



Year 2 Annual Evaluation Report

CNC Advanced Multi-Axis Programming (CAMP)

NSF/ATE Award 1501872



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YEAR 2 ANNUAL EVALUATION REPORT

Athens Technical College and Southern Polytechnic State University¹

CNC Advanced Multi-Axis Programming (CAMP)

Funded by
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Award # 1501872
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SCATE Inc.

Athens Technical College serves as the state-designated grantee for a partnership involving two colleges focused on increasing training opportunities in Multi-Axis Computer Numerical Control (CNC) programming in Georgia, thus making “it possible for Technical College System of Georgia (TCSG) instructors to develop a 21st century advanced certificate in multi-axis machining an programming.” Together with the Southern Polytechnic University College of Engineering and Engineering Technology at Kennesaw State University (KSU), the partnership initiative, CNC Advanced Multi-Axis Program (CAMP), responds to the state’s demand for well-trained precision machinists. “With over seven billion dollars of aerospace parts being exported from Georgia every year, it has become imperative to offer the advanced technical training now.”

Athens Technical College, one of the largest public two-year institutions in the state of Georgia, boasts an average annual enrollment of about 7,500 students. The college is a unit of the Technical College System of Georgia (TCSG). Together with Southern Polytechnic State University, a four-year public institution part of the University System of Georgia, the two institutions are combining efforts to provide a program of professional development opportunities for faculty throughout the state¹. The impetus of this partnership is rooted in the statewide and national demand for multi-axis workers. The following statements from the project’s abstract depicts the need:

Georgia’s largest export in 2013, at \$6.75 Billion, was aerospace products and parts. Exports from this sector grew by 19.8% in that year alone. Historically, machine tool

¹ On January 6, 2015, the Board of Regents of the University System of Georgia approved the consolidation of Kennesaw State and Southern Polytechnic State University.



technology has always been a foundational underpinning of manufacturing and this is especially true in aerospace industry. While there is a national shortage of workers available with multi-axis CNC skills, and industry demand for them is contributing to increase, the advanced training required to produce them remains unavailable. Professional development for machine tool instructors will directly address this problem by building capacity for industry-recognized training at technical colleges and 4-year institutions involved in the Coalition of Machine Tool Technology Programs of Georgia (COMP-GA).

CAMP

CAMP is a three-year project “responding to industry needs for trained workers, and meeting specific demands of the aerospace industry in Georgia.” The overarching *CAMP* goal is to “provide educators with the training necessary to bring the state’s machine tool and technology instructors’ knowledge and capabilities up to the point where it is possible for them to propose and/or implement an Advanced Multi-Axis Machining Certificate.”

CAMP is funded through the National Science Foundation’s Advanced Technological Education Program initiative. “With an emphasis on two-year colleges, the Advanced Technological Education (ATE) program focuses on the education of technicians for the high-technology fields that drive our nation’s economy. The program involves partnerships between academic institutions and employers to promote improvement in the education of science and engineering technicians at the undergraduate and secondary school levels. The ATE program supports curriculum development; professional development of college faculty and secondary school teachers; career pathways to two-year colleges from secondary schools and from two-year colleges to four-year institutions; and other activities.” (http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5464).

CAMP Goals and Objectives

The goal of *CAMP* includes providing the training necessary to bring the Georgia’s machine tool technology instructors’ knowledge and capabilities up to the point where it is possible for them to implement an advanced certificate in Multi-Axis CNC Machining. Educators will use this training to evaluate various projects, and formulate the curriculum necessary to propose an advanced certificate in multi-axis machining to the Technical College System of Georgia (TCSG). The ability to offer this training is crucial if Georgia is to be able to train students who can utilize the full capabilities of the equipment and help their employers remain competitive in a global marketplace.

