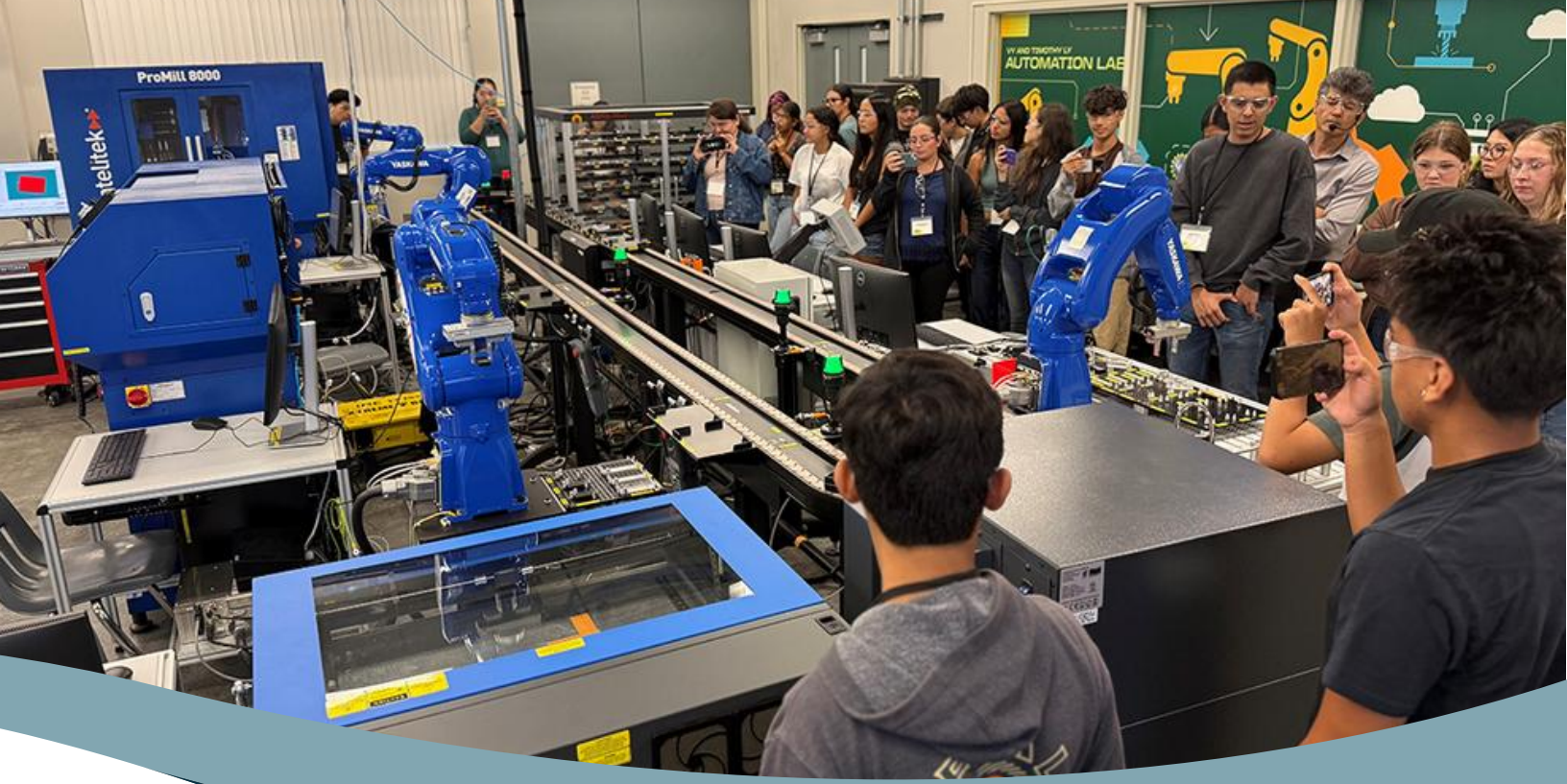

Centers of Research Excellence in Science and Technology: Center for Research Advancement in Smart Manufacturing (CREST-RASM)

California State Polytechnic University, Pomona

YEAR 1 EVALUATION REPORT

August 2026

Submitted by: COBBLESTONE APPLIED RESEARCH & EVALUATION, INC.
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COBBLESTONE

ABOUT THE AUTHORS

This report was written by Cobblestone Applied Research & Evaluation, Inc. (*Cobblestone*) for the National Science Foundation-funded Centers of Research Excellence in Science and Technology: Center for Research Advancement in Smart Manufacturing (CREST-RASM) project at California State Polytechnic University, Pomona (CPP), NSF # 2514616. *Cobblestone* specializes in designing and conducting program evaluation and applied research studies in the education field. For more information, visit www.cobblestoneeval.com.

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Any opinions, findings and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation

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Funded by the National Science Foundation (NSF; #2514616), the **Centers of Research Excellence in Science and Technology: Center for Research Advancement in Smart Manufacturing (CREST-RASM) project** at California State Polytechnic University, Pomona (CPP) is designed to deliver impactful education and training that encourages students to pursue advanced STEM careers and graduate degrees, while advancing research in smart manufacturing and strengthening CPP's research capacity. Grant partners include: (1) the University of California, Riverside (UCR); (2) the Center for Multidisciplinary Research Excellence in Cyber-Physical Infrastructure Systems (CREST-MECIS) and Center for Advanced Manufacturing Information and Cyber Systems (CAMICS) at the University of Texas Rio Grande Valley (UTRGV); (3) the Clean Energy Smart Manufacturing Innovation Institute (CESMII); and (4) PSC Biotech. Cobblestone Applied Research & Evaluation, Inc. (*Cobblestone*) is conducting the external evaluation of the project. This formative evaluation report provides a summary of the first year of project implementation (September 15, 2025 to August 31, 2026).

Year 1 Key Findings

K-12 Tasks

- Middle school campus visit with 55 students
- "Next Gen Manufacturing Academy" held with 29 high school student attendees
- Teacher training modules are under development

Community College Tasks

- 29 prospective and 59 matriculated students attended the STEM PolyTransfer day
- 94% were satisfied with the experience
- Students reported high levels of interest in attending CPP and conducting research

Undergraduate and Graduate Student Tasks

- 24 CPP undergraduate student participants, exceeding the annual target of 16
- 8 CPP graduate student participants, meeting the annual target of 8
- One student completed two credentials, one began a credential, and six indicated interest
- Overall student workshop and seminar attendance was lower than expected, possibly due to the high number of events students were informed they needed to attend, which would be reduced starting in Year 2
- Three students traveled to UTRGV in summer 2026 as part of the summer exchange
- Coordination of industry internship opportunities (e.g., with PSC Biotech) will begin in Year 2
- The CPP-UCR STEM PhD bridge program is under development, no students have enrolled yet

> *"The professional experience, working in a team and having a professor be your manager, but also getting the hands-on experience that classrooms can't provide is the greatest benefit in my opinion."*
>
> -Spring 2026 CREST-RASM Graduate Student

> *""This event helped me see clear pathways not only for my undergraduate education but also for my future career and professional growth."*
>
> -Prospective Transfer Student and PolyTransfer Participant

Research Thrusts

All four thrusts were implemented as planned, with two progressing ahead of original timeline:

Thrust	Year 1 Timeline (On Schedule)	Year 2 Timeline (Ahead of Schedule)
 **iFACT**	***Task S1-T1:*** Create digital replica of each manufacturing station with data flow from physical assets	***Task S1-T2:*** Create a digital factory by connecting the digital replica of all manufacturing stations with a communication framework that transfers data among digital units
 **AR/VR**	***Task S2-T1:*** Design virtual training environments where trainees interact with real equipment through AR/VR technologies	***Task S2-T2:*** Integrate the digital twin of the IME Smart Manufacturing Lab with AR/VR
 **Robotics & Automation**	***Task S3-T1:*** Develop leader-follower control system to map human arm and hand movements	-
 **Cybersecurity**	***Task S4-T1:*** Investigate authentication-related vulnerabilities of common industrial protocols	-

Two journal articles submitted

- One published
- One under review

Five conference papers submitted

- One presented
- Two accepted
- Two under review

Seven external proposals submitted

- $75,000 awarded
- $4,827,986 pending

Preliminary evidence suggests that student outcomes will be achieved:

Middle school visit → moderately increased interest in engineering
PolyTransfer → strong interest in CPP attendance and research participation
CPP center students → qualitatively reported increased interest in smart manufacturing and related studies and careers, enhanced research skills, and greater confidence among undergraduates specifically

Recommendations for Year 2: Create a student guide and clear requirement completion process; Consider consolidating PLA and OUR workshop requirements; Define how trained PLAs will serve as mentors; Ensure the PolyTransfer event for prospective students is advertised as an engineering and computer science-related experience; Review PolyTransfer activities for alignment with desired outcomes; Focus on journal submissions

INTRODUCTION

Funded by the National Science Foundation (NSF; #2514616), the **Centers of Research Excellence in Science and Technology: Center for Research Advancement in Smart Manufacturing (CREST-RASM) project** at California State Polytechnic University, Pomona (CPP) is designed to deliver impactful education and training that encourages CREST-RASM students to pursue advanced STEM careers and graduate degrees, while advancing research in smart manufacturing and strengthening CPP's research capacity in this field. Project partners included the University of California, Riverside (UCR); the Center for Multidisciplinary Research Excellence in Cyber-Physical Infrastructure Systems (CREST-MECIS) and the Center for Advanced Manufacturing Information and Cyber Systems (CAMICS) at the University of Texas Rio Grande Valley (UTRGV); the Clean Energy Smart Manufacturing Innovation Institute (CESMII); and PSC Biotech.

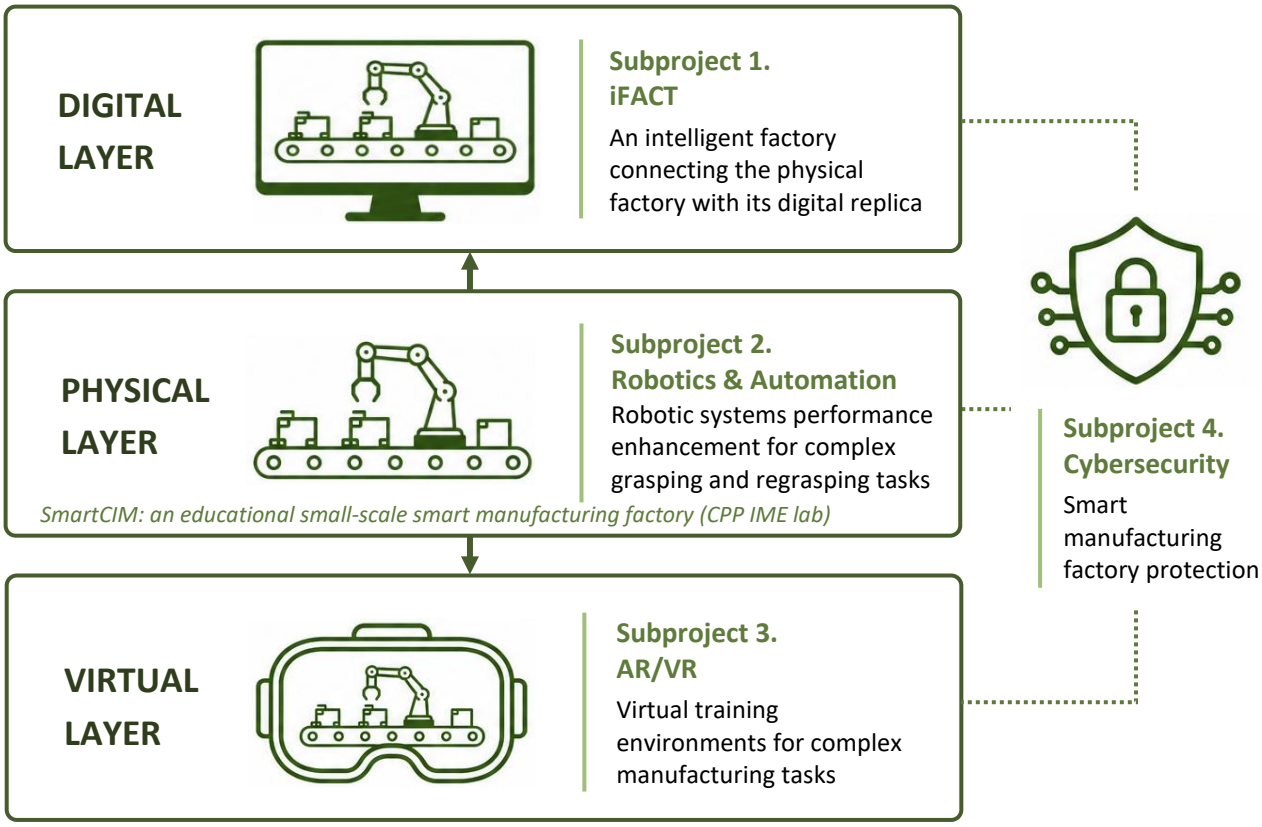
Cobblestone Applied Research & Evaluation, Inc. (*Cobblestone*) is conducting the external evaluation of the project. This formative evaluation report provides a summary of the first year of project implementation (September 15, 2025 to August 31, 2026). Evaluation of the project will continue for the duration of the five-year grant ending in August 2030.

