OCCC
Oklahoma City Community College

OKLAHOMA CITY
COMMUNITY COLLEGE

TAACCCT:

Commercial Food Equipment Service Technician (CFEST) Program

THIRD-PARTY EVALUATION FINAL REPORT

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WorkED. Consulting

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About This Publication
WorkED Consulting, LLC, a small business management consulting firm located in Burke, Virginia, and its evaluation partner, MN Associates, located in Fairfax, Virginia, wish to thank and acknowledge staff at Oklahoma City Community College for their many hours of time and effort spent providing qualitative and quantitative data.

1.0 Executive Summary

Oklahoma City Community College (OCCC) is a comprehensive community college located in Oklahoma City, Oklahoma. The community college was founded in 1972, and currently enrolls approximately 19,700 students. OCCC offers several Associate in Arts and Associate in Science degree programs, Associate in Applied Science degree programs, and Certificate of Mastery programs. Most courses are structured in a semester or 16-weeks; however, some courses can be completed in as little as four weeks. OCCC's programs maintain regional accreditation from The Higher Learning Commission.

In 2014, OCCC applied for, and was successfully awarded, a Trade Adjustment Assistance Community College and Career Training (TAACCCT) grant from the U.S. Department of Labor. OCCC's Commercial Food Equipment Service Technician (CFEST) program was a single institution award that sought to improve, expand, and accelerate learning in the Engineering Career Pathway, beginning in central Oklahoma, and scaling nationally for TAA-eligible workers and other adults via (1) expanded engagement flexibility; (2) redesigned remedial education to include acceleration and contextualization; (3) Prior Learning Assessment (PLA); (4) latticed programs and new industry-recognized credentials; (5) advanced online and technology-enabled learning; (6) strategic alignment with the workforce system and other stakeholders; and (7) sector strategies and substantial employer engagement.

CFEST program staff worked with local industry employers to develop and enhance a new workforce training program and commensurate instructional strategies to meet the workforce needs of commercial food equipment service and repair employers. Through sector-driven strategies, CFEST developed a competency-based training model that included traditional in-person instruction in an effort to increase quality and reduce the time to completion. National industry-recognized credentials were embedded into the program, and a renewed focus on prior learning assessment (PLA) allowed for articulation to credit and an associate degree.

The **program implementation study** was designed to answer sets of research questions in four key areas: (1) Curriculum Review, Use and Selection; (2) Program Delivery, Design, and Administration; (3) Assessment Tools and Processes; and (4) Partner Contributions. While the program implementation study design incorporated these required research areas, it also extended further in assisting OCCC program staff and administration with continuous improvement by cross-walking the activities and deliverables in OCCC's Statement of Work (SOW) with the research questions in the four research areas, and providing a comprehensive picture of ongoing implementation progress, accomplishment of deliverables, and continuous improvement. Therefore, the implementation design became more than information gathering and analysis, it provided OCCC leadership with qualitative information and feedback on areas of improvement as the program progressed over the four-year period of performance.

The **outcomes and impact analysis** utilized a quasi-experimental, matched comparison group design in which treatment group members who were exposed to the CFEST program were matched with equivalent comparison group members pursuing a similar technical program at OCCC. However, due to the small size of the comparison group, the completed analyses were rendered error prone; hence, the analyses were dropped from reporting. The procedures employed by the WorkED team are below.

Matching procedures included the use of propensity scores as weights to maximize the equivalence of the treatment and comparison groups in observed characteristics at baseline. The completion and employment impacts of the intervention were estimated with regression-based covariate adjustment modeling, difference-in-differences (DID), or comparative short interrupted time-series (CSITS) depending on pre-program data availability and baseline patterns.

In the absence of random or an otherwise ignorable treatment assignment, the evaluators used a matched comparison group with propensity score weighting strategy, coupled with analytic modeling procedures that sought to remove observed endogeneity effects that may otherwise bias impact estimates. Although there are limitations to this approach, the WorkED team was at least certain that the quasi-experimental contrast is with a program that more closely represents a related educational pathway as opposed to a program that is substantively different to the treatment intervention.

Individual-level matching (propensity score weighting) further maximized equivalence and permitted the evaluators to explicitly assess the extent of observed bias that remained after adjustment. Finally, analytic modeling procedures added further robustness by permitting covariate adjustment (regression modeling), removing any un-controlled-for baseline differences (DID), and adjusting for any difference in pre-program trends (CSITS) that existed between the treatment and comparison groups.

Outcomes examined by both methods included: program completion rates, credentials earned, enrollment in further education, entered employment, job retention, and wages.

Implementation Findings

The CFEST program and pathway was directly linked to employer skill needs and available occupations in the Oklahoma City area. OCCC applied for, and designed, the CFEST program as a response to employers stating they needed skilled workers in the commercial food equipment services industry. While that support ranged in intensity among individual employers, the CFEST staff maintained flexible relationships with employers in order to inform curriculum changes and improvements. Further, employer interviews demonstrated strong support for CFEST, including continued referral of participants for available jobs and hiring.

One important CFEST employer partner was Hagar Restaurant Service, one of the largest commercial food equipment service companies in the United States. The owner of Hagar was an important proponent of OCCC's program and facilitating work between the national industry association CFESA and OCCC. OCCC staff and employers communicated consistently regarding program implementation and expansion.

OCCC maintained a flexible and industry-focused approach to curriculum and course development with revisions and modifications based on offering wider array of skills training needed by CFEST participants. The original 4-6 week CFEST pathway was arguably too short to teach skills at a depth necessary to be successfully employed post-program. In addition, the array of skills necessary—from gas, steam, and refrigeration, for example—necessitated a certain amount of time and contact hours in order to learn skills and demonstrate competence. CFEST staff built out a 270 clock hour sequence of courses that is now embedded in a larger portfolio of technical skills training offered by PDI as a sustainable practice.

An undetermined question will be the ongoing affordability of the PDI CFEST courses, especially for low-income individuals. The CFEST program targeted low-income and lower-skilled individuals to promote social mobility and economic opportunity. This targeting made sense as commercial food equipment service employers report an aging workforce, combined with challenges attracting interested individuals into jobs. Further, the Oklahoma City unemployment rate has plummeted, so residents have many options for jobs and training pathways. As part of the TAACCCT program, CFEST was a no-cost-to-participant training option. To be sustainable, PDI will be charging a clock hour tuition rate, that while affordable on its face, could be a challenge for people with limited means to meet. OCCC staff will be monitoring this closely and seeking ways to continue to subsidize student costs through scholarships, apprenticeships, and other means.

