hands-on lab materials participation fee of $75.00. Bridgerland has also reduced program cost by creating courses that use open resources to eliminate the cost of books. Bridgerland also pays instructors to host the two week professional development seminar. After the two-year NSF support, these costs will be rolled out to other technical colleges and high school faculty as a professional development participation fee. The cost of high school facilitators will be covered by participating technical colleges through an increase of enrollment hours into the automated manufacturing and robotics departments. Meanwhile, Bridgerland leadership has committed to continue to support the program after successful completion of the grant by continuing to financially support the role of the instructional designer and student success coordinator.

INTELLECTUAL MERIT

Utah is experiencing a critical shortage of skilled technicians in advanced manufacturing due, in part, to the abundance of large and small industries which continue to automate their facilitates statewide and the limited number of advanced manufacturing programs which are able to adequately educate and prepare future technicians for the workforce.

In addition to creating an innovative pipeline of high school students into advanced manufacturing to support the economy, this project will provide a refined prepackaged curriculum and programmatic resources that could be easily shared anywhere across the state and/or nation. The project will serve as a model on how applied technical colleges and secondary schools can collaborate through learning management systems to simultaneously prepare participants with high paying jobs and/or a pathway towards college. We will also develop and implement a professional development model that will reveal the strategies and protocol that will best serve high school and college faculty as they adapt the advanced manufacturing program at their own institutions. We anticipate that the expected outcomes and findings will offer the educational community an insight as to how to build blended learning environments comprised of learning management systems with high levels of hands-on training.

BROADER IMPACTS

We are confident that the proposed project will make a significant impact on the capacity and quality of advanced manufacturing technicians statewide. We foresee that this project will directly impact high school and college students, Bridgerland Technical College, the Utah System of Technical Colleges, and our industry partners. The benefits to students will be: (1) improved curriculum, (2) higher retention rates, (3) access to a pathway into a career into automated manufacturing and robotics, and (4) stronger connections to local industry leaders. The benefits to the College will be: (1) improved curriculum, (2) new branding of recruitment strategies, (3) enhanced tracking/retention, (4) advanced leadership development in project management/grant writing, and (5) a pathway for the College to become a regional training leader in automated manufacturing. The benefits to the Utah System of Technical Colleges will be: (1) a pilot of curriculum development and collaboration across technical colleges, and (2) a mechanism of how to share and scale best practices across the State of Utah. The benefits to industry partners will be: (1) growing number of students pursuing careers in automated manufacturing, and (2) a curriculum more reflective of industry needs.

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FACILITIES, EQUIPMENT, AND OTHER RESOURCES

Laboratory:

Bridgerland Technical College has 12274 square feet of Automated Manufacturing and Robotics laboratory space at the college's West Campus. In that space, there are multiple industrial robots and automated manufacturing equipment, including PLC's, motors, microprocessors, and both electrical and electronic equipment. Co-PI's Fuller and Danielson will use this space and equipment to support curriculum development in support of this project.

Clinical:

Not Applicable

Animal:

Not Applicable

Computer:

PI Lefler and Co-PI's Fuller and Danielson all have computer systems provided and maintained by Bridgerland Technical College. Bridgerland has computer systems for the Student Success Coordinator as well as the future instructional designer. There is also access to the internet both wired and wireless throughout the Bridgerland. These capacities ensure efficient data handling and communications necessary to the success of the project.

Office:

PI Lefler has an office space at Bridgerland Technical College's main campus. Co-PI's Fuller and Danielson both have office spaces adjacent to the Laboratory area at Bridgerland Technical College's West Campus. Bridgerland has office space for both the Student Success Coordinator as well as the future instructional designer. These facilities ensure that the PI and his immediate research team will have the necessary space in which to perform all activities associated with this project.

MAJOR EQUIPMENT

Not Applicable

OTHER RESOURCES

Bridgerland has video recording devices, screencasting software, and video editing software for the creation of audiovisual instructional materials.

Data Management Plan

Overview

The proposed study collects four types of data: (1) teacher & student reaction data; (2) teacher & student learning performance data; (3) faculty & teacher facilitator behavioral observation data; and (4) results data (enrollment and completion). All four types of data will be collected for the documenting of activities, project progress monitoring, evaluation, and research for understanding and improving the effects of the project activities.