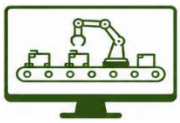
Project Context

Progress in U.S. manufacturing is essential to economic growth, productivity, next-generation product development, climate solutions, and the creation of high-quality, high-paying jobs (National Strategy for Advanced Manufacturing, 2022). In line with this national priority, CPP faculty established CREST-RASM with the vision for the Center to become a model hub for innovation and research in smart manufacturing, ultimately enhancing and sustaining nation's smart manufacturing workforce.

To this end, CREST-RASM launched four innovative smart manufacturing basic research thrusts, each designed to advance research and technologies in this field through the completion of planned tasks. All four thrusts are grounded in the CPP Industrial and Manufacturing Engineering (IME) Smart Manufacturing Lab, where the SmartCIM educational system serves as the shared foundation for the projects.

Figure 1. CREST-RASM Research Thrusts Overview



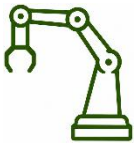


Subproject 1. **intelligent Factory for Analysis, Control, and Twinning (iFACT**). The goal is to create an intelligent factory (IF) that connects physical assets (i.e., physical factory machines) with their digital replica (i.e., digital twins). Using AI, a bidirectional data exchange will enable the digital twins to update in real time and send commands back to the physical factory, enhancing its efficiency, safety, and sustainability.

- *Task S1-T1*: Create digital replica of each manufacturing station with data flow from physical assets.
- *Task S1-T2*: Create a digital factory by connecting the digital replica of all manufacturing stations with a communication framework that transfers data among digital units.
- *Task S1-T3*: Create an IF by combining the digital factory with an embedded AI
- *Task S1-T4*: Experimental verification of the IF to quantify and test performance

Subproject 2. **Intelligent Human-System Integration and Training using Augmented and Virtual Reality (AR/VR).** Using advanced AR/VR technologies, this subproject's goal is to create, and later assess, virtual training scenarios for complex manufacturing and assembly tasks, enabling real-time monitoring and operational decision-making.

- *Task S2-T1*: Design virtual training environments where trainees interact with real equipment through AR/VR technologies
- *Task S2-T2*: Integrate the digital twin of the IME Smart Manufacturing Lab with AR/VR
- *Task S2-T3*: Formally assess the effectiveness of the AR/VR operator training system



Subproject 3. Motion, Grasp, and Regrasp Planning of Manipulator Robots for Agile Manufacturing and Assembly. The goal of this thrust is to create methods that enable robotic systems (e.g., robotic arms) to autonomously perform complex grasping and regrasping tasks in dynamic manufacturing environments.

- *Task S3-T1*: Develop leader-follower control system to map human arm and hand movements
- *Task S3-T2*: Train an AI model to allow robots to perform independent, autonomous grasping and regrasping operations
- *Task S3-T3*: Develop and enhance the robot's ability to accurately grasp objects in motion

Subproject 4. A Lightweight Mutual Authentication Protocol for the Industrial Internet of Things (IIOT). To enhance cybersecurity for smart manufacturing systems, this thrust involves the development of an authentication protocol that is resistant to various security attacks for the IIoT – a critical component of smart manufacturing that enables real-time communication between devices and equipment.

- *Task S4-T1*: Investigate authentication-related vulnerabilities of common industrial protocols
- *Task S4-T2*: Design a lightweight authentication protocol
- *Task S4-T3*: Implement and evaluate the authentication protocol in the IME Smart Manufacturing Lab

Each research thrust is led by a CPP faculty member PI from either the Engineering or Computer Science department and is supported by undergraduate and graduate STEM students. This initiative is supported by literature demonstrating that students participating in faculty-mentored research are significantly more likely to graduate with a science-related bachelors' degree, obtain admission into science-related graduate programs, and pursue a science-related career (Hernandez et al., 2018). Further, participation in research at the university level supports persistence by increasing students' sense of self-efficacy, research identity, skill acquisition, and professional preparedness (e.g., Bowman & Holmes, 2018; Kuh, 2008; Lopatto, 2010; Rodenbusch et al. 2016). Simultaneously, faculty mentors who collaborate with students over extended periods tend to produce more publications with their students than mentors who collaborate with students only briefly or superficially, suggesting that integrating students into research teams can increase research output and scholarly

productivity for both students and mentors (Morales et al., 2017).

In addition to its focus on smart manufacturing research, the project also places strong emphasis on educational activities (i.e., tasks) that empower students across the entire educational pipeline, from K-12 through community college and university, to pursue advanced STEM studies and careers (see **Table 1** for the 13 educational tasks of the project). These efforts are well supported by existing literature. At the secondary level, outreach initiatives that expose students to STEM can positively impact students' attitudes towards STEM and increase their interest in STEM careers (e.g., Greensmith & Greensmith, 2025; Vennix et al., 2018, 2023). Given this, the CREST-RASM project implements outreach activities for middle-and high-school students including STEM-focused CPP campus visits and academies.

At the community college level, research shows that active learning activities that engage students (in addition to lecture-based learning) can enhance their math and science self-efficacy beliefs and lead to long-term academic success in STEM (e.g., persistence, transfer to a 4-year institution; e.g., Sun, 2019). As such, the project plans to organize events at CPP where community college transfer students, both prospective and matriculated, can engage in experiential hands-on STEM activities that allow them to apply core engineering and science concepts to real-world challenges.

For CPP students, beyond participation in research at the CREST-RASM Center, the project offers a range of opportunities designed to strengthen academic success, career readiness, and engagement with the Center. For instance, students will have access to industry internships, consistent with evidence that internships during college enhance students' skills and competencies (e.g., problem solving, teamwork) and increase their career readiness (Wesley et al., 2018). In addition, CREST-RASM students will serve as mentors for incoming students, an initiative supported by research showing that mentoring programs can lead to multiple benefits, including in academic performance, retention rates, emotional and psychological wellbeing, and social integration (Le et al., 2024).

Table 1. CREST-RASM Educational Tasks

K-12 Tasks	CC Tasks	CPP Undergraduate Tasks	CPP Graduate Tasks
Task 1: K-12 Teacher Training Program **Task 2:** Campus Visit for Middle-High School Education Program **Task 3:** High School Summer Academy	**Task 4:** CC Education Program for Prospective Transfer Students **Task 5:** CC Education Program for Matriculated Students	**Task 6:** Research Experience for Undergraduate (REU) Students **Task 7:** Summer Student Exchange Program **Task 8:** Industry Internship Opportunity **Task 9:** Workforce Credential **Task 10:** Adapting CPP INVESTS Project Learning Assistant Model	**Task 11:** Graduate Research Program **Task 12:** CPP-UCR STEM PhD Bridge Program **Task 13:** Research & PD Seminars and Workshops

The CREST-RASM project has three overarching goals assessed through nine key objectives (see **Table 2**).

Table 2. CREST-RASM Goals and Objectives

GOAL 1: Develop novel and transformative research focused on highly integrated topics related to smart manufacturing systems **GOAL 2:** Increase the research capacity in smart manufacturing at CPP
Objective 1: Submit at least 40 (25 journal and 15 conference) papers in respected and high-impact journals and conferences by the end of the five years of the grant by the Center faculty. This is three times greater than the productivity of research-active faculty members in CPP Colleges of Engineering & Science. ***Objective 2:*** Make CREST-RASM financially sustainable by submitting at least five external proposals by Center faculty by the end of the five years of the grant, as well as securing government contracts and industrial R&D projects. ***Objective 3:*** Facilitate the recruitment of four assistant professors specializing in smart manufacturing, with expertise in digital twin, Artificial Intelligence (AI), AR/VR, robotics and automation, and cybersecurity (see the letter of support from CPP's Provost).
GOAL 3: Develop highly impactful education and training activities that empower students to pursue advanced STEM careers and graduate degrees in national areas of need
Objective 4: Establish a CPP-UCR STEM PhD Bridge program from Master of Science (MS) programs at CPP to STEM PhD programs at UCR, laying the groundwork for potentially establishing a Doctoral program in Advanced Manufacturing Engineering at CPP. ***Objective 5:*** Provide research opportunities for at least 16 undergraduates and 8 graduate students per year to become candidates for competitive graduate programs and advanced STEM careers. ***Objective 6:*** Utilize objectives 4 & 5 as a vehicle to ensure the percentage of the Center's students recruited, trained, and graduated – who will pursue graduate degrees (PhD or Masters) within 5 years of this grant -- be at least 5% (current CPP rate for pursuing PhD within 10 years after graduation is 0.8%). ***Objective 7:*** Ensure that at least 75% of the Center's students earn workforce credentials, participate in internships, or engage in summer research exchange programs offered by the Center. ***Objective 8:*** Develop engaging education and outreach programs for K-12 and community college students to enhance their awareness and interest in STEM fields, CREST-RASM initiatives, and career opportunities in smart manufacturing. ***Objective 9:*** Provide education and professional development (PD) opportunities to CREST-RASM graduate and undergraduate students in smart manufacturing, emotional intelligence, positive psychology, technical communication, and mentoring for the NSF-Graduate Research Fellowship Program (GRFP).

CREST-RASM PIs

EVALUATION OVERVIEW

Evaluation Design

Cobblestone is evaluating the CREST-RASM project using a mixed-methods design combining qualitative and quantitative indicators to answer implementation and outcome evaluation questions. The evaluation design is based on the theory of change represented in a logic model that links project inputs and activities to specific, measurable outputs and short-, medium-, and long-term outcomes (see **Appendix A**). A *formative evaluation* is occurring during Years 1-4 of the project to determine the extent to which activities are implemented with fidelity and high quality, assess initial outcomes, and provide stakeholders with ongoing performance feedback. A *summative evaluation* in Year 5 will determine (a) overall project merit; (b) the extent to which CREST-RASM objectives and outcomes were achieved; and (c) sustainability of project activities.

Evaluation Questions

The following questions guided the evaluation design and corresponding activities.

Implementation Evaluation Questions

1) To what extent were project activities implemented with fidelity and high quality?
2) To what extent are participants satisfied with RASM project activities (e.g., research, mentoring, collaboration)?

Outcome Evaluation Questions

3) To what extent did research activities across projects lead to the expected outcomes (e.g., improved efficiency and reliability of the manufacturing process)?
4) Did research activities lead to an increase in intellectual property and products?
5) To what extent were student outcomes achieved?
6) Do RASM students who graduate pursue a PhD in five years?[1]
7) To what extent are components of the RASM program sustainable through government contracts and R&D projects?

Evaluation Methods

In Year 1, a variety of methods were used to answer evaluation questions (see **Table 3**).

[1] This evaluation question will be answered in later years.

Table 3. Year 1 Evaluation Methods

Evaluation Activity	Description
Undergraduate Student Survey	Undergraduate students at the RASM Center completed a pretest survey at the end of the spring 2026 semester or beginning of summer 2026 term (*n* = 23). These students will complete a posttest survey in Year 2.
Undergraduate Student Focus Group	A sample of the Center's undergraduate students participated in a focus group interview in summer 2026 (*n* = 3).
Graduate Student Survey	Graduate students at the RASM Center were invited to complete a pretest survey at the end of the spring 2026 semester or beginning of summer 2026 term (*n* = 8). These students will complete a posttest survey in Year 2.
Graduate Student Focus Group	A sample of the Center's graduate students participated in a focus group interview in summer 2026 (*n* = 3).
Community College PolyTransfer Surveys	CC transfer students who participated in a PolyTransfer program, either for prospective students (Advantage Summer Academy) or for matriculated CPP students (Summer Transition Program), completed a survey at the end of the program (prospective student *n* = 29; matriculated student *n* = 53).
Faculty Research Log	Thrust PIs provided updates on their research progress (e.g., equipment purchase, task status) in an online Research Log (September '25 – June '26).
Observations	*Cobblestone* observed a sample of key events to assess activity implementation (e.g., middle school campus visit, High School Summer Academy, PolyTransfer).
Document & Process Review	*Cobblestone* reviewed documents produced to track project progress and implementation (e.g., activity agendas, attendance records)
Institutional Research Student Data Request	*Cobblestone* obtained student-level institutional data (e.g., major, graduation) and demographic information (e.g., race, sex) for participating students from CPP's Office of Institutional Research, Planning, & Analytics (IRPA).
Meetings & Coordination	*Cobblestone* led a monthly evaluation meeting with the project PI and attended the CREST-RASM monthly PI meetings as needed. In addition, *Cobblestone* maintained continuous coordination (e.g., emails, Zoom calls) with the PI and staff regarding evaluation efforts and activity implementation.

CREST-RASM CPP students and research PIs in the IME Smart Manufacturing Lab

EVALUATION FINDINGS: PROJECT IMPLEMENTATION

Evaluation Question 1

To what extent are the project activities implemented with fidelity and high quality?

Main Findings

In Year 1, CREST-RASM activities were mostly implemented as planned. PIs in all four basic research thrusts completed their planned research tasks, with some progressing ahead of the original timeline. K-12 activities commenced, with 54 middle school students participating in a campus visit in spring 2026, and 26 high school students completing the three-day "Next-Gen Manufacturing Academy" in summer 2026. In addition, development of the teacher training module began in preparation for implementation in Year 2. Both community college programs took place in summer 2026, with 29 prospective students and 59 matriculated CPP students attending the CREST-RASM PolyTransfer day. At CPP, 24 undergraduate and eight graduate students participated in a paid research experience at the CREST-RASM center, exceeding recruitment targets. One student completed two workforce credentials, and three students participated in the summer exchange program at UTRGV. None participated in industry internships, which are expected to commence in Year 2. Overall student workshop and seminar attendance was lower than expected, however this was possibly due to the high number of events students were informed they needed to attend, which would be reduced starting in Year 2. Some students expressed confusion around the various event types and participation requirements, indicating a need for clear communication moving forward.