During the latter half of the program, CFEST staff successfully connected to NIMS as an industry association partner. Staff and faculty participated in NIMS-sponsored training and offered industry-recognized credentials to participants. OCCC should continue looking for opportunities to offer industry-recognized credentials and partner with employers on use of these credentials to align training and jobs.

OCCC met initial milestones for hiring grant personnel, purchasing equipment, renovating space and executing contracts, and made appropriate adjustments and modifications to the staffing plan and approved equipment list. From the onset, OCCC hired qualified personnel, including individuals with experience working in the local one-stop workforce system. This provided an initial capacity to partner with the one-stop system and other community organizations. Equipment and supplies purchased were essential to implementation and operations of the program, and modifications to the statement of work that included expansion

of the equipment purchased (such as refrigeration equipment) were appropriate and aligned to employer demand.

While not quantifiable, staff turnover ultimately hampered program results. Challenges with filling the Education and Employment Coach position, and time that the position went unfilled, diminished the role of community and workforce partners in the program. More importantly, participant outreach, recruitment, and persistence were impacted due to gaps in attention and services paid to these activities by program staff.

Assigning the Dean of Business and Information Technology, who also serves as Director of the OCCC PDI, as the CFEST Project Director provided important institutional support and vision to the CFEST program. During the last year of the program, OCCC made some organizational management changes that simultaneously occurred at the time the original CFEST Project Manager left for other employment. With a renewed focus on PDI and workforce-focused training overall, assigning the Dean/Director to the CFEST Project Manager role placed a level of priority for CFEST in the hierarchy of education and training programs at OCCC. As a result, a sustainable transition for CFEST occurred and a commitment to enhancing the program as part of an OCCC technician training portfolio.

Outreach and recruitment of participants presented an ongoing challenge that will require creative solutions as a sustainability strategy. The issues of outreach and recruitment of students to CFEST and other technical training programs will take continued effort and focus. OCCC, as an institution, should develop an outreach and marketing plan in support of the PDI and technical training program portfolio.

As part of the new PDI Technical Training Portfolio, OCCC will want to continue enhancing its PLA capabilities and opportunities for students. Throughout the CFEST period of performance, OCCC was institutionally evaluating the role of non-credit training as part of its overall mission and offerings. The CFEST program received accreditation from the American Council on Education (ACE) with a recommended eighteen (18) hours of college credit. The culmination of this evaluation was a commitment to enhancing PDI workforce training and elements that make non-credit training viable to employers and the market. Therefore, a continuing improvement and evolution of PLA practices should be a focus and a pathway for students to transition to associate degree education, if appropriate and desired.

Faculty played the primary role in helping CFEST participants connect with employer partners, so OCCC PDI will want to formalize career guidance services. The full-time CFEST faculty member played an important role in referring participants to employer partners and providing a reference and assessment as to skills and progress. Participants also saw faculty as helpful resources. OCCC PDI will want to institutionalize career guidance services and ensure those services are not dependent on one or two faculty members to help participants.

While promising at the beginning of the project, impact of the local one-stop/workforce system was negligible. With the initial CFEST staff having professional experience working within the local one-stop/workforce system, it seemed as though contributions would be significant, including ITA's to pay for participants' tuition and post-training job placement services. However, by the close of the grant period of performance, the local one-stop/workforce system did not refer individuals for training, and CFEST staff reported that individuals sent to the local one-stop center for ITA eligibility determination never came back to PDI for training as they were sometimes assessed and told, "they did not demonstrate proficiency for CFEST training." OCCC does not plan on devoting time to the organizational relationship at this time.

Urban League is a community partner that saw value in the CFEST program and provided support to a cohort of participants. Urban League assessed and referred individuals to the CFEST program and supported participants with transportation and housing services. Urban League staff were positive about the CFEST program and valued it as an option for its customers needing skills training and higher wage employment.

Participant Outcomes and Impact Findings

CFEST participants showed an increase in average wages upon program completion. The average hourly wage of the CFEST participants, who were employed before completion, gained 46% after the program completion.

Rate of unemployment among CFEST participants dropped upon program completion. Sixty-five percent of the participants, who reported being unemployed at the time of entering the program, gained employment after completion.

Overall, CFEST participants were satisfied with the employment and education coach who provided support during the program. However, suggestions such as increasing the program's duration and offering more in-depth training were offered by the participants.

CFEST participants showed gains in enrollment and completion. While there were gains in enrollment and completion, CFEST's projected target numbers were not met.

Ninety-seven (97) industry-recognized credentials were awarded during the program period of Fall 2015 to Spring 2018. The number of participants earning credentials was 97 out of a target of 170 certificates and degrees.

CFEST did not meet its enrollment numbers by the end of the grant. The CFEST program fell short of its participant goal by over 400 participants. To reach the intended goal of 530 participants, the CFEST staff needed to recruit over 100 additional participants per year.

CFEST participants took roughly the same amount of time to complete their program as compared to peers in a similar program. Based on very limited comparison data, the average time taken by CFEST participants was 9.5 weeks and the comparison group (using a very small sample) took 8.5 weeks to complete their programs. However, CFEST participants who started their training in Summer 2017 and Fall 2017 took the longest time (about 19 weeks) to complete their program.

Final Conclusions

The following final conclusions are drawn from OCCC's TAACCCT-funded program:

1. ***Employer partners are key to the ongoing viability of the CFEST program.*** CFEST started due to specific and express human capital needs by commercial food equipment repair employers in the Oklahoma City region. Throughout the program, employer partners demonstrated support in a number of ways, including hiring participants, donating equipment, and providing input into curriculum and courses. Going forward, OCCC should look for ways to expand this support, including helping with outreach and recruitment initiatives.

2. ***OCCC can utilize non-credit workforce training as a viable alternative for helping people transition to middle-skills jobs by integrating nationally-recognized industry standards and credentials into career pathways and utilizing Prior Learning Assessment (PLA).*** Non-credit workforce training has not been a learning methodology priority for OCCC, mainly due to the Oklahoma Career Tech system that exists in Oklahoma. However, through CFEST and related initiatives, OCCC has demonstrated that the Professional Development Institute (PDI) is a sustainable alternative to meet employer needs for a skilled workforce. In order to sustain CFEST long-term, OCCC PDI should ensure continued partnerships with industry associations to provide industry-recognized credentials and methods for articulating experiential learning to college credit.

