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U.S. Department of Labor
Employment and Training Administration

STEM-Connect at the University of Vermont, College of Engineering and Mathematical Sciences:
Program Evaluation Final Report

September 30, 2017
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## Frequently Used Acronyms and Abbreviations

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<th>Description</th>
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<tr>
<td>CDE</td>
<td>Continuing and Distance Education (UVM)</td>
</tr>
<tr>
<td>CCV</td>
<td>Community College of Vermont</td>
</tr>
<tr>
<td>CEMS</td>
<td>College of Engineering and Mathematical Sciences (UVM)</td>
</tr>
<tr>
<td>FAFSA</td>
<td>Federal Student Aid Application (Free Application for Federal Student Aid)</td>
</tr>
<tr>
<td>SGA</td>
<td>Solicitation for Grant Applications</td>
</tr>
<tr>
<td>SPSS</td>
<td>Statistical Package for the Social Sciences (IBM)</td>
</tr>
<tr>
<td>STEM-Connect</td>
<td>Science Technology Engineering and Mathematics Program at UVM</td>
</tr>
<tr>
<td>TAACCCT</td>
<td>Trade Adjustment Assistance Community College and Career Training</td>
</tr>
<tr>
<td>UVM</td>
<td>University of Vermont</td>
</tr>
<tr>
<td>Vermont HITEC</td>
<td>Host of the Institute for American Apprenticeships</td>
</tr>
<tr>
<td>VDOL</td>
<td>Vermont Department of Labor</td>
</tr>
<tr>
<td>WLO</td>
<td>Workplace Learning Opportunity</td>
</tr>
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</table>
Executive Summary

Program Description and Activities

STEM-Connect at the University of Vermont (UVM)’s College of Engineering and Mathematical Sciences (CEMS) was designed to create certificates that provide clear and flexible pathways to employment in STEM-related fields. The program was designed to respond to the needs of both traditional and non-traditional student populations.

The program was built around stacked and latticed certificates that could be earned in two years or less. Certificate credentials included: Computer Software Certificates in Software Development, Web Development, Cybersecurity, Master’s Preparation and Self Design; Computer-Aided Engineering Technology, Complex Systems (master’s level), and Pre-Actuarial (Actuarial Science).

The delivery of the program consisted of regular credit-bearing academic course work, the mainstay of the university’s delivery for degree programs. Delivery included on-line course work and mentoring to enable non-traditional student participants to experience and master the content. Internships were coordinated through a statewide partner that had direct access to Vermont industry (Vermont-HITEC.) Participant support services consisted of the base support provided through the University’s financial aid offices, counseling and career development. In addition, the program provided enhanced recruitment, counseling, tutoring and academic advising for participants who were non-traditional students in partnership with UVM’s Division of Continuing and Distance Education (CDE).

The model that the program was built on involved the application of new and existing resources in CEMS, partnerships with Vermont business and industry, Vermont Department of Labor (VDOL) and its Career Resource Centers, and Vermont HiTEC (a non-profit apprenticeship agency). Resources were configured in the model to create capacity in CEMS to develop the program offerings and recruit participants.

Evaluation Design

The overall purpose of the STEM-Connect evaluation was to determine the extent to which UVM CEMS implemented the program plan for STEM-Connect, to determine whether the program expanded and improved CEMS’s ability to deliver education and career training programs in STEM-related fields, and to determine the extent to which outcomes specified by the program were realized by the target population.

To achieve these purposes, the evaluation included both an Implementation Study and an Outcomes/Impact Study. The Implementation Study was guided by the program logic model (see Appendix 1) and included several sources of qualitative data to inform its findings. The Outcomes/Impact Study included collection of descriptive information and a comparison of STEM-Connect certificate-enrollees (referred to as participants throughout this report) with students who engaged in a TAACCCT-funded course as part of their regular university program without enrolling in STEM-Connect.
Research questions that the study was designed to answer included:

1. How was the particular curriculum selected, used, or created?
2. How were programs and program design improved or expanded using grant funds? What delivery methods were offered? What was the program administrative structure? What support services and other services were offered?
3. Did the grantees conduct an in-depth assessment of participant’s abilities, skills and interests to select participants into the grant program? What assessment tools and process were used? Who conducted the assessment? How were the assessment results used? Were the assessment results useful in determining the appropriate program and course sequence for participants? Was career guidance provided and if so, through what methods?
4. What contributions did each of the partners (employers, workforce system, other training providers and educators, philanthropic organizations, and others as applicable) make to the design and delivery of the program?

Implementation Study

The Implementation Study was guided by the logic model in identifying partners, strategies, outcomes and measures and the flow of activities that provided a timeline for formative reporting and data collection. Implementation data included interviews with program leadership, staff, partners, and participants as well as meeting observations, review of program and University documents including program communications, marketing and recruitment material, course materials, certificate proposals used for university academic program approval, job maps, internal reports and quarterly and annual reports by the program to funders. For the purpose of the implementation study, capacity was defined as the “emergent combination of individual competencies, collective capabilities, assets and relationships that enables an organization or other system to accomplish a purpose and create value.” The measurement of capacity building included the products of the program (stackable certificates, marketing and publicity materials), the numbers of participants enrolling in the certificate programs, participant satisfaction with the program, relationships and services put into place, and the perception of key stakeholders of the extent to which capacity had been achieved and the prospects for sustainability.

Outcomes/Impact Study

The Outcomes/Impact Study was guided by an overall purpose to determine whether the program achieved its expected participant outcomes. The overall design of the outcomes/impact study was a mixed-methods, non-experimental, qualitative and quantitative approach to the research/evaluation questions. Results are reported at two levels.

Specific level 1 outcome questions were designed to answer the question stem “How many…” enrollments, completions, retentions, obtaining course credit, credentials, higher education enrollment (post completion), employment, and wages.

Specific level 2 impact questions were:
1. To what extent are the participants and non-enrolled (comparison group) different with respect to the background variables of gender, parents’ level of education, age, and financial need (Bias testing question)?
2. To what extent does the STEM-Connect program result in higher wages?
3. To what extent does the STEM-Connect program result in higher rates of employment?
4. To what extent does the STEM-Connect program result in higher grade point averages?
The level 2 impact evaluation utilized a matched-groups comparison wherein the intervention group, (the participants) was matched to a similar group of students who participated in STEM-Connect courses but did not enroll in the STEM-Connect program. Insufficient numbers of participants, particularly when disaggregated by certificate of enrollment and the demographic variables of age, dependents, veteran status, prior and education levels of parents caused the VDOL to suppress cells. The limitation of numbers of participants has prevented originally planned propensity score matching thus limiting any causal inferences from the data.

Data collection for the STEM-Connect participants was done by program staff in conjunction with the UVM registrar, UVM Office of Institutional Research, UVM Student Financial Services, and VDOL. All matching data was de-identified and consisted of the variables named above for demographic (enabling variables) and participation as well as participant outcomes. Data collection resulted in Excel spreadsheet records that were then transferred to an integrated SPSS data set suitable for statistical analysis. Data collected from university sources were reviewed by both the program data specialist and the evaluation team member designated for data checking. Discrepancies between program collected data and university system data were justified and corrected. Department of Labor data for the State of Vermont were subject to internal review and corrected for errors prior to submission to the program evaluation and the U.S. Department of Labor.

The outcomes measured for the study included counts of participants for each of the outcome variables specified by the Solicitation for Grant Applications (SGA) and enumerated in level 1, above. Additional outcomes for the Impact level 2 study included comparisons between participant and non-enrolled groups with respect to demographic variables, employment status, wages, employment and course grades earned.

**Implementation Findings**

**Building Institutional Capacity**

- The grant was used to build institutional capacity by developing leadership and new internal and external partnerships.
- This increased capacity includes new STEM Certificates, highly-involved faculty, twenty-two newly developed or enhanced courses, the delivery of course and support services, new collaborative relationships with UVM internal unit units and external partner organizations and increased public awareness of the University as a local resource for workforce training.

**Key Steps Taken**

Key steps taken to build capacity included:

- Developing recruitment strategies,
- Providing incentives for faculty to develop new certificates and courses,
- Submitting certificate proposals for approval through the University administration to the Faculty Senate,
- Testing courses and revising curriculum,
- Developing support services including off-site tutoring,
- Internship support,
◆ Prequalification of veterans’ benefits, and,
◆ Engaging partners in applying existing protocols for skill assessment.

Important Partnerships
◆ Important external partnerships were developed with VDOL, Vermont Army and Air Guards, Vermont HiTEC, the Vermont Student Assistance Corporation, and many recruitment partners, including Vermont Works for Women, Associates for Training and Development, Refugee and Immigrant Service Provider Network (RISPNet), Vermont Vocational Rehabilitation Services and Creative Workforce Solutions.
◆ Internally, new working relationships were established with the UVM’s Continuing and Distance Education Division (CDE) and Veterans Services.

Fidelity to Original Program Design
The original program design included an emphasis on workplace learning opportunities. This component was modified from a certificate requirement to an optional component. The reason for this change in the program design was that internships are an optional component of current engineering curricula at the University. UVM CEMS encourages workplace learning but recognizes that many of its non-traditional students were employed while in training. The original program design indicated that all certificates should be “stackable.” As implemented the program consisted of four certificates, one with five separate but related tracks based on foundational courses – a feature that allows for students to efficiently earn more than one certificate.

Operational Strengths
Operational strengths included the central role of strong program leadership by the Dean of the College of Engineering and Mathematical Sciences and the close working relationship with the program director. Support staff in the roles of recruiters, counselors and course designers were essential and provided coherence in management and implementation. A clear focus on the goal of the development of institutional capacity to create and offer workforce training certificates embedded in the College’s curricular offerings and thus achieve sustainability was a key operational strength. Leadership supported the program’s steady development and implementation of the certificates in order to demonstrate the efficacy of the STEM-Connect design and establish a clear presence not only at UVM but throughout the state. In addition, the University of Vermont is the ‘flagship institution’ for the State of Vermont. As such, the University has the depth of academic knowledge and resources, Research I status, and visibility not found in other state institutions.

Operational Challenges
Implementing a unique program devoted to the development of ‘stand-alone’ certificates outside the degree granting system and its reward structure (even though they were designed to fit within the degrees) is by nature challenging. In this case the program had to educate other parts of the University about the program’s benefits and constraints. Operationally, the program often had to create administrative systems that paralleled those designed for degree students, or arrange for UVM’s administrative and operational units to work outside of their normal processes. There were also challenges associated with working with the target population. UVM is better positioned to prepare individuals for entry into higher levels, and help those who need to update or hone existing
job skills. UVM is not well positioned to support those who are not prepared for rigorous academics. And, as often happens in programs that must ramp-up quickly, there were examples where communication was lacking. UVM is a decentralized environment in which units share and manage information in unique ways.

**Outcomes/Impact Findings**

**Level 1**

Key outcomes of the program included the performance of participants on the nine (9) outcomes articulated in the SGA. These outcomes are summarized in Table 1.

**Table 1: Key Outcomes**

<table>
<thead>
<tr>
<th>Outcome Measure</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Unique Participants Enrolled</td>
<td>311</td>
</tr>
<tr>
<td>Total Number of Participants Completing a TAACCCT-Funded Program of Study</td>
<td>75</td>
</tr>
<tr>
<td>Total Number of Participants Still Retained in Their Program of Study or Other TAACCCT-Funded Program</td>
<td>221</td>
</tr>
<tr>
<td>Total Number of Participants Completing a TAACCCT-Funded Program of Study</td>
<td>75</td>
</tr>
<tr>
<td>Total Number of Participants Still Retained in Their Program of Study or Other TAACCCT-Funded Program</td>
<td>221</td>
</tr>
<tr>
<td>Total Number of Participants Earning Credit Hours</td>
<td>294</td>
</tr>
<tr>
<td>Total Number of Participants Earning Credentials</td>
<td>75</td>
</tr>
<tr>
<td>Total Number of Participants Enrolled in Further Education</td>
<td>0</td>
</tr>
<tr>
<td>Total Number of Participants Employed After TAACCCT-funded Program of Study Completion</td>
<td>10</td>
</tr>
<tr>
<td>Total Number of Participants Retained in Employment After Program of Study Completion</td>
<td>2</td>
</tr>
<tr>
<td>Total Number of Those Participants Employed at Enrollment Who Received a Wage Increase Post-Enrollment</td>
<td>48</td>
</tr>
</tbody>
</table>

◆ Seventy-five of the 311 enrolled participants successfully completed their programs of study. All 75 were undergraduate students.

◆ As of June 30, 2017, the end of the program period, 42 of the 221 participants still engaged in the program had only one course remaining to complete the certificate program in which they were enrolled. These 42 individuals may well complete the program within the first year following the funding period, bringing the total number of participants completing a TAACCCT-funded program of study to 117.

◆ Undergraduates completing certificates tended to view the programs as providing a distinctive competitive advantage, including increased knowledge and skill development relevant to the job market. Those currently enrolled, either as non-degree students or graduate students additionally viewed the certificates as supporting career change, “right-sized” for those who were not seeking a degree, and useful for providing credentials for further education.
Level 2

- The participant and non-enrolled samples were not significantly different on any of the background characteristics related to the outcomes as measured.
- Non-enrolled students out-performed participants with respect to wages earned in a typical quarter.
- There was no difference between participants and non-enrolled students with respect to employment status during the program.
- Participants outperformed non-enrolled students with respect to grade point average earned during the program.

Limitations

Both Implementation and Outcomes/Impact studies were subject to several limitations related to the characteristics of the data and program design. These limitations included:

- The primary limitation of the evaluation of the implementation is that it is based in self-report. Self-report is valuable for understanding the experiences and viewpoints of those involved with implementing this program, but are inherently limited in perspective. Care was taken to interview a full range of stakeholders across the years of the project, and incorporate multiple perspectives in the evaluation reporting.
- The primary limitation of the outcome/impact evaluation is the challenge of the small size of the state’s population (626,000) and the resulting applicant pools, sample sizes and the existence of an appropriate control group.
- Another factor that affected the outcome/impact analysis is missing data from student records in both the participant and matched groups.
- In order to track outcome and background data from student records (some of which were a self-report questionnaire) the program relied upon participant and other student permission to release the social security numbers to the Department of Labor and complete the questionnaire. Approximately ten percent of these groups declined to supply social security numbers to the program. Approximately forty-three percent of participants failed to complete the data questionnaire.

Key Lessons Learned

- In a primarily undergraduate research university whose stated mission is not directly aligned with typical strategies employed by other TAACCCT grantees for adult, displaced workers, the program required a different approach. Its approach, to create certificates that had something to offer to both traditional and non-traditional students, heightened benefits for both groups.
- Significant time is required to implement a new program like STEM-Connect. New relationships often require a long time for meaningful collaboration to emerge, particularly when trying to reach new audiences and change perceptions. It will likely take a while for
the program benefits to fully surface and flourish and it is important to recognize the value of planting seeds and creating a strong and meaningful foundation.

For workforce development, UVM is better positioned to prepare individual for entry into higher levels, and help those who need to update or hone existing job skills. The career maps accompanying the certificate descriptions in Appendix 2 illustrate a need for workforce development at the level that STEM-Connect provides. As a result of STEM-Connect, UVM is in a better position to prepare individuals for entry into higher levels of the workforce, and help those who need to update or hone existing job skills. Combined, the new certificates, new courses which incorporate more engaging instructional approaches, new relationships with those focused on workforce development, and new approaches to marketing are evidence of UVM CEMS’ increased capacity and newfound commitment to serving needs in the local community and beyond.

It is extremely difficult to overcome significant barriers for non-degree students in the University setting. The cost of tuition is a significant barrier to participation in this program and efforts by STEM-Connect to address this barrier, such as working to achieve prequalification of some certificates for veterans’ education benefits through the Veteran’s Administration and working with a partner that was able to provide limited scholarships could not fully remove this barrier – one that must be addressed in the future. UVM is not always perceived as a friendly campus for non-traditional students. While this is not fully understood, possible reasons include unfamiliarity with bureaucratic processes or online course platforms, lack of academic preparation, or time constraints. There are unique challenges for serving the veteran and National Guard populations. Guard members are deployable and often hesitant to commit to this type of program. In addition, funding from the Veterans Administration generally doesn’t cover all the costs of certificate programs.

**Implications for Future Research**

Future research suggested by the STEM-Connect experiment in building institutional capacity and creating partnerships at the university level should involve the interpretation of Department of Labor specified participant outcomes on a time scale appropriate for the four-year degree. Lengthening the expected time period from three to six years would place the evaluation on a time scale appropriate to graduates’ ability to enter the job market. Likewise, the measure of wage/salary outcomes should reflect the time period for market entry that is realistic for the four-year participant enrollment.

Institutional change study designs (implementation) should engage four-year institutions in identifying what changes the institutions are committed to making and articulate the evaluation/research design on a time frame appropriate to the pace of change which is normal and reasonable for four-year institutions. In other words, for the Department of Labor or similar sponsors to facilitate growth and change in university contributions to the economy through workforce development, solicitation offerings should accommodate a time scale and institutional change strategy that fit the context of university development.
Introduction

STEM-Connect at the University of Vermont (UVM)’s College of Engineering and Mathematical Sciences (CEMS) is a four-year Trade Adjustment Assistance Community College and Career Training (TAACCCT) program designed to create certificates that provide clear and flexible pathways to employment in STEM-related fields needed in the Vermont economy. The program was designed to respond to the needs of both traditional and non-traditional student populations, especially those who were Trade Adjustment Assistance (TAA) eligible, veterans, dislocated workers, adults, underemployed or unemployed and those new to the STEM fields. The program sought to build the University’s capacity to respond to rapidly changing technology related fields and to develop partnerships between the University and Vermont’s business and industry.

Program Description and Activities

The program consisted of components that were built around stacked and latticed credentials (eight certificate tracks), enhanced, or newly developed traditional and on-line coursework in four academic areas, placement in workplace learning opportunities, recruitment, and student services. Certificate credentials included: Computer Software Certificates in Software Development, Web Development, Cybersecurity, Master’s Preparation and Self Design; Computer-Aided Engineering Technology, Complex Systems (master’s level), and Pre-Actuarial (Actuarial Science).

Program Model

Goals

The primary goal of the STEM-Connect program was to construct and test a model for STEM-related certificates at UVM that could be earned in two years or less, that would enhance academic offerings in STEM-related fields, and provide a vehicle for attracting and retaining both traditional and non-traditional students. In addition to providing opportunities for non-degree students, the program sought to accelerate the productivity of students enrolled in traditional degree programs by offering expanded Workplace Learning Opportunities (WLOs) and the opportunity to obtain credentials in less than two years along the traditional four-year educational pathway. A secondary goal was to broaden and deepen the University’s outreach and partnerships with Vermont business and industry and state government in ways that would contribute to the economic well-being of the state and its citizenry.

Delivery

The delivery of the program consisted of regular credit-bearing academic course work, the mainstay of the university’s delivery for degree programs, adapted for the narrower-scope certificates. Delivery also included the on-line course work and mentoring that better enabled participants who were non-traditional students to experience and master the content of STEM-related curricula in the above mentioned credential areas. Internships were coordinated through a statewide partner with direct access to Vermont industry (Vermont-HiTEC). Participant support
services consisted of the base support provided through University financial aid offices, counseling and career development at UVM. In addition, the program provided enhanced recruitment, counseling, tutoring and academic advising for participants who were non-traditional students in partnership with the University’s Division of Continuing and Distance Education (CDE).

**Content**

The academic and job-related content of the program consisted of five areas of computer software, computer aided engineering technology, complex systems, and actuarial science. The certificates were designed within the eight areas so that participants could enroll in courses for one certificate or track and use some of those courses for a second or third certificate or track or as part of a degree program. This is what is meant by stackable and latticed. Detailed descriptions of the certificates are included in Appendix 2.

**Development with Partners**

Course and certificate content were products of an iterative process which began when the program proposal was planned during the year prior to funding.

Figure 1 below shows the certificate launch dates, reflecting this iterative process as certificate programs were approved and begun.

![Figure 1: STEM-Connect timeline for certificate launch dates](image)

Building something new required STEM-Connect leaders to reach out and form new relationships with local businesses, area non-profit organizations that serve the TAACCCT program’s target population, and the VDOL. Additionally, the common goal of serving non-traditional students catalyzed increased communication and coordination between CEMS and service units within the university. Building new relationships with a strong network of partners, defined here as organizations and entities with overlapping missions both within and external to UVM, was foundational for the program. Internal partners included the College of Engineering and Mathematical Sciences (CEMS), Continuing and Distance Education (CDE), Veterans Services, Career Center, Registrars’ Office, and Institutional Research. External partners include VDOL, Community College of Vermont (CCV), Vermont Student Assistance, National Guard (Air and Army Guard), Vocational Rehabilitation, Vermont HiTEC (a non-profit workforce development organization), and community organizations such as Creative Workforce Solutions and Refugee
Resettlement Program/RISPNet. Interactions among these partners have brought new connections and therefore new avenues to connect with and support target populations and the business community.

Figure 2 below indicates the partner development process spanning the life of the program.

**Figure 2:** STEM-Connect timeline for building relationships to support participant engagement

**Recruitment and Marketing**

In the summer of 2014, still early in its implementation, the program took important steps toward enrolling participants and supporting them through completion of the certificate programs. In July of that year, the program hired an individual dedicated to employer outreach and participant recruiting. This individual developed a “dashboard” for tracking participant recruitment and the program began devoting time and resources to a participant recruitment plan which included coordinated, multi-media advertising, direct outreach activities by program staff, and agreements with partners to identify and connect with target populations.

These plans resulted in a steep ramp-up phase of recruitment marketing by summer 2015. This included an online presence for the certificate programs, local television (Vermont Public Television, WCAX), radio (WOKO, Vermont Public Radio), newspaper (Seven Days) advertising, bus signs, posters, and other printed materials. Online advertisements were placed on Hulu, Pandora Radio, Google Ads, and Monster.com. The certificate programs were also featured on the CEMS Facebook and Twitter feeds.

During 2015-16, the program deployed additional resources for recruitment. A staff member was added to focus on external recruitment so that the existing recruiter could concentrate on recruitments from within the UVM student population. Partnerships were also crucial for recruitment.

Program leaders worked directly with military and veteran partners at the Air and Army Guards and UVM’s Veterans Services office to develop engaging and relevant promotional materials for veterans and have presented to military audiences about the certificate where staff trained to answer questions and connected potential participants with faculty advisors and/or the program’s participant recruiter. CDE staff also tracked inquires and conversion (to enrollment) rates, sharing data with the program marketing team. The timeline below indicates the staffing and marketing activities as they unfolded.
In May 2016, Vermont HiTEC became a new recruitment partner. In addition to providing an onsite person to coordinate with program staff and develop a new data management system, Vermont HiTEC representatives worked with the program’s external recruiter to reach out to local businesses and organizations, including the Air and Army Guard. New recruitment materials were designed and began being distributed regularly to external recruitment partners.

Figure 3 shows the building of capacity to support participant recruitment during the program period.

![Figure 3: STEM-Connect timeline for building capacity and relationships to support marketing](image)

Figure 4 indicates the numbers of participants who were recruited and later completed the certificates in which they were enrolled. Note that enrollments could begin only after new certificate programs were formally approved by the university.

![Figure 4: STEM-Connect enrollment timeline](image)
Participant Characteristics

As the certificate programs were developed, they proved to be an attractive option for undergraduate students earning four-year degrees. Of the 311 participants, 265 (85%) were undergraduate students and 46 (15%) were either non-degree or graduate students.

One hundred and seventy-eight of the program’s three hundred and eleven participants (57%) completed an on-line survey describing their employment and family background, how they heard about the program, and what they hoped to achieve by enrolling in a certificate program (See Appendix 3). The following composite portrait of a typical participant is drawn from responses to the survey, along with demographic characteristics and enrollment data provided by the program.

Portrait of Typical STEM-Connect Certificate Participant

The typical participant is a male traditional undergraduate student who learned about the certificate program through direct contact from one of STEM-Connect’s recruiters – either by email, a class visit, or other informational meeting. He has a GPA greater than 2.87. As a full time student, he is most likely not employed, or if employed, is engaged part-time in conventional student employment, as for example a resident advisor, or research assistant. Already with some formal education in a STEM field, he has enrolled in a computer software certificate, focusing on web design, or preparation for a graduate degree, or in some aspect of computer software development. He is motivated to work toward the certificate by the overlapping aspirations of personal enrichment, improved skills and the potential for a better job. At least one of his parents has achieved a bachelor’s degree or beyond. As a typical undergraduate, he has no one dependent on him for care.