The CREST-RASM Center was established at CPP in Fall 2025. To serve as a model hub for innovation and research in smart manufacturing, the Center has two primary areas of focus: advancing transformative research in smart manufacturing (i.e., basic research) and developing high-impact educational activities (for K-12, community college, undergraduate, and graduate students). The following sections summarize the Year 1 implementation of the project, including both research and educational efforts.

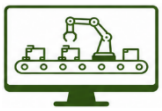
Basic Research

GOALS

1. Develop novel and transformative research focused on highly integrated topics related to smart manufacturing systems
2. Increase the research capacity in smart manufacturing at CPP

To develop cutting-edge research in smart manufacturing and increase CPP's research capacity in this field, four innovative research subprojects (i.e., thrusts) were launched at the CREST-RASM Center in Year 1. Each research thrust is led by a CPP faculty member (i.e., co-PI) from either the Engineering or Computer Science department and is supported by undergraduate and graduate STEM students. *In Year 1, all four thrusts completed their planned research tasks, with some progressing ahead of the original timeline* (see **Table 4**). See **Evaluation Question 3** for information on the progress made in each thrust in Year 1.

Table 4. Basic Research Subproject Original Plans and Status, Year 1

Subproject	Tasks	Year 1	Year 2	Year 3	Year 4	Year 5
 iFACT	S1-T1	✓				
	S1-T2	✓				
	S1-T3					
	S1-T4					
 AR/VR	S2-T1	✓				
	S2-T2	✓				
	S2-T3					
 Robotics & Automation	S3-T1	✓				
	S3-T2					
	S3-T3					
 Cybersecurity	S4-T1	✓				
	S4-T2					
	S4-T3					

K-12 Education Program

GOALS

1. Increase awareness and interest of K-12 students in STEM education and career opportunities in smart manufacturing
2. Create a pipeline of students to support CREST-RASM initiatives

Task 1: K-12 Teacher Training Program

One initiative of the CREST-RASM project is developing a training program for K-12 teachers to deepen their understanding of various STEM fields, career pathways, and smart

Figure 2. K-12 Teacher Training Module Development Status

Module Designed	Module Deployed	Number of Completions
In Progress	Expected Fall 2026	Expected Fall 2026

manufacturing, so that they can then inspire K-12 students to explore these avenues. To that end, in Year 1, the Activity 1 lead—a CPP Professor in the Department of Education—began to develop a 3-hour module on STEM fields and career pathways for prospective science teachers (see **Figure 2**). The activities implemented during the High School Summer Academy (see **Task 3**) will be used as a basis for the module content. Starting fall 2026 (Year 2), the module, along with 2-3 hours of assigned reading, is expected to be integrated into *EDU 5205: Teaching Secondary Curriculum and Methods*, part of the Single Subject Teaching Credential program for prospective high school science teachers at CPP.

Task 2: Campus Visit for Middle-High School Education Program

To foster middle and high school students' interest in pursuing advanced STEM careers and graduate degrees, CREST-RASM—in collaboration with the Cultivating Access and Mentoring through Institutional Networks and Opportunities for Success (CAMINOS) project at CPP—offers an annual campus visit for middle school and early high school students. Through this experience, students gain exposure to various STEM fields and career pathways, are introduced to smart manufacturing, visit the IME Smart Manufacturing Lab and learn about related research, and learn about pathways to STEM programs at CPP.

Middle school students attend the CAMINOS campus visit

On May 2, 2026, *54 middle school students participated in a CPP CAMINOS campus visit, part of which involved a tour of the Smart Manufacturing lab*. The visiting group was from Mendez Fundamental Intermediate School in Orange County. First, students listened to a presentation by the CREST-RASM Director for Education and Workforce Development. The presentation involved asking students engaging questions regarding what they knew about engineering, including the kinds of things that engineers in different sub-disciplines make (e.g., aerospace, civil). Engagement was moderately high. Next, the students viewed a demonstration of the smart factory. Given the number of students in the space, it was challenging for some to hear the presenter. See **Appendix B** for the agenda.

Task 3: High School Summer Academy

CREST-RASM aims to broaden high school students' participation in STEM and strengthen their interest in smart manufacturing through intensive exposure to the university environment and smart manufacturing hands-on activities that can build confidence, a sense of belonging, and STEM/engineering identity. To achieve this, in Year 1, the Activity 3 lead (the

Department of Education Professor also leading Activity 1) developed and led *a three-day summer experience, the "Next-Gen Manufacturing Academy," for high school students, held July 29-31, 2026. A total of 29 unique students attended at least one day of the academy, with 26 students attending all three days.* This was slightly fewer than the originally planned target of 30 students due to attrition. Students were from three local high schools (Bonita High School, Diamond Bar High School, and San Dimas High School). During the academy, students learned about engineering majors, engineering student clubs, and toured engineering labs including the IME Smart Manufacturing lab. They also participated in hands-on activities related to the smart manufacturing research thrusts (e.g., cybersecurity encryption exercises, digital escape room design using AR/VR, programming and operating a robot). While activities aligned to the digital twin strand of the CREST-RASM research were planned, they were not implemented due to technology constraints. Students also toured the CPP campus and were introduced to student resources and organizations. Students were highly engaged in hands-on STEM activities and moderately engaged in presentations. See **Appendix C** for the complete schedule.

High School students participating in a hands-on AR/VR activity as part of the CREST-RASM Summer Academy

Community College Education Program

GOALS

1. Inform CC students regarding pathways to STEM majors at CPP
2. Attract and retain transferred students in research and PD opportunities at CREST-RASM initiatives

Tasks 4 & 5: Community College Education Program for Prospective & Matriculated Students

One of the Center activities is a partnership with CPP's PolyTransfer Program, designed to help transfer students succeed at CPP, to incorporate a day of CREST-RASM educational activities into PolyTransfer's existing three-day summer programs: the "PolyTransfer Advantage Summer Academy" for prospective students and "PolyTransfer Summer Transition" for matriculated students. Both programs are free and designed to familiarize transfer students

with CPP campus resources, connect them with faculty and peers, and help them develop a sense of belonging at CPP. The one-day CREST-RASM STEM experience was offered as an optional add-on to interested students. See **Appendix D** for program flyers and **Appendix E** for the program agenda.

Both programs took place in July 2026, with 29 prospective students attending the "PolyTransfer Advantage Summer Academy" and 59 matriculated students attending the "PolyTransfer Summer Transition" program. The CREST-RASM day of activities were similar across both PolyTransfer sessions. They involved an opening talk introducing the CREST-RASM Center, as well as information about industrial and manufacturing engineering. Students toured labs and participated in related activities: The AR/VR lab experience allowed students to use VR headsets to explore the Smart Manufacturing training modules; The Smart Manufacturing lab experience involved demonstrations of industrial and manufacturing engineering equipment, with an opportunity for students to manipulate the robots themselves. Both days involved a panel of alumni discussing their career trajectories, with the Summer Transition program panel also including current students due to limited alumni availability.

OBJECTIVE 8

Develop education and outreach programs for K-12 and CC students.

Current Status: Developed middle school visit, PolyTransfer, and High School Academy

PolyTransfer Summer Transition Program students participate in AR/VR

CPP Student Education Program

GOALS

Undergraduate students:

1. Develop candidates for the smart manufacturing workforce and competitive graduate programs

Graduate students:

1. Develop a pathway for CPP Masters' students into selected STEM PhD programs at UCR aligned with the center focus
2. Recruit and retain students into PhD programs

At CPP, all participating CREST-RASM undergraduate and graduate students are engaged in research at the Center. Students also engage in a range of educational PD activities, some required and some optional.

Tasks 6 & 11: Research Experience for Undergraduate and Graduate Students

CREST-RASM recruits CPP STEM undergraduate and graduate students to participate in paid research at the Center. Students who assist the CREST-RASM research thrusts receive supervision and mentoring by the thrust PIs, who are responsible for student recruitment. Student assistants are expected to dedicate between 10-20 hours weekly to research activities and attend thrust and Center meetings.

OBJECTIVE 5

Provide research opportunities for 16 undergraduates and 8 graduate students per year.

Current Status: 24 undergraduates and 8 graduate students participated in Year 1

Student participation in research at the Center began in spring 2026 and continued into summer 2026, exceeding recruitment targets with a total of *24 undergraduates and 8 graduate students recruited to support the four research thrusts in Year 1* (see **Figure 3**). In addition to the 32 students supported by the grant in Year 1, five student assistants (four graduates and one undergraduate) supported the center on a volunteer basis in Year 1, working on their Master's or senior projects. See **Appendix F** for student demographic information.

Participating students were added to a CREST-RASM Canvas course where information was posted about program requirements, internship opportunities, and evaluation survey tasks.

Figure 3. CREST-RASM Student Participation in Research

iFACT		AR/VR		Robotics & Automation		Cybersecurity	
8 UGs	2 grads	4 UGs	1 grad	8 UGs	2 grads	4 UGs	3 grads

Task 7: Summer Student Exchange Program

Each year, CREST-RASM provides students with the opportunity to expand their academic and professional horizons through participation in a summer student exchange program at UTRGV. As part of this program, students conduct research under the supervision of UTRGV faculty members at one of two research centers: the CREST-MECIS or CAMICS. *In Year 1, three students (two undergraduate and one graduate) participated in the summer exchange program in CREST-MECIS.* Two of these students previously participated in research as part of the Center.

Task 8: Industry Internship Opportunity

One of the goals of CREST-RASM is to offer undergraduate students at the Center opportunities to participate in bio-manufacturing industry internships in partnership with PSC Biotech, a leader in pharmaceutical manufacturing. After the grant was awarded, the contact at PSC Biotech moved to a different organization. At present, CREST-RASM personnel will continue to pursue opportunities with PSC Biotech, while also exploring opportunities at other organizations. It is expected that in Year 2, the CREST-RASM PI will promote internship opportunities to students both within and outside of the Center.

Task 9: Workforce Credentials

OBJECTIVE 7

At least 75% of the Center's students complete workforce credentials, internships, or the summer research exchange.

Current Status: 9% completed (3/32)

To strengthen CREST-RASM students' expertise and employability, Center funds can be used to pay for completion of industry-recognized credentials in areas aligned with their major and research at the Center (up to $460 per student). In Year 1, one student completed two credentials: *Getting Started with Deep Learning* and *Introduction to Transformer-Based Natural Language Processing*, both offered by the NVIDIA Deep Learning Institute. In addition, one other student began a credential and six indicated interest.

Task 10: Adapting CPP INVESTS Project Learning Assistant (PLA) Model

To enhance students' experience and engagement with the Center, paid students supporting the CREST-RASM research thrusts are required to complete PLAs training and serve as peer mentors for incoming Center students. In addition, to set students up for success and ensure they are well equipped to mentor incoming students, students are required to attend research and career focused workshops offered by the CPP Office of Undergraduate Research (OUR), covering topics such as presenting research, data visualization, and career readiness resources. At the beginning of the Spring 2026 semester, the OUR Director, who serves as the Task 10 lead, distributed the task requirements to all paid Center students, including both undergraduate and graduate students. These requirements included completing four peer mentoring training sessions and four OUR workshops (see **Appendix G** for the spring 2026 PLA training and workshop calendar). Of note, the grant proposal classified Task 10 as an undergraduate student activity and not required for graduate students.

Of the 20 paid CREST-RASM undergraduate students in Spring 2026, approximately a third (35%) completed all four PLA training sessions and a few attended four OUR workshops (15%). None completely met both the PLA training and OUR workshop requirement. Of the eight paid graduate students, two completed all PLA training sessions, and two others attended four OUR workshops (see **Appendix H** for detailed requirement completion information for undergraduates and graduates). During the focus groups, while undergraduate students indicated that they were aware of the PLA training sessions, a sample of graduate students

reported unfamiliarity with the PLA component of the project and its requirements. Trained students (PLAs) are expected to start mentoring incoming students at the Center in fall 2026. See **Appendix I** for the undergraduate student focus group summary and **Appendix J** for the graduate student focus group summary.

OBJECTIVE 4

Establish a CPP-UCR STEM PhD Bridge Program.

Current Status: CPP & UCR faculty are discussing the program logistics

Task 12: CPP-UCR STEM PhD Bridge Program

CREST-RASM partners with UCR to establish pathways from CPP's MS programs to UCR's STEM PhD programs in key focus areas of the Center (e.g., Computer Science, Mechanical Engineering, and Electrical Engineering). This initiative includes alignment of graduate coursework between the two institutions, allowing eligible CREST-RASM graduate students, upon completion of their MS degree, to apply course credits towards their selected UCR PhD degree. Students accepted to the program receive advising from both their CREST-RASM thrust PI and a UCR faculty partner during their time at CPP as well as after transferring to UCR, and their PhD educational costs (stipend, tuition, and other fees) are covered during their first two years at UCR.

In Year 1, one potential student candidate was identified for the bridge program, however, it was determined that there was not sufficient alignment with UCR research programs. The Center faculty worked to connect this student with other PhD program options.

Task 13: Research and PD Seminars and Workshops

OBJECTIVE 9

Provide education and PD opportunities to CREST-RASM graduate and undergraduate students.

Current Status: Five research seminars and one PD workshop were provided.

