

# COLUMBUS STATE

COMMUNITY COLLEGE

PREPARING TO LAUNCH

DESIGN THINKING:

ADDITIVE MANUFACTURING SUMMER INSTITUTE

PLANNING

ALIGNING

EQUIPPING

RECRUITING

EXTERNAL EVALUATION REPORT

MAY 2018



**National Science  
Foundation**

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# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

## Acronym List

AMSI	Design Thinking: Additive Manufacturing Summer Institute
AM	Additive Manufacturing
ATE	Advanced Technological Education
Co-PI	Co-Investigator
CSCC	Columbus State Community College (Grantee)
K12	Kindergarten through 12 <sup>th</sup> grade in high school
NSF	National Science Foundation
OSU	Ohio State University
PAST	PAST Foundation (Major project sub recipient) <sup>1</sup>
P3	PAST Foundation's online hybrid courses
PD	Professional Development
PI	Principal Investigator
SME	Society of Manufacturing Engineers

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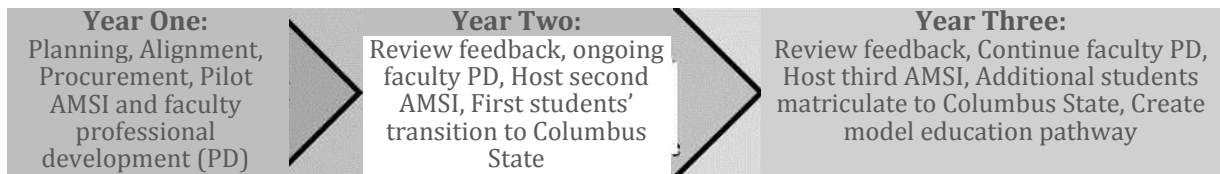
<sup>1</sup> Appendix C: NSF ATE Proposal 1700455, Project Summary

# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

## Executive Summary

This report assesses and documents the fidelity of implementation of activities and outputs outlined in Columbus State Community College's *Design Thinking: Additive Manufacturing Summer Institute* proposal to the National Science Foundation's Advanced Technological Education (ATE) program. The three-year project's long-term goal is to increase the number of qualified technicians with advanced skills in additive manufacturing. The project is being designed and implemented in collaboration with the PAST Foundation, a non-profit provider of Science, Technology, Engineering, and Math (STEM) education, school design, and workforce development.<sup>2</sup>

*Additive Manufacturing Summer Institute's* three tier strategy is a deliberate effort to increase student awareness, competencies, and enrollment in advanced manufacturing to address the gap between modern manufacturing industry needs and workforce availability and readiness. The three year progression of the pilot project is captured in a graphic that serves as a helpful overview of priority activities during each phase of project implementation.<sup>3</sup>



In its first year of implementation, The *Design Thinking: Additive Manufacturing Summer Institute* (AMSI) pilot project has successfully accomplished startup activities to establish the Summer Institute including:

- Formed project teams with defined roles and responsibilities for planning, coordinating, communicating, and implementing activities.
- Developed teacher professional development curriculum.
- Developed and aligned AMSI student curriculum with industry certification standards.
- Procured and secured additive manufacturing equipment for AMSI programming.
- Recruited teachers and students to participate in the inaugural summer session.

<sup>2</sup> <https://pastfoundation.org/transforming-learning>

<sup>3</sup> Appendix C: NSF ATE Proposal 1700455, pg. 3

# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

Materials reviewed for this report include National Science Foundation Award 1700455<sup>4</sup>, PAST Foundation quarterly reports<sup>5</sup>, and documents submitted by Columbus State Community College.<sup>6</sup>

Periodic calls, email communications, and in-person meetings were scheduled between the external evaluator and Columbus State Community College project team members, PAST Foundation administrators and evaluation staff.

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<sup>4</sup> Appendix C: NSF ATE Proposal 1700455

<sup>5</sup> Appendix A: Quarter 1 Evaluation Report, Appendix B: Quarter 2 Evaluation Report, Appendix D: Quarter 3 Report, Appendix E: May 2018 AMSI Student and Teacher Enrollment Data, Appendix G: PAST May 23, 2018 Communication

<sup>6</sup> Appendix F: CSCC May 17, 2018 Communication

# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

## Purpose of the External Evaluation Report

The Design Thinking: Additive Manufacturing Summer Institute External Evaluation Report is a summative assessment of project deliverables and outcomes to determine the extent to which the Design Thinking: Additive Manufacturing Summer Institute's first year objectives have been met. Guiding questions to assess results are:

1. Were activities implemented according to the Design Thinking: Additive Manufacturing Summer Institute proposal to the National Science Foundation's Advanced Technological Education (ATE) program?
2. Has AMSI curriculum been completed and aligned with industry standards?
3. Have recruitment activities resulted in enrollment?
4. Has equipment been identified and secured for AMSI programming?
5. Did teacher professional development and the AMSI program begin as scheduled?