To complete the participant picture, it is important to take into account, however, participants in certificates in pre-actuarial science, complex systems and computer-aided engineering design. Also, sizable portions of women, non-degree students and older, non-traditional students, many working in full-time jobs, complete the participant picture.
Participant Demographics

Table 2 below presents STEM-Connect participants’ demographic information.

The data are consistent with the typical student described above – a traditional undergraduate enrolled in CEMS. It should be noted that the lack of TAA-eligible participants is consistent with the State of Vermont’s demographics. According to information provided by VDOL, there were only 199 TAA-eligible individuals recorded in VDOL’s database for the period from October 1, 2014 to June 30, 2017.

**Table 2: Participant Demographic Characteristics**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Enrolled Count</th>
<th>Percent of Enrollments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>81</td>
<td>26.0%</td>
</tr>
<tr>
<td>Male</td>
<td>230</td>
<td>74.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Traditional (&lt;=24) /Non-traditional Age</th>
<th>Enrolled Count</th>
<th>Percent of Enrollments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Traditional</td>
<td>46</td>
<td>14.8%</td>
</tr>
<tr>
<td>Traditional</td>
<td>265</td>
<td>85.2%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GPA</th>
<th>Enrolled Count</th>
<th>Percent of Enrollments</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;= 2.87 (mean GPA)</td>
<td>197</td>
<td>63.3%</td>
</tr>
<tr>
<td>&lt; 2.87</td>
<td>100</td>
<td>32.2%</td>
</tr>
<tr>
<td>No data</td>
<td>14</td>
<td>4.5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>Enrolled Count</th>
<th>Percent of Enrollments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hispanic/Latino</td>
<td>28</td>
<td>9.0%</td>
</tr>
<tr>
<td>Asian</td>
<td>13</td>
<td>4.2%</td>
</tr>
<tr>
<td>Black or African American</td>
<td>13</td>
<td>4.2%</td>
</tr>
<tr>
<td>White</td>
<td>200</td>
<td>64%</td>
</tr>
<tr>
<td>No data</td>
<td>50</td>
<td>16%</td>
</tr>
<tr>
<td>More Than One Race</td>
<td>7</td>
<td>2.3%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other</th>
<th>Enrolled Count</th>
<th>Percent of Enrollments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Veteran</td>
<td>14</td>
<td>4.5%</td>
</tr>
<tr>
<td>Person with Disability</td>
<td>14</td>
<td>4.5%</td>
</tr>
<tr>
<td>TAA eligible</td>
<td>0</td>
<td>0%</td>
</tr>
</tbody>
</table>
Tables 3, 4, and 5 present the participant population, compared to the portion of participants who completed the online survey with respect to the certificate in which they enrolled, enrollment type, and certificate completion status. While we cannot be certain that the survey responders are representative of the total population, the tables indicates that the responders closely mirror the overall population with respect to these characteristics.

**Table 3: Participants by Certificate**

<table>
<thead>
<tr>
<th>Certificate/Track</th>
<th>Enrolled Count</th>
<th>Percent of Enrollments</th>
<th>Survey Responder Count</th>
<th>Percent of Responders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actuarial Science</td>
<td>18</td>
<td>6%</td>
<td>12</td>
<td>7%</td>
</tr>
<tr>
<td>Computer Aided Engineering Design</td>
<td>10</td>
<td>3%</td>
<td>1</td>
<td>1%</td>
</tr>
<tr>
<td>Complex Systems</td>
<td>12</td>
<td>4%</td>
<td>10</td>
<td>6%</td>
</tr>
<tr>
<td>Computer Software (CS) - Master’s Preparation</td>
<td>43</td>
<td>14%</td>
<td>27</td>
<td>15%</td>
</tr>
<tr>
<td>CS - Self Designed</td>
<td>4</td>
<td>1%</td>
<td>2</td>
<td>1%</td>
</tr>
<tr>
<td>CS - Software Development</td>
<td>71</td>
<td>23%</td>
<td>29</td>
<td>16%</td>
</tr>
<tr>
<td>CS - Web Development</td>
<td>128</td>
<td>41%</td>
<td>80</td>
<td>45%</td>
</tr>
<tr>
<td>CS - Cybersecurity</td>
<td>25</td>
<td>8%</td>
<td>17</td>
<td>10%</td>
</tr>
<tr>
<td>Total</td>
<td>311</td>
<td></td>
<td>178</td>
<td></td>
</tr>
</tbody>
</table>

**Table 4: Participants by Enrollment Type**

<table>
<thead>
<tr>
<th>Enrollment Type</th>
<th>Enrolled Count</th>
<th>Percent of Enrollments</th>
<th>Survey Responder Count</th>
<th>Percent of Responders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-degree Student</td>
<td>36</td>
<td>12%</td>
<td>25</td>
<td>14%</td>
</tr>
<tr>
<td>Graduate Student</td>
<td>10</td>
<td>3%</td>
<td>9</td>
<td>5%</td>
</tr>
<tr>
<td>Undergraduate Student</td>
<td>265</td>
<td>85%</td>
<td>144</td>
<td>81%</td>
</tr>
<tr>
<td>Total</td>
<td>311</td>
<td></td>
<td>178</td>
<td></td>
</tr>
</tbody>
</table>
Table 5: Participants by Completion Status

<table>
<thead>
<tr>
<th>Completion Status</th>
<th>Enrolled Count</th>
<th>Percent of Enrollments</th>
<th>Survey Responder Count</th>
<th>Percent of Responders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completed Certificate</td>
<td>75</td>
<td>24%</td>
<td>57</td>
<td>32%</td>
</tr>
<tr>
<td>Withdrew from Program</td>
<td>15</td>
<td>5%</td>
<td>12</td>
<td>7%</td>
</tr>
<tr>
<td>Did Not Meet Grade</td>
<td>26</td>
<td>8%</td>
<td>10</td>
<td>6%</td>
</tr>
<tr>
<td>Requirements</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Currently Enrolled</td>
<td>195</td>
<td>63%</td>
<td>99</td>
<td>56%</td>
</tr>
<tr>
<td>Total</td>
<td>311</td>
<td>100%</td>
<td>178</td>
<td>100%</td>
</tr>
</tbody>
</table>

Figures 5 and 6 below, present data from the participant online survey that show the parent level of education (a proxy indicator of Socio-Economic Status) and employment status of participants as they entered the program. These data are also consistent with the undergraduate status of most participants. Most come from homes where at least one parent has a bachelor’s degree or greater. And, most are working part-time, or unemployed and not seeking a change in their employment status.

**Figure 5:** Most participants have at least one parent with a bachelor’s degree.

**Figure 6:** Most participants were not seeking employment when they began.
**Evaluation Design**

The purpose of the STEM-Connect evaluation was to determine the extent to which the University of Vermont’s College of Engineering and Mathematical Sciences (CEMS) implemented the program plan for STEM-Connect, to determine whether the program expanded and improved CEMS's ability to deliver education and career training programs in STEM-related fields, and to determine the extent to which outcomes specified by the program were realized by the target population.

To achieve these purposes, the evaluation included both an implementation study and an outcome/impact study. The implementation study, described below, was guided by the program logic model and included several sources of data to inform its findings. The outcome/impact study included the collection of descriptive information and a comparison of STEM-Connect certificate participants with students that enrolled in a TAACCCT-funded course only as part of their regular university program without enrolling in STEM-Connect. Random assignment was not a viable alternative; the number of participants (311 in total; 75 completing their program of study) was not large enough to obtain appropriate levels of statistical significance.

**Implementation Study Design**

**Conceptual Framework**

The conceptual framework that guided the formulation of research/evaluation questions for the implementation study is expressed in the program Logic Model. The STEM-Connect theory of change in individual behavior involving the learning of new knowledge, skill and predisposition to act in ways that are consistent with employability and personal success is best expressed by the horizontal and vertical transfer models developed by Bruce Joyce and Beverly Showers (1983)\(^2\). The model described in the referenced training literature builds upon the developmental learning theories of John Dewey and Jean Piaget as articulated by David Ausubel\(^3\), requiring a sequential approach to learning that embeds:

- the rationale (theory) of the new knowledge or skill or behavior, with a demonstration of its use, initiates,
- practice of the essential elements followed by feedback to the student on his/her performance and concluding with,
- coaching to mastery of the knowledge, skill or new behavior.

The ‘scaffold’ upon which curriculum is built and student experience structured is a step by step sequence of direct student involvement in learning and constructing a personal reality. The program Logic Model describes the program process as a series of steps which move dynamically (vertically and horizontally) through Resources/Inputs, to Activities, to Outputs, Outcomes and Impacts. Evaluation measures are linked to each component of the logic model and sequenced to provide real time analysis and reporting of program development. Figure 7 below shows a simplified logic model, presented in more detail in Appendix 1.
For the purpose of the implementation study, capacity was defined as the “emergent combination of individual competencies, collective capabilities, assets and relationships that enables an organization or other system to accomplish a purpose and create value”\(^1\). Thus, the measurement of capacity building included the products of the program (stackable certificates, marketing and publicity materials), the numbers of participants enrolling in the certificate programs, participant satisfaction with the program, relationships and services put into place, and the perception of key stakeholders of the extent to which capacity had been achieved and the prospects for sustainability.

**Figure 7**: Logic model summary
Implementation Analysis Research Questions

The solicitation-specified research questions provided the foundation for the implementation analysis, which is organized around the following framework of inquiry:

1. How and to what extent did STEM-Connect build institutional capacity?
2. What key steps did STEM-Connect take to implement the program?
3. To what extent and how were important partnerships formed?
4. What modifications to the original program design were made to accommodate new or unanticipated situations?
5. What were the program’s operational strengths and challenges?

Implementation Data Analysis Strategies

The implementation study used a phenomenological approach to focus analysis. Strategies included interviews, documents analysis and consultations with program staff designed to check the alignment of the components implemented and resources allocated with those proposed. Formative evaluation was communicated to program management both informally and formally with recommendations to improve program design and implementation. Summative evaluation focused on descriptive analysis of the process of implementation and assessed operational strengths and challenges.

Implementation Data Collection

Sources of data for both formative and summative analysis included meeting observations, review of program and University documents including program communications, marketing and recruitment material, course materials, certificate proposals used for university academic program approval, job maps, internal reports and quarterly and annual program reports to funders.
In addition, interviews were conducted according to the following schedule:

Table 6: Interview Schedule Years 2-4

<table>
<thead>
<tr>
<th>Grant Year</th>
<th>Type of Interviewee</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year 2 (2015)</td>
<td>Program Leaders, Staff, &amp; Consultants</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Program Partners</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Course Instructors</td>
<td>5</td>
</tr>
<tr>
<td>Year 3 (2016)</td>
<td>Program Leaders, Staff, &amp; Consultants</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Program Partners</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Course Instructors</td>
<td>7</td>
</tr>
<tr>
<td>Year 4 (2017)</td>
<td>Program Leaders, Staff, &amp; Consultants</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Program Partners</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Course Instructors</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Current and Completed Participants</td>
<td>24</td>
</tr>
</tbody>
</table>

In Year 2, evaluators began semi-structured interviews with program leadership and administration, instructors, course developers, individuals providing technical assistance for online instruction, and those responsible for participant advising, internship coordination, employer outreach, participant outreach, and marketing. Additional interviews were conducted with Community College of Vermont and Vermont Student Assistance Corporation partners.

During Year 3, evaluators completed additional semi-structured interviews. The majority of these interviews were with University of Vermont faculty and staff, including program leadership and administration, course instructors, course and certificate developers, and those responsible for participant enrollment and advising, internship coordination, employer outreach, participant outreach, and marketing. Additional interviews were conducted with Vermont Student Assistance Corporation, Vermont HiTEC and VDOL partners.

During Year 4 evaluators completed 35 semi-structured interviews. These included a series of group interviews with program leadership and key staff focusing on research questions delineated in the SGA, and individual interviews with program staff responsible for marketing, recruitment, and data management, a course instructor, and partners including Veterans’ Services, CDE, Vermont HiTEC, and VDOL, as well as 24 interviews with participants.

The above data sources as well as extensive conversations with program management form evidence for the implementation findings.

**Outcomes/Impact Study Design**

**Goals of the Outcome/Impact Evaluation**

The goal of the outcome/impact evaluation was to determine whether the program achieved its expected participant outcomes as detailed below in Table 7 including number of enrollments,
completions, retentions, obtained credit hours, credentials, higher education enrollment (post completion), employment, and wages.

Table 7: STEM-Connect Expected Participant Outcomes

<table>
<thead>
<tr>
<th>Outcome Measure</th>
<th>Annual Targets for all Participants</th>
<th>Totals</th>
</tr>
</thead>
</table>
| 1 Total Unique Participants Enrolled | Year 1: 30  
                     | Year 2: 50  
                     | Year 3: 70  | 150 |
| 2 Total Number of Participants Completing a TAACCCT-Funded Program of Study | Year 1: 0  
                     | Year 2: 50  
                     | Year 3: 85  | 135 |
| 3 Total Number of Participants Still Retained in Their Program of Study or Other TAACCCT-Funded Program | Year 1: 2  
                     | Year 2: 2  
                     | Year 3: 3  | 7 |
| 4 Total Number of Participants Completing Credit Hours | Year 1: 30  
                     | Year 2: 46  
                     | Year 3: 70  | 146 |
| 5 Total Number of Participants Earning Credentials | Year 1: 0  
                     | Year 2: 50  
                     | Year 3: 85  | 135 |
| 6 Total Number of Participants Enrolled in Further Education | Year 1: 0  
                     | Year 2: 0  
                     | Year 3: 24  | 24 |
| 7 Total Number of Participants Employed After TAACCCT-funded Program of Study Completion | Year 1: 0  
                     | Year 2: 50  
                     | Year 3: 66  | 116 |
| 8 Total Number of Participants Retained in Employment After Program of Study Completion | Year 1: 0  
                     | Year 2: 50  
                     | Year 3: 66  | 116 |
| 9 Total Number of Those Participants Employed at Enrollment Who Received a Wage Increase Post-Enrollment | Year 1: 0  
                     | Year 2: 5  
                     | Year 3: 10  | 15 |

Design of the Outcomes/Impact Evaluation

The design of the outcomes/impact analysis of the STEM-Connect program was a mixed-methods, non-experimental, qualitative and quantitative approach to the research/evaluation questions posed below. Vermont is a very small state with respect to its population and labor market. Opportunities to populate training programs to enable comparisons of groups formed by intervention type and level are limited. The numbers of participants that were enrolled in the program necessitated limiting the comparisons to univariate analysis of outcomes for each of the intervention and control groups. The intervention group, referred to throughout the evaluation as participants, was matched to a similar group of students who participated in STEM-Connect courses but did not enroll in the STEM-Connect program. The matching of these groups enabled
group comparisons between STEM-Connect and other UVM participants on the above outcomes to determine the extent to which outcomes obtained by participants exceed those of a similar (demographic) statewide population. In addition, cohorts of STEM-Connect participants at Years 1-3 were followed longitudinally with a pre and post “slope greater than zero” basis. In particular, those program outcomes noted below as “enabling outcomes” tracked in a time series design with statistics appropriate to matched pair comparisons, both parametric and non-parametric as appropriate to the level of measurement. Other outcomes are reported as descriptive data and compared with Vermont population samples as benchmarks.

Level 1

The Outcome/Impact Study began with the collection and analysis of descriptive data and focused on the question of the extent to which the program recruited and enrolled program participants who met program requirements.

It also includes content analysis of interviews conducted with a sample of participants to assess participant perception of the program’s actual or anticipated effect on employment and earnings.

Level 2

A matched-groups comparison of the STEM-Connect participants (intervention) and a control group was employed to estimate the contribution that the program made to the nine outcomes above.

The specifications of the matched-group evaluation design were as follows:

Source and size of the comparison group: Students who enrolled for courses required for the STEM-Connect certificates but who did not enroll in any of the certificates constituted the comparison group. The number of these students available for comparison when the program ended was 2088.

Sample selection and matching: Enrolled students were matched with the above comparison group and the results of matching were assessed for comparability on age, gender, family background and financial aid eligibility.

Outcomes/Impact Data Collection

Data collection for the STEM-Connect participants was done by program staff in conjunction with the UVM registrar, UVM Office of Institutional Studies, UVM Student Financial Services, and VDOL. All matching data was de-identified and consisted of the variables named above for demographic (enabling variables) and participation as well as participant outcomes. Data collection resulted in Excel spreadsheet records that were then transferred to an integrated SPSS data set suitable for statistical analysis. Data collected from the university registrar were reviewed by both the program data specialist and the evaluation team member designated for data checking. Discrepancies between program collected data and university system data were justified and corrected. Department of Labor data for the State of Vermont were subject to internal review and corrected for errors prior to submission to the program evaluation and the U.S. Department of Labor.
Outcomes/Impact Analysis Research Questions

The principal outcomes analysis questions are designed to evaluate whether the program achieved the expected outcomes described in Table 8. Thus, the descriptive section of the Outcomes/Impact study includes nine Level 1, descriptive questions focusing on these outcomes. These outcome measures were applied to the general question stem: How many (e.g., total unique participants were served)? Thus nine research/evaluation questions resulted.

Table 8: Outcome measures

<table>
<thead>
<tr>
<th>Outcome Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Unique Participants Enrolled</td>
</tr>
<tr>
<td>Total Number of Enrollees Completing a TAACCCT-Funded Program of Study</td>
</tr>
<tr>
<td>Total Number of Enrollees Still Retained in Their Program of Study or Other TAACCCT-Funded Program</td>
</tr>
<tr>
<td>Total Number of Enrollees Earning Credit Hours</td>
</tr>
<tr>
<td>Total Number of Enrollees Earning Credentials</td>
</tr>
<tr>
<td>Total Number of Participants Enrolled in Further Education</td>
</tr>
<tr>
<td>Total Number of Enrollees Employed After TAACCCT-funded Program of Study Completion</td>
</tr>
<tr>
<td>Total Number of Enrollees Retained in Employment After Program of Study Completion</td>
</tr>
<tr>
<td>Total Number of Those Enrollees Employed at Enrollment Who Received a Wage Increase Post-Enrollment</td>
</tr>
</tbody>
</table>

The analysis looks at totals for the entire program period, without taking into account annual targets. It was expected that annual targets would be adjusted as the program timetable evolved over the program period.

In addition to the Department of Labor-specified program outcomes, the evaluators identified several enabling outcomes that served as dependent variables for the outcome evaluation to determine the potential effects of enrollment in the STEM Connect program. These outcomes are reported in the discussion of Level 2. Level 2 research/evaluation questions for these variables respond to the generalized question stem: “What was the difference in performance between enrolled and non-enrolled students for the period under review with respect to;” (e.g. wages earned, employment status, grades in courses, etc.). Level 2 questions included the following:

1. To what extent are the enrolled and non-enrolled (comparison group) different with respect to the background variables of gender, parents’ level of education, age, and financial need (Bias testing question)?
2. To what extent does the STEM Connect program result in higher wages being earned relative to the comparison group?
3. To what extent does the STEM Connect program result in higher rates of employment relative to the comparison group?
4. To what extent does the STEM Connect program result in higher grade point averages relative to the comparison group?
Outcomes Data Analysis

Outcome analysis of the program focused on a quantitative estimate of the extent to which outcomes identified above were obtained by the participants (Level 1) and the extent to which the impact of the program may be estimated by comparison with a matched group (Level 2). The major hypothesis for the evaluation at the first level identifies the target outcomes as being obtained on a “slope greater than zero” basis, positive values increasing over time, with the significance calculated on paired comparisons (parametric or non-parametric as appropriate). Probability thresholds were set at the traditional p<.05, when sufficient power was present to estimate the chance variation in performance.

Study Limitations

The primary limitation of the evaluation of the implementation is that it is based in self-report. Self-report is valuable for understanding the experiences and viewpoints of those involved with implementing this program, but is inherently limited in perspective. Care was taken to interview a full range of stakeholders across the years of the project, and incorporate multiple perspectives in the evaluation reporting. The implementation findings are thus specific to this project.

The primary limitation of the evaluation of the outcome/impact is the challenge of small size of the state’s population (626,000) and the resulting applicant pools, sample sizes and the existence of an appropriate control group. These limitations also provide a source of strength when describing the intervention and its outcomes. Vermont’s relatively homogeneous population with respect to race, income and education provides some advantage when selecting benchmarks from the general population. At the same time, little is actually known about the rates of acceptance into employment and trajectories of occupations in the technology sector which are the targets of the STEM-Connect program. Vermont TAACCCT projects share these issues with STEM educational programs funded by both the National Science Foundation and the Mathematics and Science Partnership programs of the U.S. Department of Education. Evaluations of these programs provide considerable internal validity and reliability but are challenged by the generalization of impact.

Control group data consisting of demographic and outcome variables from participants matched on age, parents’ education, gender and other demographic variables indicated above were obtained from UVM CEMS student files.

Other factors that affected the analysis include missing data from student records in both the participant and matched groups. With respect to the participant groups, the evaluation team worked with the administrative team to insure that complete data sets were obtained. With respect to the VDOL data on employment and wage related outcomes, the age and enrollment status of the primary participant population (undergraduates) limited the availability of the primary outcomes. For example, even though 2,205 participants and non-enrolled students appeared in VDOL data, only about 700 of these had wage-related data in any given quarter.

Another limitation was the fact that in order to track outcome and background data from student records (some of which were a self-report questionnaire) the program relied upon participant and student permission to release the social security numbers to the Department of Labor and complete the questionnaire. About ten percent of these groups declined to supply social security
numbers to the program. About forty-three percent of participants failed to complete the data questionnaire.

### Implementation Findings

**Introduction**

The following implementation findings are based on interviews with program staff, partners, and participants over the life of the STEM-Connect program, along with review of course and materials, other program products and documents and program communications. Following a brief consideration of how the findings respond to the four SGA-specified research questions, the findings are developed more fully and organized into the following five categories. Pages that are particularly pertinent to each research question are noted, although the questions interrelate in many ways throughout the five categories elaborated.

1. Building Institutional Capacity
2. Key Steps to Run the Program
3. Important Partnerships
4. Modifications from Original Program Design
5. Operational Strengths and Challenges

A final discussion section expands on four crosscutting themes that emerged from the implementation study: university setting, weaving new with existing structures, building relationships, and planting seeds.

**SGA-Designated Research Questions**

1. **How was the particular curriculum selected, used, or created?**

   The grantee designed and implemented a process of curriculum creation that included recruiting faculty to design the materials, consulting with external partners to inform the content of the materials and developing detailed proposals to institutionalize the curriculum by submitting the curriculum to a university wide review and approval process. (Pages 26-29)

2. **How were programs and program design improved or expanded using grant funds? What delivery methods were offered? What was the program administrative structure? What support services and other services were offered?**

   Programs and program designs were improved and expanded using the grant funds to employ faculty and online course development support in the design process and by
using grant funds to enlist partners in collaborative program development and recruitment of students. Delivery methods included regular courses, on-line courses, tutoring, and internships. (Pages 29-36)

3. Did the grantees conduct an in-depth assessment of participant’s abilities, skills and interests to select participants into the grant program? What assessment tools and process were used? Who conducted the assessment? How were the assessment results used? Were the assessment results useful in determining the appropriate program and course sequence for participants? Was career guidance provided and if so, through what methods?

The grantees did conduct in-depth assessments of participant’s abilities, skills and interests through recruitment and admissions processes for all undergraduates and through special services provided by partnerships with service units within the university and coordination with external partners. (Page 29).

4. What contributions did each of the partners (employers, workforce system, other training providers and educators, philanthropic organizations, and others as applicable) make to the design and delivery of the program?

Each of the partners made significant contributions to the design and delivery of the program by participating either voluntarily (Vermont Works for Women, Associates for Training and Development, Refugee and Immigrant Service Provider Network, Vermont Vocational Rehabilitation, Vermont Student Assistance Corporation, veterans counseling, Continuing and Distance Education) or under contract (Vermont HiTEC, and Vermont Department of Labor). Contributions included recruiting, marketing, program design, internship placements, counseling and tutoring. (Pages 32, 34, 35)
Building Institutional Capacity

STEM-Connect met its primary goal of building UVM CEMS’ capacity to respond rapidly to changing technology related fields and to develop partnerships with Vermont business, industry, and the Vermont Air and Army Guards.