Specific Data Elements

1. **Quantitative data**
   - Paper-based Likert scale survey questions administered to students/teachers at the beginning and end of the delivered curriculum to assess course quality.
   - Paper-based Likert scale survey questions administered to teachers at the end of the professional development to assess quality and competency.
   - Paper-based Likert scale survey questions administered to students at the beginning and end of the delivered curriculum and presentations to gauge intent to finish certificate and obtain a manufacturing job.
   - Enrollment and completion numbers, generated in Tableau/Jenzabar (Bridgerland enterprise student information system), for outcomes reporting.
   - Performance data collected in Canvas from completion of hands-on labs by teachers during two-week summer professional development.
2. **Qualitative data**
   - Observational data of teacher facilitator interactions with students and instructors to obtain qualitative feedback on the efficacy of professional development summer training.
   - Informal interviews administered to high school teacher facilitators and college faculty during site visits to measure teacher mastery of content and ability to facilitate program at site.
   - Observations of curriculum implementation during site visits.

Privacy and Identifiers

For each student, all data will be tied to an anonymized unique identifier (UI) that preserves confidentiality. The list that matches student/instructor identity with their unique identifier will be kept for the duration of the curriculum implementation during which that student/teacher's data is collected, maintained in a separate location from the students' data, and then destroyed once data collection has ended. Metadata contextualizing collected data such as grade and school will be preserved at this level of data collection and analysis.

Identifying information of participants interviewed will be removed immediately following initial transcription or document collection. Identifying information will not be collected in observation field notes.

Storage and Dissemination

During the course of the study, all participant data will be stored on Bridgerland password protected computers in accordance with security protocols in a college supported database. This database will incorporate all collected data keyed to individual student participant using assigned UIs. Additionally, data will be securely stored externally hard drive and kept in a

locked file drawer in the office of the PI.

In preparation for archiving, all data will be reviewed in order to assure that no identifiable personal information is present.

Observation field notes are also considered data for this project and provide valuable contextualizing information when analyzing participant data. During the course of the study, analyses and conclusions will be shared amongst the members of the research team.

SUMMARY PROPOSAL BUDGET

YEAR 1

ORGANIZATION	FOR NSF USE ONLY		
Bridgerland Applied Technology College	PROPOSAL NO.	DURATION (months) Proposed	Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR	AWARD NO.		
Mason Lefler			

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Mason Lefler - PI**	1.00	0.00	0.00	[redacted]	
2. **Scott Danielson - CO-PI**	1.00	0.00	0.00		
3. **Matt Fuller - CO-PI**	1.00	0.00	0.00		
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	**0**	
7. (**3**) TOTAL SENIOR PERSONNEL (1 - 6)	3.00	0.00	0.00	**16,639**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**0**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	0.00	0.00	0.00	**0**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**0**) UNDERGRADUATE STUDENTS				**0**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**16,639**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**12,075**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**28,714**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				**8,284**	
2. INTERNATIONAL				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**16,000**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**4,000**	
3. CONSULTANT SERVICES				**42,594**	
4. COMPUTER SERVICES				**10,944**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**73,538**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**110,536**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **College's Negotiated Rate (Rate: 10.0000, Base: 112500)**					
TOTAL INDIRECT COSTS (F&A)				**11,250**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**121,786**	
K. SMALL BUSINESS FEE				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**121,786**	

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME	FOR NSF USE ONLY		
Mason Lefler	INDIRECT COST RATE VERIFICATION		
ORG. REP. NAME*	Date Checked	Date Of Rate Sheet	Initials - ORG
John Davidson			

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

SUMMARY PROPOSAL BUDGET

YEAR 2

ORGANIZATION	FOR NSF USE ONLY		
Bridgerland Applied Technology College	PROPOSAL NO.	DURATION (months) Proposed	Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR	AWARD NO.		
Mason Lefler			