**Internal and external audiences for the report:** Results of this report will assist internal and external audiences in the following ways:

Columbus State Community College/PAST Foundation/ National Science Foundation: Assess the efficacy of the Additive Manufacturing Summer Institute, to support its evolution and improvement, and to communicate the lessons of pilot project experiences to secondary schools, career technical centers, and post-secondary educational communities.

Policymakers: Show a replicable education and workforce development model and results of federal dollars invested for the development, implementation, and management of the Additive Manufacturing Summer Institute pilot project.

Additive Manufacturing Summer Institute pilot project participants: Promote ongoing engagement with collaborating education, community, and industry partners as a result of their Additive Manufacturing Summer Institute experience.

Education and Workforce Development Community: Illustrate strategies, activities, and resources used to cultivate and expand a talent pipeline for industries seeking employees with knowledge and competencies in modern manufacturing techniques and technologies.

# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

## AMSI Project Background

The demand for a skilled workforce in additive manufacturing is expected to increase during a time when manufacturing firms report a shortage of skilled technicians within advanced manufacturing overall.<sup>7</sup> To address this gap, Columbus State Community College partnered with PAST Foundation to develop an informal summer program that connects to formal education pathways in high school and college.

Design Thinking: Additive Manufacturing Summer Institute was funded by the National Science Foundation's Advanced Technological Education (ATE) program which supports faculty-driven, two-year college projects that cultivate a prepared workforce, and improve science and engineering education through curriculum development, professional development of educators, and the creation of seamless career pathways.<sup>8</sup>

Columbus State Community College was awarded \$815,164 to operationalize Design Thinking: Additive Manufacturing Summer Institute to:

1. Develop and implement an Additive Manufacturing Institute Model to provide high school students with the opportunity to explore the variety of careers associated with advanced manufacturing leading to earning industry recognized certifications.
2. Develop and implement an interactive High School Faculty Professional Development Initiative in additive manufacturing that prepares teachers to design relevant and rigorous curriculum.
3. Develop a model education pathway between the Additive Manufacturing Institute and Columbus State manufacturing courses.<sup>9</sup>

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<sup>7</sup> NSF Award 1700455, [Broader Impacts statement and pg. 2](#)

<sup>8</sup> National Science Foundation [Advanced Technological Education Program \(ATE\)](#)

<sup>9</sup> Appendix C: NSF AWARD 1700455, pg. 3

# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

In addition to collaborating with PAST Foundation, Columbus State Community College engaged its secondary school and industry partners.

## **SECONDARY SCHOOL PARTNERS**

AMSI will serve eight high school faculty and 24 students annually.<sup>10</sup> Columbus State Community College (CSCC) will recruit students and teachers<sup>11</sup> from its AMSI partner schools Metro Early College High School and Tolles Career and Technical Center.

The Metro Early College High School draws students from 26 school districts in seven counties with approximately half of student enrollment from Columbus City Schools, Ohio's largest urban school district.<sup>12</sup> Tolles Career and Technical Center's RAMTEC program serves suburban and rural students in seven school districts and 11 high schools in Franklin, Madison, and Union counties.<sup>13</sup> The AMSI pilot program will expand enrollment to high schools participating in the Pathways to Prosperity initiative<sup>14</sup> if there are openings available in the AMSI pilot project.

## **INDUSTRY PARTNERS**

The AMSI Industry Leadership Team will play an active role in program activities and is expected to increase the number of industry members over the three year period.<sup>15</sup> The first meeting will occur after the summer program has been implemented.<sup>16</sup> Members include:

- Battelle Memorial Laboratory
- EWI (formerly the Edison Welding Institute)
- Applied Experience, LLC

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<sup>10</sup> Appendix A: Quarter 1 Evaluation Report, pg. 30

<sup>11</sup> Appendix C: ATE NSF AWARD 1700455, pg. 8

<sup>12</sup> [Metro School Profile](#)

<sup>13</sup> [Tolles Career and Technical Center The Landed Campaign](#), pg. 8-9

<sup>14</sup> Appendix C: NSF AWARD 1700455, pg. 8-9

<sup>15</sup> Appendix C: NSF AWARD 1700455, pg. 12

<sup>16</sup> Appendix F: CSCC May 17, 2018 Communication-Topic: Industry Leadership Team



# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

## Fidelity of Implementation: Pilot Project Activities and Deliverables (August, 2017-May, 2018)

The AMSI proposal outlines activities, deliverables, and a three-year project timetable.<sup>17</sup> The first year of implementation focused on program planning, curriculum development and alignment with industry certification expectations, securing equipment, and recruiting student and teacher participants.