3. ***OCCC should institutionally invest resources and time to outreach and marketing initiatives in support of CFEST and PDI training programs.*** Even with employer support and available jobs, the CFEST program suffered from underperformance. The evaluation demonstrates the need for comprehensive outreach and marketing to attract interested individuals to technical training programs. Other creative recruitment strategies with high schools and community partners should be instituted, especially with a tight labor market and competition for talent.

4. ***TAACCCT-allowable funded activities, such as equipment purchases and facilities renovation, were critical to the implementation of the CFEST program.*** CFEST training

required applied learning and hands-on demonstration of techniques and repair processes. TAACCCT allowed OCCC to purchase a wide array of equipment in pneumatics, refrigeration, gas, and steam, among others, that provided the opportunity to train participants in a wide variety of equipment needing repair in employment settings.

5. ***Program staffing that was organizationally and strategically aligned with OCCC and PDI administration was a component missing until the final year of the CFEST program.*** During the first three years of the CFEST program, qualitative data indicated a "disconnect" between the CFEST program and the strategic priorities of OCCC administration, partly because OCCC was evaluating the role of PDI during this same timeframe. As a result, critical decisions with regard to CFEST were sometimes delayed, and CFEST staff expressed frustration to the evaluators, at times. With changeover in staff in the final year of the project and additional oversight of CFEST by PDI leadership, program deliverables were achieved and outcomes improved. Concurrently, the Director of PDI was also named Dean of Business and Information Technology as part of a reorganization on the College's academic side. This reorganization better emphasized workforce training and alignment of PDI with OCCC's traditional educational pathways.

2.0 Introduction

Oklahoma City Community College (OCCC) is a comprehensive community college located in Oklahoma City, Oklahoma. The community college was founded in 1972, and currently enrolls approximately 19,700 students. OCCC offers several Associate in Arts and Associate in Science degree programs, Associate in Applied Science degree programs, and Certificate of Mastery programs. Most courses are structured in a semester or 16-weeks; however, some courses can be completed in little as four weeks. OCCC's programs maintain regional accreditation from The Higher Learning Commission.

OCCC has an aspiration statement and "Big Goals"[1] listed on its website:

Aspiration Statement

OCCC aspires, through bold and transformative action, to significantly raise the educational achievement of all our students and to be an indispensable pathway to a more prosperous and fulfilling future.

Big Goals

- Increase the number of our students who complete a certificate or degree by 50%.
- Close the academic achievement gaps that persist with our low-income, first-generation, and some racial and ethnic groups.
- Double annual giving to support student scholarships, community events, and the endowment.

In 2014, OCCC applied for, and was successfully awarded, a Trade Adjustment Assistance Community College and Career Training (TAACCCT) grant from the U.S. Department of Labor. OCCC's Commercial Food Equipment Service Technician (CFEST) program was a single institution award that sought to improve, expand, and accelerate learning in the Engineering Career Pathway, beginning in central Oklahoma, and scaling nationally for TAA-eligible workers and other adults via (1) expanded engagement flexibility; (2) redesigned remedial education to include acceleration and contextualization; (3) Prior Learning Assessment (PLA); (4) latticed programs and new industry-recognized credentials; (5) advanced online and technology-enabled learning; (6) strategic alignment with the workforce system and other stakeholders; and (7) sector strategies and substantial employer engagement.

CFEST program staff worked with local industry employers to develop and enhance a new workforce training program and commensurate instructional strategies to meet the workforce needs of commercial food equipment service and repair employers. Through sector-driven

[1] http://www.occc.edu/aboutus/mission-vision.html OCCC defines a "big goal" as one that cannot be accomplished within the status quo.

strategies, CFEST developed a competency-based training model that included traditional in-person instruction in an effort to increase quality and reduce the time to completion. National industry-recognized credentials were embedded into the program, and a renewed focus on prior learning assessment (PLA) allowed for articulation to credit and an associate degree.

The CFEST program is housed at OCCC's Professional Development Institute (PDI). PDI hosts several of OCCC's non-credit technical training programs, including automotive technology and pharmacy technology. Employer linkages and partnerships are extremely important for PDI programming as all technical training is designed to provide direct skills and competencies for available jobs listed by those very partners and others within targeted industries.

The CFEST program had two critical priorities: (1) target dislocated and unemployed workers who face poverty and related conditions, such as homelessness, and (2) develop a new career pathway focused on commercial food technology that incorporates skills in hydraulics/pneumatics, electrical, gas, and steam equipment. The initial pathway consisted of short-term, four-week training to help participants become immediately employable. As the program matured, program offerings increased to 14 weeks and 270 clock hours in a variety of commercial equipment repair areas. Additionally, the program emphasized incorporation of industry-recognized credentials, articulation to credit programs, and introduction of apprenticeship as a training modality.

The initial CFEST program staff team had experience with the public workforce system and low-income, social services programs. The CFEST program initiated partnerships with the local workforce investment board (WIB) and community-based organizations, and the evaluation tracked these partnerships and their efficacy.

3.0 Evaluation Design

The CFEST evaluation design incorporated the two major required study elements—a program implementation analysis and an outcomes and impact study.

3.1 Implementation Design

The program implementation study was designed to answer sets of research questions in four key areas: (1) Curriculum Review, Use, and Selection; (2) Program Delivery, Design, and Administration; (3) Assessment Tools and Processes; and (4) Partner Contributions. While the program implementation study design incorporated these required research areas, it also extended further in assisting OCCC program staff and administration with continuous improvement by providing a comprehensive picture of ongoing implementation progress and recommendations for program improvements in "real time." The implementation design was more than information gathering and analysis; it provided OCCC leadership with qualitative

information and feedback on areas of improvement as the project progressed over the final three years of activities. In fact, the third-party evaluation team participated in OCCC's onsite monitoring review conducted by the U.S. Department of Labor (USDOL) in 2017, and interim evaluation reports and findings provided valuable insights to the monitors, before and during the review, and OCCC staff in preparing for the review. The research questions addressed by the implementation design include the following:

How was the particular curriculum selected, used, or created? OCCC's goal was to build a new technician program for employers conducting commercial food equipment repair and maintenance in the greater Oklahoma City area. While the initial project design anticipated a for-credit program as part of Engineering Technology, the College made an early decision to develop the curriculum and program within the Professional Development Institute as a non-credit, workforce-focused program. Non-credit approaches to workforce training are rare at OCCC because Oklahoma has a network of Career Tech Centers that provide non-credit workforce training, and community colleges typically are the credit-bearing transfer institutions of higher education in the State. Therefore, OCCC developed curriculum, but also incorporated new, industry-recognized credentialing and credit for prior learning components to the curriculum development process. The approach to evaluating curriculum development included: 1) assessing and continually monitoring new curriculum implemented, including alignment with national industry and accreditation/certification standards; 2) describing the rationale for new curriculum or refinements to curriculum implemented as a result of employer feedback; and 3) monitoring curriculum implementation progress and timelines.