Achievement of this goal is supported by the following five objectives:

1. To train COMP-GA faculty members around the state of Georgia, according to industry standards on programming and machining using multi-axis CAN machining centers at Vincennes University (VU) Haas Technical Educator Center;



2. To network with and gain guidance and expertise from the Regional Advanced Machining Partnership (RAMP), and existing NSF ATE project at Central Maine Community College. RAMP is far along in its quest to develop a trained and highly technical workforce that meets industry production and productivity needs. COMP-GA can shorten the learning curve by collaborating with RAMP.
3. To evaluate multi-axis machining and programming projects that may be incorporated into the proposed curriculum at COMP-GA institutions;
4. Propose an Advanced Multi-Axis Machining Certificate curriculum to the Technical College System of Georgia for approval.
5. Promote the pathway into a BAS in Manufacturing Operations, through the articulation agreement with Kennesaw State University.

Evaluation

SCATE Inc., a 501(c)(3), not-for-profit corporation organized for educational purposes to improve the nation's technological workforce, serves as external evaluator for *CAMP*. SCATE Inc. has experience in evaluating projects funded by the National Science Foundation, U.S. Department of Education, and state agencies for two-and four-year colleges, universities, and not-for-profit corporations.

The evaluation process is guided by evaluation standards and accepted practices and guidelines provided by The Evaluation Center at Western Michigan University, the National Science Foundation, and the Kellogg Foundation.

SCATE Inc. utilizes a participatory approach in the evaluation of *CAMP*, partnering from the beginning with project management in devising appropriate outcome measures, data requirements, and assessment methods consistent with desired project outcomes. To conduct the external evaluation of the *CAMP* project, SCATE Inc. utilizes a mixed-method design, including both quantitative and qualitative methods. The rigorous evaluation process includes formative, summative, and process components.

Overall, the evaluation process is driven by the following research question:

To what degree has CAMP successfully trained and equipped Georgia machine tool and technology educators with the essential skill sets for them to propose and/or implement an Advanced Multi-Axis Machining Certificate?

During the project's first year, evaluators engaged in formative evaluation strategies including document review and assessment of progress made toward attainment of project deliverables. SCATE Inc. continued to employ these evaluation strategies during project Year 2 and also conducted structured interviews with participating instructors and attending college administrators and industry partners. *CAMP's* two-year progress toward implementing project strategies and activities designed to support and attain project objectives is presented in Tables 1 – 5. Updates since the Year 1 Annual Evaluation Report are inserted in orange.



CAMP Objective 1

Train COMP-GA faculty members around the state of Georgia, according to industry standards on programming and machining using multi-axis CNC machining centers at Vincennes University (VU) HAAS Technical Education Center.

To meet this objective, *CAMP* engaged training provided by a 3rd party vendor, Learning Labs Inc. through Mastercam University. The philosophy of Learning Labs Inc. is “geared toward reinforcing academic skills through applied hands-on learning experience to help make school a fun and exciting place for students, as well as a place where learning is relevant to the real world and workplace.” That being the case, it should be noted that *CAMP* does not create the training curriculum. Course information, including description and objectives was included in Attachment A of the Year 1 Annual Evaluation Report. In addition to providing the training desired by *CAMP*, the Mastercam University® Multiaxis Curve / Drill / Circle Mill course was selected because of its inclusion of programming projects and other hands-on components. Training is offered at Vincennes University to those faculty who satisfy the prerequisite completion of 40-60 hours online Mastercam University training.

Upon completing the Mastercam University® Multiaxis Curve / Drill / Circle Mill course, students are awarded a Certificate of Completion. The Certificate “will be stored at Mastercam University under [the student’s] unique student ID number. It remains available ... to use as proof of work completed and grades received.”

CAMP has targeted a total of 18 Georgia faculty members to undergo the online and Vincennes University training on programming and machining. Contents of both trainings conformed to industry standards. Ten faculty from eight Georgia colleges completed training during *CAMP* Year 1. During the project’s second year, *CAMP* leadership reported that in August 2016 an additional three “faculty underwent MasterCam online multi-axis training and then attended Vincennes University for hands on multi-axis training.” As of this Year 2 Annual Evaluation Report, 13 (72%) of the Georgia machine tool instructors have been trained. Table 1a identifies the completers and their respective colleges.