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Mason Lefler - PI**	1.00	0.00	0.00	[redacted]	
2. **Scott Danielson - CO-PI**	1.00	0.00	0.00		
3. **Matt Fuller - CO-PI**	1.00	0.00	0.00		
4.					
5.					
6. (**0**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	**0**	
7. (**3**) TOTAL SENIOR PERSONNEL (1 - 6)	3.00	0.00	0.00	**16,639**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**0**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	0.00	0.00	0.00	**0**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**0**) UNDERGRADUATE STUDENTS				**0**	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**0**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**16,639**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**12,075**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**28,714**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				**2,462**	
2. INTERNATIONAL				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				**0**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**1,000**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**4,000**	
3. CONSULTANT SERVICES				**42,594**	
4. COMPUTER SERVICES				**13,194**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**60,788**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**91,964**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **College's Negotiated Rate (Rate: 10.0000, Base: 112500)**					
TOTAL INDIRECT COSTS (F&A)				**11,250**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**103,214**	
K. SMALL BUSINESS FEE				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				**103,214**	

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME	FOR NSF USE ONLY INDIRECT COST RATE VERIFICATION		
Mason Lefler	Date Checked	Date Of Rate Sheet	Initials - ORG
ORG. REP. NAME* **John Davidson**			

2 *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

SUMMARY PROPOSAL BUDGET

Cumulative

ORGANIZATION	FOR NSF USE ONLY		
Bridgerland Applied Technology College	PROPOSAL NO.	DURATION (months) Proposed	Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR	AWARD NO.		
Mason Lefler			

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Mason Lefler - PI**	2.00	0.00	0.00	[redacted]	
2. **Scott Danielson - CO-PI**	2.00	0.00	0.00		
3. **Matt Fuller - CO-PI**	2.00	0.00	0.00		
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	0.00	0.00	0	
7. (**3**) TOTAL SENIOR PERSONNEL (1 - 6)	6.00	0.00	0.00	33,278	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	0	
2. (**0**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	0.00	0.00	0.00	0	
3. (**0**) GRADUATE STUDENTS				0	
4. (**0**) UNDERGRADUATE STUDENTS				0	
5. (**0**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (**0**) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				33,278	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				24,150	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				57,428	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				10,746	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **0**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**0**) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				17,000	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				8,000	
3. CONSULTANT SERVICES				85,188	
4. COMPUTER SERVICES				24,138	
5. SUBAWARDS				0	
6. OTHER				0	
TOTAL OTHER DIRECT COSTS				134,326	
H. TOTAL DIRECT COSTS (A THROUGH G)				202,500	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				22,500	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				225,000	
K. SMALL BUSINESS FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				225,000	

M. COST SHARING PROPOSED LEVEL $ **0** AGREED LEVEL IF DIFFERENT $

PI/PD NAME	FOR NSF USE ONLY		
Mason Lefler	INDIRECT COST RATE VERIFICATION		
ORG. REP. NAME*	Date Checked	Date Of Rate Sheet	Initials - ORG
John Davidson			

C *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Budget Justification

Bridgerland Technical College (Bridgerland) is requesting $225,000 from the National Science Foundation for Institutions New to the ATE Program for two years. Bridgerland is requesting $122,911 for year one, and $102,089 for year two. Grant funds are constituted as:

A. Senior Personnel (Year 1 = $16,639; Year 2 = $16,639; Total = $33,278)
The PI, Co-PIs' time will be funded through the grant. Their pay will constitute overload pay since these activities are considered as additional duties outside the scope of their normal job descriptions. Professor Mason Lefler will apply 1 month of his time in addition to his normal duties totaling [redacted] each year each year which is equivalent to his normal, prorated rate of pay. Professor Matthew Fuller will apply 1 months of his time in addition to his normal duties totaling [redacted] each year which is equivalent to his normal, prorated rate of pay. Professor Scott Danielson will apply 1 month of his time in addition to his normal duties totaling [redacted] each year which is equivalent to his normal, prorated rate of pay (year one: $16,639, year two: $16,639, total: $33,278).