CREST-RASM's PD program for graduate students and interested undergraduate students is designed to strengthen students' technical, communication, and leadership abilities for academic and industry success. The program includes: (1) *CREST-RASM research seminars* covering cutting-edge developments in smart manufacturing and related technologies; (2) *skill-building PD workshops* covering topics such as leadership and career development in smart manufacturing; and (3) *Bi-Annual NSF Graduate Research Fellowship Program (GRFP) Seminars*, providing guidance for students interested in applying for this prestigious fellowship.

In Spring 2026, all paid students, undergraduate and graduates, were informed via a Canvas assignment that they were expected to attend one CREST-RASM research seminar and one PD workshop, along with submitting a reflection for each. Of note, the grant proposal classified Task 13 as a graduate student activity and not required for undergraduate students. *Of the eight paid graduate students in Spring 2026, three attended a research seminar, and two*

attended the PD workshop. Of the 20 paid undergraduate students, most (80%; 16/20) attended a research seminar, and many (70%; 14/20) attended the PD. Of note, some students submitted reflections on seminars or OUR workshops as their PD workshop reflection, indicating they may have been confused about the definition of what qualified as a PD workshop. See **Table 5** for attendance by event. It is expected that NSF GRFP Seminars will be offered starting in Year 2.

Table 5. Year 1 CREST-RASM Program Events and Student Attendance

Event type	Date	Title	Attendee *n*
Research seminars	2/10/26	Graduate Info Session and Research Spotlight (Chemical and Materials Engineering)	1
	3/26/26	Electrical Engineering Department Info Session and Research Spotlight	6
	4/7/26	Joint COE/CBA Graduate Info Session	2*
	4/23/26	From Traditional to Smart Manufacturing: Components, Data & Cloud Platforms, and Migration Pathways	7*
	4/28/26	Graduate Info Session: MS in Aerospace Engineering and ANSYS	4
		Total	**20**
PD workshops	2/9/26	Information Literacy Instruction Session	14
		Total	**14**

**One student attended multiple seminars due to joining late and missing the PD workshop.*

Evaluation Question 2

To what extent are participants satisfied with project activities (e.g., research, mentoring, collaboration)?

Main Findings

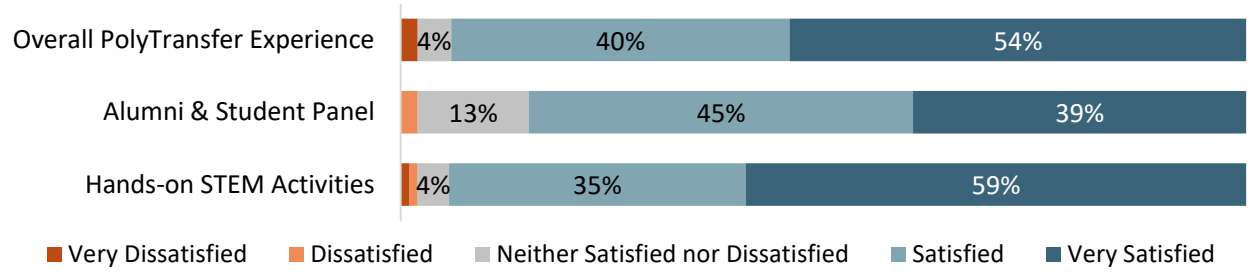
Overall, students who engaged in CREST-RASM activities in Year 1 reported high satisfaction. PolyTransfer participants were highly satisfied with the one-day experience. CPP students who participated in research at the center generally reported a positive experience that contributed to their skill development and career readiness. However, students indicated some confusion regarding the different event types offered to them (CREST-RASM seminars and PD workshops, OUR workshops, PLA training sessions) and requested to clarify event types, schedules, and requirements.

PolyTransfer

Overall, students were highly satisfied with the PolyTransfer experience across both programs (see **Figure 4**). See **Appendix K** for the complete PolyTransfer survey summary.

> *"The professional experience, working in a team and having a professor be your manager, but also getting the hands-on experience that classrooms can't provide is the greatest benefit in my opinion."*
>
> -Spring 2025 CREST-RASM Graduate Student

Figure 4. Student Satisfaction with the PolyTransfer Program



n = 81-82

CREST-RASM Research Students

During the focus group interviews, CPP students generally reported having a positive experience participating in research at the CREST-RASM Center. In addition, students who reported engaging in teamwork for their research, primarily graduate students, indicated high satisfaction with peer collaboration, including equal contribution by all team members and mutual support. Finally, students generally reported being satisfied with their research mentors (i.e., thrust co-PIs), indicating they were knowledgeable, helpful, and approachable.

However, students indicated some confusion regarding the different event types offered to them (CREST-RASM seminars and PD workshops, OUR workshops, PLA training sessions), including participation requirements, scheduling, and completion tracking. One graduate student, for example, stated, "*Honestly, I was pretty confused throughout the whole semester, I didn't really know what I had to do and what was available to me.*" As such, students suggested making a clear distinction between event types, clearly outlining requirements, maintaining an accessible event calendar, and providing a simple way to track requirement completion (e.g., through Canvas). Other suggestions for improvement included reducing event participation requirements and increased accessibility to labs for graduate students to minimize ID card coordination. See **Appendix I** for the undergraduate student focus group summary and **Appendix J** for the graduate student focus group summary.

EVALUATION FINDINGS: PROJECT OUTCOMES

Evaluation Question 3

To what extent did research activities across projects lead to the expected outcomes (e.g., improved efficiency and reliability of the manufacturing process)?

Main Findings

As planned, in Year 1, all four CREST-RASM thrusts initiated the first of their planned research tasks, with the iFACT and AR/VR thrusts progressing ahead of the original timeline and initiating work on their second task. Given the early stages of the research, conclusions regarding the extent to which the project's research efforts improve the efficiency and reliability of the manufacturing process will be drawn in later years.

As planned, all four research thrusts initiated the first of their planned research tasks, with the iFACT and AR/VR thrusts progressing ahead of the original timeline and initiating work on their second task. See **Table 6** for the specific progress made in each thrust in Year 1.

Table 6. Research Thrust Task Progress Updates, Year 1

Subproject 1. iFACT

Task S1-T1: *Create digital replica of each manufacturing station with data flow from physical assets*

- ✓ **Extensive literature review** of leading simulation and robotics software
- ✓ **Preparation for simulating AS/RS system:** derived AS/RS motion equations; explored simulation software (PyBullet) for AS/RS modeling; made progress towards establishing communication between AS/RS system and digital models
- ✓ **Progress towards simulating robotics in IME lab:** a working model of a robotic arm

Task S1-T2: *Create a digital factory by connecting the digital replica of all manufacturing stations with a communication framework that transfers data among digital units*

- ✓ **Extensive Lit review** of a digital twin of smart factories
- ✓ **Progress towards creating an initial digital twin version:** conceptualized a simple working version for a smart factory; working model of a robotic arm in place

Subproject 2. AR/VR

Task S2-T1: *Design virtual training environments where trainees interact with real equipment through AR/VR technologies*

- ✓ **Equipment purchase**: AR/VR headsets and gloves, computers for heavy processing
- ✓ **Equipment integration:** integration of headset and haptic gloves
- ✓ **Software installation:** supporting software platforms for VR training environments
- ✓ **Extensive literature review** on Extended Reality manufacturing training, confirming thrust novelty
- ✓ **Optimizing future training** including evaluation of cybersickness mitigation strategies
- ✓ **Completion of interactive 3D models** for all five IME Smart Manufacturing Lab SmartCIM stations (AS/RS, CNC milling machine, CNC lathe, laser engraving, assembly)
- ✓ **Training scenarios developed** for four stations covering component introduction
- ✓ **Exploration of VR platforms** to support AI-personalized learning within VR training modules
- ✓ **Defined AI-driven adaptive learning path architecture** for integration into VR training modules

Task S2-T2: *Integrate the digital twin of the IME Smart Manufacturing Lab with AR/VR*

- ✓ **Research** on real-time ROS data integration
- ✓ **Optimization of 3D models:** improving runtime performance while preserving visual quality
- ✓ **Design and documentation of three-layer system architecture** (physical equipment, Digital Twin VR interface) including a shared messaging format enabling information flow
- ✓ **Mock VR data** to simulate digital twin feed for development of interface

Subproject 3. Robotics & Automation

Task S3-T1: *Develop leader-follower control system to map human arm and hand movements*

- ✓ **Equipment purchase:** robotic hand, two robotic arms with compatible grippers, five special cameras for perception and safety applications
- ✓ **Extensive literature review** on robot grasping and regrasping
- ✓ **Completion of a comprehensive taxonomy** of robotic regrasping problems and solutions
- ✓ **Tests conducted including** robot control experiments, robotic hand debugging, vision-based experiments, and tests for extracting data from SmartCIM
- ✓ **Omnidirectional robotic platform** (Robotino) development and installation
- ✓ **Instructional materials development** including robot manuals, station-level operating instructions, reusable robot programs, and introductory smart factory laboratory lessons
- ✓ **Training** for CREST Co-PIs and participating students in smart factory equipment and system
- ✓ **Access and use of the Moneo condition-monitoring platform** and obtainment of operational and sensor data from the smart factory equipment (Robotics-AR/VR-Cybersecurity cross-thrust effort)

Subproject 4. Cybersecurity

Task S4-T1: *Investigate authentication-related vulnerabilities of common industrial protocols*

- ✓ **Extensive literature review** on industrial control system security and vulnerability
- ✓ **A Windows-based workstation** set up to act as a fake attacker for testing
- ✓ **Preparation for analysis:** established a pipeline to monitor and collect industrial network traffic for analysis; analyzed industrial network communication structure to support implementation of attacks
- ✓ **Completed three of the four planned attack implementations**, including message spoofing, man-in-the-middle, and tampering attacks
- ✓ **Material development:** development of reusable attack scripts
- ✓ **Documentation** of attack implementations with experimental results and video demos

Evaluation Question 4

Did research activities lead to an increase in intellectual property and products?

Main Findings

Research activities have recently begun and two manuscripts to journals and five conference papers have already been submitted. This includes a conference paper with two student researchers as co-authors. In addition, the goal of submitting five extramural research proposals by the end of the five-year grant period has already been exceeded, with seven submissions in Year 1 alone. Of these proposals, one was funded, along with two internal proposals, garnering $103,000 for the center. The five submitted proposals pending funding decision represent $4,857,986 in possible funding. One new IME faculty member was hired who will support the CREST-RASM center.

OBJECTIVE 1

Submit at least 40 (25 journal and 15 conference) papers by the end of the five years of the grant.

Current Status: Two journal & five conference papers submitted

As part of the project's commitment to increase intellectual property and products through research, CREST-RASM PIs aim to submit at least 40 papers in respected and high-impact journals and conferences. In Year 1, two manuscripts to journals and five conference papers were submitted. Of these, one journal article and one conference paper were published, with two more conference papers accepted. Of note, two CREST-RASM students were co-authors on a submitted conference paper. See **Appendix L** for the complete list.

OBJECTIVE 2

Submit at least five external proposals by the end of the five years of the grant.

Current Status: Seven submitted, one funded

The project aims for PIs to submit at least five external funding proposals to sustain the Center. At present, seven external funding proposals have been submitted, exceeding the five-year goal. One of the proposals was funded, two were not funded, and five are pending. In addition, three internal CPP funding proposals were submitted, two of which were funded. Across all proposals, $103,000 was awarded and $4,857,986 is still pending. See **Appendix L** for the complete list.

Another goal of the project is to recruit four assistant professors who specialize in smart manufacturing to CPP, with expertise in the research thrust areas. In Year 1, one assistant professor who conducts research related to smart manufacturing was hired by the IME department. In Year 2, the CREST-RASM PIs will begin collaborating with this new professor.

OBJECTIVE 3

Recruit four assistant professors specializing in smart manufacturing.

Current Status: One new Industrial and Manufacturing Engineering professor will be starting in Fall 2026

Evaluation Question 5

To what extent were student outcomes achieved?

Main Findings

Overall, preliminary Year 1 data suggests that student outcomes are being met. There is some evidence that the middle school visit increased students' interest in engineering. Students who attended PolyTransfer reported strong interest in attending CPP and participating in research. CPP students who participated in research at the center generally reported increased interest in the smart manufacturing field and related advanced studies and careers, as well as enhanced research skills. However, while undergraduate students reported gaining confidence to do research and become engineers, graduate students indicated that their confidence did not necessarily increase since their research tasks required independent problem-solving which they found challenging, albeit rewarding.

Middle and High School Students

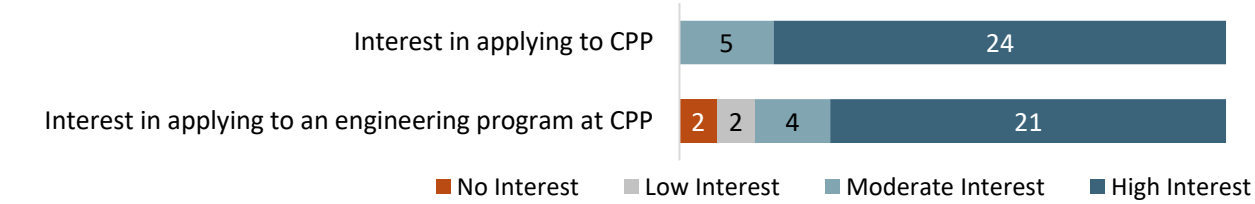
There is some evidence that the middle school visit increased students' interest in engineering. At the beginning of the first presentation, 13 students indicated that they were interested in becoming engineers. By the end of the visit, 21 students said they were interested in becoming engineers. In addition, students who participated in the high school summer academy reported to the facilitator that they learned new things as a result of participating. At the end of the experience, some students exchanged phone numbers to stay in touch and continue working on related projects.