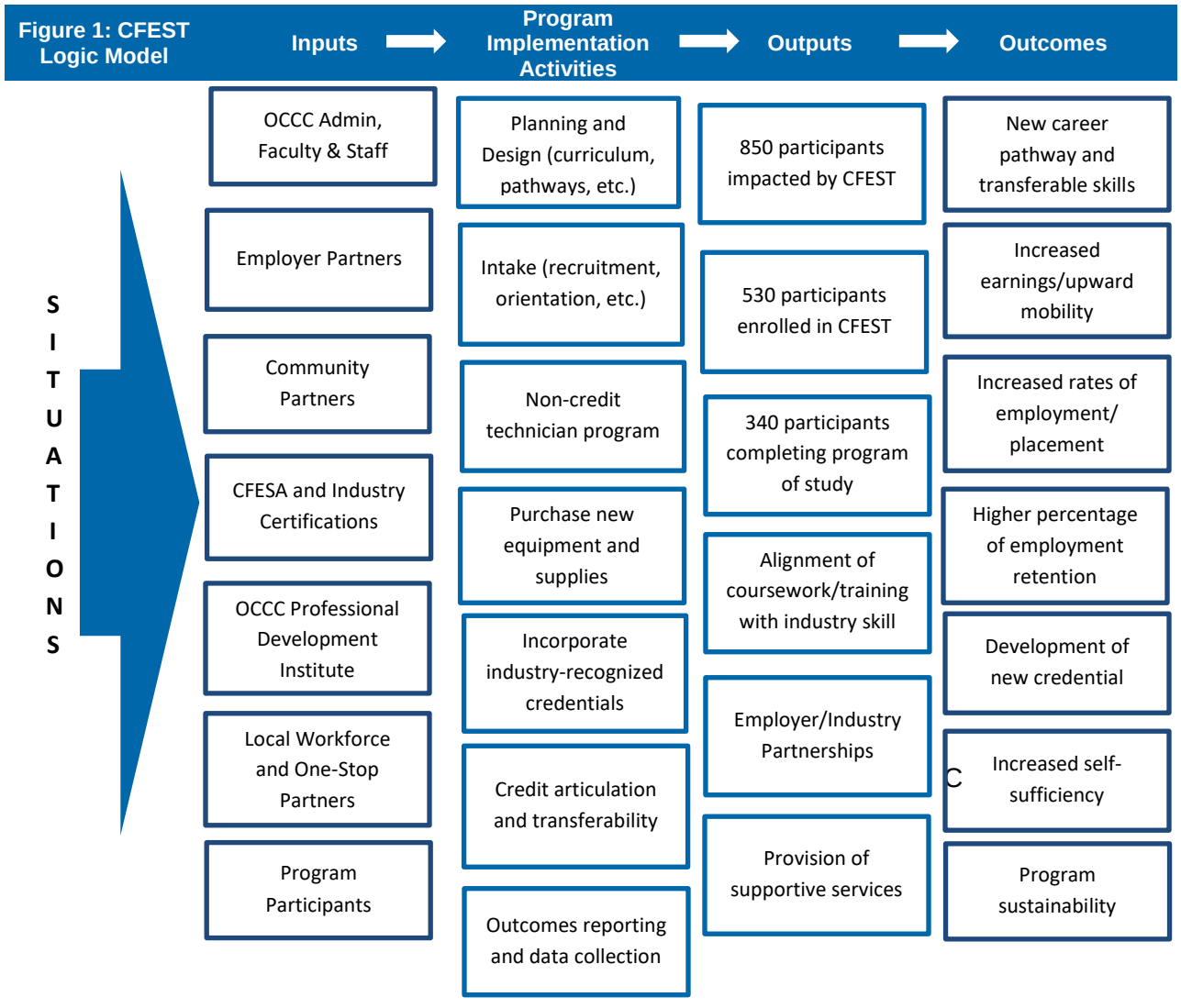
How were programs and program design improved or expanded using grant funds? What delivery methods were offered? What was the program administrative structure? What support service and other service were offered? The CFEST program commenced as a result of local employer demand and need for skilled technicians in the commercial food equipment industry. Skilled technicians include those in refrigeration, steam, gas, and electricity. The core of program design was focused in the implementation and long-term sustainability of a viable commercial equipment technician pathway as a non-credit, industry-recognized option housed in OCCC's PDI. As part of program design, OCCC targeted low-skill individuals, including those at risk of homelessness and those with low educational attainment. As a result, supportive services and employment skills were both components of the program design.

Was an in-depth assessment of participants' skills, abilities, and interests conducted, and how was it conducted? What assessment tools and processes were used? Who conducted the assessment? 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? To train more individuals for work in the commercial food equipment

industry in a targeted, workforce-based accelerated format, OCCC focused assessment efforts on implementing prior learning assessment (PLA) practices to foster career pathway completion and further educational options.

What contributions did partners make? What factors contributed to partners' involvement or lack of involvement? Which contributions from partners were most critical to the success of the program? Which contributions from partners had less of an impact? Employer partners were a key drive in development and implementation of the CFEST program. As a result, the evaluation documented specific roles and contributions of employers and whether the program met their workforce needs.

The logic model provided a framework to guide the implementation analysis and acted as a point of reference to define and assess fidelity. This included documenting changes to the program that occurred during the implementation and development process, and variations from intended approaches. The CFEST Logic Model is depicted in Figure 1.



Additionally, the evaluation plan outlined three activities for accomplishing the implementation analysis, which are outlined below:

(1) Steps taken by institution to create and run the training program. At the commencement of the program and evaluation, OCCC staff and the third-party evaluation team held weekly conference calls to establish baselines, develop data collection protocols, and communicate on implementation progress. As the program matured, calls became bi-weekly and then monthly. The WorkED team conducted five site visits to OCCC to gather qualitative data. Site visits consisted of facility tours and interviews with program staff, faculty, administration, participants, and employer partners. Interview protocols were developed prior to site visits, and site visit reports were completed and provided to staff.