Table 1a			
Mastercam University® Multi-axis Curve / Drill / Circle Mill Course Completers			
College/University	<i>CAMP</i> Year 1 <small>(June 1, 2015 – May 31, 2016)</small>	<i>CAMP</i> Year 2 <small>(June 1, 2016 – May 31, 2017)</small>	<i>CAMP</i> Year 3 <small>(June 1, 2017 – May 31, 2018)</small>
Athens Technical College	Kiszka, Edward		
	Rolf, Stuart		
	Whitener, Benjamin		
Chattahoochee Technical College		Jack Dempsey	



Coastal Pines Technical College	Gibbs, Chris		
Georgia Northwestern Technical College	Shirley, Phillip		
Kennesaw State University	Randall Emert		
Lanier Technical College		Tommy Morris	
		Craig Taylor	
North Georgia Technical College	Gary, Shannon		
Oconee Fall Line Technical College	Hall, David		
Savannah Technical College	Friend, Jeffrey		
West Georgia Technical College	White, Tim		

During *CAMP* Year 2, Tommy Morris (Lanier Technical College) also attended the four-day 4-axis class that was held at Central Maine Community College (May 2016). *CAMP* Co-PI, Edward Kiszka, attended a 5-axis workshop in June 2016 also at Central Maine Community College.

Table 1b lists the objective-related project strategies and supporting activities with corresponding evaluation comments.

Table 1b Objective 1 Evaluation Activities and Evaluator Comments	
Project Strategies and Supporting Activities	Evaluation Comments
Schedule class times, register for classes and make travel arrangements to attend Vincennes University Haas Technical Education Center (HTEC) Mastercam Multi-axis Toolpaths course.	<i>CAMP</i> leadership is responsible for scheduling training. Since faculty originate from different parts of the state (Georgia), each participant is responsible for making his/her own travel arrangements. Thirteen completers of the training since the project's inception attest to the project's successful completion of this activity.
Each faculty member to complete 40-60 hours of online Mastercam University training prior to attending Vincennes University.	When seeking to determine how the completion of the 40-60 hours is verified, <i>CAMP</i> leadership informed SCATE Inc. that "the MasterCam online training was homework to prepare the instructors for 5-axis Computer Numerical Control (CNC) programming." <i>CAMP</i> leadership further reported that "the instructors were already very familiar with the software and all had



	<p>experience with three axis programming” and that because the participating faculty seemed knowledgeable, verification of completion of 40-60 hours did not occur.</p> <p>While SCATE Inc. can understand the above-stated rationale for not administering a formal check of hours completed, evaluators encourage <i>CAMP</i> leadership to institute a method of documenting each compliance exemption with the stated project strategy and supporting activity.</p>
<p>Virtually participate and complete Vincennes University Mastercam University Multi-axis Curve / Drill / Circle Mill online – course that provides students with a strong foundation in 5-axis CNC programming.</p>	<p>At the end of two <i>CAMP</i> years, 13 of the targeted 18 Georgia faculty have participated in, and completed, the Mastercam University Multi-axis Curve/Drill/Circle Mill online course.</p>
<p>Attend in-person trainings and complete the hands-on portion of the Mastercam Multiaxis Toolpaths course that includes: setting up a 5-axis trunnion; 5-axis simultaneous tool paths; running actual parts and modifying Mastercam parameters that affect the outcome of the program.</p>	<p>All 13 of the faculty identified in Table 1a have completed this activity.</p>

During *CAMP* Year 2, SCATE Inc. interviewed training completers, college administrators, and industry representatives who were present at the September 30, 2016 meeting of the IFCC to obtain viewpoints regarding the training content and the extent to which the training increased training completers’ knowledge of 5-axis CNC programming. Specifically, SCATE Inc. sought to determine the degree to which faculty have acquired the skills, knowledge and confidence to teach this technology. Collected feedback is summarized in Attachment A4.