Findings

UVM CEMS increased its capacity to meet workforce development needs by:

- Developing new STEM-focused academic certificates that benefit both traditional and non-traditional students.
- Creating four new courses and enhancing 18 existing courses (online and/or updated).
- Delivering courses and support services to both traditional and non-traditional students.
- Building new relationships with other organizations promoting workforce development in Vermont both to inform certificate development and reach out to adult learners, including those in the TAACCCT target populations.
- Through extensive marketing, increasing general public awareness of UVM as a local resource for workforce training.

New STEM-Focused Certificates

Based on input from Vermont businesses, the Vermont Air and Army Guards, and UVM faculty, STEM-Connect leaders completed the first work plan activities by designing four new STEM-focused certificates programs, one of which has five separate tracks, so that it is now possible for students to select from eight distinct new academic certifications. The rigorous certificate development and approval process at UVM includes reviews at multiple levels of the institution, including the Faculty Senate and the Board of Trustees. These processes, although they take many months to complete, help to ensure relevant, high quality content and instruction. Certificates in the following areas were developed and approved over the life of the grant:

1. Actuarial Science
2. Computer Aided Engineering Technology
3. Complex Systems
4. Computer Software (five tracks)
   (1) Master’s Preparation  (2) Self-Designed
   (3) Software Development  (4) Web Development
   (5) Cybersecurity

These certificates were built on the foundation of existing courses or course sequences, and designed so that participants can complete them in two years.

STEM-Connect Work Plan Activities

1. Identify and develop stackable certificates aligned with employer needs.
2. Develop courses to support stackable certificates.
3. Develop infrastructure to support workplace learning opportunities.
4. Perform outreach to recruit adult learner participants including TAA-Eligible workers, unemployed and underemployed individuals, and veterans.
5. Enroll, place, and mentor participants.
6. Deliver certificate education through classroom, online, and work-based learning.
7. Perform management oversight, grant reporting, monitoring, fiscal management and evaluation of outcomes (program administration).
or less. Building from existing sequences created buy-in from faculty who already understood the relevance of the content they teach to future employability, and were excited for the opportunity to redesign course offerings to now also reach non-traditional students. This approach also ensured that any new development would be integrated into existing structures within CEMS, thus making it more likely to sustain beyond the life of the grant. In fact, in interviews faculty describe themselves as “academic champions” for the certificates developed with grant funds. It appears that not only the new certificates, but also the process of certificate development will be sustained beyond the life of the grant. Successful collaboration between UVM CEMS faculty and the business community has led to discussion around development of additional certificates in the areas of biomedical, computer simulation, and computer fluid dynamics. STEM-Connect leadership also reports that other colleges at UVM are now expressing interest in developing their own certificate programs.

Each certificate is comprised of five three-credit courses. Most of the courses in these new certificates are available online. These certificates are stackable in the sense that their content is inter-related, and some of the individual courses count toward more than one certificate. The courses also count toward academic minors, majors, culminating in Bachelor of Science or Arts and/or Master of Science or Arts degrees. For non-traditional students, these certificates serve as stand-alone credentials they can use to increase their employment options. For traditional students, earning certificates as part of working toward a bachelor degree is useful in obtaining internships prior to graduation as well as a way to highlight specific skills upon graduation and entry into the labor force.

Creating New Courses and Enhancing Existing Courses

As shown in Table 9 on the following page, to address the second work plan activity, UVM CEMS leadership and faculty created four new courses and enhanced eighteen existing courses, thus increasing capacity to serve a broader range of students and workforce needs. New course development was necessary for the Cybersecurity Certificate because prior to the STEM-Connect grant, student access to cybersecurity content was limited to higher-level computer science courses or to students interested in research and development. From conversations with employers, and especially with the Vermont Air and Army Guards, the need for introductory, application-focused cybersecurity courses became evident. Grant funds were used to develop four new cybersecurity courses, all of which are available online. Two are non-technical introductory courses: Exploring Cybersecurity and Cybersecurity Law and Policy. The other two, Applied Cybersecurity I and II, are technical, and have a prerequisite of one basic programing course. These new courses are the foundation for a new cybersecurity curriculum that will eventually extend beyond the certificate. UVM CEMS has recently hired new faculty to support this development, and all courses are designed using guidelines from the National Security Agency with the goal of achieving certification as a National Security Agency Center of Academic Excellence in Cyber Defense.

Eighteen existing CEMS courses were made more broadly accessible through the grant, in terms of both format and instructional approach. Sixteen of these are now available online, and instructors reported that the process of developing their content for online options enhanced their on-campus offerings as well. Lecture and exam review videos are now available to students, whether they are in an online or in-person section of a course. Instructors received support from instructional designers and online courses were developed from the same basic course “shell” to
reduce time returning students need to become familiar with the online environment – something instructors report is particularly important for non-traditional students. Instructors also talked of how watching themselves on video inspired them to revise some of their lectures, edit videos to clarify explanations, or otherwise improve their instruction. One mentioned consensus among participating faculty that STEM-Connect made it possible for them to implement changes they had long been considering, but had previously not had the time to fully develop.

An example of change in instruction was in the Computer Organization course. Until last year, this core required course in the computer science department was a highly theoretical, lecture-based course that consistently received negative student course evaluations. One faculty member who has extensive experience with workforce development was asked to cover this course, and agreed to also redesign it. The new version, which was piloted in spring of 2017, explicitly connects theory and application using the Raspberry Pi (www.raspberrypi.org) as an instructional medium. Each student had use of one of these micro-computers, and approximately half of class time is now devoted to labs or projects which include writing and running assembly language programs. This shift in instructional approach was highly engaging for students, whose evaluations for this version of the course were positive. Some even requested to purchase the Raspberry Pis to continue development on their own. Beyond engaging students, this approach to instruction is also responsive to employer concerns that UVM undergraduates often enter the workforce unable to apply their theoretical understanding to solve actual workplace problems.

Table 9: Courses Developed or Enhanced through STEM-Connect

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>New</th>
<th>Enhanced</th>
<th>Online</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEMS 095/295</td>
<td>Interactive Design</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>CIS 096</td>
<td>Cybersecurity Law &amp; Policy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS 005</td>
<td>Cybersecurity: Intro &amp; Exploration</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>CS 008</td>
<td>Intro to Web Site Development</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>CS 008</td>
<td>Intro to Web Site Development</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS 021</td>
<td>Computer Programming: Python</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>CS 110</td>
<td>Intermediate Programming: Java</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS 121</td>
<td>Computer Organization</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>CS 142</td>
<td>Advanced Web Design</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>CS 148</td>
<td>Database Design for the Web</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>CS 195 (CS 166)</td>
<td>Applied Cybersecurity I (Cybersecurity Principles)</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>CS 195 (CS 167)</td>
<td>Applied Cybersecurity II (Cybersecurity Defense)</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>CSYS 266/MATH 266</td>
<td>Chaos, Fractals &amp; Dynamical Systems</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>CSYS 300/MATH 300</td>
<td>Principles of Complex Systems</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>CSYS 303/MATH 303</td>
<td>Complex Networks</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>EC 011</td>
<td>Principles of Macroeconomics</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>EC 012</td>
<td>Principles of Microeconomics</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>ENGR 002</td>
<td>Graphical Communication</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>ENGR 195</td>
<td>Fundamentals of Labview</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>MATH 183</td>
<td>Fundamentals of Financial Math</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>STAT 151</td>
<td>Applied Probability</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>STAT 183</td>
<td>Statistics for Business</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
Course Delivery and Support Services for Traditional and Non-Traditional Students

In addition to the new certificates, and new and enhanced courses, STEM-Connect offered program participants access to services above and beyond those offered to traditional on-campus students and for non-degree seeking students through CDE. Actions to fulfill the third, fifth, and sixth work plan activities include running the courses described above, and also establishment of a lending library, off-site tutoring, internship support, and prequalification of certificates for veteran’s education benefits through the Veteran’s Administration. Assessment of non-traditional student ability, skills, and interests was conducted by program partners VDOL, Vermont Student Assistance Corporation, and UVM’s CDE using their existing protocols. While this assessment was of some value to non-traditional students, most participants were UVM undergraduates who had undergone a rigorous application process prior to matriculating at the university, and for this group the program deemed that additional assessment prior to enrollment in the certificate programs was unnecessary.

**Lending Library:** Textbooks for many of the courses in the certificate programs are prohibitively expensive. To address this barrier to enrollment, STEM-Connect leadership established a lending library. Students who enrolled in a certificate program had free use of required textbooks for the duration of a course. For some students this was so valued that it became an incentive for enrollment in the certificates.

**Tutoring:** In addition to the tutoring generally available to all students enrolled in UVM courses, certificate course instructors shared stories of the extra efforts they made to connect especially with non-traditional students. In one example, a teaching assistant offered to meet a group of non-traditional participants all from one organization at or near their workplace. Several instructors talked of meeting with students through online formats rather than expecting students to come to traditional office hours.

**Internships and Career Counseling:** STEM-Connect staff and partners shared information with participants about available internships. Participants who were interested in applying or were accepted into internships were mentored by partner organization staff with expertise in workforce development. Staff and partner representatives integrated career counseling with their recruitment efforts, and continued to be available to participants who sought advice after enrollment in a certificate.

**Pre-Qualifying STEM-Connect Certificates with the Veterans Administration:** STEM-Connect staff worked with UVM’s Veterans Services Coordinator to prequalify the new certificates for education funding through the Veterans Administration. Generally such requests are not made until a veteran seeks to use benefits for a particular program. The process can be lengthy. Prequalifying allows veterans who wish to use benefits to cover the cost of enrollment in STEM-Connect certificates can now do so right away.
Building New Relationships

In addition to building external relationships for the purpose of creating relevant and responsive certificate programs, STEM-Connect formed new connections with VDOL, Vermont Army and Air Guards, and local non-profit organizations whose mission involves workforce development. Aligned with the fourth work plan activity, these new relationships helped the program recruit participants from TAA-eligible populations, unemployed and under-employed individuals, and veterans. Program leadership made initial connections with some of these organizations, and eventually other staff and consultants/partners extended the network of connections. Additionally, the common goal of serving non-traditional students catalyzed increased communication and coordination between CEMS and service units within the university, including Veterans Services as described in the section above. These partnerships will be discussed in more detail later in this report.

Marketing to Raise Awareness of UVM CEMS’s Role in Workforce Development

STEM-Connect invested heavily in marketing the new certificate programs to a wide audience, and in the process increased UVM CEMS’ capacity to raise awareness of its role in workforce development. Beginning in 2015, STEM-Connect initiated web and social media campaigns targeted at local, national, and international audiences. This was soon followed by advertising on local television and radio stations, in newspapers and on buses in communities near the UVM campus. Posters, flyers, and information sheets were designed, printed, and distributed to regional VDOL sites around Vermont, and delivered to partner organizations focused on recruiting participants. Marketing continued throughout the grant period, adjusted based on semester start dates and as new certificates were formally launched. Over time, staff involved in the marketing learned what was and was not effective. There is consensus among those interviewed that community members are much more aware of the certificate programs. Toward the end of the program, emphasis in the marketing efforts shifted toward engaging potential participants through social media – to build relationships around the CEMS’s brand. The idea of building relationships through marketing is now being applied to other UVM CEMS degree programs, and includes new flyers targeted at drawing undergraduates from other UVM colleges into the certificate programs. An unanticipated impact is that another UVM college has begun to run advertisements that mimic those run by STEM-Connect.

Key Steps to Run the Program

Findings

UVM CEMS proved to be a learning organization, able to adapt the program over time to meet employer and participant needs, comply with university policies, and meet grant requirements.

As outlined in the program timeline (Figure 8) STEM-Connect took key steps in the areas of staffing and partnerships to develop and market certificates and ultimately engage participants. Each year of the program presented new challenges and opportunities.
STEM-Connect’s leadership was and continues to be critical to the success and sustainability of the program. CEMS new Dean stepped into the role of Program Director after a personnel change within UVM between application and awarding of the grant. Under his leadership, a program manager was hired late in Year 1, and part of the existing CEMS communications director’s time was allocated to marketing the new certificate programs. Since UVM’s organizational structure distinguishes between degree seeking and non-degree seeking students, CEMS’s initial core partnership was with CDE. This university division traditionally creates programs and manages enrollment for non-degree students, and at this stage it was anticipated that most participants would be non-traditional students. In Year 1, STEM-Connect and CDE leadership clarified roles and responsibilities related to employer outreach, development of new certificates, marketing, and
participant recruitment and enrollment. Breaking with tradition, the key decision was made that CEMS would drive development of the certificate programs to meet workforce development needs, and take the lead for marketing and recruitment. As a result, CEMS, an academic unit, and CDE, a support unit, had to establish new ways of sharing information, linking web sites, designing online courses, and supporting participants. Leveraging these existing structures - an academic unit and a service unit within the university – in a new way was critical to the long-term sustainability of new development through STEM-Connect. It allowed CEMS faculty and staff to really “own” the new development and be more intentional about designing courses that combine academic rigor with responsiveness to workforce needs, thereby improving their capacity to serve both traditional and non-traditional students. The shift ultimately strengthened the connection between CEMS and organizations outside the academic community.

**Year 2 – New Partnerships and New Certificate Launches**

Recruiters served in Years 2 – 4 as key liaisons with the business community, area non-profits serving the under-and unemployed, VDOL, and the UVM undergraduate population. They also directly recruited participants into the program, mentoring them through the application and registration processes. Focus groups and individual meetings with employers were held in several regions of Vermont to gather input for new certificates and build relationships to support both participant recruitment and future internship opportunities.

For the TAACCCT target audience, representatives of agencies that work with the under- or unemployed report that UVM is often perceived as “unattainable.” Barriers include relatively high tuition and academic preparedness to succeed in rigorous academic settings. To address this challenge, the program manager established recruiting partnerships with local workforce development organizations including the Vermont Student Assistance Corporation, Vermont Works for Women, and Associates for Training and Development. Attempts were also made to work with Community College of Vermont to assess prospective enrollees’ prior learning and build a pipeline of students prepared to participate in the certificate programs. The program manager also reached out to the UVM Veterans Services Coordinator and the Vermont Army and Air Guards to develop engaging and relevant promotional materials for veterans, and presented to military audiences about certificate opportunities. These efforts to build relationships were supported by the extensive marketing effort to raise awareness of the new CEMS certificates, and have potential to serve as the foundation for long-term workforce development networks beyond the grant period.

In 2015, the first three certificates - in actuarial science, computer software, and complex systems - were formally launched. STEM-Connect leaders strategically chose to begin certificate development by enhancing pre-existing course sequences in these areas so they could be shepherded more quickly through UVM’s extensive design and review process. Approval for certificates that include new course development is more difficult. The process of establishing formal new certificates required substantial time and effort on the part of program leaders. Since university policy prohibits advertising for certificates prior to formal approval, it was important to prioritize those certificates that could be developed more quickly.
Year 3 – Focus on Recruitment

As progress on certificate development continued in Year 3, including formal launch of the cybersecurity track of the computer software certificate, primary focus shifted to participant recruitment. After a site visit from program officers in December 2015, the program definition of participant expanded to include both traditional and non-traditional students. STEM-Connect leadership responded by expanding recruitment to matriculated UVM students. The program recognized that it did not yet have adequate capacity to reach the TAACCCT target audience, so it formed a new partnership with Vermont HiTEC, a non-profit with extensive experience working with local businesses to recruit and train employees. As mentioned earlier, a textbook lending library was established to serve as a recruitment incentive and lower the cost of participation.

Year 4 – Full Implementation and Completion of Deliverables

In spring 2017, the final certificate – in computer-aided engineering technology – was formally launched, exceeding STEM-Connect’s commitment to develop at least five certificate programs. Focus on participant recruitment and support continued through June 2017. Rounding out the project’s outreach to local businesses, partner Vermont HiTEC conducted an employer survey to inform future CEMS program development. Year 4 also included winding down administrative activities necessary for grant management and reporting.
**Important Partnerships**

**Findings**

The common goal of serving non-traditional students catalyzed increased communication and coordination between the CEMS and service units within the university.

UVM CEMS formed strategic partnerships with Vermont non-profit organizations that serve the TAACCCT program’s target population, and the Vermont Department of Labor.

As described above, STEM-Connect worked in partnership with other organizations within and external to UVM to build the certificate programs and recruit and support participants. Key partnerships are summarized below.

**Increased Collaboration between the CEMS and Service Units within UVM**

Partnerships between CEMS and units within UVM were formed with CDE and Veterans Services.

**Division of Continuing and Distance Education (CDE):** CDE conducted market research to inform certificate development, supported CEMS faculty with instructional design expertise, and coordinated with the STEM-Connect communications director to build parallel web sites with a shared back end so that all inquiries and enrollment requests from non-traditional students were managed through one system. All non-degree students at UVM enroll through CDE, and its academic advisors are now trained to respond to inquiries about the certificates or set up connections with appropriate faculty in CEMS. CDE also modified its application process to meet STEM-Connect data collection requirements. Going forward, CDE will continue to market the certificates as part of its larger portfolio, and intends to continue building relationships initiated through STEM-Connect with VDOL and the veterans’ community.

**Veterans Services:** The UVM Veterans Services office worked with STEM-Connect staff to secure pre-approval of the certificates for Veterans Administration education benefits. This is especially important in a state like Vermont that does not offer tuition reductions or waivers for those serving or who have served in the military. Tuition, as well as limited time, are reported as significant barriers to veteran participation in higher education. Pre-approval of the certificates potentially reduces both the cost and the time it takes for veterans to enroll in the certificate programs. The Veterans Services office also provided feedback on marketing materials early in the program.
Strategic Alliances External to UVM

To better reach and support the TAACCCT target populations, STEM-Connect also worked closely with VDOL and local non-profit organizations.

Vermont Department of Labor: Through its regional offices across the state, VDOL posts marketing materials about the STEM-Connect certificates at its Career Resource Centers. These materials are also included in its Rapid Response packets whenever area employers announce large layoffs. VDOL counselors met periodically with STEM-Connect recruiters to learn about the certificate programs, including prerequisite skills and potential career pathways. Going forward, VDOL has committed to continuing to distribute promotional materials and feature the certificates quarterly on its website home page banner. VDOL was also a key partner in providing data for the outcome evaluation, discussed elsewhere in this report.

Vermont HiTEC: Vermont HiTEC, a non-profit that works closely with local businesses to prepare job-seekers for industry-specific employment opportunities, worked with STEM-Connect on participant recruitment, employer outreach and internships, and data management. Efforts to recruit from TAACCCT target populations included coordination with VDOL regional offices, and presentations at the Air and Army Guard facilities. To help address the barrier of high tuition, HiTEC secured scholarships for a computer science course for one group of Guard members. To help build capacity within CEMS, Vermont HiTEC staff mentored a CEMS external recruiter. A Vermont HiTEC staff member was also embedded in CEMS to conduct extensive data organization and management, which supported both reporting requirements and recruitment of UVM undergraduates into the STEM-Connect certificates. Vermont HiTEC identified internship opportunities and mentored students who obtained internships. Late in Year 4, one of its staff members conducted a survey of local employers to inform CEMS about next steps in development of programs that support workforce development.

Other Organizations Working to Build Education and Employment Opportunities:
As noted in the section above on key actions taken to implement STEM-Connect, the program reached out to many local organizations that aim to improve education and employment outcomes for under-served populations. These organizations include Vermont Student Assistance Corporation, Vermont Works for Women, Associates for Training and Development, Refugee and Immigrant Service Provider Network (RISPNet), Vermont Vocational Rehabilitation, and Creative Workforce Solutions. These new partnerships have not immediately led to enrollments, but the CEMS certificates are now known and personal contacts have been established that reinforce messages more broadly disseminated through STEM-Connect’s media campaigns.
Modification from Original Program Design

Findings

UVM requirements for course and certificate approval led to changes in how workplace learning opportunities were structured and how the certificates are stackable.

Change in the definition of participant to include traditional undergraduates increased the number of individuals who benefit from the certificate programs.

Workplace Learning Opportunities (WLOs)

While the original work plan called for WLOs to be integrated into the certificates, WLOs evolved to be optional components. This change reflects institutional constraints (WLOs for credit are not part of the CEMS curriculum) and the needs of non-traditional students, many of whom were already employed while enrolled. As described above, internships and career counseling were offered as benefits to enrolling in the certificates.

“Stackable” Sequence of Certificates

The original program plan envisioned certificates that moved (stacked) in a sequence from (1) an initial four-course sequence to (2) internship/co-op work or other WLO to (3) complementary general education courses. Instead, all the new STEM-Connect certificates are self-contained academic certificates. While not stackable as envisioned in the original grant proposal, these certificates are interrelated. They also build upon one another in cases where particular courses are required for and count toward more than one certificate. This change reflects the change in the approach to the WLOs and aligns with the University’s current protocols for academic certificates. Each stand-alone certificate is also stackable in the sense that it is an important milestone on the path toward a bachelor’s or master’s degree.

Broader Definition of Participant

STEM-Connect proposed enrolling participants through CDE and monitoring and mentoring them from enrollment, through course work, WLOs, graduation and into employment. The development of process and procedure manuals for enrollment, monitoring, and mentoring participants were proposed to support these activities.

As enrollments began in year two, participants who fell into at least one of the following categories were considered participants:

- TAA eligible
- Underemployed
- Unemployed
- Displaced worker
• New to STEM
• Veteran
• Non-traditional student (24 years of age or older, independent)

Following discussions with Department of Labor program personnel during a monitoring visit in December of 2015, this definition was broadened to be more consistent with one of the proposal’s stated goal to “accelerate the productivity of students enrolled in traditional degree programs by offering . . . the opportunity to obtain stack able credentials in less than two years along the traditional 4-year educational pathway” and with DOL’s criteria for including participants in its reporting. In January of 2016 a new definition emerged and undergraduates enrolling in STEM-Connect’s certificate programs were added to the definition. At that point in time, the program also began tracking UVM students who enrolled in STEM-Connect’s courses as part of their regular program of study, but did not enroll in a STEM-Connect certificate program.

While this was not a modification in the original program design, with this change STEM-Connect began to focus recruitment on both traditional and non-traditional students. Enrollment of non-traditional students continued through CDE, while enrollment of traditional students was managed directly by CEMS faculty and staff.

Operational Strengths and Challenges

Findings

From the outset, new development by STEM-Connect was designed to be sustainable beyond the grant funding period.

STEM-Connect focused use of grant funds to build capacity and meet grant reporting and knowledge sharing requirements.

While challenged by operating outside of the normal UVM degree-granting structure and by an accelerated ramp-up following a delayed implementation, STEM-Connect made important steps to connect with the TAACCCT grant target audience; there is more work to be done on this front.

As noted earlier, CEMS has shown itself to be a learning organization, assessing needs and responding to changing contexts to build sustainable new academic certificates.

Strengths

Designed for Sustainability

As described above, the certificates developed through STEM-Connect were carefully woven into the fabric of CEMS, and are continuing beyond the life of the TAACCCT grant. The Dean and faculty see the value of these certificates for their traditional students, and are invested in helping them develop both theoretical knowledge and practical application skills for future careers in STEM. The content of the certificates is aligned to national and industry standards, and in the case
of cybersecurity forms the basis for a new area of development in the college. Both CEMS and CDE are committed to ongoing outreach to non-traditional students as well. Institutional structures also favor such outreach. Under a new university-wide budgeting framework called Incentive Based Budgeting, academic units are rewarded for high enrollment rates.

**Capacity Building and Grant Reporting**

Grant funds were carefully allocated to activities that built capacity and responded to grant reporting requirements. Even though, for example, marketing and advertising for the certificates will not continue at the same scale as was possible during the grant period, efforts during that period raised CEMS’s profile in and beyond Vermont. Marketing in the future can build on this foundation. Similarly, STEM-Connect’s program director and recruiters were “temporary” in the sense that their positions did not continue beyond the grant period, but their time and effort was necessary for the new development.

Also temporary, but critical for internal management and grant reporting, was STEM-Connect’s contract with an external partner to organize and analyze data. The program has filed periodic reports to funders and has been supportive of evaluation activities, open with sharing information, and receptive to suggestions.