(2) Operational strengths and weaknesses of project after implementation. After WorkED Consulting was procured as the third-party evaluator and an initial site visit in 2015, WorkED Consulting produced an *Early Implementation Report* that baselined implementation progress and highlighted areas of focus moving forward. Because delays in hiring, equipment purchases, and implementation of sound program and business practices early in a comprehensive training program's lifecycle have ripple effects, and thus impacts on final outcomes, the *Early Implementation Report* served as a baseline document from which to measure continuous improvement.

(3) How operations might be strengthened. During the course of the implementation analysis, WorkED Consulting continually communicated and provided OCCC with recommendations and information to be used for continuous improvement and best practices to consider sustaining after the end of the grant-funded program. Additionally, the program implementation analysis design, which incorporated program deliverables, allowed OCCC to track items also subject to core monitoring by the USDOL Federal Project Officer (FPO). WorkED Consulting provided data and information to OCCC staff prior to the federal monitoring visit and participated onsite during the visit to utilize evaluation data and findings to inform the monitors and confirm areas for improvement.

3.2 Outcomes and Impact Design

The outcome study methodology assesses the impact of the TAACCCT program on participant outcomes. The four areas addressed in this section are: evaluation questions, research design, data collection methods, and limitations and challenges. The purpose of this section is to highlight the type of outcomes that the evaluation focuses on, share the process used to obtain information, and clarify the type of information the evaluation is able to provide.

1. Evaluation Questions

The outcome evaluation questions were designed to help understand how well the OCCC CFEST TAACCCT program improved student persistence in training, employment and career

outcomes, and student career pathways. The research questions are listed below in Table 1 and includes the data sources used to address each question.

Table 1: Outcome Questions and Data Sources

#	Evaluation Question	Outcome Data Source		
		Student Surveys	Administrative Data	State Unemployment & Education Data
1	***Persistence***[1]			
1a	Does the enhanced CFEST training program result in increased graduation/certification rates relative to the comparison group?		X	
1b	Does the workplace-based trainings program result in decreased time to achieve certification/ graduation?		X	
1c	Does the workplace-based trainings program result in increased retention in training programs?		X	
1d	Does the workplace-based trainings program result in increased course completion rates?		X	
1e	Does the workplace-based trainings program result in improved industry and occupational skills/ program-related credentials?			
1f	Does the CFEST training program result in increases in the # and % of students who pursue additional education post program participation relative to the comparison group?			
2	***Employment/Career outcomes***			
2a	Does the workplace-based trainings program result in increased rates of employment (for electrical appliance technician, relative to comparison group)?	X		
2b	Does the workplace-based trainings program result in increased earnings?	X		
2c	Does the program result in a decreased time lapse between graduation and job placement relative to the comparison group?[1]			
2d	Does the workplace-based trainings program result in a decreased time lapse between completion and job placement?			
2e	Does the workplace-based trainings program result in higher quality jobs (benefits, wages, etc.)?	X		
3	***Career pathways***			
3a	Does the workplace-based trainings program result in sustained employment in the target industry?[1]			
3b	Does the workplace-based trainings program result in an increase in promotions?[1]			

Notes: [1]Question could not be addressed with the available data.

2. Research Design

To assess the outcomes and impact of CFEST, the outcome evaluation questions were addressed using multiple research designs. In selecting the designs, the most rigorous ones possible were used to understand the program's effects, given feasibility constraints. In particular, since a comparison group was only available for students in the pharmacy technology program, the evaluation focused on understanding outcomes for that particular group. The study uses combination of quasi-experimental and pre-test/post-test designs to study program impact.

The evaluation used the following designs for each type of training program:

CFEST participants in TAACCCT-funded programs. For the participants who enrolled in the CFEST program, the study used a pre-test/post-test design that examined changes in participants' employment and career outcomes before, and after, completing the training. This design was used because a comparison group was not available for the overall TAACCCT program.

3. Data Collection Sources

To answer the outcome evaluation questions, different data collection sources were used, including surveys and school administrative data.

CFEST-Enrolled TAACCCT Participants

*Surveys***.** A paper survey was administered to participants once: during the semester. Completers were also given a paper survey either when they came to campus to receive their credential/certification or via email. The analysis, therefore, only includes current and exit survey data.

Administrative data. The CFEST staff provided the evaluation team with administrative data on the individuals participating in TAACCCT–funded programs and the comparison group of welding students. CFEST provided data on students from Fall 2015 to Spring 2018. The Spring 2018 semester was the final semester for grant participant enrollment.

4. Limitations & Challenges

Study design. For most participants in the program, the evaluation used a pre-test/post-test design that examined changes over time. Wage data obtained from the comparison group through self-reported surveys was limited and did not allow to reasonably estimate what would have happened had the participant not enrolled in the program. Hence, it is unclear how much of a change was due to the program or other circumstances. For example, if a participant's wage increased, it is possible it could have occurred simply because time had passed since he/she started the program, rather than due to the training itself. Therefore, while the design can suggest what employment outcomes resulted from the program, it cannot definitively show that the program caused them.

Comparison group. The comparison group was created from students who took pharmacy technology courses between Fall 2016-Spring 2018. First, in attempting to control for differences between the two groups, the analysis only used the student characteristics of gender, age, and race/ethnicity, Pell grant status. There are potentially other differences between the two groups that were not controlled for. In addition, the academic design and expectations of pharmacy technician program could be quite different from a commercial equipment technician program. Such differences were not possible to account for in the study design.

Survey sample and response rate. Since not all participants in the TAACCCT program completed both the baseline and exit surveys, the survey data only represents a sample of TAACCCT participants. Further, the baseline survey was not always administered in the same semester that the participant started the program, and the exit survey was not given in the same semester of completion. In those cases, the data was not included in the analysis below. As a result, the final sample for the survey data was 44 of the 178 students in the intervention (25%).

Wage and Employment data. The data was obtained from self-reported surveys and was underreported. Self-reported data was not as reliable as unemployment insurance data. Underreported of wage data may have under- or over-estimated the employment rates and wages of some participants after leaving the program.

4.0 Implementation Findings

4.1 Curriculum Review, Use, and Selection

Research Question: How was the particular curriculum selected, used, or created?

INITIAL PATHWAY DEVELOPMENT

The CFEST program launched on July 20, 2015, with the first iteration of the training curriculum designed as a 4-6 week course. The initial pathway was comprised 82 contact hours, including a week of Hydraulic/Pneumatic, a week of Electrical, a week of Gas and a week of Steam, with OSHA 10 embedded in the curriculum. This initial program design was based on early employer feedback on basic entry-level skills needed for local technician employment.