CAMP Objective 2

Network with and gain guidance and expertise from the Regional Advanced Machining Partnership (RAMP), an existing NSF ATE project at Central Maine Community College.

Through an assessment of the Project Strategies and Supporting Activities listed in Table 2, SCATE Inc. examines *CAMP's* interaction with the Regional Advanced Machining Partnership - RAMP (an NSF ATE recipient developing an advanced machining certificate), to ascertain the extent to which the partnership reduced the learning curve and/or shortened the learning time for COMP-GA project personnel, and if best practices and other knowledge have been shared. *As reported in the CAMP Year 1 Annual Evaluation Report, these impacts and outcomes were projected to be determined by SCATE Inc. interviews with project personnel during CAMP Year 2. A summary of the conducted interviews appears in Attachment A4.*

SCATE Inc. continued to determine progress that *CAMP* has made toward implementing the Project Strategies and Supporting Activities that support Objective 2 throughout the second year of the project as summarized in Table 2.

Table 2	
Objective 2 Evaluation Activities and Evaluator Comments	
Project Strategies and Supporting Activities	Evaluation Comments
Additional faculty unable to attend Vincennes University complete 40-60 hours of online Mastercam University training.	<p><i>CAMP</i> leadership reports that, as of this Year 1 Evaluation Report, no faculty have completed the online training. It should be noted that this training is designed to support learning among those who either are not already familiar with the software and processes or who will be unable to attend the in-person Mastercam training. The next Mastercam training is scheduled for August 23-25, 2016.</p> <p><i>As of this Year 2 Annual Evaluation Report, CAMP reported that the only faculty to complete MasterCam training during this report period also attended Vincennes University. The evaluator further was informed that MasterCam has introduced a new version 2017 and that members of the CAMP leadership team have been invited to take part in the new certification pilot program, noting the following as the benefit according to MasterCam:</i></p> <p><i>“Once complete you will be a nationally certified Mastercam Instructor. Your school will be a Certified Mastercam Training Center.</i></p>



	<p>We will be marketing you, your program and your students to industry. You will be able to certify your students and even to into local industry and do classes that end with you certifying industrial customers.”</p> <p>Finally, the evaluator learned that <i>CAMP</i> plans to offer a 3-day MasterCam workshop for all Georgia instructors later in 2017.</p>
<p>Faculty who attended and completed Vincennes University Mastercam Multi-axis Toolpaths course select a training project for faculty unable to attend Vincennes University that will cover the hands on training.</p>	<p>Similar to an “each one, teach one” philosophy, this project strategy is intended to increase training awareness and interest among Georgia machine tool and technology instructors. <i>CAMP</i> reports that 17 TCSG instructors and the <i>CAMP</i> PI (Randy Emert) attended a statewide Instructional Faculty Consortium Committee meeting on March 3, 2016. Among the 17 attendees were the nine identified in Table 1a who had undergone the Mastercam online and Vincennes University Training. These nine faculty discussed their training experiences which generated interest in participating in the training among seven of the other faculty. Follow-up evaluation activities will seek to determine the degree to which these sharing opportunities result in additional instructor participation in training opportunities.</p>
<p>Faculty development workshop where additional TCSG Machine Tool Technology faculty will receive hands on training involving setting up and running a multi-axis machining center.</p>	<p>This project is designed to increase the capacity of machine tool programs to teach the multi-axis technology. Initially, there was a machine shortage impeding the ability of the offering of additional workshops. At the time of the Year 1 Annual Evaluation Report, there was only one Georgia technical college (Lanier Technical College) that had a 5-axis machine, which was donated. As of this Year 2 Annual Evaluation Report, the following Georgia Technical Colleges are now equipped with 4-axis or 5-axis machines:</p> <p><u>4-axis</u>: Coastal Pines, Columbus, Georgia Northwestern, Lanier, Oconee Fall Line, and West</p> <p><u>5-axis</u>: Columbus, Georgia Northwestern, Lanier, and Oconee Fall Line.</p> <p><i>CAMP</i> leadership reports of its intent to offer a 2-or 3-day MasterCam certification workshop to be held in May 2017. <i>CAMP</i> leadership hopes to “bring projects from industry to discuss for future use ... and include some hands on training as a refresher course” as part of the workshop. Workshop location has yet to be determined.</p> <p><i>CAMP</i> leadership also reported that a group of machine tool instructors will be sent for training to either Vincennes University or Danville Community College which will bring the project closer to its goal of 100% of Georgia machine tool instructors trained in multi-axis programming.</p>