**Challenges**

**Hurdles Associated with Implementing an Atypical Program**

Challenges resulted from locating a program devoted to the development of ‘stand-alone’ certificates that were sometimes perceived as outside the degree granting rewards system (even though they were designed to fit within the degrees). The program had to educate other parts of the University about the program’s benefits and constraints. Operationally, the program often had to create administrative systems that paralleled those designed for degree students, or arrange for UVM’s administrative and operational units to work outside of their normal processes. These challenges are shared by other programs at the University that are devoted to developing skills and knowledge that lie outside of existing programs and are designed for non-traditional students.

**UVM’s Capacity and Commitment to Serving Non-Traditional Students**

For workforce development, UVM is better positioned to prepare individuals for entry into higher levels, and help those who need to update or hone existing job skills. UVM is not well positioned to support those who are not prepared for rigorous academics or those transitioning from community college to UVM.

**Communications**

As noted in earlier evaluation reports, personnel changes early in the grant period led to delays in implementation of all aspects of the program. And, as often happens in programs that must ramp-up quickly, there were examples where communication was lacking. While steps were taken in the
last two years to streamline information sharing for participant recruitment and enrollment, UVM is a decentralized environment in which units share and manage information in unique ways.

**Discussion of Implementation Findings**

**Notable Themes**

As noted in earlier sections, STEM-Connect was awarded to a major land-grant institution with the primary mission of serving traditional full-time students. This institutional context, a *University Setting*, is an important theme that runs throughout the implementation findings. Closely related to this is a second theme of *Weaving New Initiatives* into the fabric of the existing institutional structures to ensure quality and sustainability. In order to build capacity that will sustain beyond the grant funding period, program leaders respected and leveraged existing institutional strengths to build rigorous academic certificates that serve the needs of both TAACCCT target populations and traditional undergraduate students. This new capacity, grounded in eight new professional certificate tracks that include new and enhanced university courses, was the result of intentional outreach and consultation with local businesses, non-profits, and VDOL. *Building New Relationships* both within and external to UVM bode well for ongoing collaboration aimed at workforce development and make up third theme in the STEM-Connect findings. A fourth theme encompasses the first three. Much careful foundational work was important and necessary in order to develop, implement, and integrate a unique program at UVM with new partners. Much of the work may be viewed as *Planting Seeds*.

These four overarching themes frame the “story” of STEM-Connect and resonate with the implementation findings.

**University Setting**

Unlike most TAACCCT grantees, principally community colleges, STEM-Connect was awarded to UVM, a major land-grant institution with the primary mission of serving traditional full-time students. This had important implications for program implementation, including partnership building, certificate development, and participant recruitment. For example, UVM’s organizational structure distinguishes between degree seeking and non-degree seeking students, so one of the key partnerships was within the university itself – between CEMS, the academic unit where the program was housed, and CDE, a service unit through which non-degree seeking students access UVM courses. The rigorous certificate development and approval process at UVM includes reviews at multiple levels of the institution, including the Faculty Senate and the Board of Trustees. While these processes help to ensure relevant, high quality content and instruction, comprehensive review can take many months to complete. As a result, enrollment in STEM-Connect certificates could not begin until well into the second year of the grant. Separate but simultaneous to implementation of STEM-Connect, UVM launched a new budgeting framework, known as Incentive-Based Budgeting, in which academic units are provided funds based on the enrollment in their classes. This new budget framework provided the financial resources for CEMS to offer new classes or sections of classes (the grant did not cover the cost of instruction) and recruit students to meet grant enrollment targets. For the TAACCCT target audience, however,
UVM is often perceived as “unattainable.” Barriers include relatively high tuition (currently each 3-credit course for in-state students costs $1,968) and academic preparedness to succeed in rigorous academic courses. Despite these barriers, UVM offers some singular advantages. These include access to professors with research and publication experience, access to current technology, access to advanced technology support services, perception of the certificates as rigorous and high quality, and ease of transfer from certificate to degree programs. For traditional students on campus, an unanticipated outcome of the program included interim certifications that increased their opportunities for internships, as well as revised courses that integrate theory with project-based learning and took advantage of on-line learning tools.

Weaving New Academic Certificates and New Student Populations into the Fabric of UVM

This theme is closely related to the first. In an institution like UVM focused on serving traditional undergraduates, also serving non-traditional students with STEM certificates requires finding the overlap in the needs of both of those populations, while also building systems responsive to the unique needs of each group. The original design of the grant called for a separate program of stackable intermediate certifications for non-degree students, but the UVM certificate approval process mentioned above requires an academic certificate be connected to completion of five university courses. In order to build certificates that met university requirements and would be sustainable beyond the period of grant funding, program leaders used what they learned from university faculty and local employers about workforce development needs to expand course and certificate offerings that increase academic and career options for both traditional and non-traditional students. The success of this strategy bodes well for the long-term sustainability of the new certificates and is a foundation for development of additional new certificates in the coming years. While CEMS, and UVM in general, excel at supporting traditional students, the grant allowed CEMS to experiment with supports for non-traditional students, including a textbook lending library, off-site tutoring, internship placement, and career counseling. Certificate participants raised the issue of advising, and suggest that even for degree seeking students, the traditional academic advising structure is no longer adequate. A new advising system that integrates academics and career pathways is one approach that could meet overlapping needs of traditional students and those in the TAACCCT target populations.

Building New Relationships

The idea of relationships is embedded in the name STEM-Connect. Grant funding empowered CEMS to reach out to local employers, the National and Air Guards, and organizations interested in a shared goal of building workforce development pathways. Formal and informal partnerships were formed with VDOL, Vermont HiTEC, Vermont Student Assistance Corporation, and several smaller service groups such as Vermont Works for Women and Vermont Refugee Resettlement. Some of these new relationships informed development of the certificate programs, and many were key to raising awareness in TAACCCT target populations about the new workforce preparation opportunities. CEMS also embarked on a multifaceted marketing campaign to raise awareness about the new certificates. Relationships across units within UVM were also enhanced, particularly with the Veterans Services office and with CDE. The latter case is particularly noteworthy, because in the grant the traditional roles of CDE and an academic unit
were reversed. Historically CDE created programming for non-degree students; in STEM-Connect the academic unit CEMS drove creation of new certificates and collaborated with CDE on their design, delivery, and marketing.

Planting Seeds

In a large academic institution where change is by design slow, there are indications that CEMS’ efforts to develop new academic certificates, raise local awareness of the certificate programs, and build new relationships across UVM and with other organizations focused on workforce development are a strong foundation for building an agile approach to supporting workforce preparation. Within CEMS the grant has reinvigorated faculty who are now “academic champions” for current and future certificates. In order to implement STEM-Connect, CEMS had to learn from partners and participants, showing itself to be a true learning organization – and in the process is changing how partners and their clients think about UVM’s accessibility. Across UVM more broadly, CEMS has become a model for using academic certificates to develop new programs and reach new audiences. Other colleges are now talking about developing their own certificates, and already marketing of some of their degree programs in ways similar to those used by CEMS through STEM-Connect.

Outcome Study Findings

Level 1: Outcomes for Participants

Findings

More than twice as many participants as expected enrolled in STEM-Connect Certificates (311).

However, approximately half of the expected number of participants completed their programs of study by the end of the program period (75), with nearly three-quarters of the enrollees still engaged in the program. Contributing factors for this lag mentioned in the implementation analysis include delays at the beginning of the project and the lengthy and rigorous certificate review process. Many of the 221 participants currently enrolled are poised to complete the program.

Undergraduates completing certificates tended to view the programs as providing a distinctive competitive advantage, including increased knowledge and skill development relevant to the job market. Those currently enrolled, either as non-degree students or graduate students additionally viewed the certificates as supporting career change, “right-sized” for those who were not seeking a degree, and useful for providing credentials for further education.
Descriptive Statistics:

The following tables and narrative provide a description of the outcomes for students enrolled in the STEM-Connect program. These data correspond to the nine designated outcome measures of the TAACCCT program.

Table 10: Expected vs Actual Outcome Measures Designated in the SGA

<table>
<thead>
<tr>
<th>Outcome Measure</th>
<th>Expected</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Unique Participants Enrolled*</td>
<td>150</td>
<td>311</td>
</tr>
<tr>
<td>Total Number of Participants Completing a TAACCCT-Funded Program of Study</td>
<td>135</td>
<td>75</td>
</tr>
<tr>
<td>Total Number of Participants Still Retained in Their Program of Study or Other TAACCCT-Funded Program</td>
<td>7</td>
<td>221</td>
</tr>
<tr>
<td>Total Number of Participants Earning Credit Hours</td>
<td>146</td>
<td>294</td>
</tr>
<tr>
<td>Total Number of Participants Earning Credentials</td>
<td>135</td>
<td>75</td>
</tr>
<tr>
<td>Total Number of Participants Enrolled in Further Education</td>
<td>24</td>
<td>0</td>
</tr>
<tr>
<td>Total Number of Participants Employed After TAACCCT-funded Program of Study Completion</td>
<td>116</td>
<td>10</td>
</tr>
<tr>
<td>Total Number of Participants Retained in Employment After Program of Study Completion</td>
<td>116</td>
<td>2</td>
</tr>
<tr>
<td>Total Number of Those Participants Employed at Enrollment Who Received a Wage Increase Post-Enrollment</td>
<td>15</td>
<td>48</td>
</tr>
</tbody>
</table>

Source: Program Administrative Records and VT DOL Employment data.

*Over the life of the program an additional 2,088 students who did not enroll in a certificate program took a TAACCCT-funded course as part of their regular University Program.

As indicated in Table 10, actual enrollment in STEM-Connect’s certificate programs was more than double the enrollment expected (311 vs. 150). Most of this enrollment is accounted for by the perceived benefits of the certificate programs for traditional undergraduates.

At the same time, a little more than half the number of participants expected to complete the program did so (75 vs. 135). The implementation evaluation findings note a change in leadership at the beginning of the program. This caused some delay in the program’s implementation. As of June 30, 2017, the end of the program period, 42 of the 221 participants still engaged in the program had only one course remaining to complete the certificate program in which they were enrolled. These 42 individuals may well be expected to complete the program within the first year following the funding period, bringing the total number of participants completing a TAACCCT-funded program of study to 117 after the first year.

The number of participants obtaining credit hours (294) is more than the 135 expected, and consistent with the total enrollment count of 311 for this credit-bearing program.
While no participants were counted as enrolled in further study (defined as study at other than the awardee institution), many of the participants are completing bachelor’s degrees at the University of Vermont.

Actual employment related outcomes are lower than those expected, but no conclusions may be drawn from these results. As explained earlier in the sections describing the limitations of the study, employment data was obtained from VDOL, which did not have wage data on many participants. In the earlier description of participant characteristics it was noted that as primarily undergraduates, most participants, if working at all when they enrolled, reported working in part-time positions typical of undergraduates. The 75 participants who completed the program were all undergraduates. Of that number, 43 remain enrolled in a degree program and of the 32 that graduated, all but 2 graduated in May of 2017. Thus, it is too early to judge career earnings.

**TABLE 11: Participant Count by Certificate**

<table>
<thead>
<tr>
<th>Certificate/Track</th>
<th>Enrolled Count</th>
<th>Percent</th>
<th>Earned Certificate</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Actuarial</td>
<td>18</td>
<td>6%</td>
<td>1</td>
<td>1%</td>
</tr>
<tr>
<td>Computer Aided Engineering Design</td>
<td>10</td>
<td>3%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Complex Systems</td>
<td>12</td>
<td>4%</td>
<td>2</td>
<td>1%</td>
</tr>
<tr>
<td>Cybersecurity</td>
<td>25</td>
<td>8%</td>
<td>5</td>
<td>3%</td>
</tr>
<tr>
<td>Computer Software (CS) - Master’s Preparation</td>
<td>43</td>
<td>14%</td>
<td>31</td>
<td>17%</td>
</tr>
<tr>
<td>CS - Self Designed</td>
<td>4</td>
<td>1%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>CS - Software Development</td>
<td>71</td>
<td>23%</td>
<td>5</td>
<td>3%</td>
</tr>
<tr>
<td>CS - Web Development</td>
<td>128</td>
<td>41%</td>
<td>31</td>
<td>17%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>311</strong></td>
<td></td>
<td><strong>75</strong></td>
<td></td>
</tr>
</tbody>
</table>

Seventy-five of the 311 participants successfully completed their certificate programs. As shown in Table 11, no participants had completed the Computer Aided Engineering Design or CS-Self Designed Certificates during the program period. The Computer Aided Engineering Design Certificate was the last certificate up and running, completing the University’s approval process in May of 2017. The CS-Self Designed Certificate serves a small niche of participants.
Participants’ Perceptions of Program’s Employment-Related Value

To further explore employment-related outcomes, the evaluation included a content analysis of interviews conducted with a sample of participants to assess participant perception of the program’s actual or anticipated effect on employment and earnings.

Findings

Undergraduates completing certificates tended to view the programs as providing a distinctive competitive advantage, including increased knowledge and skill development relevant to the job market. Those currently enrolled, either as non-degree students or graduate students additionally viewed the certificates as supporting career change, “right-sized” for those who were not seeking a degree, and useful for providing credentials for further education.

Sample: The evaluators selected a sample of 78 participants for phone interviews from the population of the 227 participants identified by the program at the time the interview process began (February 2017). The sample of 78 participants (roughly 1/3) included those with the following characteristics:

- All 20 participants who withdrew from the program before completion at that point in time;
- All 27 participants who had completed the program; and,
- All 31 participants still actively engaged in the program who were not part of the typical university undergraduate population.

Respondents: Of the sample, 24 individuals agreed to be interviewed, 10 who had completed the program and 14 still actively enrolled. No individuals who withdrew agreed to be interviewed.

Process: The interview process began with an email communication from the Program Manager describing the interviews, their importance, and how those selected for interviews would be contacted. This communication also reminded the participants that they were provided information about their role in the program evaluation when they enrolled. This communication was followed by email communication from the interview team to introduce the process and set up appointments for the phone interviews. The interview team followed up twice with those who did not respond to the initial request.

Protocol: The phone interview protocol (See Appendix 4), solicited a qualitative assessment of the participants’ experience in the program and of the program’s actual or anticipated effect on employment and earnings.

Timeline: The first communication to interviewees was sent on February 17, 2017 and the final interview took place on May 3, 2017.

Results: Tables 12 and 13 below and on the following page describe the employment-related outcomes perceived by participants interviewed by the evaluation team.
<table>
<thead>
<tr>
<th>ID</th>
<th>Type</th>
<th>Traditional (T)/Non-traditional (NT)</th>
<th>Certificate</th>
<th>Employment Status During Enrollment</th>
<th>Employment Status at Time of Interview</th>
<th>Perceived employment-related value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Distinctive competitive advantage</td>
</tr>
<tr>
<td>101</td>
<td>Undergraduate</td>
<td>T</td>
<td>CS-Web Development</td>
<td>Full-time student working part time</td>
<td>Undergraduate entering 2018 job market</td>
<td>X</td>
</tr>
<tr>
<td>102</td>
<td>Undergraduate</td>
<td>T</td>
<td>CS-Web Development</td>
<td>student working part time</td>
<td>2017 graduate entering job market</td>
<td>X</td>
</tr>
<tr>
<td>103</td>
<td>Undergraduate</td>
<td>T</td>
<td>CS-Web Development</td>
<td>Not employed</td>
<td>2017 graduate entering job market</td>
<td>X</td>
</tr>
<tr>
<td>104</td>
<td>Undergraduate</td>
<td>T</td>
<td>CS-Web Development</td>
<td>Full-time student working part time</td>
<td>obtained post graduation position at $80,000 annual salary</td>
<td>X</td>
</tr>
<tr>
<td>105</td>
<td>Undergraduate</td>
<td>T</td>
<td>CS-Web Development</td>
<td>Full-time student working part time</td>
<td>Undergraduate entering 2018 job market</td>
<td>X</td>
</tr>
<tr>
<td>106</td>
<td>Undergraduate</td>
<td>T</td>
<td>CS-Web Development</td>
<td>Not employed</td>
<td>Undergraduate entering 2019 job market</td>
<td></td>
</tr>
<tr>
<td>107</td>
<td>Undergraduate</td>
<td>N</td>
<td>CS-Web Development</td>
<td>No data</td>
<td>2017 graduate entering job market</td>
<td>X</td>
</tr>
<tr>
<td>108</td>
<td>Undergraduate</td>
<td>T</td>
<td>CS-Masters Prep</td>
<td>Not employed</td>
<td>Undergraduate entering 2019 job market</td>
<td></td>
</tr>
<tr>
<td>109</td>
<td>Undergraduate</td>
<td>T</td>
<td>CS-Web Development</td>
<td>student working part time</td>
<td>2017 graduate entering job market</td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>Undergraduate</td>
<td>NT</td>
<td>CS-Web Development</td>
<td>in internship</td>
<td>employed, programming/</td>
<td></td>
</tr>
</tbody>
</table>
Table 13: STEM-Connect Participant Interviews: Current Participants’ Perceived Employment Related Value

<table>
<thead>
<tr>
<th>ID</th>
<th>Type</th>
<th>Traditional (T)/ Non-traditional (NT)</th>
<th>Certificate</th>
<th>Employment Status During Enrollment</th>
<th>Employment Status at Time of Interview</th>
<th>Perceived employment-related value</th>
</tr>
</thead>
<tbody>
<tr>
<td>111</td>
<td>Graduate T</td>
<td>Complex Systems</td>
<td>Part time research assistant</td>
<td>Working toward Ph.D.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>Undergraduate T</td>
<td>CS-Software Development</td>
<td>Full-time student working part time</td>
<td>Current Undergraduate entering 2020 job market</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>113</td>
<td>Non-degree NT</td>
<td>CS-Web Development</td>
<td>Full-time, technical services</td>
<td>Attained full-time employment as Web Developer</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>114</td>
<td>Non-degree NT</td>
<td>CS-Masters Prep</td>
<td>Full-time, speech pathology</td>
<td>Still working in current position</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>115</td>
<td>Graduate NT</td>
<td>Complex Systems</td>
<td>Fellowship student</td>
<td>Working toward Ph.D.</td>
<td>X</td>
<td>X X</td>
</tr>
<tr>
<td>116</td>
<td>Non-degree NT</td>
<td>Pre-Actuarial</td>
<td>Full-time in health science field</td>
<td>Still working in current position</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>117</td>
<td>Non-degree NT</td>
<td>CS-Web Development</td>
<td>Full-time technical support</td>
<td>Still working in current position</td>
<td>X</td>
<td>X X X</td>
</tr>
<tr>
<td>118</td>
<td>Non-degree NT</td>
<td>CS-Software Development</td>
<td>Recently laid off</td>
<td>Unemployed</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>119</td>
<td>Non-degree NT</td>
<td>CS-Software Development</td>
<td>Full-time equipment technician</td>
<td>Still working in current position</td>
<td>X</td>
<td>X X</td>
</tr>
<tr>
<td>120</td>
<td>Graduate T</td>
<td>Complex Systems</td>
<td>Unemployed</td>
<td>Unemployed</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>121</td>
<td>Non-degree NT</td>
<td>Complex Systems</td>
<td>Full-time IT professional</td>
<td>Still working in current position</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>122</td>
<td>Graduate T</td>
<td>Complex Systems</td>
<td>Part time graduate assistant</td>
<td>Part time graduate assistant</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>123</td>
<td>Graduate T</td>
<td>Complex Systems</td>
<td>Part time graduate assistant</td>
<td>Part time graduate assistant</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>124</td>
<td>Non-degree NT</td>
<td>CS-Web Development</td>
<td>Full time H.S. teacher</td>
<td>Plans uncertain</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
Because all the participants who had completed a certificate series when the interviews were conducted were undergraduate students, several could not distinguish the job-related benefits of the certificate from those of their undergraduate major. Those that did articulate the certificate program’s employment-related benefits specifically, however, believed that the certificate provided a distinctive competitive advantage, particularly in showing evidence of a unique skill that not everyone in their field would be able to demonstrate. They also mentioned its relevance to the job market they were entering. Many also mentioned the value it provided in learning new content and skills.

Interviews with participants still currently enrolled in the program focused on those who were part-time or non-degree students, or those older students in a graduate program. These students more closely reflect the target population for certificate programs that can be completed in two years or less. These participants articulated many employment-related benefits. In addition to the benefits of competitive advantage, job market relevance, and content and skills development mentioned by those who had completed certificates, these participants also spoke of the certificate programs as a valuable support for career change, being “right-sized,” and providing a credential that would support the pursuit of further study.

For example, one participant, a non-degree student working full-time while enrolled in the CS-Web Development Certificate, who credits the certificate program as enabling his acquiring a new position as a web developer with a 20% wage increase, describes the distinctive advantage provided in this way.

“[I] think that [the certificate] can’t be underestimated in terms of getting an employer to think twice about you not having a bachelor’s degree in Computer Science… Overall I think the program is super useful, I would recommend it to someone else.”

A graduate student participant talked about skills and knowledge gained through the Complex Systems Certificate in this way:

“[I] like the fact that I come from very natural science background but I am able to get and apply these strong engineering and math type courses is something I haven’t seen in any other school.”
Another described its relevance to the job market as follows:

“Data Science and Complex Systems’ fields are very relevant to the job market. Many companies looking for people in these fields. The need is strong for those who can understand how to mine data. Courses align well with job market needs.”

A participant who described himself as someone without a bachelor’s degree nor the background courses needed to matriculate, described the benefits of the CS-Software Development Certificate as the “right-sized” option for credentialing:

“Feels like I’m making up for something that I lack; wasn’t exactly planning on taking the Certificate program, but once I figured out it was there, it kicked me into gear to actually move towards a Certificate. . . provides a pathway to credentialing – especially for someone that doesn’t have a college experience.”

With only 24 of the 78 participants contacted agreeing to be interviewed (31%), there is no way of knowing whether those who responded are representative of all participants who completed certificates and of the non-degree and graduate students currently enrolled. Thus, the results of the interviews reflect only the self-report of those willing to be interviewed. It is possible the overall results would be different if the response rate had been 100%. Nonetheless, these results do provide examples of successful career outcomes and realized value for some participants. They offer insight into participants’ perceptions and experiences in STEM-Connect’s certificate programs that can serve as a starting point for continuing support and development after the funding period, particularly in terms of providing value for non-degree students seeking career changes or for whom a bachelor’s degree is not a present option.
Level 2: Comparison of Participants and Non-Enrolled Samples

Comparison Groups

As indicated in Figure 9, the population for comparison consisted of 311 Participants and 2,088 non-enrolled students who took a STEM-Connect course as part of their regular University program.

Figure 9: Comparisons groups

Comparison of Background Variables

Question 1: To what extent are the participants and non-enrolled students (comparison group) different with respect to the background variables of gender, parents’ level of education, age, and financial need?

As indicated in Figures 10-13 below the percentage of difference between the participant and the non-enrolled samples were relatively small and not significant in any of the chi-square analyses performed on the data. See Appendix 5 for accompanying tables.
Figure 11: Comparison groups traditional/non-traditional college age distribution

Dichotomy was split (by age in years, T = Traditional, N = Non-traditional) as follows: T <= 24 < N

Figure 12: Comparison Groups level of parent education distribution

Data were summarized in order to protect the identity of participants in small cell sizes (11 or fewer). Categories originally coded as ranks of parent education from less than high school to graduate degrees were collapsed as follows. High/medium = some college or beyond; Low=middle/jr high, high school; no data.
Estimate of Financial Need was determined by whether or not the individual had completed a Free Application for Federal Student Aid (FAFSA) Application.

**Wage Comparisons**

**Question 2:** To what extent does the STEM-Connect program result in higher wages being earned by participants relative to the comparison group?

It is evident from Figure 14 below that the non-enrolled students out-performed the participant group. Since the demographic variables, above are not statistically different among the groups studied there is no opportunity to explain the difference in wages on that basis. The direction of gender differences and financial aid eligibility are consistent with larger demographic trends, e.g. females and lower income students tend to obtain less desirable employment outcomes.
Rates of Employment

**Question 3:** To what extent does the STEM Connect program result in higher rates of employment relative to the comparison group?