In Oklahoma, state licensing requirements dictate that individuals must work for a minimum of three years to obtain a journeyman technician license for refrigeration. This means that a technician cannot work on refrigeration repair projects on his/her own during that three-year time period. According to employer partners interviewed, this means that they are strategic in their use of new hires—for instance, a newer employee may be able to drive their own truck to a job where an electrical or gas appliance needs repair, but a refrigeration job requires a licensed journeyman to also be at the job with the technician.

This is why, at the onset of CFEST, refrigeration was not included in the curriculum and that basic exposure to the other technical areas would suffice with most learning occurring on-the-job. However, very quickly, employer partners informed OCCC that the basic curriculum was not enough for a new hire to perform adequately. The first change of the training curriculum occurred January 1, 2016, with the expansion of the Electrical module from one week (18 hours) to two weeks (36 hours) to accommodate the inclusion of computerized and hands-on simulation equipment. CFEST staff utilized participant feedback through surveys to make curriculum adjustments. As indicated by the surveys, the electrical component of training was too difficult to grasp in a week of training.

Also, employer partners requested the inclusion of Refrigeration as a CFEST program offering to provide a basic skillset for a new hire. As a result, a Refrigeration module was added to the training pathway, and the requisite equipment was purchased with approval from USDOL through an approved modification. The Refrigeration module included 18 contact hours. In addition, the CFEST pathway integrated additional safety training and replaced OSHA 10 with OSHA 30 as an industry-recognized credential required by employers for equipment technician employment. Finally, participants expressed a need for a basic training in use of computers to conduct job searches and develop resumes. CFEST program staff partnered with Goodwill Industries to provide a computer basic course for CFEST participants and other PDI and GED students.

At the midpoint of the CFEST program, the pathway was enhanced from a 4-6 week program to a 6-8 week program that included 150 contact hours as shown in Table 2:

Table 2: CFEST Program Course Structure

Module	Number of Contact Hours
Hydraulic/Pneumatic Job Ready/Workplace Skills	18 hours 2 hours
Electrical Job Ready/Workplace Skills	36 hours 4 hours
Gas Job Ready/Workplace Skills	18 hours 2 hours
Steam Job Ready/Workplace Skills	18 hours 2 hours
Refrigeration Job Ready/Workplace Skills	18 hours 2 hours
Independent Study OSHA 30 Online	30 hours

FURTHER PATHWAY DEVELOPMENT

During 2016-17, CFEST staff continued creating courses and modifying curriculum based on feedback from employers and employability of participants. By the start of the Fall semester 2017, the CFEST program expanded development of curriculum and courses to embody a 12-14 week program with up to 270 clock hours of courses available for participants. This represented the final maturity of the CFEST pathway and provided skills and competency development in all areas of commercial food equipment repair including pneumatics, hydraulics, gas, electrical, and refrigeration. Table 3 highlights final course development and rationale for curriculum:

Table 3: CFEST Program Course Structure—Updates

Module	Number of Contact Hours as of Fall 2016	Number of Contact Hours as of Fall 2017	Explanation/Rationale for the Modification or New Curriculum
Electrical Job Ready/Workplace Skills	36 hours 4 hours	72 hours 8 hours	Industry partners required an increase in electrical training hours due to the relevance of the topic. Hours increased to meet ACE and NIMS requirements as part of program sustainability.
Gas Job Ready/Workplace Skills	18 hours 2 hours	36 hours 4 hours	Industry partners required an increase in gas training hours due to the relevance of the topic. Hours increased to meet ACE and NIMS requirements as part of program sustainability.
Steam Job Ready/Workplace Skills	18 hours 2 hours	No Change	No Change
Refrigeration Job Ready/Workplace Skills	18 hours hours	54 hours 6 hours	Industry partners required an increase in refrigeration training hours due to the relevance of the topic. Hours increased to meet ACE and NIMS requirements as part of program sustainability.
Independent Study OSHA 30 Online	30 hours	No Change	No Change
Pneumatics Job Ready/ Workplace Skills	9 hours 2 hours	18 hours 2 hours	Industry partners required an increase in pneumatics training hours due to the relevance of the topic. Hours increased to meet ACE and NIMS requirements as part of program sustainability.

Hydraulic	9 hours	18 hours	Industry partners required an increase in hydraulic training hours due to the relevance of the topic.
Job Ready/Workplace Skills	2 hours	2 hours	Hours increased to meet ACE and NIMS requirements as part of program sustainability.
Information in Table provided by John Claybon, OCCC Dean of Business and Information Technology and Director of PDI			

POST-CFEST SUSTAINABILITY

Implementation of the CFEST program and the resulting capacity-building within PDI created a larger conversation among OCCC leadership regarding the role of industry-focused workforce training. Rather than maintain CFEST as a stand-alone program, the competencies and skills taught through CFEST courses and the new, industry-recognized credentials offered are going to be part of a larger portfolio of offerings at PDI. Thus, the qualitative impact of CFEST has been a larger effort on meeting the human capital needs of employers in the Oklahoma City metropolitan area through a more robust technical training portfolio for residents. The graphic to the right highlights the OCCC PDI workforce program pathways:

Technical Trade Program Pathways

Trade Program Pathways and Recommended Course Sequence

Courses	Basic HVAC/R	Refrigeration Apprentice	HVAC/R Apprentice	Basic Electrical	Electrician Apprentice	Commercial Food Equipment Service Technician	General Maintenance Technician	Industrial Maintenance Technician	Hydraulics	Pneumatics
Mathematics 1		•	•		•		•	•		
Trigonometry 1					•		•	•		
Communication Skills		•	•		•		•	•		
Conflict Resolution		•	•		•		•	•		
Working in Groups		•	•		•		•	•		
OSHA 30		•	•		•		•	•		
Basic Measurements		•	•		•		•	•		
Mechanical Fabrication		•	•		•		•	•		
AC/DC Electrical Systems	•	•	•	•	•	•	•	•		
Electric Motor Control		•	•	•	•			•		
Rotating Electric Machines		•	•	•	•		•	•		
AC/DC Motor Troubleshooting		•	•	•	•		•	•		
Electronic Sensors		•	•	•	•		•	•		
Programmable Controllers - AB CompactLogix								•		
Programmable Logic Controller Troubleshooting								•		
AC Motor Drives		•	•		•		•	•		
AC Motor Drive Troubleshooting		•	•		•		•	•		
Electrical Fabrication					•		•	•		
Electrical Power Distribution					•		•	•		
Electrical Wiring Systems					•		•	•		
Thermal Systems 1		•	•				•	•		
Environmental Applications	•	•	•				•	•		
Thermal System Troubleshooting	•	•	•			•	•	•		
Gas Systems	•		•			•	•	•		
Steam Systems						•		•		
Basic Hydraulics							•	•	•	
Intermediate Hydraulics								•	•	
Electro-Fluid Power								•	•	
Basic Hydraulic Troubleshooting								•	•	
Hydraulic Maintenance							•	•	•	
Basic Pneumatics							•	•		•
Intermediate Pneumatics								•		•
Basic Pneumatic Troubleshooting								•		•
Total Hours	260	592	632	272	510	240	830	1360	260	140