Evaluate faculty on completion of the selected multi-axis machining project.	No data or other documented evidence provided/reported to enable SCATE Inc. to determine/verify progress.
Track training proliferation of TCSG Machine Tool Technology faculty.	At the end of project Year 1, <i>CAMP</i> reported that due to the small number of TCSG Machine Tool Technology faculty, tracking to this point has been “pretty basic.” However, the project PIs conveyed their plans to develop a spreadsheet to capture the anticipated increased training. <i>The latter was developed during project Year 2 and enabled the evaluator to update information pertaining to Year 1 multi-axis training participants in Table 1a of this report.</i>

During *CAMP’s* first year, only Lanier Technical College had a 5-axis machine. The lack of equipment posed project implementation challenges. According to the project Principal Investigators, they were under the impression that the state was going to purchase new equipment, including 5-axis machines, for machine tool programs. As of the Year 1 Annual Evaluation Report, such had yet to occur. Without the necessary equipment, the project would be challenged to meet its training goals and workshop offerings as stated in the grant.

Recently, *CAMP* leadership reported the following:

Athens Tech Machine tool program received a new CNC milling machine at the end of 2016 that is equipped with the Haas Wireless Intuitive Probing System (WIPS). Training on the WIPS will be included in our multi-axis certificate and is part of the curriculum from [Central Maine Community College] (CMCC). The new machine is wired for a fourth axis attachment and will hopefully be equipped with the attachment in the near future allowing us to teach four axis programming and machining. More machine tool programs are receiving multi-axis equipment as the need for technicians grows.

The evaluator considers the preceding as a demonstration of *CAMP* leadership’s efforts to ensure that project deliverables are attained.



CAMP Objective 3

Evaluate various multi-axis machining and programming projects that may be incorporated into the proposed curriculum for COMP-GA institutions

Although prerequisite steps toward realizing evaluation activities associated with *CAMP* Objective 3 have occurred under project objectives 1 and 2, implementation of goal 3 activities **was** slated to occur later during project implementation. **However, during the project’s first year**, evaluator conversations with the *CAMP* Leadership Team sought to identify strategies intended to be used by *CAMP* to find and evaluate projects for incorporation into the proposed curriculum.

During *CAMP* Year 2 (2016 – 2017), SCATE Inc. committed to seeking responses to the following in order to evaluate *CAMP*’s progress toward fully attaining this objective:

- **What kind of multi-axis machining and programming projects were evaluated and selected for incorporation into the proposed for COMP-GA colleges? How many?**
- **In what ways did industry participate in project selection?**
- **Which programs desire to implement the evaluated projects? How was this determined?**

Since project selection had not occurred at the time when the evaluator attended the Machine Tool Technology Instructional Faculty Consortium Committee – Statewide Instructors Meeting (September 30, 2016), responses to the above questions were not sought. Instead, the evaluator took the opportunity to collect general information from attendees pertaining to training received under *CAMP* and the impact of the training on machine tool instructional faculty’s curriculum delivery (see Attachment A).