Community College Students

Students who attended PolyTransfer reported strong interest in attending CPP and participating in research (see **Figure 5** and **Figure 6**). Interest in CPP and research more broadly were slightly higher than interest in engineering and CREST-RASM research specifically. Of note,

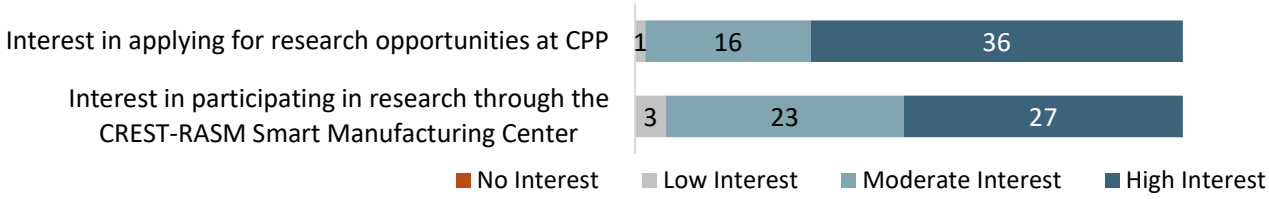
students may have had high levels of interest before participating.

Figure 5. Prospective Student Interest in CPP after PolyTransfer



n = 29

Figure 6. Matriculated Student Interest in Research after PolyTransfer



n = 53

CPP Undergraduate and Graduate Students

The CPP student focus groups provide preliminary insights into student outcomes. Beginning in Year 2, a student survey will provide more comprehensive student outcome data.

Confidence as a Scientist/Engineer

Undergraduate students generally reported gaining confidence to do research and become engineers as a result of conducting research, noting that applying what they learned from classes to the real world facilitated this growth. One undergraduate student, for example, shared, "*Being able to be an engineer and being able to actually go into the workforce, like oh, I actually have the abilities to do something useful.*" Graduate students indicated that their research experience did not necessarily increase their confidence as scientists or engineers, explaining that completing the tasks assigned by their thrust PIs often required independent research and problem-solving, which they found challenging. For example, one student described, "*Telling us to conduct these [tasks] had us lost at first… because what we're doing is far beyond the classroom.*" Nevertheless, they described this independent process as rewarding, noting that they learned how to use new tools (e.g., Python) and successfully overcame challenges. As one graduate student described, "*It's kind of an unknown land… you're going into without much road signs... but I believe there's a satisfaction at the very end of getting it all to work together.*"

> *"Being able to be an engineer and being able to actually go into the workforce, like oh, I actually have the abilities to do something useful."*
>
> -Spring 2025 CREST-RASM Undergraduate Student

Interest in Smart Manufacturing

Students generally reported that participating in CREST-RASM research increased their interest in smart manufacturing topics, indicating that they envisioned pursuing a graduate/Ph.D. program or a career in these fields. One graduate student, for example, shared, "*Yeah, [my interest in thrust-area has increased]… the [thrust-specific tool], to me, just opened a new door that I can eventually know.*" One undergraduate student, however, shared that participating in research helped clarify they were not interested in smart manufacturing as a career: "*I was interested to see if this was a subject I was interested in… in terms of whether I wanted to pursue this further, I would probably have to say probably not.*"

Research Skills

Overall, students reported enhanced research skills following their research experience. Undergraduate students primarily reported learning how to effectively conduct literature reviews. For example, one undergraduate student shared, "*Navigating research papers is not something I always had an easy time with... So I've learned how to expedite my reading and figure out what papers are actually important, what are not.*" Graduate students primarily cited hands-on implementation of classroom concepts, as well as hypothesis development and testing and problem solving. In addition, graduate students noted that working as part of a team helped develop their collaboration skills and accept making mistakes as part of the research process.

> *"[Participation in research] definitely helped me learn how to put what I've been learning on paper into hands-on real work… [to] create that bridge between what I learned in class and my certifications into what we do in the lab."*
>
> -Spring 2025 CREST-RASM Graduate Student

CONCLUSIONS

In Year 1, the CREST-RASM project began implementing all planned activities (see **Appendix M** for status across educational tasks and objectives). The fall semester was used to purchase needed equipment, hire students, and plan for the operation of the Center. Students began conducting research in Spring 2026 and targets for number of undergraduate and graduate participants were exceeded. The K-12 and community college engagement activities were executed as planned. While fewer middle school students were served than planned, it is expected that the balance will be served in Year 2. Students across educational activities were generally satisfied by the support they received from the Center. Clearly communicating the workshop and seminar requirements for undergraduates and graduate students would be beneficial, as students were not always clear which events they were supposed to participate in and sometimes confused the multiple types of events. The semester workload was also quite large in spring 2026: across activities, students were informed that they needed to engage in 10 hours of events outside of their research obligations and coursework. Given student feedback, as well as the original grant proposal distinction between undergraduate versus graduate activities, the PI is planning to clarify and reduce the number of requirements in Year 2.

Preliminary Year 1 data suggests that student outcomes are on track to be met. There is some evidence that the middle school visit increased students' interest in engineering. Students who attended PolyTransfer reported strong interest in attending CPP and participating in research. CPP students who participated in research at the Center generally reported increased interest in the smart manufacturing field and related advanced studies and careers, as well as enhanced research skills. These outcomes will continue to be tracked both quantitatively and qualitatively in subsequent years to obtain a more accurate assessment of the Center's impacts.

Research progress is on track with two thrusts—iFACT and AR/VR—progressing ahead of the original timeline. Extramural funding proposal submissions have exceeded targets, with most still pending a funding decision. Given the research is in early stages, it is reasonable that journal paper submissions are currently low. However, it is important to note that the five-year goal is 25 journal articles and 15 conference papers, with conference submissions currently outpacing journal submissions. Co-PIs should take care to ensure that journal submissions are prioritized when feasible or serve as next steps after conference papers are presented.

Overall, the CREST-RASM project was well-executed in Year 1. Continuation of research and refinement of program activities in Year 2 will position the project to achieve desired outcomes.

Recommendations for Year 2

- ☐ **Create a student guide and clear requirement completion process** on Canvas aligned to the original grant proposal (e.g., undergraduates complete PLA training, graduate students complete PD seminars and workshops)
- ☐ **Consider consolidating PLA requirements**, including possibly reducing the number of OUR workshops students are required to attend
- ☐ **Define how trained PLAs will serve as mentors** including who they are expected to mentor, frequency of mentoring interactions, and mentoring conversation topics
- ☐ **Ensure the PolyTransfer event for prospective students is advertised as an engineering and computer science-related experience** rather than a general STEM experience to ensure alignment of expectations
- ☐ **Review PolyTransfer activities for alignment with desired outcomes**, for example if critical thinking skills are expected to be developed (as stated on the flyer), activities should go beyond a demonstration
- ☐ **Incorporate digital twin and machine learning activities into the high school summer academy** given that technology issues prevented the execution of these activities in 2026
- ☐ **Focus on journal submissions** given the target of 25 per year exceeds the conference goal of 15, yet conference submissions currently dominate

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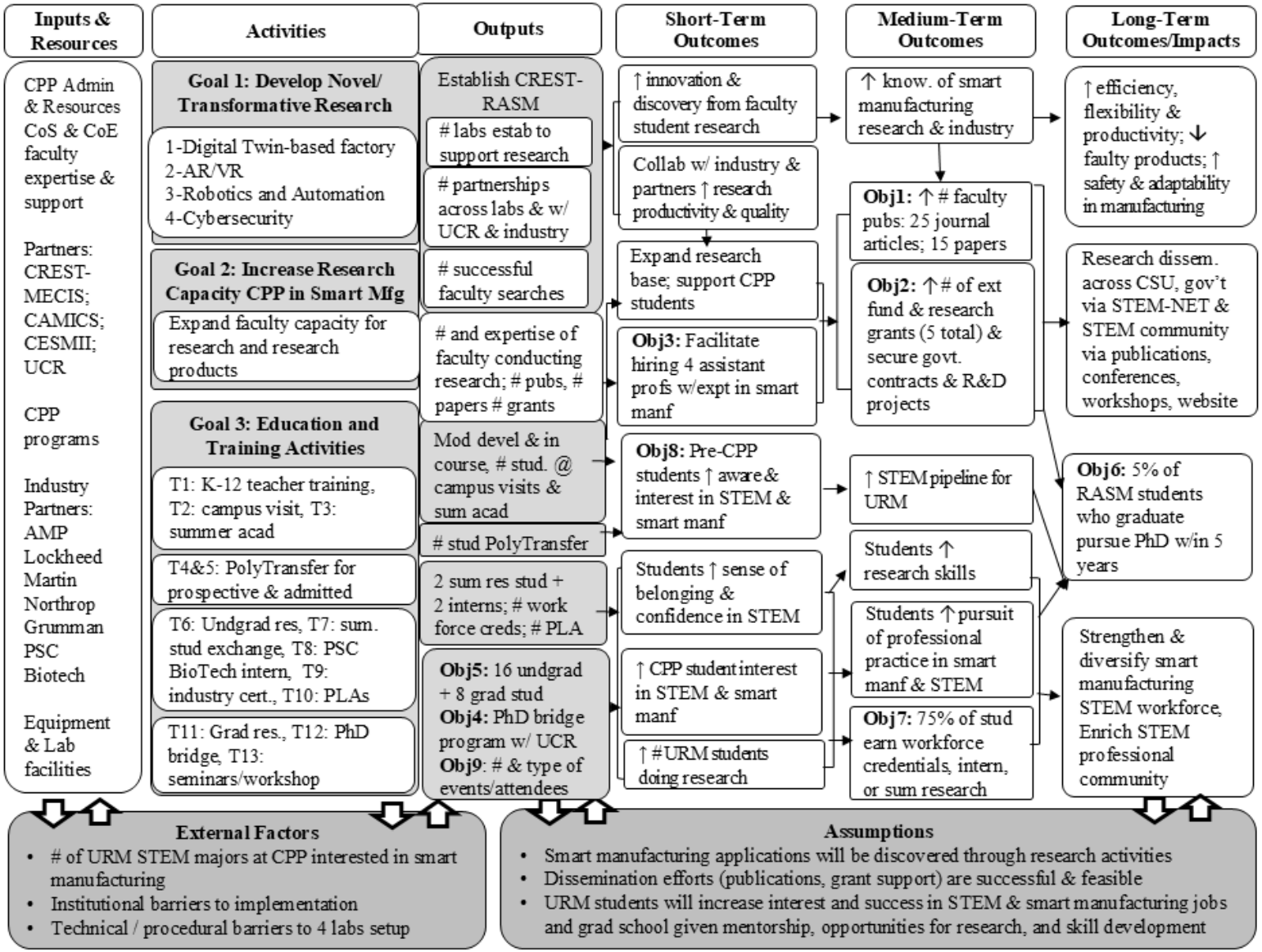
APPENDIX A. CREST-RASM LOGIC MODEL



APPENDIX B. MIDDLE SCHOOL CAMPUS VISIT AGENDA

Time	Session/Topic	Presenter
9:00 AM	Bus Arrival / Welcome	-
9:10 AM	Campus Exploration	Project CAMINOS
10:00 AM	Student Success Presentation	Project CAMINOS
10:30 AM	Transition	-
10:40 AM	CREST-RASM Overview	CREST-RASM Director for Education and Workforce Development
10:55 AM	Transition	-
11:05 AM	Tour of Smart Manufacturing Lab	CREST-RASM Co-PI
12:00 PM	Transition	-
12:10 PM	Lunch	-

APPENDIX C. HIGH SCHOOL SUMMER ACADEMY AGENDA

Day 1 — Wednesday, July 29, 2026

Time	Session
9:00 AM–9:20 AM	Morning Check-In & Community Builder
9:20 AM–10:50 AM	Hands-On Activity Block 1—Cybersecurity
10:50 AM–11:00 AM	Break
11:00 AM–11:45 AM	CoE Lab Tour
11:45 AM–1:00 PM	Break and Lunch
1:00 PM–1:15 PM	Transition
1:15 PM–1:45 PM	Project CAMINOS Success Workshop: Welcome to Cal Poly Presentation
1:45 PM–2:00 PM	Break
2:00 PM–3:15 PM	Hands-On Activity Block 2—AR/VR
3:15 PM–3:30 PM	Reflection & Feedback

Day 2 — Thursday, July 30, 2026

Time	Session
9:00 AM–9:20 AM	Morning Check-In & Community Builder
9:20 AM–10:50 AM	Hands-On Activity Block 3—Robotics I (Intro to Microbit)
10:50 AM–11:00 AM	Break
11:00 AM–12:00 PM	CPP STEM Student Organization Panel
12:00 PM–1:00 PM	Lunch
1:00 PM–1:15 PM	Transition
1:15 PM–1:45 PM	Project CAMINOS Success Workshop: Overview of the California State University (CSU) System
1:45 PM–2:00 PM	Break
2:00 PM–3:15 PM	Hands-On Activity Block 4—Robotics II (Bunny-Bot Build)
3:15 PM–3:30 PM	Reflection & Feedback

Day 3 — Friday, July 31, 2026

Time	Session
9:00 AM–9:20 AM	Morning Check-In & Community Builder
9:20 AM–10:50 AM	Campus Tour
10:50 AM–11:00 AM	Break
11:00 AM–12:00 PM	CPP Transfer Pathways Talk & Q&A—Dr. Jeyoung Woo
12:00 PM–1:00 PM	Lunch
1:00 PM–1:15 PM	Transition
1:15 PM–1:45 PM	Project CAMINOS Success Workshop: Building a High School Resume
1:45 PM–2:00 PM	Break
2:00 PM–3:15 PM	Hands-On Activity Block 5 / Celebratory Exhibit & Presentations
3:15 PM–3:30 PM	Reflection & Feedback

APPENDIX D. POLYTRANSFER FLYERS

POLYTRANSFER ADVANTAGE SUMMER ACADEMY

JULY 9-11, 2026

Program Details

The PolyTransfer Advantage Program at Cal Poly Pomona is a **free** program dedicated to empower prospective community college students with a clear pathway to success in transferring to CPP or another CSU campus. Our summer academy equips students with the tools, knowledge, and mentorship needed to seamlessly transition from a community college to a 4-year university. Join us for this free, 3-day program and experience university life as a CPP transfer student.