As Figure 15 below indicates, there is essentially no difference in the proportion of individuals in either group employed at the time the data were obtained. Since the population is a traditional student age and not representative of the adult population which would tend to be in the labor market, this outcome is not surprising.

![Figure 15: Percent employed for participants and non-enrolled](image)

The chi-square statistic is 0.1438. The p-value is .704501. This result is *not* significant at $p < .05$.

Academic Achievement

**Question 4:** To what extent does the STEM Connect program result in higher Grade Point Averages (GPAs) relative to the comparison group?

Response: As Figure 16 below indicates, there is a significant difference between the participant and non-enrolled groups which favors the participant group. Participants are 10 percent more likely to have High to Mid-Range GPA's and 10 percent less likely to have low GPAs than their non-enrolled peers.
**Figure 16:** Mean grade point average for participants and non-enrolled

GPA: an arithmetic mean of 2.87 was calculated for the GPA (from unique participant records). The student GPA value used for each student was the most recent available (at the time of most recent course within a TAACCCT certificate was taken). GPA was split into two groups (L = Low, HM = High-Medium) by the mean as follows: L< 2.87 <= HM

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**Discussion of Level 2 Findings**

Quantitative analysis of program outcomes reflect a generalized picture that is heavily influenced by the limitations of both the program design and the characteristics of the data with respect to the outcomes of individual participants. That is, recruitment of students began mid-way through the second year of the program at the University. As described earlier the University is a predominantly undergraduate institution attracting a traditional student-aged population. While it was a primary goal of the grant program to build the capacity of the institution to develop coursework, systems and supports to serve an adult, non-traditional aged population, the development of the program must of necessity precede the recruitment of participants. Although the TAACCCT goals and specified outcomes are increased wage levels and employment, it was unlikely that large numbers of graduates would enter the workforce by program’s end. Thus, estimates of targets for participants and non-enrolled students and any comparisons between participant and non-enrolled groups were subject to the same limitations on opportunities to become employed. In particular, students could (and did) complete certificates (n=75) in the last year in numbers that nearly met that year’s target without the opportunity (because they are for the most part still undergraduates) to enter the workforce.

One set of relationships that emerged from the data concerned the relationship between financial aid and the program outcomes of participants either remaining active status, completing the
certificate, or withdrawing from the program. Here it seems that financial aid was both a driver to success and a source of failure when absent.

In addition, as discussed in the section on Limitations (above) there were certain limitations that have constrained the study of outcomes and relationships among student characteristics. Chief among these limitations was the failure to complete the student questionnaire which was the source of variables such as the student background characteristics and certain outcomes. Fifty-seven percent of the population of participants completed the online survey. The non-enrolled students did not complete the survey. Comparisons between participants and non-enrolled students were limited to only those variables contained in the University’s general student data base and the VDOL data base.

Conclusion

Key Lessons Learned

Different Institutional Contexts require Different Approaches to Implementation

One key lesson stems from the first two themes that emerged from the implementation analysis, University Setting and Weaving New Academic Certificates and New Student Populations into the Fabric of UVM. In a primarily undergraduate research university whose stated mission is not directly aligned with typical strategies employed by other TAACCCT grantees for adult, displaced workers, the program required a different approach. Its approach, to create certificates that had something to offer to both populations, heightened benefits for both. Non-degree students earn certificates that offer advanced skills and academic recognition, as well as career paths and assist them in finding internship opportunities. Traditional undergraduates earn a credential that will offer a distinctive advantage not seen by other undergraduates and gain assistance with finding internships and increased interdisciplinary interactions.

Program Benefits Emerge over Time

A second key lesson stems from the third and fourth themes, Building New Relationships and Planting Seeds. It is important to recognize the significant time required to implement a new program like STEM-Connect. New relationships often require a long time for meaningful collaboration to emerge, particularly when trying to reach new audiences and change perceptions. Universities are often perceived as preparing students for jobs that don’t yet exist. It will take a while for the program benefits to fully surface and flourish and it is important to recognize the value of planting seeds and creating a strong and meaningful foundation.
UVM Can Serve a Unique Workforce Development Niche

- For workforce development, UVM is better positioned to prepare individuals for entry into higher levels of employment, and help those who need to update or hone existing job skills. It is not well positioned to support those who are not prepared for rigorous academics. The career maps accompanying the certificate descriptions in Appendix 2 illustrate a need for workforce development at the level that STEM-Connect provides.
- Combined, the new certificates, new courses which incorporate more engaging instructional approaches, new relationships with those focused on workforce development, and new approaches to marketing are evidence of UVM CEMS’ increased capacity and newfound commitment to serving needs in the local community and beyond.
- Challenges remain, however. Undergraduate admission to UVM is quite competitive, and as a result the University is not yet well positioned to support those who are not prepared for rigorous academics. As CEMS seeks to enroll non-traditional students, especially those in the TAACCCT target population who may have little experience with higher education or have been out of school for many years, it may be necessary to further enhance its student support systems.

Barriers for Non-Traditional Students are Substantial

- The cost of tuition is a significant barrier to participation in this program. Grant funds were not allowed for direct participant support, and other funding depends on fitting neatly into specific categories (Post 911 GI Bill, for example).
- UVM is not always perceived as a friendly campus for non-traditional students. While this is not fully understood, possible reasons include unfamiliarity with bureaucratic processes or online course platforms, lack of academic preparation, or time constraints.
- There are unique challenges for serving the veteran and National Guard populations. Guard members are deployable and hesitant to commit to this type of program. Because funding generally doesn’t cover all the costs it can seem financially risky for them.
- CEMS’s certificate programs do not meet all needs. Those who work directly with the unemployed report that many recently unemployed individuals are looking for short-term training and immediate employment.

Implications for Future Research

Future research suggested by the STEM-Connect experiment in building institutional capacity and creating partnerships at the university level should involve the interpretation of Department of Labor-specified participant outcomes on a time scale appropriate for the four-year degree. Lengthening the expected time period from three to six years would place the evaluation on a time scale appropriate to graduates’ ability to enter the job market. Likewise, the measure of wage/salary outcomes should reflect the time period for market entry that is realistic for the four-year student enrollment.

Institutional change study designs (implementation) should engage four-year institutions in identifying what changes the institutions are committed to making and articulate the
evaluation/research design on a time frame appropriate to the pace of change which is normal and reasonable for four-year institutions. In other words, for the Department of Labor or similar sponsors to facilitate growth and change in university contributions to the economy through workforce development, then solicitation offerings should accommodate a time scale and institutional change strategy that fits the context of university development.
References Cited

**Logic Model:** STEM-Connect aims to expand and improve UVM’s ability to deliver education and career training in STEM-related fields by creating stackable certificate programs that can be completed in two years or less for traditional students and non-traditional adult learners. Programs will be developed in collaboration with employer partners and will require the completion of a combination of college courses and work-based learning opportunities (WLOs). A number of the courses for each certificate will be offered online.

**Resources/Inputs**
- Staff hired with grant resources will participate in on-line course development, provide infrastructure to support WLO’s, develop marketing materials and recruit participants alongside VDOL Career Resource Centers and veterans organizations.
- UVM CEMS faculty and staff, drawing on experience with a successful pilot program will develop and deliver program content, assess participants’ prior learning, and oversee admission of traditional students.
- Faculty from Community College of Vermont will also deliver courses.
- Industry partners will help to define the program strategies, goals and content; provide staff and equipment resources for Internships and other WLOs, and will give consideration to the hiring, promoting and retention of qualified participants.
- DOL Career Resource Centers and Veterans organizations will play a key role in identifying, recruiting and assessing qualified potential participants.

**Activities**
- Identify and develop Stackable Certificates aligned with employer needs
- Develop supporting courses - including online and on campus
- Develop infrastructure supporting WLOs
- Develop marketing plan and campaign.
- Conduct outreach to recruit participants
- Assess participant prior learning
- Enroll, place and mentor participants
- Deliver certificate courses and WLOs

**Outputs**
- At least five stackable certificate programs developed and delivered in the following areas of employment need, such as: web development, software development, manufacturing process, computer-aided design, survey engineering, data science, STEM teaching and historic preservation engineering.
- Certificate features include WLOs, classroom based and online instruction and carry college credit.

**Outcomes**
- Cumulative, 150 participants enter programs offered
- 135 participants complete programs and earn credentials
- 146 participants complete some credit hours
- 24 participants go on to other program of study
- 116 participants (non-incumbent workers) completing program obtain and retain employment for at least nine months
- 15 incumbent workers receive wage increase

**Impact**
- UVM’s improved delivery of STEM-related career training programs to traditional and non-traditional students results in better wage and employment outcomes for participants

**Key Intervening variables for success**
- Ability to recruit and retain key staff such as outreach director, on-line course developer, experiential learning director, etc.
- Faculty comfort with Creative Commons
- Continued engagement of employer partners to develop and offer WLOs
- Engagement of DOL CRCs and Veterans’ organizations for successful recruitment.
- Faculty engagement and ability to work in distance and on-line formats.
- Strong communication structure among a wide variety of partners with different needs and interests to maintain and nurture project collaboration.
- Strong mentoring for participants.

**Evidence based intervention:**
The potential effectiveness of STEM-Connect’s outputs is based on strong evidence of success from the Pathways to Prosperity Project and “two large well-designed, well-implemented randomized controlled multi-site studies,” particularly for the WLO feature. Additional features to evaluate for effectiveness include improved access and accelerated completion through on-line access, career placement support, one-on-one mentoring for low-skilled participants, benefit of offering college credit.

**Evaluation Measures:**
- Alignment of resources with proposed activities.
- Implementation steps completion and effectiveness.
- Outputs, number and characteristics.
- Outcomes achieved.
- Impact on UVM’s ability to deliver STEM-related career education.
Certificate Descriptions

Certificate Programs

UVM CEMS Certificate Programs

Our certificate programs lead to careers in STEM (Science, Technology, Engineering and Mathematics) and related fields such as information technology, computing, design, and manufacturing. Certificates are available for people at all levels of education.

Through our certificates, you can build the knowledge and develop the skills you need for career advancement today. An academic certificate may be right for you if:

- You want to build skills in a specific area that relates to your field of interest.
- You need a flexible path toward a professional development credential.
- You are interested in an undergraduate or graduate degree and would like to earn a specialized credential along the way.
- You are a degree student interested in gaining a specialized credential.

The University of Vermont was a proud recipient of the TRACCT grant, entrusted with the mission to expand and improve our training and development certificate. Certification programs that can be completed in two years or less, are suited for workers who are eligible for training under the 3AA program, and prepare program participants for employment in high-wage, high-skill occupations. Through these multi-year grants, the Department of Labor is helping to ensure that our nation’s institutions of higher education are helping adults succeed in acquiring the skills, degrees, and credentials needed for high-wage, high-skill employment while also meeting the needs of employers for skilled workers.
Certificate Descriptions

Computer-Aided Engineering Technology Certificate (CAET)

Computer-Aided Engineering Technology (CAET) is the broad usage of computer software to aid in engineering analysis, design and manufacturing. The term encompasses design, validation, simulation and optimization of products and manufacturing tools. CAET systems are playing an increasing role with regard to information to help support design teams in decision making. CAET is used in many fields such as automotive, aviation, space, and shipbuilding industries. One of the components of CAET is Drafting and Design (CADD or CAD) which is the term for an evolving set of computer-based tools used for the development, communication and evaluation of product designs. The sequence of design to product realization is furthered by streamlined prototyping and manufacturing, known as Rapid Prototyping and Computer-Aided Manuf.

The Certificate in Computer-Aided Engineering Technology is a program designed to give qualified students and transitioning professionals a set of skills needed to enter the workplace with one companies that foster an immediate positive impact to an employer.

Successful completion of the CAET certificate enables employers to evaluate applicants by reviewing the class curriculums and portfolio. Certificate recipients will be prepared for evolving technologies due to a sound basis in computer-based design software combined with a mastery of three-dimensional form and location geometry for different industries from mechanical to land development or structural.

Learn More
Apply Now
CERTIFICATE IN
COMPUTER-AIDED ENGINEERING TECHNOLOGY

I. Program Title
Certificate in Computer-Aided Engineering Technology (CAET)

Responsible Academic Unit
College of Engineering and Mathematical Sciences (CEMS)

Description of the Program

Computer-aided engineering technology (CAET) is the broad usage of computer software
to aid in engineering analysis, design and marketing. The term encompasses design,
validation, simulation and optimization of products and manufacturing tools. CAET systems
are playing an increasing role with regard to information to help support design teams in
decision making. Computer-aided engineering technology is used in many fields such as
automotive, aviation, space, and shipbuilding industries. One of the components of CAET is
Drafting and Design (CADD or CAD) which is the term for an evolving set of computer based
tools used for the development, communication and evaluation of product designs. The
sequence of design to product realization is furthered by streamlined prototyping and
manufacturing, known as Rapid Prototyping and Computer-Aided Manufacturing (CAM).
II. Exact wording of the degree to be awarded, if appropriate:

Certificate in Computer-Aided Engineering Technology

III. Rationale for the curriculum, program, or endeavor:

A. Philosophic goals statement:

The Certificate in Computer-Aided Engineering Technology is a program designed to give qualified students and transitioning professionals the skill set needed to enter the workplace with core competencies that foster an immediate positive impact to the employer.

B. General and specific objectives:

Successful completion of the CAET certificate enables employers to evaluate applicants by review of the class curriculums and portfolios. Certificate recipients are well prepared for evolving technologies due to a sound basis in computerized design software combined with a mastery of three dimensional form and location geometry and software for different industries from mechanical to land development or structural.

IV. Relationship of this curriculum, program or endeavor to current mission and long-range plans of:

A. Participating departments, programs, schools, and colleges:

The proposed CAET certificate will be strongly supportive of the CEMS mission focuses of:

1c – Engendering strong visual communication skills; and
3 – Providing the State of Vermont an intellectual resource for technologically driven economic growth.

The proposed CAET certificate will complement the CEMS Engineering Departments course developments focused on strengthening design and analysis capabilities in future engineers. Upon review and approval by appropriate oversight committees, courses developed for this certificate could be used as technical electives for engineering students towards their degrees.

The CAET certificate includes courses from other colleges at the university as well. In addition to the College of Engineering and Mathematical Sciences, the CAET certificate will include courses from the College of Agriculture and Life Sciences (Computer-Aided

1 (the CEMS mission statement can be found in its’ entirety here: http://www.uvm.edu/~cems/?Page=explore/visionmission.php&SM=explore/_exporemenu.html)
Drafting & Design), the College of Arts and Sciences (Geotechnologies), and the Rubenstein School of Environment and Natural Resources.

B. The University:

The proposed CAET certificate will not be restricted to CEMS students. Therefore it will enhance course offerings for students both within the college and throughout the university. Further, it will be designed to be flexible with both traditional and online course offerings.

*Hybrid Course Offerings* - To accommodate both traditional students and address the time & access constraints of working professionals, some courses within the certificate will be offered both on campus and in an online format.

V. Relationship to programs offered currently:

No structured certificate programs in this discipline are currently offered at the University.

VI. Indicate any other programs at the University which are similar in title or content and illustrate how they may overlap or differ:

There is no other certificate program at the University with a primary focus on CAET. There is one computer-aided design (CAD) course required for a minor in Green Building and Community Design (GBCD) offered by the Department of Community Development and Applied Economics (CDAE). The course is CDAE 101 Computer-Aided Drafting and Design. This course uses architectural CAD programs (DataCad or ArchiCad) and focuses on housing. CDAE 101 comprises 3 of the 21 credit hours required for the GBCD minor. Details on the GBCD minor can be found at the following URL:


There is a UVM minor in Geospatial Technologies/Geographic Information Systems. One of the required course options is CE10 Geomatics. CE10 is a course on land surveying which also addresses the fundamentals of GIS systems.

The Rubenstein School of Environment and Natural Resources hosts a cross-campus minor in Geospatial Technologies that is supported by the teaching and learning computer laboratory in the Spatial Analysis Lab (SAL) in the Aiken Center. In partnership with the departments of Geography, Geology, Civil Engineering, Computer Science and UVM Libraries, the GST minor is the only other related technology program on campus.

https://www.uvm.edu/~geosptal/?Page=GSTMinor.html

VII. What comparable programs, if any, are in existent today in reputable colleges and universities:

A. What are the highlights of these programs and how do they compare with the projected program at UVM.
Many technical and trade schools offer certificate programs in computer-aided engineering or a related field. These programs are often designed as part of an established educational pathway into an associate’s degree followed by a career in drafting or as an engineering technician. As such, most programs include general education requirements in addition to the core computer software content and require additional credit hours.

The proposed Certificate of Study in Computer-Aided Engineering Technology at UVM would provide students the core competencies and skill sets in the computer software applications desired by employers to apply immediately and with positive impact in the workplace.

Students who have participated in other similar academic certificates such as the Certificate of Study in Actuarial Sciences and the Certificate in Computer Software have been for the most part non-traditional students with baccalaureate degrees as well as work experience who are seeking career advancement or a career change. The Certificate of Study in Computer-Aided Engineering Technology will provide those types of students the opportunity to update their skills and differentiate their resumes, especially those who completed their undergraduate studies some time ago.

Educational and government entities have recognized the growth of computer integration into the development and manufacture of products running in a range from consumer items to buildings. Design automation is evolving into multiple sub-disciplines:

- **Building Information Modeling (BIM)**
- **Computer-Aided Design (3D CAD), Product Development & Rapid Prototyping**
- **Computer-Aided Manufacturing (CAM)**
- **Geomatics and Topographic Surveying**

1. **Building Information Modeling (BIM) certificates.** Certificate programs are offered at New York University both in house and online. Virginia Tech does not have a stand-alone certificate, but has integrated BIM into both the Structural Engineering and Architecture & Urban Studies.

2. **Product Design, Rapid Prototyping & Computer-Aided Manufacturing (CAM) certificates.** There are many certificate offerings both by Colleges and the CAD parent companies (such as AutoDesk & Solidworks). Almost all focus on mastery of a single program. For example, UCAL-Long Beach has an AutoCad focused program. [http://www.ccpe.csulb.edu/continuinged/course_listing/programdescription.aspx?Course_Id=161&course_version=1&Content=20](http://www.ccpe.csulb.edu/continuinged/course_listing/programdescription.aspx?Course_Id=161&course_version=1&Content=20)

Most colleges who offer Solidworks certificates actually are prep and proctor centers for the Solidworks Corporate certification. This is a measure of ability used by potential employers. Corporate certifications are a measure of application of program specific skillsets not typically a certificate based on an educational group of courses.
Very few colleges have a certificate in Product Development. There is a certificate offering at NYU with only one CAD course:

There are degree programs offered at UCAL-Irving and Northwest Technical College (Minnesota):
http://www.ntcmn.edu/academics/programs/model_making_technology/industrial_model_making/

http://academics.ivc.edu/mcse/dmp/Pages/default.aspx

There is an industry association certificate in product development:
http://productinnovationeducators.com/pdma/what-is-npdp-certification/

Autodesk offers certifications including: 1) Autodesk Certified User (Certiport is the provider), 2) Autodesk Certified Professional, and 3) Autodesk Certified Specialist:

3. Rapid Prototyping & 3D Modeling certificates. There are a couple of programs just focused on this:

NYU Certificate in 3D Modeling and Printing
http://www.scps.nyu.edu/academics/departments/cada/academic-offerings/noncredit/certificate-in-rapid-prototyping.html

The Milwaukee School of Engineering Additive Manufacturing Certificate
http://www.sme.org/rtam-certificate-program/

4. Geomatics and Topographic Surveying certificates. Due to the depth of the discipline, there are a number of certificate programs. There is one at Metro State in Denver, but it is a 19 credit certificate discounting prerequisites.

http://catalog.msudenver.edu/preview_program.php?catoid=1&poid=169&returnto=33

There is a minor degree in this at Purdue:
http://eng.purdue.edu/CE/Academics/Groups/Geomatics/LS_Minor_Program.pdf

Due to the nature of land measurement and modeling, there are added complexities which hinder teaching such subject matter online to the extent needed for the comprehensive nature of a certificate.

B. Do universities engaging in regional participation with UVM offer these programs? In light of existence or absence of such programs, are there good reasons for promoting UVM or another university offering this program?
Similar programs exist within the New England region, however, they tend to be part of a community college curriculum and not offered through other universities.

The proposed Certificate of Study in Computer-Aided Engineering Technology program at UVM would be unique in serving the needs of non-traditional students as well as other identified populations including veterans, displaced and unemployed workers, and those new to STEM in Vermont.

As a result of the requirements of the Trade Adjustment Assistance Community College and Career Training grant program, a series of needs assessment meetings were held with employers from around the state in Fall 2014. The proposed Certificate of Study in Computer-Aided Engineering Technology is meant to respond to those employer needs including the desire for CAD training, 3-D design and modeling, and the general workforce need to stay current with software tools in engineering and engineering related positions.

VIII. Evidence of demand or need for program:

The CEMS team working on the TAACCCT grant has direct evidence from local employers as to the need for the type of training in the proposed Certificate of Study in Computer-Aided Engineering Technology as demonstrated through regional employer meetings in Fall 2014 and Spring 2015 as well as ongoing direct employer outreach in the state.

Vermont faces a challenge in finding skilled workers in STEM-related fields like engineering, manufacturing and information technology. The proposed Certificate of Study in Computer-Aided Engineering Technology aims to address that state-wide workforce challenge.

A. Indicate justification of inauguration of program at this time.

1. Explain education personnel needs and social needs that exist (refer to specific authorities or studies consulted):

   According to UVM STEM-Connect application for the U.S. Department of Labor TAACCCT grant program, Vermont employers are seeking workers who can operate at middle to high level of technical skill in STEM related careers. The proposed Certificate of Study in Computer-Aided Engineering Technology will provide training in current computer software tools to those entering or re-entering the workforce or those seeking career advancement in these types of technical positions and careers.

2. Anticipated enrollment or anticipated impact in case of a service or research endeavor for the first five years (five supporting evidence for estimate):

   As with existing academic certificates offered through CEMS, non-degree enrollments are initially modest with steady growth in program interest. Overall enrollments will be limited as students will be required to take courses on-campus in addition to online. As an example program the Certificate of Study in Actuarial Science started as a sequence with three applicants in Spring 2014 and has grown to eight so far in Spring 2016. One may anticipate as few as five students in the first year with growth of up to twenty over five years. These students will enroll in
existing courses that are offered for degree students, and certificate students will fill excess capacity and not require stand-alone course sections.

3. Indicate how this program will meet local and regional needs:

According to the June 2015 Vermont Department of Labor, Pathways to Promising Careers: Vermont’s High-Pay High-Demand Jobs publication, 180 total job openings for Civil Engineers are expected during the period 2012 – 2022. The proposed Certificate of Study in Computer-Aided Engineering Technology will help provide skill sets that will differentiate students, who complete the certificate, to demonstrate their competency with high demand engineering software tools. Vermont Department of Labor Occupational Projections 2012-2022, Vermont Statewide from August 2014 reveals employment opportunities in a wide range of Architecture and Engineering Occupations, many of which would benefit from the proposed Certificate of Study in Computer-Aided Engineering Technology.

In addition, a copy of Tapping Tech Vermont’s Digital Future can be found here:

https://issuu.com/vtsda/docs/tappingtech3

Additional References:

1. Vermont Department of Labor Occupational Projections 2012-2022
2. Vermont Technology Council Publication ‘Tapping Tech #3’, pg 18-21
3. 2015 US Bureau of Labor (BLS) Occupational Outlook
4. 2015 Worldwide CAD Trends Survey by the Business Advantage Group

4. If a doctoral program, include specific data on previous and present graduate programs at master’s level with the number of students and degrees awarded:

Not applicable

X. Students (if curriculum or academic program):

1. Evidence of a source of candidates:
Candidates would potentially come from UVM graduates, professionals in the area looking to change or advance their careers, veterans, displaced workers, unemployed or underemployed populations through referrals from Vermont Department of Labor, Community College of Vermont, the Vermont Army and Air National Guard, transitioning professionals looking to switch careers or modernize skillsets; dual enrollment for secondary STEM Career and Technical Education students; and students out of the area interested in the online component of the program.