EVALUATION FINDINGS-CURRICULUM

The CFEST program and pathway was directly linked to employer skill needs and available occupations in the Oklahoma City area. OCCC applied for, and designed, the CFEST program as a response to employers stating they needed skilled workers in the commercial food equipment services industry. While that support ranged in intensity among individual employers, the CFEST staff maintained flexible relationships with employers in order to inform

curriculum changes and improvements. Further, employer interviews demonstrated strong support for CFEST, including continued referral of participants for available jobs and hiring. One important CFEST employer partner was Hagar Restaurant Service, one of the largest commercial food equipment service companies in the United States. The owner of Hagar was an important proponent of OCCC's program and facilitating work between the national industry association CFESA and OCCC. OCCC staff and employers communicated consistently regarding program implementation and expansion.

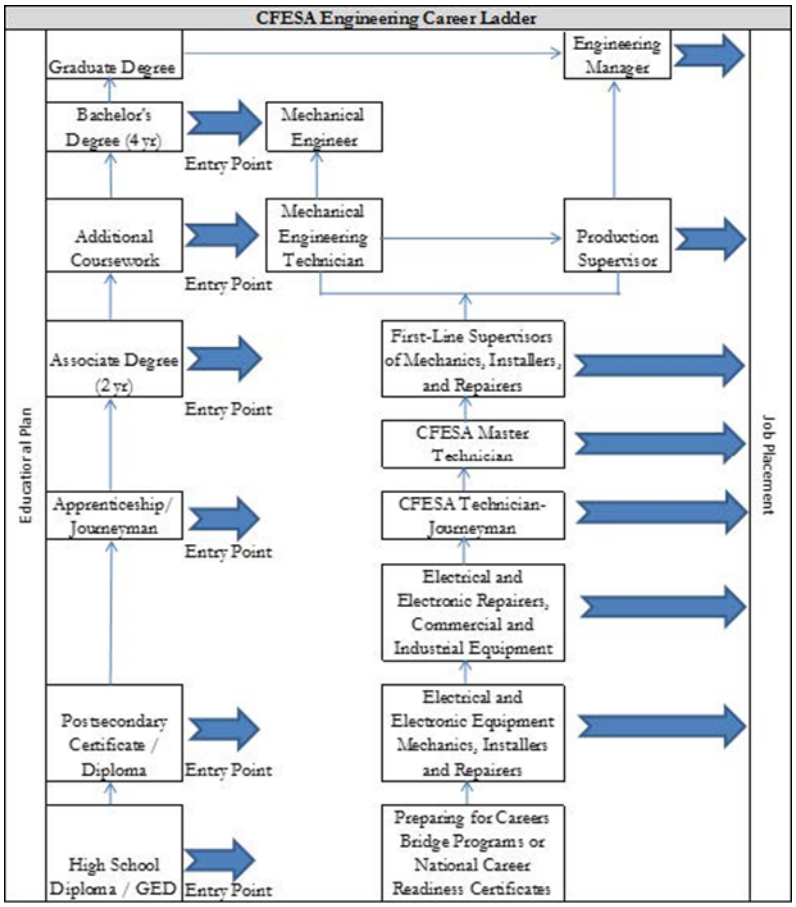
OCCC maintained a flexible and industry-focused approach to curriculum and course development with revisions and modifications based on offering wider array of skills training needed by CFEST participants. The original 4-6 week CFEST pathway was arguably too short to teach skills at a depth necessary to be successfully employed post-program. In addition, the array of skills necessary—from gas, steam, and refrigeration, for example—necessitated a certain amount of time and contact hours in order to learn skills and demonstrate competence. CFEST staff built out a 150 clock hour sequence of courses that is now embedded in a larger portfolio of technical skills training offered by PDI as a sustainable practice.

An undetermined question will be the ongoing affordability of the PDI CFEST courses, especially for low-income individuals. The CFEST program targeted low-income and lower-skilled individuals to promote social mobility and economic opportunity. This targeting made sense as commercial food equipment service employers report an aging workforce, combined with challenges attracting interested individuals into jobs. Further, the Oklahoma City unemployment rate has plummeted, so residents have many options for jobs and training pathways. As part of the TAACCCT program, CFEST was a no-cost-to-participant training option. To be sustainable, PDI will be charging a clock hour tuition rate, that while affordable on its face, could be a challenge for people with limited means to meet. OCCC staff will be monitoring this closely and seeking ways to continue to subsidize student costs through scholarships, apprenticeships, and other means.

4.2 Program Design, Delivery, and Administration

Research Questions: 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 service and other service were offered?

The original CFEST program envisioned a training curriculum and course sequence formally connected to the Engineering Technology associate degree pathway. This is due, in part, to OCCC's historic role as a credit-bearing transfer institution of higher education. However, as the CFEST program rolled out, it aligned more closely with programming offered in the Professional Development Institute (PDI), which is the non-credit, workforce arm of OCCC. The CFEST Statement of Work contained the graphic titled "CFESA Engineering Career Ladder":



TAACCCT funding allowed OCCC to implement the CFEST program, in whole. In addition to development of the curriculum and courses, as described earlier, TAACCCT impacted the creation and ongoing viability of the CFEST program in the following ways:

1. **Industry-Recognized and Stackable Credentials.** OCCC staff originally envisioned national industry credentialing through the Commercial Food Equipment Service Association (CFESA), which is a national industry membership organization. CFESA has a battery of training courses and certifications; however, the training is targeted to those who have one year or more of experience as technicians in the food services equipment industry. Because CFEST was focused on serving individuals with little to no work experience in the industry, this mismatch between CFESA credentialing and CFEST participant employment history created delays in CFEST credentialing outcomes.