Program Benefits

- FREE meals, parking, and room
- Connecting with CPP faculty, staff, and students
- Learning about the CSU admissions process
- Learning about ways to pay for college, including financial aid
- and scholarships
- Learning about different careers and majors
- Meeting other community college students
- Fun activities, giveaways and more!

Additional Learning Opportunities

CREST STEM Academy: July 8

Open to all students interested in a STEM major. Engage in hands-on STEM challenges and concepts to real world problems. Build critical thinking skills, collaborate in teams, and explore the impact of STEM solutions.

ARISE Academy: July 9

Designed for AANHPI and APIDA students, explore your transfer pathway through workshops and community-building experiences with this free residential experience. Connect with AANHPI faculty, staff, and peers while reflecting on identity, belonging, and cultural strengths.

Ready to Apply?

Scan the QR code or visit
bit.ly/ptasa-application26
to submit your application.

Questions?

Contact us at polytransfer@cpp.edu and follow us on Instagram @polytransfer for updates.

Cal Poly Pomona | PolyTransfer

CALIFORNIA STATE POLYTECHNIC UNIVERSITY, POMONA 3801 W. TEMPLE AVE., POMONA, CA 91768 www.cpp.edu/polytransfer | 909-869-2192

POLYTRANSFER SUMMER TRANSITION PROGRAM

JULY 16-18, 2026

Program Details

The PolyTransfer Summer Transition program is a **free**, 3-day program for Fall 2026 Cal Poly Pomona transfer students. In the program, you'll:

- Get familiar with tools, resources, services and programs
- Receive a peer mentor to guide you during your first year
- Find a sense of belonging and community by connecting with faculty, staff and other transfer students

Program Benefits

- Free meals, parking, and housing
- Connect with CPP faculty, staff, and students
- Explore college specific resources and career pathways
- Meet peers, enjoy activities, giveaways, and more!

CREST STEM Academy on July 15

Engage in hands-on STEM activities that apply engineering and computer science concepts to real-world challenges. **Open to all students in Engineering and Computer Science majors.** Join us and discover how to:

- Apply STEM concepts to practical problems
- Strengthen problem-solving and critical thinking
- Collaborate and communicate in teams
- Explore the real-world impact of STEM solutions

SECURE YOUR SPOT TODAY!

Scan the QR code or visit bit.ly/pt-summer-transition26 to submit an application.

Questions?

Contact us at polytransfer@cpp.edu and follow us on Instagram @polytransfer.

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APPENDIX E. POLYTRANSFER AGENDA

PolyTransfer Advantage STEM Summer Academy

Time	Session/Topic	Presenter
8:00 AM – 9:15 AM	Check in to dorm	Student Success
9:15 AM – 9:30 AM	Transition	
9:30 AM – 10:15 AM	Introduction	CREST-RASM PI
10:15 AM – 10:30 AM	Snack & Transition	
10:30 AM – 11:30 AM	Hands-On STEM Activities (AR/VR lab)	CREST-RASM Co-PIs
11:30 AM – 1:00 PM	Lunch and transition	
1:00 PM – 2:00 PM	Alumni panel	CREST-RASM PI
2:00 PM – 2:15 PM	Transition	
2:15 PM – 3:15 PM	Hands-On STEM Activities (Smart Manufacturing lab)	CREST-RASM Co-PIs
3:15 PM – 3:30 PM	Transition	
3:30 PM – 4:00 PM	Reflection & Feedback	Cobblestone

PolyTransfer STEM Summer Transition Program

Time	Session/Topic	Presenter
8:00 AM – 9:15 AM	Check in to dorm	Student Success
9:15 AM – 9:30 AM	Transition	
9:30 AM – 10:15 AM	Introduction	CREST-RASM PI
10:15 AM – 10:30 AM	Snack & Transition	
10:30 AM – 12:00 PM	Hands-On STEM Activities (lab rotation)	CREST-RASM Co-PIs
12:00 PM – 1:00 PM	Lunch and transition	
1:00 PM – 1:50 PM	Alumni & Student panel	CREST-RASM PI
1:50 PM – 2:00 PM	Transition	
2:00 PM – 3:30 PM	Hands-On STEM Activities (lab rotation)	CREST-RASM Co-PIs
3:30 PM – 3:45 PM	Transition	
3:45 PM – 4:00 PM	Reflection & Feedback	Cobblestone

APPENDIX F. CPP STUDENT DEMOGRAPHIC INFORMAITON

Category			Percentage of Students (*n*)
Sex		Male	70% (*n* = 26)
		Female	11% (*n* = 4)
		Other/Unknown	19% (*n* = 7)
IPEDS Ethnicity		Hispanic/Latino (any race)	30% (*n* = 11)
		White Only	11% (*n* = 4)
		Black/African American Only	3% (*n* = 1)
		Asian Only	30% (*n* = 11)
		Other/Unknown	27% (*n* = 10)
Spring 2026 Academic Level		Freshman	0% (*n* = 0)
		Sophomore	0% (*n* = 0)
		Junior	8% (*n* = 3)
		Senior	49% (*n* = 18)
		Graduate Student	32% (*n* = 12)
		Unknown	11% (*n* = 4)
First-Generation Status		First College	16% (*n* = 6)
		First Degree	19% (*n* = 7)
		Not First Generation	49% (*n* = 18)
		Unknown	11% (*n* = 4)
Admission Basis		First-time Freshman	41% (*n* = 15)
		Transfer	16% (*n* = 6)
		Postbaccalaureate	32% (*n* = 12)
		Unknown	11% (*n* = 4)
Spring 2026 College and Major	College of Business	Information Security	3% (*n* = 1)
	College of Engineering	Aerospace Engineering	19% (*n* = 7)
		Computer Engineering	5% (*n* = 2)
		Electrical Engineering	5% (*n* = 2)
		Electromechanical Systems Engineering Technology	3% (*n* = 1)
		Manufacturing Engr	3% (*n* = 1)
		Mechanical Engineering	14% (*n* = 5)
	College of Professional and Global Education	Systems Engineering	3% (*n* = 1)
	College of Science	Computer Science	30% (*n* = 11)
		Unknown	11% (*n* = 4)
Graduated in Spring 2026		Yes	14% (*n* = 5)
		No	86% (*n* = 32)

N = 37; Note: Availability of student demographic information was dependent on students providing consent

APPENDIX G. PLA TRAINING ACTIVITY CALENDAR & PROGRAM REQUIREMENTS

All CREST students (undergraduate and graduate) are required to attend:

- One (1) workshop per month (minimum of 4 total)
- One (1) peer mentoring training session per month

Table a. Workshop & Peer Mentoring Schedule (In-Person Location: Building 163, Room 2005)

Date	Time	Activity	Format	Location
Feb 13, 2026	11:00–12:00	Workshop #1: Reclaiming Self (Dr. Ross)	In-Person	Building 163, Room 2005
Feb 20, 2026	Asynchronous	Peer Mentoring #1: Introduction (Canvas)	Online	Canvas
Feb 27, 2026	11:00–12:00	Workshop #2: How to Present Your Research	In-Person	Building 163, Room 2005
Mar 6, 2026	Asynchronous	Peer Mentoring #2: Project-Based Management (Canvas)	Online	Canvas
Mar 13, 2026	11:00–12:00	Workshop #3: Data Visualization	In-Person	Building 163, Room 2005
Mar 27, 2026	11:00–12:00	Workshop #4: Elevator Pitch & Career Center	In-Person	Building 163, Room 2005
Mar 27, 2026	12:00–1:00	Peer Mentoring Training	In-Person	Building 163, Room 2005
Apr 10, 2026	11:00–12:00	Workshop #5: Philosophy of the Scientific Method	In-Person	Building 163, Room 2005
Apr 24, 2026	11:00–12:00	Workshop #6: AI Tools in Medical Informatics	In-Person	Building 163, Room 2005
Apr 24, 2026	12:00–1:00	Peer Mentoring Training	In-Person	Building 163, Room 2005
May 8, 2026	11:00–1:00	Workshop #7: End-of-Year Celebration	In-Person	Building 163, Room 2005

APPENDIX H. PLA TRAINING COMPLETION RATES

			Spring 2026 Students	
	Attendance/Completion		Undergraduates	Graduates
Peer Mentor Trainings	Requirement not met	0	1 (5%)	4 (50%)
		1	4 (20%)	1 (12.5%)
		2	2 (10%)	1 (12.5%)
		3	6 (30%)	0
		Total not met	**13 (65%)**	**6 (75%)**
	Requirement met	4	7 (35%)	2 (25%)
		Total met	**7 (35%)**	**2 (25%)**
OUR Workshops	Requirement not met	0	5 (25%)	4 (50%)
		1	5 (25%)	0
		2	6 (30%)	2 (25%)
		3	1 (5%)	2 (25%)
		Total not met	**1 (85%)**	**(100%)**
	Requirement met	4	3 (15%)	0
		Total met	**3 (15%)**	**0**

APPENDIX I. UNDERGRADUATE STUDENT FOCUS GROUP SUMMARY

In summer 2026, three undergraduate students participated in a focus group interview reporting on their experiences with the CREST-RASM project at CPP during the Spring 2026 semester.

Research Experience

Students learned about the opportunity to join the CREST-RASM Center through multiple avenues, including announcements by professors and Canvas notifications. Students decided to pursue the opportunity to gain more real-world engineering experience, explore research as a possible future career interest, and earn money in a potentially career-relevant role.

Students reported engaging in various tasks as part of the research experience. This included conducting systematic literature reviews and digitally modeling smart manufacturing equipment. Most reported meeting with their faculty mentor and research group weekly. One student explained the structure of these meetings, saying "*we [met] as a group, but we all presented our own, what we've worked on in the last week during each meeting individually*." One student reported weekly one-on-one meetings with their faculty mentor as well.

Students reported communicating with one another via Discord. Two students worked mostly alone, noting that "*we work on things separately and then put them together afterwards rather than working on things together at the same time*." The other student collaborated with peers on specific tasks: "*For example, we're working on an abstract for a research conference, and so we're kind of both collaborating, working on that abstract, like checking each other's work to make sure things make sense*."

All students shared that their faculty mentors were knowledgeable and helpful. They described receiving guidance while still being afforded freedom to explore within the research process. For instance, one student shared that their mentor was "*keeping us in the right direction while not forcing us in a direction either*." Another noted that their mentor "*helps us out in kind of a hands-off way. [Mentor] lets us explore on our own, like mostly and we ask [them] for advice and [they] give good advice*."

Benefits

The primary reported benefits of participating in CREST-RASM research were increased research skills, increased confidence, and career clarity. Given the early stage of the research process across thrusts, the main research skill students reported gaining was conducting literature reviews. One student explained how their skills grew in this area: "*Navigating research papers is not something I always had an easy time with... So I've learned how to expedite my reading and figure out what papers are actually important, what are not*." In addition, several students reported gaining confidence as a result of conducting research. They noted that applying what they learned from classes to the real world facilitated this growth in confidence. In addition, one student noted that they felt more confident "*being able*

> *"In terms of the be biggest benefit, I was hoping to find something to kind of get my foot in the door. This is… a great way to start it out… and I'm hoping I can use this in the future to get an internship later."*
>
> -Spring 2025 CREST-RASM Undergraduate Student

to be an engineer and being able to actually like, go into the workforce like, oh, I actually have the abilities to do something useful." A couple students said that participating in CREST-RASM research increased their interest in smart manufacturing topics, expressing a desire to possibly attend graduate school in the future. The other student shared that participating in the research helped clarify they are not interested in smart manufacturing as a career: "*I took on this research assistant position because I was interested to see if this was a subject I was interested in… in terms of whether I wanted to pursue this further, I would probably have to say probably not*."

Workshop & Seminar Experience

Students reported attending multiple workshops and seminars as part of the Center participation requirements. One set of activities was related to the PLA component of the project. Students described these peer mentor training sessions as "*asynchronous assignments where you watched a video or you read through something and then you basically wrote a response… And it was like usually giving a kind of theoretical situation where you're a peer mentor and you're working with a student, what do you do about it*." In addition, students were expected to attend four Office of Undergraduate Research workshops as part of the PLA training. Some students expressed confusion regarding the PLA activities. They noted that workshop locations changed at the last minute and some of their fellow students were unaware of the requirements. Separate from the PLA activities, students also described attending one required research seminar and one required PD workshop. A few students expressed confusion around the scheduling of various program requirements, with one student noting "*it was a little hard to articulate what exactly was going on*" and requested that information "*should be like preferably in an essential place. I think maybe using Canvas for that*." Another student added that "*there was a lot of mishaps and changes throughout the semester… Communication, in terms of the actual emails, when you actually read them, they were pretty clear. It just kept getting changed. The dates and the buildings and meeting locations and the status of them kept changing*."