Table 3 lists the objective-related project strategy with corresponding evaluation comments.

Table 3 Objective 3 Evaluation Activities and Evaluator Comments	
Project Strategies and Supporting Activities	Evaluation Comments
After completing the Vincennes University Mastercam Multi-axis Toolpaths course, faculty along with industry will discuss and select appropriate projects to be included in the proposed certificate.	During <i>CAMP</i> year 1, evaluators were informed that identification of projects to be included in the proposed Multi-axis Machining Certificate was scheduled to occur later during project implementation. As of the Year 1 Annual Evaluation Report , <i>CAMP</i> leadership had not provided data or other documented evidence to enable SCATE Inc. to determine/verify progress, nor was any expected. As of this Year 2 Annual Evaluation Report , <i>CAMP</i> leadership reported that project selection is underway and that the intent is to narrow project selection down during the MasterCam



	<p>Workshop and at the next Advisory Committee meeting where industry input will be sought. <i>CAMP</i> leadership also informed the evaluator of its consideration of projects made available through the Titans of CNC Academy.</p> <p>Since <i>CAMP</i>'s third and final project year will begin within weeks of this Year 2 Annual Evaluation Report, the evaluator appeals to <i>CAMP</i> leadership to make sure this strategy/activity is completed in timely manner to be incorporated into the proposed certificate and to inform the evaluation perspective.</p>
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CAMP Objective 4

Propose a Multi-Axis Machining Certificate to the Technical College System of Georgia.

Work on, and completion of, project strategies and supporting activities associated with CAMP Objective 4 was scheduled for project years 2 and 3. However, during project year 1, the CAMP leadership team had either taken preliminary steps and/or been granted opportunities that positioned the project on an upward trajectory toward full attainment of Objective 4.

Table 4 discusses progress made to date for each Objective 4 strategy/activity.

Table 4	
Objective 4 Evaluation Activities and Evaluator Comments	
Project Strategies and Supporting Activities	Evaluation Comments
<p>With industry input, identify areas of multi-axis, lathes with live tooling, mill/turn to be included in a Multi-Axis Machining Certificate.</p>	<p>During Year 1, CAMP reported the establishment of a new multi-axis program at Chattahoochee Technical College (Marietta, GA) and that a professor of the program has years of experience in industry. CAMP PI, Stuart Rolf, planned to initiate contact with the professor for the purpose of obtaining input regarding courses to include in a proposed Multi-Axis Machining Certificate. SCATE Inc. applauded this outreach intent and suggested that CAMP leadership also consider scheduling roundtables with area industry representatives to expand the discussion of components and courses to include in the proposed Certificate.</p> <p>As of this Year 2 Annual Evaluation Report, CAMP reported that development of the multi-axis certificate is in progress and that the plan is to use as much of the curriculum given by Central Maine Community College (CMCC) as possible. CAMP also reported its intent to build on what CMCC has done, remaining mindful of the “different needs for the separate industries” that the project supports.</p>
<p>Develop course names, descriptions, times and credit hours.</p>	<p>It remains too soon to evaluate progress made toward completing this project strategy. SCATE Inc. believes that CAMP leadership will complete the stated strategies as CAMP works through development of the Multi-Axis Machining Certificate.</p>