Information regarding project activities and outcomes were documented in quarterly reports submitted by PAST Foundation.<sup>18</sup> Activities to date addressed two of the three primary deliverables which concur with the Project Timetable.<sup>19</sup>

- Deliverable 1: Additive Manufacturing Summer Institute Pilot Project Model (Year 1-3)
- Deliverable 2: Faculty Professional Development (Year 1-3)
- Deliverable 3: Model Educational Pathway (Year 2-3)

To create AMSI, CSCC and PAST have established integrated teams consisting of the Principle Investigator, Co-Principle Investigators, faculty, administrators, and staff to manage different elements of the project:

- The Project Management Team meets monthly and is responsible for leading AMSI progress and addressing any changes or modifications to the original proposal.
- The Implementation Team meets weekly and is responsible for achieving the stated deliverables of the pilot project.
- The Stakeholders Group is responsible for monitoring AMSI progress and activities and is comprised of administrators and grant authors.<sup>20</sup>
- The Internal Evaluation Team is responsible for internal project evaluation during startup activities, formative and summative evaluation.<sup>21</sup>

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<sup>17</sup> Appendix C: NSF AWARD 1700455, pg. 6-10

<sup>18</sup> Appendix A: Quarter 1 Evaluation Report, Appendix B: Quarter 2 Evaluation Report, Appendix D: Quarter 3 Report

<sup>19</sup> Appendix C: NSF AWARD 1700455, pg. 10

<sup>20</sup> Appendix A: Quarter 1 Evaluation Report, pg. 18-19, 21

<sup>21</sup> Appendix C: NSF AWARD 1700455, pg. 13-14

# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

## Activities Completed

In preparation for the Additive Manufacturing Summer Institute, six preliminary activities have taken place and have made significant progress in the past ten months.

1. **Planning Workshops Convened:** The different AMSI teams met on a weekly or monthly basis<sup>22</sup> to plan, coordinate activities between CSCC, PAST, and external partners, communicate updates on progress, and troubleshoot issues. Quarterly reports document planning activities in recruitment, equipment selection, AMSI learning module development, and CSCC coursework alignment with Additive Manufacturing Book of Knowledge content.

Specific outcomes and accomplishments include:

- Formed project teams with defined roles, responsibilities, and schedule for activities.<sup>23</sup>
- Developed an internal communication plan to ensure timely updates and status reports are shared with CSCC and PAST project stakeholders.<sup>24</sup>
- Aligned CSCC Advanced Manufacturing course content with Additive Manufacturing Body of Knowledge content.<sup>25</sup>
- Aligned AMSI curriculum and equipment with Additive Manufacturing Body of Knowledge.<sup>26</sup>
- Secured Institutional Review Board approval for research and evaluation activities.<sup>27</sup>
- Developed an internal evaluation schedule for quarterly and annual reporting. Quarterly reports submitted through May, 2018.<sup>28</sup>
- Convened, communicated, and collaborated with external partners.<sup>29</sup>

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<sup>22</sup> Appendix A: Quarter 1 Evaluation Report, pg. 14-16, Appendix B: Quarter 2 Evaluation Report, pg. 17-39, Appendix D: Quarter 3 Report, pg. 2-8

<sup>23</sup> Appendix A: Quarter 1 Evaluation Report, pg. 18-19, 21, 27-28

<sup>24</sup> Appendix A: Quarter 1 Evaluation Report, pg. 17-22

<sup>25</sup> Appendix B: Quarter 2 Evaluation Report, pg. 55-56, 59-68

<sup>26</sup> Appendix D: Quarter 3 Report, pg. 12-15

<sup>27</sup> Appendix C: NSF AWARD 1700455, pg. 13, Appendix A: Quarter 1 Evaluation Report, pg. 33-53

<sup>28</sup> Appendix A: Quarter 1 Evaluation Report, pg. 54-61, Appendix A: Quarter 1 Evaluation Report, Appendix B: Quarter 2 Evaluation Report, Appendix D: Quarter 3 Report

<sup>29</sup> Appendix A: Quarter 1 Evaluation Report, pg. 6-10, Appendix B: Quarter 2 Evaluation Report, pg. 13-16, 77-78

# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

2. **Certification, Curriculum, and Equipment Alignment Completed:** Team members reevaluated the stackable certificate goal as originally proposed to NSF<sup>30</sup> and chose to focus on one industry recognized credential in additive manufacturing instead.<sup>31</sup> The team utilized the Additive Manufacturing Body of Knowledge specifications to align certification content areas with AMSI curriculum and to identify equipment needs during the four-week program.