Suggestions for Improvement

The main suggestions for improvement that students offered centered around communication and program requirements. One student requested more communication between research thrusts, including possibly using Microsoft Teams or other programs to promote collaboration. In addition, clearer communication of program requirements and workshop timing were requested. Finally, one student suggested reducing the number of participation requirements or offering more asynchronous options: "*The four different workshops, I think it was just hard just to fit them into my schedule… maybe some streamlining of that, of like making some of them asynchronous online or something. But overall, like, I can't think of too many big improvements. The biggest one is just like, I think yeah, too many events*."

APPENDIX J. GRADUATE STUDENT FOCUS GROUP SUMMARY

In summer 2026, three graduate students participated in a focus group interview reporting on their experiences with the CREST-RASM project CPP during the Spring 2026 semester.

Participation in Research

Background

Students reported joining their research projects (i.e., thrusts) at the CREST-RASM Center due to personal interest in the Center's research areas and after being recruited by a thrust PI.

Relationships with Peers

> *"I think the collaboration for each of the team members in my group is great… Every group member in my team enjoyed [working on the research project]."*
>
> -Spring 2025 CREST-RASM Graduate Student

Overall, students reported positive teamwork within their research groups, including equal contribution by all team members, mutual support, and regular updates through informal conversations as well as through digital platforms (e.g., Google Drive, Discord). Most indicated that they did not know their team members before joining the Center but developed closer relationships through working together. For example, one student shared, "*When you're working in a team… it forms a sort of bonding sense, whether you are succeeding and doing well… or you're facing a challenge and you all need to struggle a little and vent to each other.*"

Relationships with Research PIs

Students reported knowing their thrust PIs before joining the Center through courses taught by those faculty members. One student noted that familiarity with their PI's standards was useful: "*I had known the professor the semester before joining the project, so I had an idea of what they expect, how they expect that information to be presented.*" Another reported getting closer to their thrust PI through working on the project.

Student Outcomes

Development of Research Skills

> *"[Participation in research] definitely helped me learn how to put what I've been learning on paper into hands-on real work… [to] create that bridge between what I learned in class and my certifications into what we do in the lab."*
>
> -Spring 2025 CREST-RASM Graduate Student

Students generally indicated that their participation in research at the Center helped develop their research skills, including hands-on implementation of classroom concepts, hypothesis development and testing, and problem solving. One student, for example, shared, "*[Skills I gained included applying] the scientific method of hypothesizing… assuming what would be the result, testing that… another thing that it helped [with] was to go back to the basics if something goes wrong… and pick off from there to iterate on that.*" In addition, students noted that working as part of a team helped develop their collaboration skills and accept making mistakes as part of the research process.

Confidence as a Scientist/Engineer

Students indicated that their participation in research did not necessarily increase their confidence as scientists or engineers. They explained that completing the tasks assigned by their thrust PIs often required independent research and problem-solving, which they found challenging. For example, one student described, "*Telling us to conduct these [tasks] had us lost at first… none of us really know what's going on or what we should be doing… because what we're doing is far beyond the classroom.*" Relatedly, one student noted, "*[It] could have been better if there was more of a baseline knowledge… of our system, so that we understand a little bit better what we're working with*" while also emphasizing, "*There's no way to blame it on the program or the professor. This is something that is never going to be taught in the classroom.*" Nevertheless, students described this process as rewarding, noting that they learned how to use new tools (e.g., Python) and successfully overcame challenges. For example, one student described, "*It's kind of an unknown land… you're going into without much road signs... but I believe there's a satisfaction at the very end of getting it all to work together.*"

Interest in Thrust Area

Students generally reported that participating in research at the Center increased their interest in both their thrust area and smart manufacturing more broadly and indicated that they envision pursuing a Ph.D. or a career in these fields. One student, for example, shared, "*Yeah, [my interest in thrust-area has increased]… the [thrust-specific tool], to me, just opened a new door that I can eventually know*."

Participation in Educational Activities

Seminars and Workshops

While graduate students were generally aware of the requirement to attend CREST-RASM *research seminars* and *professional development (PD) workshops* over the spring semester, they reported that having three types of events, combined with the *career and research workshops* (provided by CPP's Office of Undergraduate Research [OUR], covering topics such as data visualization, AI, and the Career Center), was confusing, and that communication regarding requirements and schedules was not straightforward. For example, one student stated, "*Honestly, I was pretty confused throughout the whole semester, I didn't really know what I had to do and what was available to me*." Another described, "*Communication was very back and forth… the initial email would say, 'this is all the PDs and workshops that can be attended,' but then further information would either clarify that, 'well, it is actually this number of PDs and workshops [you need to attend], or 'now you don't have to do them.'*" Further, one student expressed confusion about how attendance was tracked: "*It is unclear whether we should just punch in the time by ourselves… they don't really have some official… system [that] will automatically put you into a list that tells you, 'okay, you attended this workshop.'*"

Students said they found the events they attended generally useful. For example, one student stated, "*I liked the [OUR research workshop] one that I went to, it was the data visualization one. I can help with publications*." However, one student noted that although a research seminar on smart manufacturing covered useful information, the amount of content presented in a one-hour session made it difficult to fully absorb and understand.

PLA Training

Students reported being unfamiliar with the PLA component of the program. They indicated that they were unaware of the requirement to complete four PLA training sessions and did not know they were expected to serve as mentors for incoming students to the Center.

Greatest Benefits

According to students, one of the greatest benefits of participating in the CREST-RASM Center was the hands-on research experience. One student, for example, shared, "*I can finally get some real-world experiences… that to me is really helpful and I think it's improved my resume or… [my] chances to get into a real job in the future.*" Another benefit was gaining teamwork and various technical skills (e.g., coding, operating a robotic arm). In addition, students appreciated the rich experience and extensive learning they gained from their research projects. As one student described, *"[If] someone asks me, 'Hey, what did you work on?' I'm like, 'well, we worked on cybersecurity, we worked on so many different tools on this system,' … I don't think many people have the opportunity to say something like that.*" Finally, one student reported that working with other departments was beneficial: "*[The greatest benefit was learning] how to work with each other or even with the other department… sometimes we need to borrow tools… like the wire cables… when you talk to them, I think that is something interesting.*"

> *"The professional experience, working in a team and having a professor be your manager, but also getting the hands-on experience that classrooms can't provide is the greatest benefit in my opinion."*
>
> -Spring 2025 CREST-RASM Graduate Student

Suggestions

To minimize confusion around seminar and workshop requirements, students suggested making a clear distinction between event types, clearly communicating participation requirements, maintaining an accessible event calendar, and providing a simple way to track requirement completion (e.g., through Canvas). In the words of one student, "*We can separate those three types of seminars into three sections, and each of them can be labeled as an assignment… just tell us how many assignment you have to finish in [each] different type of [event]. I think that will help.*" In addition, students requested increased accessibility to their labs, with one explaining: "*We have a single ID card that we use to get into the lab, so it's either the right person has it or needs to come over to hand it over so that people can get into the lab.*"

APPENDIX K. POLYTRANSFER FEEDBACK SURVEY SUMMARIES

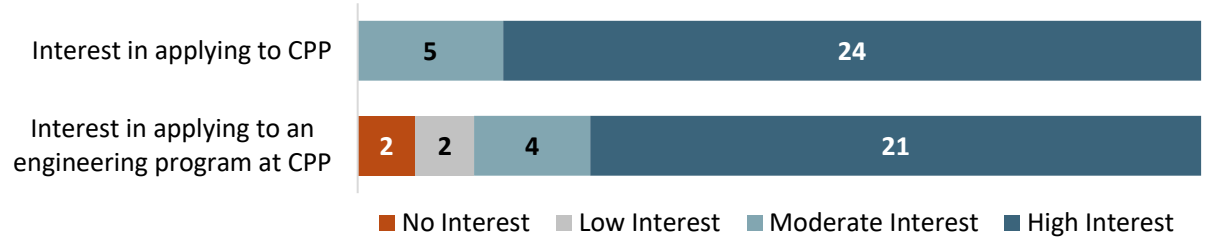
PolyTransfer Advantage Summer Academy

On July 8, 2026, 29 prospective CPP transfer students participated in the one-day PolyTransfer Advantage STEM Summer Academy (PolyTransfer) sponsored by CREST-RASM. Students learned about research opportunities through the CREST-RASM Center, engaged in hands-on activities in the STEM laboratories, and listened to an alumni panel. At the end of the day, all 29 students responded to a survey administered by the external evaluation team to provide feedback on their PolyTransfer experience. They reported their level of interest in applying to CPP and satisfaction with the event.

Interest in CPP

Students reported their level of interest in applying to CPP on a scale from 1 = "No Interest" to 4 = "High Interest." Most students reported a high level of interest in both applying to CPP overall as well as applying to engineering programs at CPP (see **Figure a**). Interest in applying to CPP overall was higher than interest in applying to engineering programs specifically.

Figure a. Student Interest in CPP after the PolyTransfer Advantage STEM Summer Academy

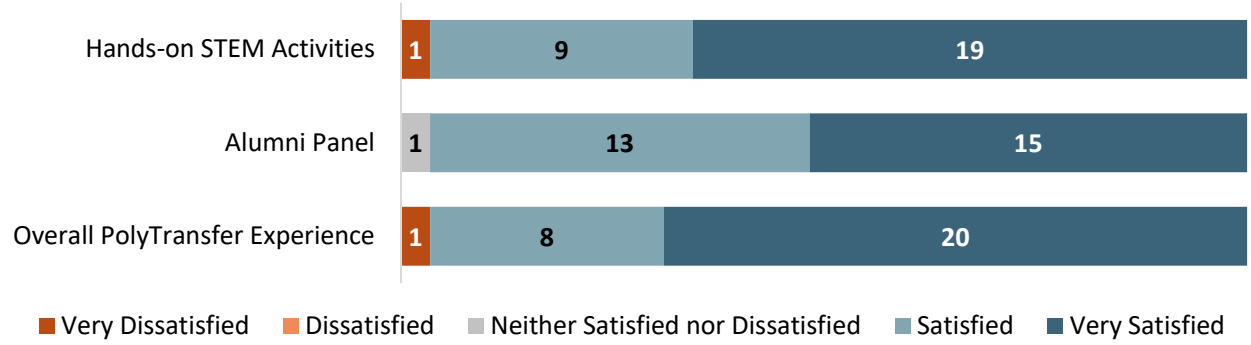


n = 29

Satisfaction

Students rated their level of satisfaction with the PolyTransfer components, as well as the experience overall, on a scale from 1 = "Very Dissatisfied" to 5 = "Very Satisfied." Students were highly satisfied with all components of the PolyTransfer event (see **Figure b**). A greater proportion of students were highly satisfied with the hands-on STEM activities compared to the alumni panel, however nearly all students expressed they were satisfied with both. The student who indicated dissatisfaction with both the hands-on STEM activities and program overall did not elaborate on their reasons for these responses. However, they did indicate that they had no interest in applying to an engineering program at CPP, suggesting that perhaps the program content was not aligned to their desired major.

Figure b. Student Satisfaction with the PolyTransfer Advantage STEM Summer Academy



n = 29

Best Aspects

Students reported what they found to be the best aspects of the PolyTransfer event. Most shared that the hands-on and interactive activities were the best part of the event. As one student said, "*Getting to see a bit of what people in the field experience is a cool way to get insight on what I might like or dislike if I'm considering these fields of study*." Students also noted that they appreciated the resources and information that was provided, the alumni panel, and the people they met (e.g., faculty, current students, alumni, other prospective students).

> *"This event helped me see clear pathways not only for my undergraduate education but also for my future career and professional growth."*
>
> -Prospective CPP student

Suggestions for Improvement

Most students shared that they had no suggestions for improvement. Those who did share suggestions requested more hands-on time relative to presentations during the lab activities. In addition, some students suggested providing presenters with microphones to facilitate understanding, more opportunities to interact with other students, and indicating what students should bring to the event (e.g., notebook).

> *"[This was] very different to other types of events hosted where nothing hands-on is really done. This actually sparked my interest in the topics we learned about today."*
>
> -Prospective CPP student

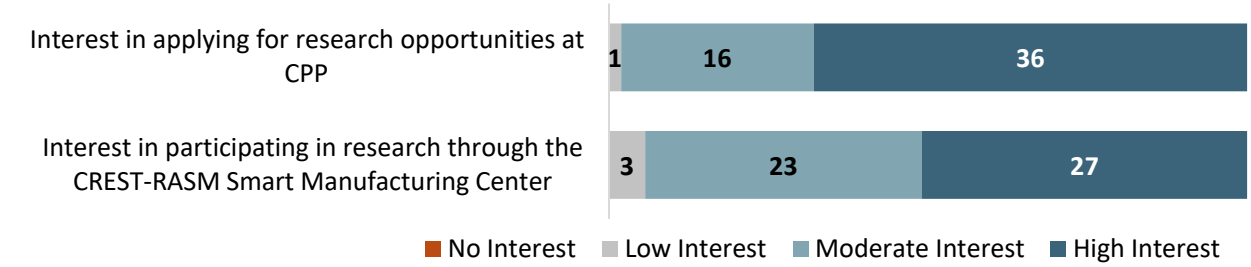
PolyTransfer Advantage Summer Academy

On July 15, 2026, 59 transfer students who were admitted to CPP participated in a similar one-day PolyTransfer STEM Summer Transition Program (PolyTransfer) sponsored by CREST-RASM. Students learned about research opportunities through the CREST-RASM Center, engaged in hands-on activities in the STEM laboratories, and listened to an alumni and current student panel. At the end of the day, 53 students responded to a survey administered by the external evaluation team to provide feedback on their PolyTransfer experience. They reported their level of interest in research opportunities at CPP and satisfaction with the event.