<p>Receive feedback from Machine Tool Technology faculty at the yearly TCSG consortium meeting and modify as necessary.</p>	<p>During Year 1, SCATE Inc. reviewed the Minutes from the October 8, 2015 meeting of Machine Tool Technology instructors. The minutes present suggestions pertaining to industry certifications that include course scheduling, course credit hours, prerequisites and apprenticeships. The extent to which suggestions offered during the meeting will be incorporated into the proposed Multi-Axis Machining Certificate will be revisited during future evaluation visits. SCATE Inc. encourages <i>CAMP</i> leadership to track all suggestions/feedback to formulate a graphic depiction that charts the transferring of suggestions into implemented actions.</p> <p>The evaluator attended the meeting of the Machine Tool Instructional Faculty Consortium Committee (IFCC) on September 30, 2016 and can attest to feedback being sought from faculty, and appropriately implemented. At the same meeting, the evaluator also offered input regarding the new name for MTT which was taken into consideration and subsequently implemented (See Meeting Minutes and email documentation in Attachment B.)</p>
<p>Identify the academic resources required to implement a Multi-Axis Machining Certificate</p>	<p>SCATE Inc. has reason to believe that <i>CAMP</i> leadership will complete the stated strategies as a result of evaluator-obtained input received from industry representatives at the September 30, 2016 meeting of the IFCC.</p>
<p>Write a proposal to present to TCSG for approval.</p>	<p>Implementation of strategies and activities to attain this deliverable is not expected until later during project implementation. As of this Year 2 Evaluation Report, SCATE Inc. is not able to provide evaluation comments pertaining to this deliverable.</p>
<p>Receive approval from TCSG consortium</p>	<p>Implementation of strategies and activities to attain this deliverable is not expected until later during project implementation. As of this Year 2 Evaluation Report, SCATE Inc. is not able to provide evaluation comments pertaining to this deliverable.</p>

At the end of *CAMP* Year 1, SCATE Inc. was informed that *CAMP* PI, Stuart Rolf, would be among a team of other Georgia technical college faculty selected to travel to Germany for a week for the purpose of touring German companies and plants that employ Machine Tool Technology workers. The experience and connections are anticipated to contribute to information needed to build the Multi-Axis Certificate for the Technical College System of Georgia. Subsequent to the German trip, Stuart reported the following to the evaluator:

“The visit to Germany was a great opportunity to see how the European apprenticeship works. We have a number of companies that are interested in working with the machine tool program to develop an apprenticeship agreement. Part of the German apprenticeship that covers machining also requires students to be trained in multi-axis machining. This fits perfectly with our future plans.”



CAMP Objective 5

Develop a pathway into a BAS of Manufacturing Operations Specialist, through the creation of an Articulation Agreement with Southern Polytechnic State University.

This objective focuses on, “getting the word out.” According to *CAMP* leadership, wording of this objective has been slightly modified to reflect the project’s intent to “promote [not develop] an articulation pathway which allows students who obtain an associate degree in Machine Tool Technology to continue their education at Kennesaw State University and obtain a Bachelor of Applied Science in Manufacturing Operations (BASMO) which opens the possibility of pursuing graduate studies.” *CAMP PIs have plans to promote the machine tool program and the articulation pathway to the BASMO degree offered at Kennesaw State University KSU). Among the plans is a scheduled presentation to counselors at the annual guidance counselors’ conference at KSU.*

Table 5 lists the initially-stated objective-related project strategies with corresponding evaluation comments.

Table 5	
Objective 5 Evaluation Activities and Evaluator Comments	
Project Strategies and Supporting Activities	Evaluation Comments
Propose a BAS in Manufacturing Operations Specialist for an online articulation.	<i>CAMP reports that the online articulation exists and that students from the technical colleges are being made aware of it through the project leadership’s efforts to promote the BASMO degree.</i>
Website documentation of articulation.	Implementation of strategies and activities to attain this deliverable is not expected until later during project implementation. <i>As of this Year 2 Evaluation Report</i> , SCATE Inc. is not able to provide evaluation comments pertaining to this deliverable.
Promote BAS of Manufacturing Operations Specialist to professional organizations.	SCATE Inc. was provided evidence to support the presence of the <i>CAMP PI</i> at the 2015 and 2016 NSF ATE PI Conferences, and understands that networking during the conference enabled the <i>CAMP PI</i> to promote the project and the project’s intent among fellow conference attendees. <i>Project leadership informed SCATE Inc. of it plans to promote the BAS at a statewide meeting of career counselors to be held at Kennesaw State University early into CAMP Year 3. Also, according to CAMP leadership, although the STEM Guitar Institute (a train-the-trainer workshop) is for teachers and instructors, an opportunity will be provided to “high school students to attend the STEM Guitar Project this summer. This project will</i>