2. Requirements of admission and retention of students:
Existing students will have no additional admission requirements for the sequence. They will be required to declare their intent to earn a certificate for the sequence. Students who are not currently full-time students must meet the prerequisite requirement of the appropriate certificate courses.
3. Selection process:

Students in the Computer-Aided Engineering Technology Certificate will be selected based on interest and academic standing/preparation, similar to students in other Certificate programs offered through CEMS.
4. Financial Support available through the department and expected from the Graduate College or other UVM sources (Graduate Programs):

Not Applicable

5. Mechanism of advising students:

Students will be advised by the program instructors within the Engineering Departments with support from the CEMS Dean’s Office, and the Continuing & Distance Education staff.

6. Prospects for employment or opportunities for further education of graduates:

Vermont Department of Labor Occupational Projections 2012-2022, Vermont Statewide from August 2014 reveals employment opportunities in a wide range of Architecture and Engineering Occupations many of which would benefit from the proposed Certificate of Study in Computer-Aided Engineering Technology. The Occupational Outlook Handbook (OOH) is published by the Bureau of Labor (BLS) Statistics and can be found at [http://www.bls.gov/ooh](http://www.bls.gov/ooh). Due to aging infrastructure, demand for Civil Engineers is expected to grow by 20% by 2022. Electrical and Electronics engineering positions will grow by 4%. OOH predicts little growth in Mechanical Engineering and drafting-support positions due to increased efficiencies due to advances in computer automation. In other words, employed MEs will be utilizing the Computer-Aided-Engineering tools currently evolving from CAD systems. A side note states: ‘Job prospects may be best for those who stay abreast of the most recent advances in technology.’

Please see the Business Advantage Group’s 2015 Worldwide CAD Trends Survey report (attached). CAD professionals can download a freely accessible, high-level report of the results using this link.

- Growth of 3D modeling in AEC is predicted to be up to 4 times greater than in Manufacturing
- PDM actual growth last year was more than double the prediction and 21% growth is expected this year
- Simulation adoption was more than double last year's prediction, AEC usage predicted to grow by 58% in 3-5 years
- PLM predicted to grow by 19% this year and 43% in the next 3-5 years
- Concurrent Engineering predicted to grow 32% this year, 63% in 3-5 years
- BIM growth lower than predicted last year but 45% predicted in AEC for next 3-5 years
- Mobile CAD usage highest in North America but highest 3-5 year growth expected in APAC
- 3D Printing to grow 50% this year, 39% in Manufacturing, 110% in AEC, usage to more than double in 3-5 years
- Cloud based CAD usage predicted to double this year and triple in 3-5 years - highest in AEC
Nearly 60% of CAD users are downloading 3D CAD models monthly, 30% of Manufacturing users download >10/month

XI. Programs of Study

A. Indicate all courses to be included in the program:

B. Existing UVM Courses that could fit

Name/Subject Instructor Credits Focus

REQUIRED:

ENGR 002 - Graphic Communications - 2 credits - General Engineering Fall & Spring Semester, V Rossi.

ENGR 112 – Building Information Modeling – up to 3 credits - Building Information Modeling (BIM) is a digital representation integrating the design tools used by most building disciplines under a single computer model. Buildings, facilities and infrastructure are modeled with special attention to Mechanical, Plumbing, Electrical and Structural systems. (Design integration of architecture with structural and mechanical-electrical-plumbing systems.) Spring Semester, V Rossi, open to degree and non-degree.

OPTIONS TO COMPLETE 3 ADDITIONAL COURSES INCLUDE:

CE 010 - Geomatics - 3 credits – An introduction to surveying including distance and angle measurements, leveling, traverse surveys, error propagation, topographical mapping, global positioning systems (GPS), and geographic information systems (GIS). This courses also includes an introduction to Civil3D (a specialized land-modeling/civil_application software offered by AutoDesk), Just Fall Semester, A Bomblies.

CDAE 101- Computer-Aided Drafting & Design - 3 credits - Using a computer to create, manipulate, and record drafting and design concepts, symbols, and conventions to prepare technical and/or presentation drawings. Fall & Spring Semester, C Ferreira.

GEOG 081 - Geospatial Concepts and Visualizations - 3 credits - Geospatial Technologies Listed as Geotechnologies Fall Semester, I Nelson; Spring Semester, Staff

CEMS 085 - Robotics - 3 credits - This is a course that guides the learning of beginning and intermediate students through the fascinating and interdisciplinary field of Robotics and Physical Computing. Merging the language of computer code with physical inputs and outputs results in a fascinating blend of technologies that often lead to surprising results. Students in this class will develop fluency with the physics of small robots, an understanding of physical inputs and outputs, and programming tools that enable autonomous behavior. J. Chase
ENGR 114 - Advanced 3D Drafting – 3 credits - This course covers solid modeling of physical objects using three dimensional CAD. It introduces parametric design; analysis tools; assembly simulation; dimension methods & standards; tolerances & geometric tolerancing. Furthermore, it addresses the design for manufacturing of machined parts; sheet metal; mold design and rapid prototyping. *Spring Semester, V Rossi.*

ENGR 116 – Virtual Instrumentation – 1 credit - This course introduces logical and electrical circuit modeling using LabView and includes: LabView Environment & Electrical Characterization Circuit Simulation, Scripting and Programming Interfacing and Control of Instrumentation. *Spring Semester, V Rossi.*

CEMS 095/295 - Interactive Design and Prototyping - 3 credits - This course opens up a world of innovation to students across disciplines. Within the span of a semester, students without previous engineering or programming knowledge will learn to build working interactive prototypes using sensors, light, sound and motion. In preparation for a final independent project, course teachings will include rapid prototyping, aesthetics, project management and presentation skills, the study of meaningful interaction between humans and machines, and profiles of prominent innovators from the humanities and sciences.

In hands-on labs students will learn how to build with the Arduino microcontroller, an electronics platform based on relatively easy-to-use hardware and software. The Arduino is a favorite tool of inventive designers, musicians, educators, artists, entrepreneurs, makers, architects, scientists and researchers. Assignments will challenge students to apply their newly acquired technical skills to creative projects that solve problems, inspire curiosity and follow independent lines of inquiry.

D. Research Endeavor (list arrangements for collaboration and/or supervision):

Not applicable

E. Field Work (clinical experience: arrangements for placement & supervision):

Not applicable
Computer-Aided Engineering Technology (CAET) Certificate

Occupational profiles for probable career outcomes of the CAET certificate program. These occupations were found a VTLMI proprietary tool. The occupations had the most postings for those with a certificate in computer aided design and drafting (CADD) and computer aided manufacturing programming (CAM) knowledge. Unless otherwise specified, national information comes from the Bureau of Labor Statistics and Vermont information comes from the Labor Market Information branch of the Vermont Department of Labor.

Mechanical Drafters

NAICS Code: 17-3013

Job synopsis: Use computer software to create detailed and accurate three-dimensional schematics of machinery. The work is necessary to finish engineering plans and to transition the creation of machinery to a manufacturer.

Median Yearly Wage:
- $57,290 for Vermont (VTLMI)
- $54,480 Nationally

Projected Growth by 2024:
- -8% for Vermont
- -6.8% Nationally

Education levels (O*Net):
- 40% Associate’s degree
- 23% Master’s degree
- 22% Post-secondary certificate

Vermont Employment: (VTLMI)
- Number of jobs (2014): 140
- Projected jobs in 2024: 129
- Projected job openings* through 2024: 2

Nationwide Employment:
- Number of jobs (2014): 65,700
- Projected jobs in 2024: 61,200
- Projected job openings through 2024: 7,800

Industries (O*Net):
- 58% Manufacturing
- 25% Professional, Scientific, and Technical Services
- 17% Other

Top Location Quotients by State:

Location quotients are the ratio of concentration of employment in the designated area to the concentration of employment in the nation for the specified occupation.

- Maine: 2.79
- Connecticut: 2.52
- Michigan: 2.26
- Wisconsin: 2.15
- Minnesota: 1.77
**Drafters**

BLS/VTLMI Code 17-3019

This occupation is classified as drafters, all other. Representing drafters from a variety of different industries and skills. Each individual occupation would be too specific for independent classification so they have been grouped here.

**Job Synopsis:** Draw up engineered plans that smooths out nuisances such as size of parts or measurements to take engineering ideas and manufacture them.

**Median Yearly Wage**
- $50,470 Nationally
- $56,080 For Vermont

**National projected growth by 2024:**
- -3.4 % Nationally
- N/A for Vermont

Vermont employment information is unavailable

**Nationwide Employment:**
- Number of jobs (2014): 14,700
- Projected jobs in 2024: 14,200
- Projected job openings through 2024: 1,700

Education levels: N/A

**Top Location Quotients by State:**
- Louisiana: 5.54
- Oregon: 4.45
- Montana: 3.62
- Ohio: 2.03
- Kentucky: 1.79

**Industries:**
- 37% Professional, Scientific, and Technical Services
- 24% Manufacturing
- 10% Construction
- 29% Other
Electric Motor, Power Tool, and Related Repairers
BLS/VTLMI Code 49-2092

Job Synopsis: Test machinery and measure parameters to diagnose problems. Assemble, clean, and repair mechanical parts to make machinery fully operational.

Median Yearly Wage:
- $41,570 Nationally
- $43,710 For Vermont

National projected growth by 2024:
- 3.6% Nationally
- N/A for Vermont

Vermont employment information is unavailable.

Nationwide Employment:
- Number of jobs (2014): 19,300
- Projected jobs in 2024: 20,000
- Projected job openings through 2024: 6,000

Education levels (O*Net):
- 44% High school diploma or equivalent
- 40% Post-secondary certificate
- 10% Less than high school diploma

Industries (O*Net):
- 29% Wholesale trade
- 26% Other services
- 10% Self employed
- 35% Other industries

Top Location Quotients by State:
- Idaho: 2.89
- West Virginia: 2.77
- Alabama: 2.22
- North Dakota: 2.12
- Minnesota: 2.10
Designers
BLS/O*Net Code 27-1029
This occupation is classified as designers, all other. Representing designers from a variety of different industries and skills. Each individual occupation would be too specific for independent classification so they have been grouped here.

Job Synopsis: Combine creative and technical skills to provide industry designs, then execute the design.

Median Yearly Wage:
   $53,380 Nationally
   Vermont: N/A

National projected growth by 2024:
   6.2% Nationally
   N/A for Vermont

Vermont Employment N/A

Nationwide Employment:
   Number of jobs (2014): 8,900
   Projected jobs in 2024: 9,500
   Projected job openings though 2024: 2,700

Industries:
   23% Self-employed
   17% Professional, scientific, and technical services
   11% Administrative and support services
   11% Information

Top Location Quotients by State:
   Montana: 3.39
   California: 2.29
   Maryland: 2.13
   Colorado: 1.88
   Minnesota: 1.81
Architectural and Civil Drafters
VTLM/O*Net Code 17-3011
  Architectural Drafter: 17-3011.01
  Civil Drafter: 17-3011.02

Job synopsis: Use computer software to create detailed and accurate three-dimensional drawings of buildings and civil engineering projects. The drawings are used for the construction projects. The work is necessary to understand the dimensions and required material to found structures soundly.

Median Yearly Wage:
  $51,640 Nationally
  $46,080 for Vermont

National Projected Growth by 2024:
  -3% Nationally
  -5% for Vermont

Vermont Employment:
  Number of jobs (2014): 258
  Projected jobs in 2024: 245
  Projected job openings through 2024: 30

Nationwide Employment:
  Number of jobs (2014): 94,000
  Projected jobs in 2024: 91,200
  Projected job openings though 2024: 11,100

Education Levels of Architectural Engineers (O*Net):
  68% bachelor’s degree
  15% post-baccalaureate certificate
  8% some college, no degree

Education Levels of Civil Engineers (O*Net):
  57% Associate’s degree
  29% Post-secondary certificate
  5% Some college, no degree

Industries:
  76% Professional, Scientific, and Technical Services
  24% Other

Top Location Quotients by State:
  Montana: 1.92
  Utah: 1.80
  Texas: 1.44
  Idaho: 1.45
  Colorado: 1.39
Electrical & Electronics Drafters

VTLM/BLS Code 17-3012
   Electronics Drafter O*Net Code: 17-3012.01
   Electrical Drafter O*Net Code: 17-3012.02

Job Synopsis: Use computer software to create detailed and accurate schematics of an electrical wiring layout. The drawings are used for the installation of electrical systems.

Median Yearly Wage:
   $59,970
   There is Vermont wage data

National Projected Growth by 2024:
   5% Nationally
   10% for Vermont

Vermont Employment:
   Number of jobs (2014): 48
   Projected jobs in 2024: 53
   Job openings through 2024: 10

Nationwide Employment:
   Number of jobs (2014): 30,100
   Projected jobs in 2024: 31,700
   Projected job openings through 2024: 5,200

Education Levels of Electrical Drafters (O*Net):
   30% Post-secondary certificate
   21% Bachelor’s degree
   19% Associates degree

Education Levels of Electronics Drafters (O*Net):
   51% Post-secondary certificate
   38% Bachelor’s degree
   9% Associates degree

Industries (O*Net):
   42% Professional, Scientific, and Technical Services
   23% Manufacturing
   16% Construction
   19% Other

Top Location Quotients:
   New Hampshire: 2.40
   Washington: 1.66
   Maine: 1.66
   California: 1.67
   Hawaii: 1.53
Complex Systems

UVM’s Graduate Certificate in Complex Systems will provide you with cutting-edge approaches to help you move to the forefront of your field and stand out when competing in a tough job market.

In complex physical, biological, social and engineered systems, the self-organizing dynamics of interacting entities (e.g., molecules, cells, genes, bacteria, plants, birds, humans, nanobots, electrical substations, etc.) give rise to emergent system properties (such as consciousness, cancer, global warming, societies, etc.). Fortunately, many essential properties of such systems may be studied, modeled and understood using similar approaches, regardless of the application domain. The Complex Systems (CSYS) Center is an emerging strength at UVM, one where the institution has already begun to assert leadership. CSYS research uses sophisticated mathematical modeling techniques to analyze real-world challenges. From developing next-generation information technology for a national smart grid to mapping the global influence of social media.

For further details, please visit: [http://www.uvm.edu/mgcsy/learning/learning/certificates/certificates/complex-systems/](http://www.uvm.edu/mgcsy/learning/learning/certificates/certificates/complex-systems/)

For Certificate Requirements, visit the [Complex Systems Certificate Requirements](#).

Learn More  Apply Now
Complex Systems Certificate

Courses offered Online and On Campus

In complex physical, biological, social and engineered systems, the self-organizing dynamics of interacting entities (be they molecules, cells, genes, bacteria, plants, birds, humans, nanobots, electrical substations, etc.) give rise to emergent system properties (such as consciousness, cancer, global warming, societies, etc.). Fortunately, many essential properties of such systems may be studied, modeled and understood using similar approaches, regardless of the application domain. The Complex Systems (CSYS) Center is an emerging strength at UVM, one where the institution has already begun to assert leadership. CSYS research uses sophisticated mathematical modeling techniques to analyze real-world challenges, from developing next-generation information technology for a national smart grid to mapping the global influence of social media.

Curriculum

The Certificate Requirements are 5 courses (15 credits), with a minimum GPA of 3.0 in these 5 courses. Students must complete the 2 required core courses, at least 1 elective from the A-list, and 2 more electives from the A-list or the B-list, shown below.

Required Courses

<table>
<thead>
<tr>
<th>CSYS/MATH 300 (Principles of Complex Systems)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSYS/CS 302 (Modeling Complex Systems)</td>
</tr>
</tbody>
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A List (1-3 courses)

<table>
<thead>
<tr>
<th>CSYS/MATH 266 (Chaos, Fractals, and Dyn. Sys)</th>
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<tbody>
<tr>
<td>CSYS/MATH 303 (Complex Networks)</td>
</tr>
<tr>
<td>CSYS/BIOL/CS 352 (Evolutionary Computation)</td>
</tr>
<tr>
<td>CSYS/STAT/CS 256 (Neural Computation)</td>
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<tr>
<td>CSYS/STAT/CS 355 (Statistical Pattern Recognition)</td>
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<tr>
<td>CSYS/STAT 253 (Appl Time Series &amp; Forecasting)</td>
</tr>
<tr>
<td>CSYS/STAT/CE 369 (Applied Geostatistics)</td>
</tr>
<tr>
<td>CSYS/CE 359 (Applied Artificial Neural Networks)</td>
</tr>
</tbody>
</table>
List (select 0-2 courses)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
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</thead>
<tbody>
<tr>
<td>CSYS/MATH 221</td>
<td>Deterministic Models Operational Research</td>
</tr>
<tr>
<td>CSYS/MATH 268</td>
<td>Mathematical Biology &amp; Ecology</td>
</tr>
<tr>
<td>MATH 330</td>
<td>Advanced Ordinary Differential Equations</td>
</tr>
<tr>
<td>CSYS/CS 251</td>
<td>Artificial Intelligence</td>
</tr>
<tr>
<td>CSYS/CE 245</td>
<td>Intelligent Transportation Systems</td>
</tr>
<tr>
<td>CSYS/CE 226</td>
<td>Civil Engineering Systems Analysis</td>
</tr>
<tr>
<td>CSYS/CE 295</td>
<td>Reliability of Engineering Systems</td>
</tr>
<tr>
<td>EE/STAT 270</td>
<td>Stochastic Processes</td>
</tr>
<tr>
<td>CSYS/ME 295</td>
<td>Systems and Synthetic Biology</td>
</tr>
<tr>
<td>CSYS/ME 312</td>
<td>Advanced Bioengineering Systems</td>
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<tr>
<td>CSYS/ME 350</td>
<td>Multi-Scale Modeling</td>
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<tr>
<td>CSYS/EE 395</td>
<td>Optimization in Engineering</td>
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<tr>
<td>PA 308</td>
<td>Decision Making Models</td>
</tr>
<tr>
<td>PA 317</td>
<td>Systems Analysis and Strategic Management</td>
</tr>
<tr>
<td>PA 306</td>
<td>Policy Systems</td>
</tr>
<tr>
<td>BIOL 271</td>
<td>Evolution</td>
</tr>
<tr>
<td>CSYS/PBIO 295</td>
<td>Ecological &amp; Environmental Modeling</td>
</tr>
<tr>
<td>PHYS 265</td>
<td>Thermal Physics</td>
</tr>
<tr>
<td>CS 206</td>
<td>Evolutionary Robotics</td>
</tr>
<tr>
<td>STAT 330</td>
<td>Bayesian Statistics</td>
</tr>
<tr>
<td>ENVS 295</td>
<td>Environmental Modeling and Systems Thinking</td>
</tr>
</tbody>
</table>
Certificate of Graduate Studies in Complex Systems

Information on occupations with required skills matching those developed in complex systems courses. These occupations were chosen because they had the most relevant jobs found using Vermont Labor Market Information (VTLMI) proprietary software when searching for candidates with experience in subjects relating to complex systems. Additional occupations are from a more specific elective track; e.g. GIS technician arises from elective courses focusing on GIS. A complete list of skills used to find these professions can be found at the end. Unless otherwise specified national data comes from the Bureau of Labor Statistics and Vermont data comes from the Labor Market Information branch of the Vermont Department of Labor.

Software Developer, Applications

NAICS Code*: 15-1132

Job Synopsis: Develop computer applications to be used by consumers. The applications will function as programs the users will either need or want.

Median Yearly Wage:

$100,080 Nationally
$91,720 for Vermont

Projected Growth from 2014 to 2024:

19% Nationally
16% for Vermont

Vermont Employment:
Number of jobs (2014) 863
Projected number of jobs in 2024: 1,008
Projected annual job openings* through 2024: 260

Nationwide Employment:
Number of jobs (2014): 718,400
Projected jobs by 2024: 853,700
Projected annual job openings: 238,000

Education Levels (O*Net):
80% bachelor’s degree
16% master’s degree
3% associates degree

Top location quotients by state:
Location quotients are the ratio of concentration of employment in the designated area to the concentration of employment in the nation for the specified occupation.
Washington: 2.83
New Jersey: 1.88
Colorado: 1.79
Virginia: 1.64
Massachusetts: 1.59

Industries:
42% Professional, Scientific, and Technical Services
19% Information
39% Other
Computer and Information Research Scientist
NAICS Code: 15-1111
Job Synopsis Research and find solutions in computer science, both in principle and practice.

Median Yearly Wage:
   $111,840 Nationally
   Vermont: N/A
Projected Growth from 2014 to 2024:
   11% Nationally
   N/A for Vermont

Vermont employment and wage information is not available.

Nationwide Employment:
   Number of jobs (2014): 25,600
   Projected jobs in 2024: 28,300
   Projected job openings through 2024: 6,000

Education Levels (O*Net):
   59% Master's degree

Top Location quotients by state:
   New Mexico: 5.83
   Maryland: 4.99
   Rhode Island: 4.79
   District of Columbia: 4.80
   Virginia: 3.59

Top Industries:
   Professional, Scientific, and Technical Services
   Government
**Database Administrator**

NAICS Code: 15-1141

Job Synopsis: Organize data frames for efficient analysis. Update databases and store them. Amend database structures.

Median Yearly Wage:
- $84,950 Nationally
- $67,850 for Vermont

Projected Growth by 2024:
- 11% Nationally
- 7% for Vermont

Education level:
- 77% Bachelor’s degree
- 11% Professional degree
- 7% Associate’s degree

Vermont Employment:
- Number of jobs (2014): 296
- Projected jobs in 2024: 318
- Projected job openings through 2024: 80

Nationwide Employment:
- Number of jobs (2014): 120,000
- Projected jobs in 2024: 133,400
- Projected job openings through 2024: 39,200

Top Location Quotients by State:
- Virginia: 1.91
- Delaware: 1.71
- Maryland: 1.71
- D.C.: 1.68
- Georgia: 1.45

Top Industries:
- 25% Professional, Scientific, and Technical Services
- 14% Finance and Insurance
- 12% Information
- 11% Educational Services
- 38% Other
Due to the precise classification of these professions, they fall under the BLS/VTLMI classification of computer occupations, all other. Therefore, having the same data representation as each other, which is an aggregate of all other computer occupations data.

**Business Intelligence Analyst**
NAICS Code: 15-1199.08  
Job Synopsis: Use business intelligence tools to analyze industry trends to make informed decisions.  
Education Levels (O*Net):
- 58% Bachelor’s degree
- 33% Master’s degree
- 4% Some college

**Geographic Information Systems Technician**
VTLMI/O*Net code: 15-1199.05  
Job Synopsis: Find best routes for transportation or best locations for renewable energy sources using expertise in geographic information systems.

**Computer Systems Engineers**  
VTLMI/O*Net code: 15-1199.02  
Job Synopsis: Design both the hardware and software sides of an organization’s computer systems to fit the needs and functionality of the organization.  
Education Levels (O*Net):
- 62% Bachelor’s degree
- 13% Post-secondary certificate
- 9% Some college, no degree
Wage and Employment information of Business Intelligence Analysts, Geographic Information Systems Technicians, and Computer Systems Engineers

Median Yearly Wage:
- $86,510 Nationally
- $80,460 for Vermont

Projected growth from 2014 to 2024:
- 3.3% Nationally
- 8% for Vermont

Vermont Employment:
- Number of jobs (2014): 192
- Projected jobs in 2024: 207
- Projected job openings through 2024: 40

Nationwide Employment:
- Number of jobs (2014): 233,000
- Projected jobs in 2024: 240,800
- Projected job openings through 2024: 37,700

Top Location Quotients by State:
- D.C.: 11.26
- Maryland: 2.86
- Colorado: 2.44
- Oregon: 1.90
- West Virginia: 1.73

Top Industries:
- Government
- Professional, Scientific, and Technical services
Management Analysts
NAICS Code: 13-1111
Job Synopsis: Gather and analyze information to make decisions benefitting the efficiency of an organization.

Median Yearly Wage:
  $81,330 Nationally
  $77,220 for Vermont

Projected Growth by 2024:
  14% Nationally
  15% for Vermont

Education Levels:
  46% Master’s degree
  38% Bachelor’s degree
  12% Post-baccalaureate certificate

Vermont Employment:
  Number of jobs (2014): 1,045
  Projected jobs in 2024: 1,207
  Projected job openings through 2024: 300

Nationwide Employment:
  Number of jobs (2014): 758,000
  Projected jobs in 2024: 861,400
  Projected job openings through 2024: 208,500

Top location quotients by state:
  D.C.: 6.21
  Virginia: 2.73
  Maryland: 1.54
  Massachusetts: 1.43
  California: 1.42

Top Industries:
  Professional, Scientific, and Technical Services
  Self-Employed
**Computer Systems Analysts**

NAICS Code: 15-1121

What they do: Combine knowledge of both business industry and IT to analyze an organization’s use of information to design a more effective system.