AMSI instructors have tested equipment to be used during the summer program<sup>32</sup> and are scheduled to complete the Additive Manufacturing Fundamentals Certification exam on May 31, 2018. Student participants will take the certification exam during the last week of AMSI on June 28, 2018.<sup>33</sup> The Additive Manufacturing Fundamentals Certification<sup>34</sup> is obtained by scoring 70% or higher on an online, proctored exam.<sup>35</sup>

Curriculum and equipment planning sessions also included discussions on the continuum of learning experiences between AMSI, CSCC's additive manufacturing coursework, the College Credit Plus program, two and four-year educational pathways, and work-study options.<sup>36</sup>

Specific outcomes and accomplishments include:

- CSCC Course Alignment with Additive Manufacturing Body of Knowledge Content Rubric<sup>37</sup>
- Crosswalk of SME Additive Manufacturing Body of Knowledge Content Rubric with AMSI activities and equipment<sup>38</sup>
- Scheduled Additive Manufacturing Fundamental Certification exams for AMSI instructors and students.<sup>39</sup>

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<sup>30</sup> Appendix C: NSF AWARD 1700455, Attachment 6: Outline Agenda for AMSI

<sup>31</sup> Appendix B: Quarter 2 Evaluation Report, pg. 5, 21

<sup>32</sup> Appendix D: Quarter 3 Report, pg. 1

<sup>33</sup> Appendix F: CSCC May 17, 2018 Communication-Topic: Certification Exam

<sup>34</sup> Appendix B: Quarter 2 Evaluation Report, pg. 5-6

<sup>35</sup> Appendix B: Quarter 2 Evaluation Report, pg. 48-51

<sup>36</sup> Appendix B: Quarter 2 Evaluation Report, pg. 17-24

<sup>37</sup> Appendix B: Quarter 2 Evaluation Report, pg. 55-56, 59-68

<sup>38</sup> Appendix D: Quarter 3 Evaluation Report, pg. 12-15

<sup>39</sup> Appendix D: Quarter 3 Evaluation Report, pg. 1

# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

3. **AMSI Curriculum Developed:** The AMSI curriculum for students and K12 educators has been developed and includes specific outcomes for each group. The student-focused four-week immersive learning curriculum is designed for students to gain knowledge and competencies in additive manufacturing and to successfully pass an online additive manufacturing certification exam.<sup>40</sup>

The teacher-focused seven-week professional development program<sup>41</sup> prepares educators to design project-based experiential learning modules that integrate additive manufacturing into high school course work and are aligned with Ohio Learning Standards.<sup>42</sup> Experiential learning modules will be implemented by teachers in their classes after completing the AMSI professional development program. Student and teacher participants are scheduled to tour advanced manufacturing facilities in the central Ohio region.

Specific outcomes and accomplishments include:

- Developed a Memorandum of Understanding for teacher participants outlining the summer schedule, online (P3 Applied course) and in-person attendance requirements, responsibility to develop and implement project-based learning modules, and agree to participate in research/evaluation activities. Document also includes stipend details.<sup>43</sup>
- Designed seven-week hybrid professional development course for teachers.<sup>44</sup>
- Launched AMSI on-line teacher professional development course in project-based learning on May 7, 2018.<sup>45</sup>
- Created AMSI four-week, project-based student curriculum that is aligned with certification requirements.<sup>46</sup>
- Scheduled tours to manufacturing facilities at medical and design firms and on-campus facilities at CSCC and OSU's Center for Design and Manufacturing Excellence.<sup>47</sup>

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<sup>40</sup> Appendix D: Quarter 3 Report, pg. 29-40

<sup>41</sup> Appendix D: Quarter 3 Report, pg. 23-28

<sup>42</sup> [Ohio Department of Education Learning Standards](#)

<sup>43</sup> Appendix D: Quarter 3 Report, pg. 23-24

<sup>44</sup> Appendix D: Quarter 3 Report, pg. 25-28

<sup>45</sup> Appendix D: Quarter 3 Report, pg. 1

<sup>46</sup> Appendix D: Quarter 3 Report, pg. 29-40, pg. 12-15

<sup>47</sup> Appendix D: Quarter 3 Report, pg. 1, 30

# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

4. **Shared Equipment Hub Established:** Partner organizations are leveraging existing resources to establish a centralized hub of shared equipment at PAST Innovation Lab for the AMSI program.<sup>48</sup> Equipment from CSCC, PAST, and Tolles Career Center has been integrated into the curriculum and AMSI activities.