	<p>recruit students into the machine tool program and on to KSU towards the BAS degree (a long-term impact of the STEM Guitar Institute)."</p> <p><i>CAMP</i> partner, Kennesaw State University, hosted one of the Summer 2016 Institutes (June 27 – July 1) of the National STEM Guitar Projects. Nine people attended the 2016 Institutes including five from Georgia and four from other states.</p> <p>The Institutes "provide faculty training on science, technology, engineering and math (STEM) for middle, high school, and post-secondary faculty." The overarching goal of the STEM Guitar Institutes "is to showcase a new way to present learning for students with applied methods." The STEM Guitar project also provides opportunities for students to learn by actually machining parts required for manufacturing a guitar, tying the activity directly to the technology that is the focus of the <i>CAMP</i> project. The Institute at Kennesaw State University is viewed by <i>CAMP</i> leadership as an extension of the project's Objective 5 strategies and activities and as an opportunity for <i>CAMP</i> to have a broader impact in terms of increasing training opportunities. SCATE Inc. also views the Institute as an example of <i>CAMP</i> leveraging partner resources.</p> <p><i>CAMP</i> leadership is uncertain of any future offerings of the STEM Guitar Institute.</p>
<p>Promote the BAS of Manufacturing Operations Specialist at HTEC conference.</p>	<p><i>CAMP</i> leadership promoted the BAS of Manufacturing Operations Specialist during the 2015 and 2016 Haas Technical Education Conferences (HTEC). During the 2016 HTEC Conference <i>CAMP</i> leadership presented on the topic of "Multi-Axis Machining: A Critical Need for Innovative Manufacturing Education." The presentation discussed "what Georgia faculty have discovered about multi-axis machining and their plans to implement an advanced multi-axis machining program in the state of Georgia." <i>CAMP</i> will not be presenting at the 2017 HTEC Conference. However, as earlier stated, <i>CAMP</i> will be presenting at the KSU guidance counselors' conference.</p>



Conclusion and Recommendations

Much of *CAMP* Year 1 was devoted to start-up aspects of the project. Even so, *CAMP* leadership made notable progress toward implementing the strategies and activities associated with project objectives, despite being plagued by a significant challenge (equipment) impacting the project's progress. During *CAMP* Year 2, project leadership continued to work toward full attainment of the project's five objectives. The evaluator is impressed by the *CAMP* leadership team's ongoing efforts to promote the project and leverage other opportunities and resources, and recognizes the following as Year 2 nuggets:

- *CAMP* PI, Stuart Rolf, was among a team of other Georgia technical college faculty traveling to Germany for a week for the purpose of touring German companies and plants that employ Machine Tool Technology workers. Rolf summarized the experience as "a great opportunity to see how the European apprenticeship works. We have a number of companies that are interested in working with the machine tool program to develop an apprenticeship agreement. Part of the German apprenticeship that covers machining also requires students to be trained in multi-axis machining. This fits perfectly with our future plans."
- Three additional Georgia Machine Tool Technology faculty underwent MasterCam training. As of this Year 2 Annual Evaluation Report, 13 (72%) of the Georgia machine tool instructors have been trained.
- The *CAMP* leadership team has been invited to take part in the new MasterCam certification pilot program. Once complete, they will be designated as nationally certified MasterCam Instructors.
- Six Georgia technical colleges now have 4-axis or 5-axis machines. Four of the six technical colleges have both.
- Precision Machining and Manufacturing will be the new name for the Machine Tool Technology program.

As the project enters its third and final year, SCATE Inc. encourages project PIs to constantly revisit activities and strategies related to each project objective to ensure completion and attainment by the end of the funding period.