Interest in Research Opportunities

Students reported their level of interest in applying for research opportunities at CPP on a scale from 1 = "No Interest" to 4 = "High Interest." Most students reported a high level of interest in both research opportunities at CPP overall as well as specifically within the CREST-RASM Center (see **Figure c**). Interest in research overall was slightly higher than interest in the CREST-RASM Center specifically.

Figure c. Student Interest in Research after the PolyTransfer STEM Summer Transition Program

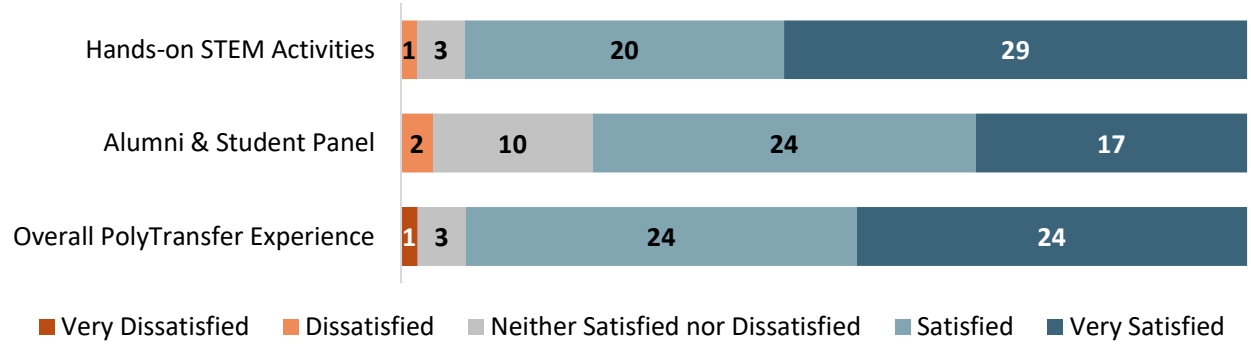


n = 53

Satisfaction

Students rated their level of satisfaction with the PolyTransfer components, as well as the experience overall, on a scale from 1 = "Very Dissatisfied" to 5 = "Very Satisfied." Students were highly satisfied with all components of the PolyTransfer event (see **Figure d**). A greater proportion of students were highly satisfied with the hands-on STEM activities compared to the alumni panel, however most students expressed they were satisfied with both. A student who indicated dissatisfaction with multiple program components explained that they wanted "*less time talking, more time dedicated to the hands on parts*." The student who indicated they were "Very Dissatisfied" with the PolyTransfer event overall said they were "Very Satisfied" with each of the other components, suggesting this response was in error.

Figure d. Student Satisfaction with the PolyTransfer STEM Summer Transition Program



n = 52-53

Best Aspects

Students reported what they found to be the best aspects of the PolyTransfer event. Most shared that the hands-on and interactive activities were the best part. As one student said, "*I was given an insight of a world I had not given the chance to experience, and it actually got me thinking about my major*." They also frequently cited the opportunity to network with fellow students as a benefit, specifically other new transfers in their field. Other best aspects included the information provided (about research, majors, and career pathways) and the alumni and student panel ("*the panel members provided insightful experience on how I should plan my next 2-3 years*").

> *"I really appreciate the time people took to talk about their experiences in CPP. I think it's important to remember that we all go through this path and we could help each other."*
>
> -CPP transfer student

Suggestions for Improvement

Many students shared that they had no suggestions for improvement. Those who did requested more hands-on STEM activities. For instance, one student said, "*I would prefer to have more opportunities to do hands on exercises with different program (i.e. cybersecurity)*." Some students also asked to participate in activities relevant to other engineering majors (e.g., civil), with one suggesting "*working on a project/problem as a team*." Several students noted that technical issues with the AR/VR lab presentation occurred, and one requested "*a way to experience the AR/XR labs in a desktop environment because the AR goggles gave me a headache mid-session*." Other suggestions included opportunities for small-group interactions with panelists and transportation accommodations for students with disabilities when moving between buildings.

APPENDIX L. LIST OF SUBMITTED PAPERS AND PROPOSALS

Journal Articles

Published

Najafi, A. & **Mirzaei, S.** (2026). Hidden Markov inference framework for error propagation mitigation in modular digital twins. *ASME Journal of Risk Uncertainty in Engineering Systems, Part B, 12*(4), 041108. https://doi.org/10.1115/1.4071964

Submitted

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Published

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Hussain, K., Parsa, S.P., **Jamshidi, F.**, & Kosaraju, S.C. (2026). Ensemble based real time facial emotion recognition with adaptive feedback for mental health support. Paper accepted for presentation at the *2026 IEEE International Conference on Electro/Information Technology*.

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Funding Proposals

Table b. External Funding Proposals Submitted and Status

Status	Funder	Title	Award Amount
Funded	California State University Agricultural Research Institute	Digital Twin–Enabled Bioprocessing of California Alfalfa into Antimicrobial Peptides for Biological Control of Postharvest Fungal Spoilage in Strawberries	$75,000
		Total Dollars Awarded	**$75,000**
Pending	National Aeronautics and Space Administration	The ARTEMIS (Aerospace Regional Talent Ecosystem for Manufacturing, Industry, and Spaceflight) Workforce Pipeline	$1,500,000
	National Science Foundation	CyberAI Innovation: Experiential CyberAI Education through a Hands-on Range Platform and Integrated Training Activities	$150,000
		California Coordination Hub: California AI Readiness Network	$3,000,000
	United States Department of Agriculture	Acquisition of a Benchtop Tangential Flow Filtration System for Digital Twin–Integrated Downstream Bioprocessing of Agricultural Protein Ingredients	$79,986
	National Dairy Council	A Digital Twin for Predictable Bioconversion of Whey Protein into Consistent, Value-Added DPP-IV-Inhibitory and Antioxidant Ingredients	$98,000
		Total Dollars Pending	**$4,827,986**
Not Funded	United States Department of Education	Advancing Privacy-Aware Personalized Student Advising and Learning Through 5G-Enabled AI Infrastructure in California	$4,000,000
	National Aeronautics and Space Administration	California space grant consortium (CaSGC) AI Workforce “Internal Competition” Proposal	$600,000

Table c. Internal Funding Proposals Submitted and Status

Status	Title	Award Amount
Funded	RSCA- Smart Manufacturing Approach to Tomato Seed Protein Valorization: Digital Twin Development for Real-Time Monitoring and Prediction of Enzymatic Hydrolysis	$10,000
	SIRG - Integrating Digital Twin Technology with Fermentation-Based Bioprocessing for Sustainable Protein Valorization from Sorghum DDGS	$18,000
	Total Dollars Awarded	**$28,000**
Pending	Bridging Theory and Practice through Digital Twin–Enabled Smart Manufacturing Across Engineering Curricula	$30,000
	Total Dollars Pending	**$30,000**

APPENDIX M. CREST-RASM EDUCATIONAL TASKS, OBJECTIVES, & YEAR 1 STATUS

Table d. Educational Tasks and Status

	Task Target	Year 1 Status
K-12 Educational Tasks	1. Develop a 3-hour module on STEM fields and career pathways for K-12 teachers, accompanied by 2-3 hours of assigned course reading	The module was under development in Year 1 and is expected to be integrated into the EDU 5205 course for prospective science teachers starting Year 2.
	2. An annual one-day visit for 80+ middle- and high-school students	A CPP campus visit for middle school students took place in spring 2026 with 54 attendees. Given that this is fewer than the target, it is expected that more than 80 students will visit in Year 2.
	3. Develop an annual 3-day summer academy program ("Next-Gen Manufacturing Academy") for 30 high school students in 11th and 12th grades	The summer academy took place in July 2026 with 26 unique students across 3 high schools attending.
Community College Educational Tasks	4. Develop a partnership with PolyTransfer to add one day of activities related to the CREST-RASM initiatives to PolyTransfer Advantage Summer Academy for Prospective transfer students	One day of CREST-RASM activities was incorporated into the 2026 PolyTransfer Advantage Summer Academy; 29 prospective students attended.
	5. Develop a Partnership with PolyTransfer to add one day of activities related to the CREST-RASM initiatives to PolyTransfer Summer Transition program for Prospective transfer students	One day of CREST-RASM activities was incorporated into the 2026 PolyTransfer Summer Transition program; 59 matriculated students attended.
CPP Undergraduate Student Educational Tasks	6. Provide research opportunities for at least 16 undergraduates and 8 graduate students per year	24 undergraduate students participated in paid research at the Center in Year 1.
	7. 2 students participate in the summer research exchange program with CREST MECIS & CAMICS annually	3 students traveled to CREST MECIS & CAMICS to conduct research in summer 2026.
	8. Internship opportunity at PSC Biotech for 2 students per year	Internship activities have not yet begun. The collaboration will likely be expanded beyond PSC Biotech to other companies as well.
	9. Opportunity to obtain industry-known certifications and workforce credentials	In Year 1, one student completed two credentials. In addition, one other student began a credential.
	10. Adapting CPP INVESTS Peer Learning Assistant model for students' peer mentoring and professional development	Of the 28 paid CREST-RASM students in Spring 2026, none met both the PLA training and OUR workshop requirement, however approximately a third met the PLA training requirement and approximately one tenth met the OUR workshop requirement.

	Task Target	Year 1 Status
CPP Graduate Student Educational Tasks	11. Research experience for 8 graduate students per year	8 graduate students participated in paid research at the Center in Year 1.
	12. CPP-UCR STEM PhD Bridge Program to support 1-2 students/year for pursuing STEM PhD at UCR	No students have been selected for the bridge program yet. One potential candidate was identified but ultimately was not the right fit.
	13. Seminars and workshops for students' professional development in smart manufacturing, emotional intelligence, positive psychology, technical communication, and NSF-Graduate Research Fellowship Program	There were five research seminar options covering topics related to smart manufacturing. There was one PD workshop option on information literacy. Most students attended the required seminar (68%; 19/28) and half attended the PD workshop (50%; 14/28).

Table e. Objectives and Status

Objective	Year 1 Status
Objective 1: Submit at least 40 (25 journal and 15 conference) papers in respected and high-impact journals and conferences by the end of the five years of the grant by the Center faculty. This is three times greater than the productivity of research-active faculty members in CPP Colleges of Engineering & Science.	In Year 1, two journal papers and five conference papers were submitted. Of these, one journal paper and one conference paper were published, with two more conference papers accepted. Of note, two CREST-RASM students were co-authors on a submitted conference paper.
Objective 2: Make CREST-RASM financially sustainable by submitting at least five external proposals by Center faculty by the end of the five years of the grant, as well as securing government contracts and industrial R&D projects.	Seven external funding proposals were submitted, exceeding the five-year goal. One of the proposals was funded, two were not funded, and five are pending. In addition, three internal CPP funding proposals were submitted, two of which were funded. Across all proposals, $103,000 was awarded and $4,857,986 is still pending.
Objective 3: Facilitate the recruitment of four assistant professors specializing in smart manufacturing, with expertise in digital twin, Artificial Intelligence (AI), AR/VR, robotics and automation, and cybersecurity (see the letter of support from CPP's Provost).	In Year 1, one assistant professor who conducts research related to smart manufacturing was hired by the IME department. In Year 2, the CREST-RASM PIs will begin collaborating with this new professor.
Objective 4: Establish a CPP-UCR STEM PhD Bridge program from Master of Science (MS) programs at CPP to STEM PhD programs at UCR, laying the groundwork for potentially establishing a Doctoral program in Advanced Manufacturing Engineering at CPP.	CPP & UCR faculty are discussing the program logistics. One potential student candidate was identified for the bridge program, however, it was determined that there was not sufficient alignment with UCR research programs.

Objective	Year 1 Status
Objective 5: Provide research opportunities for at least 16 undergraduates and 8 graduate students per year to become candidates for competitive graduate programs and advanced STEM careers.	24 undergraduates and 8 graduate students conducted paid research as part of the Center in Year 1.
Objective 6: Utilize objectives 4 & 5 as a vehicle to ensure the percentage of the Center's students recruited, trained, and graduated – who will pursue graduate degrees (PhD or Masters) within 5 years of this grant -- be at least 5% (current CPP rate for pursuing PhD within 10 years after graduation is 0.8%).	It is too early to assess this objective. Graduate school attendance will be tracked and reported in later years.
Objective 7: Ensure that at least 75% of the Center's students earn workforce credentials, participate in internships, or engage in summer research exchange programs offered by the Center.	One Center student earned workforce credentials and two participated in the summer exchange. This is a total of 3/32 students for Year 1 (9%).
Objective 8: Develop engaging education and outreach programs for K-12 and community college students to enhance their awareness and interest in STEM fields, CREST-RASM initiatives, and career opportunities in smart manufacturing.	In Year 1, outreach programs included a middle school campus visit (54 students), the high school summer academy (29 students) and PolyTransfer days (88 students).
Objective 9: Provide education and professional development (PD) opportunities to CREST-RASM graduate and undergraduate students in smart manufacturing, emotional intelligence, positive psychology, technical communication, and mentoring for the NSF-Graduate Research Fellowship Program (GRFP).	There were five research seminar options covering topics related to smart manufacturing. There was one PD workshop option on information literacy.

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