Median Yearly Wage:
- $87,220 Nationally
- $76,570 for Vermont

National projected growth by 2024:
- 20.9% Nationally
- 21% for Vermont

Vermont Employment:
- Number of jobs (2014): 394
- Projected jobs in 2024: 485
- Projected job openings through 2024: 140

Nationwide Employment:
- Number of jobs (2014): 567,800
- Projected jobs in 2024: 686,300
- Projected job openings through 2024: 191,600

Top Location Quotients by State:
- Delaware: 1.96
- Virginia: 1.74
- D.C.: 6.35
- Maryland: 1.47
- Washington: 1.46

Industries:
- 35% Professional, Scientific, and Technical Services
- 13% Finance and Insurance
- 52% Other
These occupations were found using proprietary labor insights software. The skills that led to job postings in these occupations were:

- Artificial Intelligence
- Big data
- C and C++
- Data management
- GIS software
- Data science
- Machine learning
- Mathematical modeling
- Statistical software
- Statistics
Certificate in Computer Software

UVM’s Certificate in Computer Software allows you to enroll in courses that suit your interests and experience, plus offers a highly flexible curriculum. All courses in this program award UVM credits, and you can also apply them toward a degree if desired.

You can select a course of study from one of the following tracks:
- Web Development Track
- Software Development Track
- Cybersecurity Track
- Self-Designed Track
- CS Master’s Preparation Track

Students Use This Certificate To:
- Enhance their computer science skills and become a more valuable employee
- Receive certification prior to entering or while working toward a degree in Computer Science
- Prepare for graduate studies in Computer Science

The highly flexible nature of the certificate allows students to enroll in a variety of courses suitable to their experience and interests. Many courses are available online and on campus. In all cases, students must complete five courses, for at least 15 credits, in approved computer software courses, with a minimum GPA of 2.0 in each course. Browse the complete list of computer science courses.

VA Benefits

The University of Vermont is able to certify VA benefits for this program. If you intend to use VA benefits for this program, please apply to the program and contact UVM’s Veterans Affairs Coordinator, David Carlson, via email at dcarter2@uvm.edu or by phone at (802) 656-0581, and Program Coordinator, Nichole Hathaway at Nichole.Hathaway@uvm.edu or by phone at (802) 656-4682, to inform the university of these intentions.

For further details, please visit https://www.uvm.edu/programs/certificate-in-computer-software/

Learn More  Apply Now
Computer Software Certificates

Courses offered Online and On Campus

UVM’s Computer Software Certificate is for those interested in careers in IT-related fields, earning credits toward a degree, or preparing for a MS in Computer Science.

The certificate offers a highly flexible curriculum. All courses in this program receive UVM credit, and you can apply them toward a UVM degree. The flexible nature of this certificate allows you to enroll in a variety of courses, available online and on campus.

The Certificate in Computer Software is a 15-credit academic certificate. Students choose from pre-set tracks, or a self-designed track and can complete more than one track, and courses may overlap between tracks.

In all cases, students must complete five courses, for at least 15 credits, in approved computer software courses, with a minimum GPA of 2.0 in each course.

Curriculum

Web Development Track
A selection of computer science courses specifically designed to prepare students for careers in web development,

- CS 008 Intro to Web Site Development
- CS 021 Computer Programming I
- CS 110 Computer Programming II
- CS 142 Advanced Web Design
- CS 148 Database Design for the Web

Software Development Track
A selection of computer science courses specifically designed to prepare students for careers in software development.

- CS 021 Computer Programming I
- CS 110 Computer Programming II
- CS 124 Data Structures & Algorithms*
- CS 205 Software Engineering
- CS 275 Mobile Apps & Embedded Devices

Self-Designed Track
If students don’t see a track that aligns with their interests, they may work with an advisor to design their own approved set of five courses under the ‘self-designed track.’
• CS 021 Computer Programming I
• Four (4) other advisor-approved courses

Cybersecurity Track
A selection of computer science courses specifically designed to prepare students for careers in cybersecurity,
• CS 021 Computer Programming I
  Plus 4 approved cybersecurity electives in CS or CIS. Such as:
• CS 008 Intro to Web Site Development
• CIS 096: Cybersecurity: Introduction and Exploration
• CIS 196: Applied Cybersecurity I
• CIS 096: Cybersecurity: Law, Policy, and Organizational Change

CS Master’s Preparation Track
A selection of computer science courses specifically designed to prepare students for continued studies in computer science at the graduate level. * This track can be especially helpful for students that didn’t major in computer science as an undergraduate, but are considering a master’s level program in C.S.

• CS 021 Computer Programming I
• CS 110 Computer Programming II
• CS 121 Computer Organization
• CS 124 Data Structures & Algorithms**
• CS 125 Computability and Complexity

*Please note that acceptance to the MS in Computer Science also requires prior coursework in calculus, linear algebra, and probability & statistics.
**Please note that CS 124 carries prerequisites of both calculus and discrete mathematics (structures).
Certificate Programs in Cybersecurity and Computer Software Occupational Profiles

Occupations corresponding to certification in computer software with the skills based on the track chosen. Occupations found through proprietary software. The software was used to find occupational postings that are looking for individuals with the specified certificate and associated skill. Unless otherwise specified, national information comes from the Bureau of Labor Statistics and Vermont information comes from the Labor Market Information branch of the Vermont Department of Labor.

Cyber Security
Occupation 1: Information Security Analysts
NAICS Code: 15-1122
Job Synopsis: Research and work with security technology to prevent cyberattacks and protect information and computer systems. Design recovery plans, plans for employees to follow in case of a cyberbreach.
Median Yearly Wage:
$75,400 for Vermont
$92,600 Nationally

Projected Growth by 2024:
13% for Vermont
18% Nationally

Vermont Employment:
Number of jobs (2014): 104
Projected jobs by 2024: 117
Projected job openings* by 2024: 20

Nationwide Employment:
Number of Jobs (2014): 82,900
Projected jobs by 2024: 97,700
Projected job openings by 2024: 25,500

Top Location Quotients by State:
Location quotients are the ratio of concentration of employment in the designated area to the concentration of employment in the nation for the specified occupation.
Virginia 4.45
Maryland 2.44
Minnesota 1.84
D.C. 1.76
Delaware 1.56

Top Industries:
38% Professional, Scientific, and Technical Services
Track Cyber Security
Occupation 2: Computer Systems Engineers/Architects

This information is from O*Net, BLS does not have information specifically on this occupation as it is too precise for BLS categorization.

NAICS Code 15-1199.02
Job synopsis: Work with software and computer technology to optimize both software and hardware for current project use. Then engineer new ways to further the efficiency of computers.

Median Yearly Wage:
$80,460 for Vermont
$86,510 Nationally (O*Net)

Projected Growth by 2024:
8% for Vermont
3% Nationally (O*Net)

Vermont Employment:
Number of Jobs (2014): 192
Projected jobs by 2024: 207
Projected openings by 2024: 40

Nationwide Employment (O*Net):
Number of Jobs (2014): 233,000
Projected jobs by 2024: 240,800
Projected job openings by 2024: 37,700

Education Levels of Computer Systems Engineers/Architects (O*Net)
61% bachelor’s degree
13% post-secondary certificate
9% some college, no degree

Top Location Quotients N/A

Top industries:
38% Government
18% Scientific and Technical Services
44% Other
**Web Development Track**

**Occupation:** Web Developers  
**NAICS Code** 15-1134  
**Job Synopsis:** Design websites with optimal performance. Ensure the content of web sites matches user interest by analyzing data.

**Median Yearly Wage:**  
- $57,730 for Vermont  
- $66,130 Nationally

**Projected Growth by 2024:**  
- 25% for Vermont  
- 27% Nationally

**Vermont Employment:**  
- Number of jobs 2014 estimate: 691  
- Projected by 2024: 862  
- Projected job openings by 2024: 260

**Nationwide Employment:**  
- Number of jobs (2014): 149,000  
- Projected jobs by 2024: 189,230  
- Projected job openings by 2024: 58,600

**Education levels of web developers: (O*Net)**  
- 43% bachelor’s degree  
- 20% associate’s degree  
- 13% post-secondary certificate

**Top Location Quotients by State:**  
- Vermont: 2.00  
- D.C.: 1.95  
- Oregon: 1.82  
- Washington 1.70  
- Maryland 1.65

**Top Industries for this Profession (O*Net):**  
- 31% Professional, Scientific, and Technical Services  
- 17% Information  
- 14% Self-Employed  
- 38% Other
Software Development Track
Occupation: Software Developers, Applications
NAICS Code 15-1132
Job Synopsis: Develop computer applications to be used by consumers. The applications will function as programs the users will either need or want.

Median Yearly Wage:
$91,720 For Vermont
$100,080 Nationally

Projected Growth by 2024:
16% Vermont
19% Nationally

Vermont Employment:
Number of jobs (2014) 863
Projected number of jobs by 2024: 1,008
Projected job openings by 2024: 260

Nationwide Employment:
Number of jobs (2014) 718,400
Projected jobs by 2024: 853,700
Projected job openings by 2024: 238,000

Top Location Quotients by State:
Washington: 2.83
New Jersey: 1.88
Colorado: 1.79
Virginia: 1.64
Massachusetts: 1.59

Education levels: (O*Net)
80% bachelor’s degree
16% master’s degree
3% associates degree

Top Industries:
42% Professional, Scientific, and Technical Services
19% Information
39% Other
Comparing Computer Science Graduates and Job Openings in Computer Professions

Per the National Center for Education Statistics (NCES) there were approximately 96,000 computer and information science degrees conferred in 2015. This is an aggregate of bachelor’s, master’s, and doctorate’s degrees. The number of graduates is not meeting the growth in job openings in computer professions, 1,038 thousand by 2024 (BLS). Or approximately 104,000 job openings due to growth or replacement per year. There is an 8,000-person gap between the compounded projected number of openings and graduates in 2015.
Pre-Actuarial Certificate

Offered Online and On Campus

Actuarial consistently ranks in the top 10 of all US jobs. No graduate degree is required, and the role promises high salary and job-growth potential.

UVM’s Pre-Actuarial Certificate is for individuals with strong math skills and an undergraduate degree who want to pass the Actuarial Science certification exams and work as an actuary. Courses are ideal for professionals with strong quantitative backgrounds and an interest in this field.

Whether you prefer learning in the convenience of your own desktop, with the discipline of a classroom, or a little bit of both, these classes are specifically designed to prepare you for your Actuarial Science exams. They are offered entirely online, entirely in the classroom, or a combination of both—so you know what you need to succeed and UVM’s Pre-Actuarial Certificate is here to help you do just that.

Many students begin working as actuaries after passing the initial exams. Companies often pay for employees’ remaining exams or offer salary increases for each exam passed.


For further details, please visit: http://learn.uvm.edu/programs/professional-actuarial-exam-preparation

UVM Lecturer Joseph Kuche made a great podcast about becoming an actuary. For more information, visit:

- Be An Actuary: http://www.becomeanactuary.org/
- SOA: https://www.soa.org/member/
- CAS: http://www.casact.org/

Learn More  Apply Now
Actuarial Science is the computation and theoretical engine by which insurance companies evaluate policy and risk and make decisions about their business streams. Professionals in this area are highly sought individuals with great job security.

The Pre-Actuarial Certificate is a program designed to give qualified students and transitioning professionals the fundamental base knowledge needed to enter the broad field of Actuarial Sciences and Financial Engineering. Successful completion of the Pre-Actuarial Certificate and subsequent professional exams, prepares individuals to join the financial workforce via internships or entry level positions.

In order to be eligible for the certificate, a student must be enrolled in or have attained at least a bachelor’s degree from an accredited school.

The Pre-Actuarial Certificate consists of fifteen credits hours of course study (i.e. five courses), spanning two different units within the University.

- STAT 151 – Applied Probability (CEMS)
- MATH 183 – Fundamentals of Financial Math (CEMS)
- STAT 183 – Statistics for Business (CEMS)
- EC 011 – Principles of Macroeconomics (CAS)
- EC 012 – Principles of Microeconomics (CAS)

This sequence of courses already exists at UVM and is already being offered to interested students and professionals during both the academic year and the summer sessions. What we seek is a formalization of this path of study and the institutional recognition through the existence of the Pre-Actuarial Certificate.

Furthermore, to accommodate the diverse backgrounds and time-constraints of working professionals and current students, the Pre-Actuarial Certificate is designed to be extremely flexible, allowing for traditional face-to-face sections as well as on-line sections of each of the required courses. It should be noted that all of the courses within the program have been taught as both face-to-face and as on-line courses.

The overall objective of the proposed Pre-Actuarial Certificate is to create a bridge between a student’s academic life and their professional life. The Pre-Actuarial Certificate will accomplish this goal in two ways. First and foremost, the coursework will supply the knowledge and desire needed in order to successfully sit for and pass the first two exams in the series of professional actuarial exams. Secondly, the coursework will supply the needed industry required VEE (Validation of Educational Experience) credits. Upon obtaining these credentials, a student will be a highly desirable candidate in the actuarial and risk-analysis workforce.

Looking specifically at Vermont, several area firms have commented on the difficulty in finding well qualified individuals. Many out of state students, who come to UVM for studies, eventually return to their home states to seek employment. Furthermore, many of the in-state students migrate to larger, more metropolitan areas, upon graduation. There is large demand but little supply.
Application for proposed Pre-Actuarial Certificate

I. Program title, director, participating faculty, responsible academic unit, and description of the program, as it would be included in the University or Graduate College Catalogue.

Program Title: Pre-Actuarial Certificate

Director: Joe Kudrle

Participating Faculty: Joe Kudrle Director/MATH 183 Instructor, Karen Benway STAT 151 Instructor, Katherine Merrill STAT 183 Instructor

Responsible Academics Unit: CEMS

Description of the Program

Actuarial Science is the computation and theoretical engine by which insurance companies evaluate policy and risk and make decisions about their business streams. Professionals in this area are highly sought individuals with great job security.

The Pre-Actuarial Certificate is a program designed to give qualified students and transitioning professionals the fundamental base knowledge needed to enter the broad field of Actuarial Sciences and Financial Engineering. Successful completion of the Pre-Actuarial Certificate prepares individuals to join the financial workforce via internships or entry level positions.

Three governing organizations maintain the credentials required to become a licensed actuary. These organizations are the Society of Actuaries (SOA), the Casualty Actuarial Society (CAS), and the Canadian Institute of Actuaries (CIA). The licensing process involves both formal educational credits as well as a series of professional exams.

The Pre-Actuarial Certificate consists of fifteen credits hours of course study (i.e. five courses) which all help to satisfy different components of this licensing process.

These courses fall into one of two categories:

VEE Credit Bearing Courses

Nine of the fifteen credits hours (i.e. three courses) satisfy the Validation of Educational Experience Credit (VEE Credits) requirements of the SOA, CAS, and CIA. These courses are:

1. EC 011 Principals of Macroeconomics (3-Credits) – Together, EC 011 and EC 012 satisfy the VEE Economics credit.
2. EC 012 Principals of Microeconomics (3-Credits) – Together, EC 011 and EC 012 satisfy the VEE Economics credit.
3. STAT 183 Statistics for Business (3-Credits) – STAT 183 Satisfies the VEE Applied Statistical Methods credit.

Professional Exam Preparation Courses

The remaining six credit hours (i.e. two courses) of study are designed to introduce students to the materials and skills needed to sit for and successfully pass two preliminary actuarial exams recognized by the SOA, CAS, and CIA. These courses are:

1. STAT 151 Applied Probability (3-Credits) – Prepares students to sit for and successfully pass Exam P/1. Note that the successful passing of this course does not count as a substitute for a successful pass of SOA Exam P and CAS Exam 1.
2. MATH 183 Fundamentals of Financial Mathematics (3-Credits) – Prepares students to sit for and successfully pass Exam FM/2. Note that the successful passing of this course does not count as a substitute for a successful pass of SOA Exam FM and CAS Exam 2.

Note: UVM’s Pre-Actuarial Certificate course sequence has obtained approval from the (SOA) as satisfying these stated credits.

https://www.soa.org/Institutions/University-of-Vermont.aspx

In order to be eligible for the certificate, a student must meet at least one of the following requirements:

(1) currently enrolled in at least a bachelor’s degree program from an accredited school. Students who are currently enrolled in a degree program must notify the director of the Pre-Actuarial Certificate of their intent to obtain the certificate prior to the student’s graduation.

(2) have at least a bachelor’s degree from an accredited school.

In order to successfully complete the program, a student must meet all of the following requirements:

(1) attained at least a bachelor’s degree from an accredited school. Note that this could be done concurrently with the certificate program.

(2) Achieved a grade of B- or better in each of the five certificate program courses. Note that a grade of B- or better is required in order for the VEE Credit bearing courses to count towards SOA, CAS, or CIA credit.

Students may transfer a total of 3-credits (1 course) from another institution provided that the grade in the course was at least a B-. Please note that students must be matriculated at the time credits are transferred.

Prerequisites required for courses within the Pre-Actuarial Certificate are:

- Two semesters of Calculus – MATH 019/020 or MATH 021/022 from UVM
- Introductory Statistics – STAT 141 from UVM
II. Exact wording of the degree to be awarded, if appropriate.

Pre-Actuarial Certificate

III. Rational for the curriculum, program, or endeavor:

A. Philosphic goals statement;

The overall objective of the proposed Pre-Actuarial Certificate is to create a bridge between a student’s academic life and their professional life. The program will do this in a two-fold manner.

- First, the program will allow for a student to earn several of the VEE Credits required to become a practicing actuary.
- Second, the program will give a student the skills needed to sit for and successfully pass the preliminary examinations needed in order to be deemed a desirable candidate

Furthermore, students who are enrolled within the program will also benefit from the ongoing connections between local industry and the University.

B. General and specific objectives.

An additional aspect of the Pre-Actuarial Certificate is to supply the knowledge and desire needed in order to successfully sit for and pass the first two actuarial exams (Exam P/1 and Exam FM/2), as well as supply the needed course-credit to satisfy industry required VEE Credits.

Upon obtaining these credentials, a student will be a highly desirable candidate in the actuarial and risk-analysis workforce.

Furthermore, to accommodate the diverse backgrounds and time-constraints of working professionals and current students, the Pre-Actuarial Certificate is designed to be flexible, allowing for traditional face-to-face sections and on-line sections of each of the required courses.

It should be noted that all of the courses within the program have been taught as both face-to-face and as on-line courses.

IV. Relationship of this curriculum, program, or endeavor to current mission and long-range plans of:
A. Participating departments, programs, schools, and colleges;

The proposed curriculum for the **Pre-Actuarial Certificate** has been in existence since 2010, and the course-work has run through Continuing and Distance Education (CDE) as an informal “sequence” of courses.

The participating colleges, CEMS, CAS and CDE, and their respective departments, *Mathematics and Statistics*, *Economics*, and *Distance Education*, have worked successfully over the last five years under this informal offering.

See below for a comprehensive explanation of the mission of the program and how it aligns with the mission of the Colleges involved and the University as a whole.

B. The University.

The proposed **Pre-Actuarial Certificate** curriculum would only work to enhance the coursework already being done at the university. Current UVM undergraduate students, who express an interest in actuarial studies, work to take the same sequence of courses, along with the required coursework for their major area of study. Current undergraduate students who wish to obtain the certificate in conjunction with their undergraduate degree must meet with the Program Director prior to their graduation.

One of the main goals of the University is to “identity necessary investments to ensure a bright future”. The **Pre-Actuarial Certificate** proposes to accomplish this goal by setting a concrete and stable career path for students with the appropriate skills.

Fundamentally students attend post-secondary education to foster their intellectual curiosities and to grow into productive citizens. Realistically, students attend post-secondary educational institutions to help prepare for future careers. In regards to students enrolled in programs through Continuing and Distance Education, this goal of career growth/enhancement is at the forefront. The **Pre-Actuarial Certificate** plans to aid students in finding a future in a very lucrative and high-demand career.

V. **Relationship to programs offered currently.**

The proposed **Pre-Actuarial Certificate** is currently offered through CDE as an informal “sequence” of courses.

Here is the current webpage for the sequence offered through CDE:  
http://learn.uvm.edu/program/professional-actuarial-exam-preparation/

Students will continue to have the ability to enroll in the less formal sequence offered through CDE, as this program will continue to be in existence.
VI. Indicate any other programs at the University which are similar in title or content and illustrate how they may overlap or differ.

The Mathematics Department offers a track for a BS in Mathematics with a concentration in Actuarial Science, but this might be seen as too much of a focus for students who have already obtained an undergraduate degree. Furthermore, this track is not accessible to non-math majors.

The program will be marketed towards professionals who already have an undergraduate education and who are looking to transition careers.

It should be noted that CDE has successfully been running an informal version of the Pre-Actuarial Certificate as a “sequence” for the last five years.

VII. What comparable programs, if any, are in existent today in reputable colleges and universities.

A. What are the highlights of these programs and how do they compare with the projected program at UVM?

Many large universities have specific degrees or even entire departments dedicated to actuarial studies, University of Connecticut, for example. These programs are designed for undergraduate and graduate students who are certain in their career path, and the curriculums in these programs align with industry requirements. The goal of these programs is to create a very focused and industry ready student.

The proposed Pre-Actuarial Certificate at UVM would look to give the same credentials to existing students (i.e. ability to sit for and successfully pass the first two actuarial exams (Exam P/1 and Exam FM/2), as well as multiple VEE Credit). However, the resulting students would differ in the experiences in which they could bring to potential employers.

Students who have successfully gone through (or are currently part of) the informal “sequence” have ranged from a recent graduate with a BA in Political Science, to an IBM engineer with a PhD in Theoretical Physics, to a high-school math teacher from Kansas.

In talks with industry professionals, one of the most desirable qualities within a successful actuarial work-force is having a set of highly-qualified individuals from diverse educational backgrounds. The idea of having too many “cookie-cutter” students from “large university programs” does not fit this model.
B. Do universities engaging in regional participation with UVM offer these programs? In light of existence or absence of such programs, are there good reasons for promoting UVM or another university for offering this program?

The ambitions of the **Pre-Actuarial Certificate** are modest when compared to programs in Boston (BC & BU) and Connecticut (UConn), but there is definitely a local market, a national market, and some existing connections with interested companies who have visited the campus and extolled the multi-disciplinary approach that UVM offers.

Specifically, a visiting group from Liberty Mutual, one of the largest employers in the insurance field, shared that their company is less interested in students who have studied actuarial science in a traditional four year program. They are more interested in liberal arts students who have a modest exposure to the field, but can offer perspectives generally found from study done outside of the financial industry.

**VIII. Evidence of communication with academic units likely to be involved in or affected by the program.**

Communication between the various academic units would be organized by CEMS.

A. Indicate the effect (cost, enrollment, etc.), the program will have on other academic units.

The effects would be minimal, and having the informal “sequence” in existence for the past five-years has given a benchmark on what can be expected.

B. Faculty engaged in the development of a new program must discuss the proposal with each dean and chairperson/program director of an academic unit likely to be affected by the new program. All units whose courses are an integral part of the proposed program must be included. A letter of support, or at least a record of e-mail correspondence, from each such unit must be attached to the proposal.

See attached letters.

C. The Graduate College Executive Committee must approve proposals for new graduate programs before they come to the Faculty Senate Curricula Affairs Committee. A letter indicating the approval and explaining the rationale for same must accompany the proposal.

Not applicable.

**IX. Evidence of demand or need for program:**
Looking specifically at Vermont, several area firms have commented on the difficulty in finding well qualified individuals. Many out of state students, who come to UVM for studies, eventually return to their home states to seek employment. Furthermore, many of the in-state students also migrate to larger, more metropolitan areas, upon graduation. Needless to say, there is demand for highly skilled, quantitative folks within the Vermont community.

Furthermore, with uncertainty abound amongst one of Vermont’s largest employers (IBM/Global Foundries), a large set of very qualified folks may be looking to make a career change in the near to immediate future.

A. Indicate justification of inauguration of program at this time:

1. Explain education, personnel needs, and social needs that exist (refer to specific authorities or studies consulted);

   There is no pressing need to add personnel at this juncture.