Specific outcomes and accomplishments include:

- Identified, procured, and tested equipment for the AMSI program.<sup>49</sup>
- Secured partner equipment to expand resources available for the AMSI program.<sup>50</sup>
- Aligned CSCC equipment with AMSI curriculum and Additive Manufacturing Book of Knowledge.<sup>51</sup>

5. **Students and Teachers Recruited and Enrolled:** Outreach and recruitment activities occurred in urban and rural high schools throughout 2018. Audience-specific marketing materials were created, an application process for admission to the program was developed and an AMSI website was launched. There are four teachers and 18 students currently enrolled.<sup>52</sup>

Specific outcomes and accomplishments include:

- Met with guidance counselors and high school students at urban and rural schools to promote AMSI.<sup>53</sup>
- Designed and disseminated teacher recruitment flyers promoting AMSI professional development with schedule, continued education units options, additive manufacturing certification possibilities and stipend information.
- Designed and disseminated student recruitment flyers promoting AMSI with schedule, additive manufacturing certification option, industry tours and scholarship information.<sup>54</sup>
- Created AMSI website.<sup>55</sup>

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<sup>48</sup> Appendix C: ATE NSF AWARD 1700455 pg. 8-9, Attachment 5, Logic Model

<sup>49</sup> Appendix B: Quarter 2 Evaluation Report, pg. 23, 75-76, Appendix D: Quarter 3 Report, pg. 1, Appendix F: CSCC May 17, 2018 Communication-Topic: -AMSI Expenditures

<sup>50</sup> Appendix G: PAST May 23, 2018 Communication: Instructor changes and Tolles' Equipment loan details

<sup>51</sup> Appendix D: Quarter 3 Report, pg. 12-15

<sup>52</sup> Appendix E: May 2018 AMSI Student and Teacher Enrollment Data

<sup>53</sup> Appendix B: Quarter 2 Evaluation Report, pg. 77-78

<sup>54</sup> Appendix B: Quarter 2 Evaluation Report, pg. 79-84

<sup>55</sup> Appendix B: Quarter 2 Evaluation Report, pg. 85-97

# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

- Hosted AMSI “meet and greet” and gave tour of facilities at PAST Innovation Lab on May 22, 2018<sup>56</sup> for enrolled teachers, students, their parents and prospective students.

6. **Evaluation and Research Design Progressing:** PAST’s Knowledge Capture Evaluation Team is responsible for designing and conducting internal evaluation during the first year of planning, and formative and summative evaluation of the AMSI project.<sup>57</sup> The Evaluation Team convened CSCC’s PI and Co-PIs to outline and discuss the proposed schedule of research and evaluation activities for Year 1 and was engaged in meetings and planning activities.

Pre/post survey materials are in development and have not been submitted for this report.<sup>58</sup>

Specific outcomes and accomplishments include:

- Secured Institutional Review Board approval for research and evaluation activities.<sup>59</sup>
- Developed a Shared Data Agreement between PAST and CSCC to provide CSCC access to aggregate participant data collected by PAST during the AMSI pilot project.<sup>60</sup> The document is not signed by partners as of May, 2018.
- Developed an internal evaluation schedule for quarterly and annual reporting.<sup>61</sup>
- Prepared and submitted Quarter 1 (August, 2017- November, 2017) and Quarter 2 (November, 2017 – February, 2018) Evaluation Reports.
- Produced a record of activities and detailed chronology in planning, recruitment, external partner communications and collaborations, decisions, changes, and curriculum and evaluation development activities.<sup>62</sup>

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<sup>56</sup> Appendix D: Quarter 3 Report, pg. 16-22

<sup>57</sup> Appendix C: NSF AWARD 1700455 pg. 13-14

<sup>58</sup> Appendix F: CSCC May 11, 2018 Communication-Topic: Pre/Post Surveys

<sup>59</sup> Appendix A: Quarter 1 Evaluation Report, pg. 33-53

<sup>60</sup> Appendix B: Quarter 2 Evaluation Report, pg. 110-111


<sup>61</sup> Appendix A: Quarter 1 Evaluation Report, pg. 54-61

<sup>62</sup> Appendix A: Quarter 1 Evaluation Report, Appendix B: Quarter 2 Evaluation Report

# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

## Modifications to AMSI National Science Foundation Proposal

Changes to the original proposal occurred and do not appear to negatively impact stated deliverables and outcomes. Changes included:

- Students will pursue an industry recognized credential through SME's Additive Manufacturing Fundamentals Certification exam instead of four individual certificates.<sup>63</sup>
- Scott Wegeng of CSCC assumed Co-PI role and responsibilities after Chris Brandon, Co-PI of PAST changed jobs and was no longer involved in AMSI.<sup>64</sup>
- AMSI participation numbers changed due to a lower than requested funding levels. The program can serve eight teachers and 24 students annually. 
- Principal Investigator and CSCC faculty Trevor Warfield will be an instructor for the AMSI program.<sup>66</sup>
- The number of certified instructors/coordinators was reduced from 5 to 2 because of the recent retirement of a faculty member at Ohio State University.<sup>67</sup>

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<sup>63</sup> Appendix B: Quarter 2 Evaluation Report, pg. 5, 21

<sup>64</sup> Appendix B: Quarter 2 Evaluation Report, pg. 5, 40-44

<sup>65</sup> Appendix A: Quarter 1 Evaluation Report, pg. 30

<sup>66</sup> Appendix G: PAST May 23, 2018 Communication: Instructor change explanation and Tolles' Equipment loan details

<sup>67</sup> Appendix G: PAST May 23, 2018 Communication: Instructor change explanation and Tolles' Equipment loan details

# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

## Summary of AMSI Project Activities Results

Anticipated activities and progress outlined in the proposal have been accomplished and are on schedule to launch the Additive Manufacturing Summer Institute. AMSI has developed teacher and student curriculum, aligned materials with industry certification requirements, and effectively promoted the program to urban and rural schools. Four teachers are participating in the online professional development course which began May 7, 2018. Four teachers and 18 students begin the AMSI program scheduled to start June 4, 2018.

### DELIVERABLE 1: AMSI PILOT PROJECT MODEL

Year 1 Project Activities (August, 2017-May, 2018)	Materials Reviewed for Evidence of Completion	Progress <ul style="list-style-type: none"> <li>• Completed</li> <li>• On Schedule</li> <li>• In Progress</li> <li>• Off Track</li> <li>• Not applicable</li> </ul>
Fall Planning Workshops-  Product: K12 alignment with postsecondary plan and certification	Team Chronology Notes <sup>68</sup>  CSCC AMSI College Credit Plus Course Levels <sup>69</sup>  CSCC Additive Manufacturing Career and Educational Pathway <sup>70</sup>	In Progress
Alignment of Certifications for advanced manufacturing  Product: Alignment Chart	CSCC Course List for AMSI (SME ToolingU online courses) <sup>71</sup>  CSCC Course Alignment with Additive Manufacturing Body of Knowledge Content Rubric <sup>72</sup>  Crosswalk of SME AM Certificate and AMSI activities and equipment <sup>73</sup>	Completed

<sup>68</sup> Appendix B: Quarter 2 Evaluation Report, pg. 17-22

<sup>69</sup> Appendix A: Quarter 1 Evaluation Report, pg. 13

<sup>70</sup> Appendix F: CSCC May 17, 2018 Communication-Topic: AM Career and Educational Pathway graphic

<sup>71</sup> Appendix A: Quarter 1 Evaluation Report, pg. 11-12

<sup>72</sup> Appendix B: Quarter 2 Evaluation Report, pg. 55-56, 59-68

<sup>73</sup> Appendix D: Quarter 3 Evaluation Report, pg. 12-15



# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

<b>Year 1 Project Activities (August, 2017-May, 2018)</b> (DELIVERABLE 1: AMSI MODEL Continued)	<b>Materials Reviewed for Evidence of Completion</b>	<b>Progress</b> <ul style="list-style-type: none"> <li>• <b>Completed</b></li> <li>• <b>On Schedule</b></li> <li>• <b>In Progress</b></li> <li>• <b>Off Track</b></li> <li>• <b>Not Applicable</b></li> </ul>
Evidence Based Evaluation Observations  Product: Research Study Planning	Internal Evaluation Project Meetings <sup>74</sup>  Proposed Internal Evaluation Plan <sup>75</sup>  IRB Approved Human Subject Research Materials (IRB No. 2017.11.0016ETH) <sup>76</sup>	On Schedule
Spring Planning Workshops  Product: AMSI Scope and Shared Resources	Implementation Team Chronology notes and agendas <sup>77</sup>  CSCC/PAST purchased equipment inventory <sup>78</sup>  Crosswalk of SME AM Certificate and AMSI activities and equipment <sup>79</sup>  AMSI Teacher P3 Professional Development and Teacher/Student 4 week schedule overview with daily learning module topics/activities <sup>80</sup>	Completed