C. Fringe Benefits: Senior Personnel employees (year 1 = $12,075; year 2 = $12,075; total = $24,150) For full time, benefits eligible employees, fringe benefits make up 32% of the base salary plus $27,000 per employee for health and dental per year. (year 1 for Danielson, Fuller, and Lefler = $12,075, year 2 = $12,075, total = $24,150)

E. Travel (year 1 = $8,284; year 2 = $2,462; total = $10,746)
Participant Support Costs will support travel to the annual NSF ATE PI conference in 2019 and 2020 and the annual HI-TEC conference 2020 for two people (PI and a CO-PI).
1. Stipend: Standard meal stipend for Bridgerland employees (Tier 2 city $228 per person, per conference) We don't know where HI-TEC will be so we will assume Tier 2 for that as well. (Year 1: 912, Year 2: $456, Total: $1,368)
2. Airfare ($600 each per person per conference), $50 baggage, Hotel at HI-TEC ($500 for four nights per person), to and from the airport 172 miles round trip ($66). Total: (Year 1: $6,732, Year 2: $1,366, Total 8,098)

Travel expenses will also support the team's travel to and from the pilot schools of Tooele Tech, Ogden-Weber Tech, Ben Loman High, Ogden High, and Wendover High. Bridgerland's current travel reimbursement rate is $0.38 per mile. Tooele Technical College (and as far as Wendover high school) is located 262 miles round trip from Bridgerland (262*.38 * 5 = $498) and year to Ogden-Weber and surrounding schools is 74 miles (74*0.38*5=$141). Year one: ($640), year two: ($640), total: ($1,280).

G. Other Direct Costs (year 1 = $19,000; year 2 = $4,000; total = $23,000)

1. Materials and Supplies (year 1 = $16,000; year 2 = $1,000; total = $17,000)
This item supports miscellaneous materials and supplies in support of grant activities. This includes office supplies, USB drives, presentation materials for conferences and recruiting activities, printing materials for reports and the Facilitator Guidebook, etc.

There are hands-on labs for each of the eleven Bridgerland core courses. Bridgerland has determined four students can participate in all courses for $7,500 worth of equipment. Year one: $15,000, year two: $0.00, total: $15,000.

2. Publication Costs/Documentation/Dissemination (year 1 = $4,000; year 2 = $4,000; total = $8,000). The cost for the initial creation and production of the marketing materials to promote advanced manufacturing as a career, apprenticeship as an attractive path to an advanced manufacturing career, and opportunities for women and minorities in apprenticeship and advanced manufacturing is included in this item. The first year cost is for commissioning the creation of the materials and an initial printing of banners, flyers, and posters. All printing is done in house, and costs are based upon materials already printed.

3. Consultant Services (year 1 = $42,594; year 2 = $42,594; total = $85,188)
Dr. David Feldon will be the external evaluator of the program. He provides evaluation throughout the entire program and also prepare the final project report. He will meet twice a year. He will be compensated [redacted] per year for his evaluation services which includes the cost of visiting Bridgerland (which is located in the same city). The total cost for evaluation will be [redacted] for both years.

The Instructional Designer will be paid at the rate o[redacted]per hour based upon current industry median in Utah, and will work [redacted] hours per week for [redacted] (the college is closed for two weeks in December and one week in April for one year; total salary will be [redacted]

A current Student Success Coordinator (Laura Parrish) will be paid at the rate of [redacted] per hour based on her current pay rate at Bridgerland. Laura will wo[redacted] hours per week fo[redacted] (the college is closed for two weeks in December and one week in April) for year 1; total salary will be [redacted]

4. Computer Services (year 1 = $10,944, year 2 = $13,194, total = $24,138)
We will be adding CirQLive, a Canvas plugin to facilitate better student/teacher communication. We currently use Webex for some communication both inside and outside of broadcast time, but it is difficult for students to figure out which instructors room to go to for each course. This plugin makes it obvious.

To help with student tracking and retention, we will also use AspireEDU, which is another Canvas API. As stated in our description, a big problem we have with retention is our inability to track students at all levels in the program.

Indirect Costs (year 1 = $11,250; year 2 = $11,250; total = $22,500)
Indirect costs will be set at the de minimis rate of 10%. The base for year 1 is $112,500 equating to $11,250 in indirect costs. The base for the second year is $112,500 equating to $11,250 in indirect costs. Total indirect costs will be $22,500.