2. Anticipated enrollment or anticipated impact in case of a service or research endeavor for the first five years (give supporting evidence for estimate);

   As of seven or eight years ago, the Department of Mathematics and Statistics had relatively few students who expressed interest in the BS in Mathematics with a concentration in Actuarial Science. However, recent discussions with students have shown a level of interest that has increased dramatically.

   Under the guise of the less formal “sequence”, dozens of students expressed interest in the program, and several have been directed through the sequence of classes, passed one or more exams, and landed internships or gained full-time employment.

   CDE’s Salesforce data system gives the following information regarding interest in the program as of Feb. 17, 2015.

   - 252 total students who have expressed interest in the program (though please note that some of these records are more than a year old and others may be duplicates with records of those students who later applied to the program.

   - There have been 31 inquiries (students who have expressed interest) in the last 30 days

   - There have been 55 inquiries in the last 90 days

3. Indicate how this program will meet local and regional needs.
The greater percentage of today's actuaries work in the insurance industry, but the most significant growth will be in industries such as health care and consulting firms, according to the Bureau of Labor Statistics. Data from the bureau show a 26 percent growth for actuarial jobs by 2022, this is much higher than the average growth for all occupations.

4. If a doctoral program, include specific data on previous and present graduate programs at master’s level with the number of students and degrees awarded.

Not applicable.

X. Students (if curriculum or academic program):

A. Indicate:

1. Evidence of a source of candidates:

Candidates would potentially come from current UVM graduates, professionals in the area looking to switch careers, or students out of the area interested in the online component of the program. In the past five years, a handful of students have been directed through classes which comprise the proposed certificate, have passed one or more exams, have landed internships and have gained full time employment.

Furthermore, with the uncertainty in one of Vermont’s largest employers (IBM/Global Foundries), the demand for qualified, quantitative professionals looking to make career changes has the potential to increase.

2. Requirements of admission and retention of students;

In order to be eligible for the certificate, a student must meet at least one of the following requirements:

(1) currently enrolled in at least a bachelor’s degree program from an accredited school. Students who are currently enrolled in a degree program must notify the director of the Pre-Actuarial Certificate of their intent to obtain the certificate prior to the student’s graduation.

(2) have at least a bachelor’s degree from an accredited school.

In order to successfully complete the program, a student must meet all of the following requirements:

(1) attained at least a bachelor’s degree from an accredited school. Note that this could be done concurrently with the certificate program.
Achieved a grade of B- or better in each of the five certificate program courses. Note that a grade of B- or better is required in order for the VEE Credit bearing courses to count towards SOA, CAS, or CIA credit.

Students may transfer a total of 3-credits (1 course) from another institution provided that the grade in the course was at least a B-. Please note that students must be matriculated at the time credits are transferred.

3. Selection process;

Students who have the appropriate prerequisites will be admitted to the program.

4. Financial support available through the department and expected from the Graduate College or other UVM sources (Graduate Programs);

Not applicable.

5. Mechanism of advising students;

Students will be advised by the program instructors within the Department of Mathematics and Statistics, with support from the CEMS Dean’s Office.

6. Prospects for employment or opportunities for further education of graduates.

Students who have gone through the informal “sequence” have obtained careers in firms such as Aon Hewitt and Milliman (the latter having a local branch in South Burlington).

From the BLS, median annual earnings of actuaries were $93,680 in 2012. The job outlook for the period from 2012 – 2022 is expected to grow by 26%, which is much faster than the average job growth.

XI. Programs of study:

A. Indicate all courses to be included in the program:

1. List existing courses envisioned as a part of new program. What effect on enrollment is anticipated?

Exam Preparation Courses – The effect on enrollment to these classes will be manageable within the current offerings of the courses.

- STAT 151 – Applied Probability
- MATH 183 – Fundamentals of Financial Math
VEE Credit Bearing Courses – The effect on enrollment to these classes will be manageable within the current offerings of the courses.

- STAT 183 – Statistics for Business
- EC 011 – Principles of Macroeconomics
- EC 012 – Principles of Microeconomics

2. List required new courses or changes to existing courses in order to initiate program. (If new course or changes to existing course are required, complete a “Course Change Form” for each course and submit request(s) concurrent with the program proposal.)

Not applicable.

3. Courses offered under the Special Topics course rubric (i.e. X29/X296) may not be listed as requirements for majors, minors or graduate degree or certificates.

Not applicable.

B. Research endeavor (list arrangements for collaboration and/or supervision).

Not applicable at this time.

C. Field work (clinical experience: arrangements for placement and supervision).

Several local firms (Milliman, Marsh USA, National Life Group, Vermont Mutual Insurance Company) have offered the desire to potentially work with candidates in the program via internships or mentoring. The requirement of an internship is not a formal part of the certificate, but students who have the desire and ability to take part in an internship experience will be supported.
Occupational Profile Report: Actuaries (15-2011)

Occupation Description:

Actuaries analyze the financial costs of risk and uncertainty by compiling statistical data and other information for analysis. Duties include estimating the probability and likely economic cost of an event such as death, sickness, an accident, or natural disaster. Actuaries design, test, and administer insurance policies, investments, pension plans, and other business strategies to minimize risk and maximize profitability. The final conclusions of these analyses are compiled in charts, tables and reports that display calculations and proposals regarding risk, which are then explained to company executives, government officials, shareholders, and clients.

Education and Certification Requirements:

All actuarial positions require a bachelor’s degree in mathematics, actuarial science, or another analytical field. Beyond a bachelor’s degree actuaries must also have certification with the Society of Actuaries or Casualty Actuarial Society. Entry level positions require the successful completion of at least two of the actuarial exams, and the completion of the Validation by Educational Experience requirements. The completion of the associateship level certification can take 4-6 years of on the job training and individual study.

National Occupational Outlook:

The median annual wage for actuaries in the United States is $100,610 (2016) which is well above the median annual wage of $37,040 (2016) for the United States across all occupations. The lowest 10 percent of actuaries earned less than $58,910, and the highest 10 percent earned more than $186,250 annually (BLS 2017).

The graph below illustrates a comparison of the median annual wage in the United States during 2016 for occupations that require skills like those of an actuary. Compared with similar occupations actuaries had the third highest median income in 2016 behind mathematicians and economists, both of which require a master’s degree.
In the United States the occupational job outlook projects that actuarial employment will grow by 18% during the years 2014-2024 resulting in 4,400 new jobs by 2024 (BLS 2017). Accounting for net replacement and growth there will be 1,170 job openings annually during that period (O*NET 2017). This is more than double the national growth rate of 7% for all occupations over the same period. The following graph shows a comparison of similar occupational growth rates for the 2014-2024 period (BLS 2017).

**National Outlook by Industry:**

In the United States actuaries are employed in four major industries. The chart to the right shows the percent of total employed actuaries in each industry. The chart below breaks down the median annual wage of actuaries based on their industry of employment.

**Actuaries Median Annual Wages Across Industries**

<table>
<thead>
<tr>
<th>Industries</th>
<th>Median Annual Wages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional, Scientific, Technical</td>
<td>$104,550.00</td>
</tr>
<tr>
<td>Finance and Insurance</td>
<td>$101,120.00</td>
</tr>
<tr>
<td>All Industries</td>
<td>$100,610.00</td>
</tr>
<tr>
<td>Government</td>
<td>$95,550.00</td>
</tr>
<tr>
<td>Management</td>
<td>$93,370.00</td>
</tr>
</tbody>
</table>
Vermont Occupational Outlook:

The wage data in Vermont for actuaries is not large enough to publish median wage, however the Labor Market Information Division of the Vermont Department of Labor can project 1.5% annual growth over 10 years starting in 2014, which is 15.9% growth from 2014 to 2024. This will result in 10 new jobs by 2024 and 3 job openings every year due to growth and net replacement.

National Location Quotient:

The Bureau of Labor Statistics complies information regarding the concentration of occupational employment and publishes that information as a location quotient. Per the BLS website “The location quotient is the ratio of the area concentration of occupational employment to the national average concentration. A location quotient greater than one indicates the occupation has a higher share of employment than average, and a location quotient less than one indicates the occupation is less prevalent in the area than average” (BLS 2017). The following graph displays the top five areas with the highest concentration of actuarial employment relative to the country.

<table>
<thead>
<tr>
<th>Location Quotient for Actuaries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Massachusetts</td>
</tr>
<tr>
<td>Kansas</td>
</tr>
<tr>
<td>Rhode Island</td>
</tr>
<tr>
<td>Iowa</td>
</tr>
<tr>
<td>Connecticut</td>
</tr>
</tbody>
</table>

Occupations with Similar Skill Requirements:

The following are occupations with similar skill requirements. The numbers next to the occupations are the O*NET numbers associated with each occupation.

- Accountant and Auditors (13-2011)
- Budget Analysts (13-2031)
- Cost Estimators (13-1051)
- Economists (19-3011)
- Financial Analysts (13-2051)
- Insurance Underwriters (13-2053)
- Mathematicians (15-2021)
- Personal Financial Advisor (13-2052)
- Statistician (15-2041)
Data Resources:

The Bureau of Labor Statistics Website:
- Website: https://www.bls.gov/ooh/Math/Actuaries.htm#tab-1
- Website: https://www.bls.gov/oes/current/oes152011.htm#(9)
  Information on occupation description, education required, United States median wage data, national industry data, and national job growth data.

Economic & Labor Market Information Website:
- Website: http://www.vtlmi.info/oic3.cfm?occcode=15201100
  Information on occupation wages, growth, and job openings in Vermont.

O*NET Online Website:
- Website: https://www.onetonline.org/link/summary/15-2011.00
  Information on national annual job openings.

Society of Actuaries Website:
- Website: https://www.soa.org/pathway/
  Information on the pathway to become an Associate Actuary with the Society of Actuaries.

Casualty Actuarial Society Website:
- Website: http://www.casact.org/admissions/process/
  Information on the pathway to becoming an Associate of the Casualty Actuary Society.
STEM-Connect
Student Survey

1. Last Name, First Name, Middle Initial

2. Please enter the last four digits of your social security number.

3. What is your preferred method of contact?
   - [ ] email
   - [ ] phone
   - [ ] text
   - [ ] Other (please specify)
     ______________________________________

4. Please select the Certificate/Sequence in which you are enrolled.
   - [ ] Pre-Actuarial Certificate (Actuarial Science)
   - [ ] Computer Software Certificate in Computer Software Development
   - [ ] Computer Software Certificate in Web Development
   - [ ] Computer Software Certificate in Cyber Security
   - [ ] Computer-Aided Engineering Technology Sequence
   - [ ] Computer Software Certificate - CS Master's Preparation Track
   - [ ] Computing Systems Certificate
   - [ ] Computer Software - track not specified
   - [ ] I am not working toward a Certificate
5. How did you hear about the certificate programs? Please check all that apply.

- Radio Commercial
- Website
- Social Media
- Google Search
- Online Advertisement
- Television Commercial
- Seven Days Newspaper
- Brochure or Printed Material
- CCTA Bus Sign
- Front Page Forum
- VSAC (Vermont Student Assistance Corp.)
- Vermont Dept. of Labor
- National Guard
- Vermont Vocational Rehabilitation
- Personal Referral
- Other State or Service Agency (Please identify in Comment Box below)
- Other (Please identify in Comment Box below)

Comment:

6. What goal(s) are you hoping to achieve by enrolling in this certificate program (please check all that apply)?

- Personal enrichment
- Improved skills
- A better job
- To try out college
- To obtain courses to transfer to another program
- To obtain the certificate
- To obtain an associate degree
- To obtain a bachelor's degree
- To obtain a master's degree
- Other (Please specify in Comment Box below)

Comment:

7. What is your marital status?

- Married
- Single
8. Do you have a disability as defined by the Americans with Disability Act (ADA)? The ADA defines a disability as a physical or mental impairment that substantially limits one or more of a major life activity (for example, performing manual tasks, seeing, hearing, eating, sleeping, walking, standing, lifting, bending, speaking, breathing, learning, reading, concentrating, thinking, communicating, and working).

- [ ] Yes
- [ ] No
- [ ] Don't know

9. Was the highest level of education or degree that you received in the United States or in another country?

- [ ] in the U.S.
- [ ] in another country

10. What is the highest level of education or highest degree you have received?

- [ ] High school degree
- [ ] High school degree equivalent (e.g., GED, foreign degree equivalent)
- [ ] Some college but no degree
- [ ] Associate degree or foreign equivalent
- [ ] Bachelor degree or foreign equivalent
- [ ] Graduate degree or foreign equivalent
- [ ] Other (please specify)

11. What is the highest level of education or highest degree that at least one of your parents has received?

- [ ] Did not complete high school
- [ ] High school degree or equivalent (e.g., GED) or completed foreign secondary education
- [ ] Some college but no degree
- [ ] Associate degree or completed similar foreign post-secondary technical/vocational training
- [ ] Bachelor's degree or equivalent
- [ ] Master's degree or equivalent
- [ ] Beyond master's degree
- [ ] Don't know
12. Do you have any formal education in the STEM (Science, Technology, Engineering or Mathematics) fields?
   ○ Yes
   ○ No

13. Do you consider yourself a non-traditional student? A non-traditional student is defined as a student with at least one of the following characteristics: at least 24 years of age, married, a graduate or professional student, a veteran, a member of the armed forces, an orphan, a ward of the court, someone with legal dependents other than a spouse, an emancipated minor, or someone who is homeless or at risk of becoming homeless.
   ○ Yes
   ○ No
   ○ Don't know

14. Have you or your spouse ever served on active duty in the U.S. Armed Forces?
   ○ Yes
   ○ No

15. Are you Trade Adjustment Assistance (TAA) eligible? You may be TAA-eligible if you are a member of a group of workers who lost their jobs or experienced a reduction in wages as a result of foreign trade. In order to be eligible, a petition must have been filed with the US Department of Labor by or on behalf of your group and the Department must grant the petition and certify your worker group is eligible.
   ○ Yes
   ○ No
   ○ Don't know

16. Are you a displaced worker? Displaced workers are individuals who lose their jobs because their employer closed a plant or division; moved or abolished their position; or simply had insufficient work for them.
   ○ Yes
   ○ No
   ○ Don't know

17. Which of the following categories best describes your employment status when you began the certificate courses?
   ○ Employed, working full-time (defined as 30 hours or more per week) either as an employee or independent contractor (self-employed)
   ○ Employed, working part-time (working less than 30 hours per week) either as an employee or independent contractor (self-employed)
   ○ Not employed, looking for work
   ○ Not employed, NOT looking for work
   ○ Retired, or a full-time student not seeking employment
   ○ Other (please specify)

18. Do you consider yourself underemployed? A person is considered underemployed if he or she is employed part-time but desires full-time work, or if he or she has education, experience, or skills beyond the requirements of the job.
   ○ Yes, I am working part-time in a job that requires my level of education, experience or skills, but desire to work full-time.
   ○ Yes, I am working full-time, but in a job that does not require the level or education, skills, or experience I have.
   ○ Yes, I am working part-time and desire full-time work and the job I have does not require the level of education, experience, or skills I have.
   ○ I am not underemployed.
19. Please select one item from the list below that most closely describes the field of your employment when you began the certificate courses?

- Agriculture, Food and Natural Resources
- Architecture and Construction
- Arts, Audio-Video Technology and Communication
- Business, Management and Administration
- Education and Training
- Finance
- Government and Public Administration
- Health Science
- Hospitality and Tourism
- Human Services
- Information Technology
- Law, Public Safety and Security
- Manufacturing
- Marketing, Sales and Service
- Science, Technology and Engineering
- Transportation and Distribution
- Other (please specify)

20. What was your job title at the time you began your certificate courses?

______________________________

21. What was your wage per hour at the time you began the certificate courses?

______________________________

22. How many employers have you had over the past five years?

- None
- One
- Between 1 and 4
- More than 4
- Self-employed
23. Please select one item from the list below that most closely describes the field in which you have been employed most of your work life.

- I have never worked
- Agriculture, Food and Natural Resources
- Architecture and Construction
- Arts, Audio-Visual Technology and Communication
- Business, Management and Administration
- Education and Training
- Finance
- Government and Public Administration
- Health Science
- Hospitality and Tourism
- Human Services
- Information Technology
- Law, Public Safety and Security
- Manufacturing
- Marketing, Sales and Service
- Science, Technology and Engineering
- Transportation and Distribution
- Other (please specify)

24. Is anyone in your household dependent on you for care?

- Yes
- No

Thank you so much for taking the time to complete this survey.

Your answers will help us continue to improve our certificate programs and design programs that help you achieve your goals.
INTERVIEW PROTOCOL to Accompany Data Collection Survey Sheet

Group: Completer, Current Enrollees, or Withdrawn

Prior to interview CHECK to see whether online survey data available

Introductory Description of the Certificate Program
I am a member of the team conducting an evaluation of the UVM College of Engineering and Mathematical Sciences Certification program. Do you have any questions before we begin?

1. SURVEY #4: What Certificate Program are you enrolled in?
2. SURVEY #5: How/where did you first learn about the certificate program?
3. SURVEY #6: What made you decide to enroll in the certificate program?
4. Were there any requirements to enroll in the program? Y/N
   Did you take any tests to measure your skills or knowledge prior to enrollment? Y/N

   If yes, what were they?

5. Did anyone ask you questions about specific needs you might have or any assistance you might need? Y/N

   If yes, how was this done?

6. What were you told about the expectations and requirements for the certificate program?
   Was there a formal orientation process? [If so, please describe]

Background (may have this information from on-line survey)
7. SURVEY #11: What is the highest level of education or highest degree that at least one (either) of your parents has received?
   a. Did not complete high school
   b. High school degree or equivalent (e.g. GED) or completed foreign secondary education
   c. Some college but no degree
   d. Associate degree or completed similar foreign post-secondary technical/vocational training
   e. Bachelor's degree or equivalent
   f. Master's degree or equivalent
   g. Beyond master's degree
   h. Don't know

8. SURVEY #24: Is anyone in your household dependent on you for care?
   a. Yes
   b. No
   c. If yes, please explain

9. SURVEY #17: Were you employed when you began the certificate program?
   a. SURVEY #21: If yes, what was your hourly wage/salary level at that time?
b. Was it a part-time or full-time position?

10. What is your age? ____

11. What is your Estimated GPA in the Certificate Courses? _____

12. AVAIL SPREADSHEET: When did you begin the program (semester and year)?

The Courses

13. What certificate courses are/were you enrolled in?

14. Which course(s) did you find the most useful in helping advance your learning goals?

15. Which course(s) did you find the least useful?

16. For each of the courses, please answer the following:
   a. Did you successfully complete the course?
   b. Which, if any of the COURSE RELATED supports offered by UVM did you use?
      (For example, lending library, tutoring, academic counseling, etc
   c. Were these courses online or in-person?
      [if online, probe for strengths and weaknesses related to format – what they like;
      don’t like about online offerings? More of? Less of?]
   d. For in-person courses, were there also on-line options available through
      Blackboard or other platforms? If yes, in what way were they beneficial?
   e. What other supports, if any, would have been helpful?
   f. What stands out to you as the overall value of the course(s)?
   g. How did the courses influence your thinking about STEM and STEM careers?
   h. Anything else you want to share about the courses?

17. In addition to the certificate program courses, have you connected with other college
   services? Did the program help you connect to these services? Who at the college has
   provided this assistance?

   [Probe as needed for specific services such as academic advising, financial aid,
   or counseling? Services could include financial stability supports; academic
   support; personal supports; sources of public support used to ensure financial
   stability; and career transition supports.

The Certificate Program

18. Are you working to complete a certificate? Y/N  If yes, which one? (or more)

19. What makes the certificate program unique?

20. Is the program personalizing its approach so that it supports your strengths and growth?

   Please comment.

21. How does the certificate program fit with demands of the job market?

22. What about the certificate program should be improved (because it isn’t working for you)?

23. What about the certificate program should not be changed (because it is really good)?

24. How could the certificate program be improved to increase your prospects for a career in
   STEM?

25. Have you participated in an internship (work-based learning) while enrolled in the
   certificate program?
   a. If no, why not?
b. If yes,
   i. What worked well?
   ii. What changes would improve the experience?

Current Employment, Future Education and Future Employment
26. Are you currently employed; is it the same position as when you started the certificate? Y/N
   a. SURVEY #19: If yes, is your employment in a STEM related field?
   b. SURVEY #21: If yes, what is your CURRENT hourly wage/salary level?
      i. Is this hourly wage/salary level for full-time or part-time work?
   c. Is your current hourly wage/salary level an increase since the start of enrollment in the certificate program? Y/N
      i. If yes, do you think that you can attribute the increase to your experience with the certificate program? Y/N _______ (estimated increase). Please comment.
26.d. If NOT employed, have you accepted a position for next year or are you actively pursuing employment?
26.e. If NOT employed, what hourly wage/salary level are you aiming for? __________

27. Do you plan to continue towards completing a degree (Bachelor’s or Masters) at UVM? (or elsewhere) Y/N
   a. If Yes, What factors influenced your decision to continue?
   b. How has participation in the certificate program impacted your future career plans?
      [Probe: Do you think the college will help you get a job in your field once you complete the program? How so? Probe as needed for internship opportunities, referrals to local employers, job search services, or referrals to job search services.]

Overall Satisfaction
28. Are you satisfied with the education, training, and supports you are receiving from UVM’s CEMS Certificate Program?

Anything Else?
29. Is there anything else you would like to share about your experience in the program?

For students Who Have Withdrawn
30. Why did you withdraw from the program? (Was it, for example: lack of preparation, lack of financial aid, lack of counseling and academic support services, family commitments, time commitments, illness, other? (Include all that apply.)

31. What do you think UVM could have done in order to help enable you to remain in the certificate program and complete it?
Background variables based on project records:

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UVM TAACCCT Participant Crosstabulations

*Based on VDoL’s 2016 4th quarter Administrative Wage Records*

*July 2017 v1*

**Participants (Enrolled) Tables-Employment**

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## GEN * Employed Crosstabulation

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## Participants (Non-Enrolled) Tables-Employment

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### Participants (Non-Enrolled) Tables-Employment

**GEN * Employed Crosstabulation**

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## Participants (Non-Enrolled) Tables-Employment

### ACAD * Employed Crosstabulation

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### AGE * Employed Crosstabulation

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## Participants (Non-Enrolled) Tables-Wage Level

**EDLEV * Wage_Level Crosstabulation**

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### Participants (Non-Enrolled) Tables-Wage Level

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<td>48.9%</td>
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% within GEN
- F: 57.7%, M: 47.6%
- Total: 51.1%

% within Wage Level
- F: 39.4%, M: 60.6%
- Total: 100.0%

% of Total
- F: 20.1%, M: 31.0%
- Total: 51.1%
### ACAD * Wage_Level Crosstabulation

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Participants (Non-Enrolled) Tables-Wage Level

### AGE * Wage_Level Crosstabulation

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The following tables were suppressed per the reporting criteria specified in the MOU:

- **TAACCCT Certificate Enrolled Participants Employed Cross Tabulations**
  - ACAD GPA: Too few “No Data” observations
  - DEP: Too few ‘Y’ observations

- **TAACCCT Certificate Non-Enrolled Participants Employed Cross Tabulations**
  - DEP: Too few ‘Y’ observations

- **TAACCCT Certificate Enrolled Participants Wage Level Cross Tabulations**
  - All Tables had at least one cell below the suppression threshold
TAACCCT Certificate Non-Enrolled Participants Wage Level Cross Tabulations

- **DEP:** Too few ‘Y’ observations.

### UVM TAACCCT 4 Participants with Wages in 4th Quarter 2016 (n=701)

#### Group Statistics

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<th>Std. Error Mean</th>
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#### Independent Samples Test

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<th>Std. Error Difference</th>
<th>95% Confidence Interval of the Difference</th>
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<th>Std. Error Difference</th>
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<td>$563.495</td>
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### Background Variables and Participant Outcome Tables

- **Enrolled** 85 (87.74) [0.09] 616 (613.26) [0.01] 701
- **Not Employed** 191 (188.26) [0.04] 1313 (1315.74) [0.01] 1504
- **Marginal Column Totals** 276 1929 2205 (Grand Total)

The chi-square statistic is 0.1438. The p-value is .704501. This result is not significant at p < .05.