<sup>74</sup> Appendix A: Quarter 1 Evaluation Report, pg. 54-58

<sup>75</sup> Appendix A: Quarter 1 Evaluation Report, pg. 59-61

<sup>76</sup> Appendix A: Quarter 1 Evaluation Report, pg. 33-53

<sup>77</sup> Appendix B: Quarter 2 Evaluation Report, pg. 17-39, Appendix D: Quarter 3 Evaluation Report, pg. 3-8

<sup>78</sup> Appendix D: Quarter 3 Report, pg. 11

<sup>79</sup> Appendix D: Quarter 3 Report, pg. 12-15

<sup>80</sup> Appendix D: Quarter 3 Report, pg. 23-40

# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

<b>Year 1 Project Activities (August, 2017-May, 2018)</b> (DELIVERABLE 1: AMSI MODEL Continued)	<b>Materials Reviewed for Evidence of Completion</b>	<b>Progress</b> <ul style="list-style-type: none"> <li>• <b>Completed</b></li> <li>• <b>On Schedule</b></li> <li>• <b>In Progress</b></li> <li>• <b>Off Track</b></li> <li>• <b>Not applicable</b></li> </ul>
Model Presentation to Stakeholders  Product: Research Study Planning	PAST Quarter 3 Report submitted to CSCC:  AMSI Curriculum for students: Four-week immersion and tour schedule  AMSI Curriculum for Teachers: seven week professional development curriculum and tour schedule <sup>81</sup>	Completed
Training for Certification Coordinators  Product: Certified trainers on equipment and processes	AMSI instructors' exam for Additive Manufacturing Fundamentals Certification is scheduled for May 31, 2018. <sup>82</sup>	In Progress
Outreach and promotion to attract Students  Product: 24 Student Scholarships for AMSI	Student Outreach schedule, hard copy/digital marketing materials <sup>83</sup> and AMSI Program website <sup>84</sup>  AMSI Open House/Kick Off Event at PAST Foundation <sup>85</sup>  18 students enrolled in AMSI <sup>86</sup>	Completed
Evidence Based Evaluation Baseline Survey for teachers, instructors, and students  Product: Baseline data collection tool developed	In development <sup>87</sup>	In Progress

<sup>81</sup> Appendix D: Quarter 3 Report, pg. 23-40

<sup>82</sup> Appendix F: CSCC May 17, 2018 Communication-Topic: Certification Exam

<sup>83</sup> Appendix B: Quarter 2 Evaluation Report, pg. 77-78, 82-84 Appendix D: Quarter 3 Report, pg. 16-18

<sup>84</sup> Appendix B: Quarter 2 Evaluation Report, pg. 85-97

<sup>85</sup> Appendix D: Quarter 3 Report, pg. 21-22

<sup>86</sup> Appendix E: May 2018 AMSI Student and Teacher Enrollment Data

<sup>87</sup> Appendix F: CSCC May 11, 2018 Communication-Topic: Pre/Post Surveys

# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

<b>Year 1 Project Activities (August, 2017-May, 2018)</b> (DELIVERABLE 1: AMSI MODEL Continued)	<b>Materials Reviewed for Evidence of Completion</b>	<b>Progress</b> <ul style="list-style-type: none"> <li>• <b>Completed</b></li> <li>• <b>On schedule</b></li> <li>• <b>In Progress</b></li> <li>• <b>Off Track</b></li> <li>• <b>Not applicable</b></li> </ul>
Host Additive Manufacturing Summer Institute  Product: Prototype AMSI Model with 8 teachers and 24 students	Year 1: June, 2018	On Schedule
Evidence Based Evaluation  Product: Administer Pre/post student assessments-Quantitative growth measurement	Year 1: June, 2018	In Progress

# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

## DELIVERABLE 2: FACULTY PROFESSIONAL DEVELOPMENT

Year 1 Project Activities (August, 2017-May, 2018)	Materials Reviewed for Evidence of Completion	Progress <ul style="list-style-type: none"> <li>• Completed</li> <li>• On schedule</li> <li>• In Progress</li> <li>• Off Track</li> <li>• Not applicable</li> </ul>
Faculty PD Planning Workshops  Product: Initial PD Design	AMSI Teacher PD Timeline <sup>88</sup>	Completed
Outreach and promotion to attract Teachers  Product: 8 Teacher Scholarships for AMSI	Teacher Outreach schedule, hard copy/digital marketing materials <sup>89</sup> and AMSI Program website <sup>90</sup>  AMSI Teacher Commitment Letter <sup>91</sup>  4 Teachers enrolled in AMSI <sup>92</sup>	Completed
Teacher Professional Development design finalized  Product: 8 Teachers create lesson modules	AMSI Teacher Schedule May-June 2018 <sup>93</sup>  4 Teachers enrolled in AMSI <sup>94</sup>	On Schedule
Teacher PD P3: Delivery  Product: Assist teachers in successful implementation of planned coursework and training	Year 2	Not Applicable

<sup>88</sup> Appendix B: Quarter 2 Evaluation Report, pg. 7, 36, Appendix D: Quarter 3 Report, pg. 23-28

<sup>89</sup> Appendix B: Quarter 2 Evaluation Report, pg. 77-81 Appendix D: Quarter 3 Report, pg. 19-21

<sup>90</sup> Appendix B: Quarter 2 Evaluation Report, pg. 86-97

<sup>91</sup> Appendix D: Quarter 3 Report, pg. 24

<sup>92</sup> Appendix E: May 2018 AMSI Student and Teacher Enrollment Data

<sup>93</sup> Appendix D: Quarter 3 Report, pg. 25-30

<sup>94</sup> Appendix E: May 2018 AMSI Student and Teacher Enrollment Data

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## DELIVERABLE 3: MODEL EDUCATION PATHWAY

<b>Year 1 Project Activities (August, 2017-May, 2018)</b>	<b>Materials Reviewed for Evidence of Completion</b>	<b>Progress</b> <ul style="list-style-type: none"> <li>• <b>Completed</b></li> <li>• <b>On schedule</b></li> <li>• <b>In Progress</b></li> <li>• <b>Off Track</b></li> <li>• <b>Not applicable</b></li> </ul>
Develop Model Education Pathway  Product: Educational Pathway completed	Year 2 & 3	Not Applicable

# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

## Conclusion

The External Evaluation has focused on the startup activities to prepare and establish the AMSI program for teachers and students. Efforts over the past ten months have achieved Columbus State Community College's plan to "rapidly prototype"<sup>95</sup> and launch the pilot project.

Columbus State Community College, PAST Foundation, and external partners have implemented first year activities for AMSI with fidelity. Critical outputs have been completed, specifically:

1. First year activities to establish and prepare for the Design Thinking: Additive Manufacturing Summer Institute were implemented according to the proposal plan submitted to the National Science Foundation's Advanced Technological Education (ATE) program.
2. AMSI curriculum has been completed and has been aligned and informed by industry expectations through SME's Additive Manufacturing Book of Knowledge.
3. Recruitment activities were successful resulting in the enrollment of four teachers and 18 students.
4. Necessary equipment to support AMSI programming has been secured to support curriculum activities.
5. Teacher professional development curriculum has been completed and is occurring during May, 2018 and will continue through June, 2018.
6. AMSI will begin as scheduled. AMSI's student-focused four-week program is scheduled, staffed, equipped and 18 student participants are enrolled.

Lessons learned and materials developed during the first year will be helpful to other institutions hoping to implement a similar program.

Insights and knowledge gained through the actual implementation of the program will be available in the next two years through feedback garnered from pre/post survey data results of participants, learning modules developed and implemented by teachers during the upcoming school year of 2018-2019 and other insights from instructors and external partners after the implementation of AMSI.

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<sup>95</sup> Appendix C: ATE NSF AWARD 1700455, pg. 4

# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

## Appendix A

### AMSI Evaluation Report, Quarter 1: August-November 2017

Submitted to Columbus State Community College  
Submitted by PAST Foundation

# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

## Appendix B

### AMSI Evaluation Report, Quarter 2: November 2017-February 2018

Submitted to Columbus State Community College  
Submitted by PAST Foundation



# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

## Appendix C

### Design Thinking: Additive Manufacturing Summer Institute Proposal Number 1700455

Submitted to National Science Foundation  
Submitted by Columbus State Community College

# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

## Appendix D

### AMSI Quarterly Report, Quarter 3: February 2018 – May 2018

Submitted to Columbus State Community College  
Submitted by PAST Foundation

# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

## Appendix E

### May 2018 AMSI Student and Teacher Enrollment Data

Submitted to Harkin Consulting Services  
Submitted by PAST Foundation

# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

## Appendix F

CSCC May 17, 2018 Communication

Columbus State Community College Career and Educational  
Pathway Map

Travel, Supplies, Equipment and Sub-recipient Expenditures

Submitted to Harkin Consulting Services  
Submitted by Columbus State Community College

# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

## Appendix G

PAST May 23, 2018 Communication

Instructor changes and Tolles' Equipment loan details

Submitted to Harkin Consulting Services  
Submitted by PAST Foundation

# ADDITIVE MANUFACTURING SUMMER INSTITUTE (AMSI)

## External Evaluator Contact Information

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