   In 2016, the National Institute for Metalworking Skills (NIMS), a national industry association focused on credentialing in precision manufacturing occupations, launched a series of nationally portable, industry-recognized credentials in Industrial Maintenance. These credentials aligned to nine duty areas that included Hydraulics, Pneumatics, and Electrical systems, among others. In a budget modification approved in 2017, OCCC

received approval and began working with NIMS to train faculty and offer participant testing for NIMS certifications. With new, industry-recognized credentialing offered as part of the CFEST pathway, as of June 2018, 53 participants earned a credential, with another 14 participants in the process of earning a credential. OCCC leadership indicate that NIMS credentialing is a sustainable element of the CFEST program that will continue within PDI training and pathways.

2. **Equipment.** Because applied learning was a critical methodology for participants interested in CFEST-related employment, OCCC used TAACCCT funds to identify and purchase critical laboratory infrastructure at the onset of the program, including: a UCS Chassis with 4 servers, a Multi-skilled Lab, a Pneumatics Lab, a Hydraulics Lab, an Electrical Lab, and a USC C-Series Server with GPU. With the budget modification request and alignment with NIMS Industrial Maintenance credentialing, OCCC requested, and was granted approval, to purchase Amatrol equipment aligned to the NIMS Duty Areas, but more importantly, equipment to train in Refrigeration repair. With the purchase of this final equipment, PDI has, at the conclusion of the grant period of performance and as an ongoing sustainable component, equipment that allows for participants to train on the modern equipment needing repair in restaurants, cafeterias, and other locations. Employer partners highlighted the importance of the CFEST equipment and the resulting applied learning in interviews with the third-party evaluation team. All together, the equipment purchased with TAACCCT funds amounted to $345,376.

3. **Delivery Methods.** Most CFEST training was delivered in-person using applied learning with the purchased equipment. Curriculum aligned to both CFESA standards and NIMS standards, depending on the course taught and relevance to participant learning and needed competencies. Due to the skill levels of the participants and access issues with technology, CFEST online learning was mainly limited to OSHA 30 training and certification as it could be completed efficiently online.

4. **Supportive Services.** Because the CFEST program targeted low income individuals, including individuals at-risk of homelessness, community partnerships and supportive services were an initial focus of the program design. The initial CFEST staff, such as the Education and Employment Coach, had experience working with community partners prior to the CFEST program. Therefore, an initial focus for the Education and Employment Coach was providing counseling, advising, and referrals to supportive services. Examples of services included:

    1. Guiding CFEST participants through the program and presenting training opportunities

2. Advising and supporting CFEST participants as they completed the program, including assistance with retention and persistence
3. Providing job referrals and soft skills training, as well as resume preparation
4. Providing referrals to community partners such as Urban League and helping with non-academic issues (counseling, homelessness, health insurance)
5. Following up with CFEST completers at employment sites for additional support
6. Coordinating service provision within OCCC such as connecting participants to student services staff, tutors, and other instructors

PROGRAM ADMINISTRATIVE STRUCTURE

The initial CFEST program administrative structure consisted of five positions: a Project Manager, an Administrative Data Assistant, an Education and Employment Coach, a Simulation and Web Developer, and a Senior Technical Instructor. This initial program administrative structure stayed mostly consistent throughout the entire program with one exception: the Simulation and Web Developer position was never filled. First, OCCC was not able to recruit a viable candidate for the position. Second, the focus for curriculum development became in-class applied learning due to the skillsets needed and the additional hands-on experience required by the participants.

To enhance teaching and learning, in the modification request to the U.S. Department of Labor in 2017, OCCC requested, and received approval, to eliminate the Simulation and Web Developer position and hire two part-time faculty instead. OCCC hired and utilized these two part-time faculty members in Fall 2017 and Spring 2018, up until March 31, 2018. Specifically, they utilized the two part-time instructors to expand program offerings to evenings and some weekends to assist participants who may be working or searching for work.

While the program administrative structure stayed relatively stable throughout the entire period of performance, the CFEST program did experience some turnover in personnel. Of particular note is the program had three different Education and Employment Coaches. After the initial Education and Employment Coach left during year 3 of the period of performance, data and interviews indicate that activities fell off dramatically. Relationships and communication with community partners and the local workforce system seem to have diminished, and participants did not receive the same level of advising and employment assistance as occurred with the original Coach.

Another position impacted by turnover was the Administrative Data Assistant. The current Administrative Data Assistant at completion of the grant program has been on staff for approximately six months. She has had to review entire participant files, rebuild case files, and manually conduct follow-up data collection as a result of work not being accomplished, or accomplished correctly. During interviews with current staff during a final evaluation site visit,

statements were made such as, "We wish we had worked on this program earlier." "We lost opportunities for better results." "This program [CFEST] has so much more potential [for outcomes]." Because current staff review CFEST this way, it demonstrates a commitment to sustain the program and enhance engagement with community and employer partners.

OUTREACH AND RECRUITMENT OF PARTICIPANTS

The greatest challenge the CFEST program faced was the consistent outreach and recruitment of viable participants who were committed to skills training completion, the rigorous work schedule of commercial food equipment repair technicians, and were drug free when tested. Urban League reported referring 15 participants for training, but the local workforce system did not refer many people. Because of local workforce system policies that allow "customer choice," a local one-stop center staff member reported in an interview that one person was referred and entered the CFEST program.

CFEST staff report that the greatest challenge to the viability of the program is finding people who "want to work" and are able to meet basic criteria for employment, such as remaining drug free. Due to sensitive locations, such as schools and hospitals, where equipment must be repaired, commercial food equipment repair employers must have technicians who test drug free and do not have criminal histories. Therefore, while targeting low-income, homeless, and other individuals with barriers to employment was an ongoing goal of the CFEST program, it remained an ongoing challenge to get them enrolled at the level of commitment OCCC made in the CFEST outcome measures. Concurrently, staff reported that outreach overall was limited and that creative avenues needed to be implemented moving forward if the CFEST program is to be sustained long-term.

EVALUATION FINDINGS-PROGRAM DESIGN

During the latter half of the program, CFEST staff successfully connected to NIMS as an industry association partner. Staff and faculty participated in NIMS-sponsored training and offered industry-recognized credentials to participants. OCCC should continue looking for opportunities to offer industry-recognized credentials and partner with employers on use of these credentials to align training and jobs.

OCCC met initial milestones for hiring grant personnel, purchasing equipment, renovating space and executing contracts, and made appropriate adjustments and modifications to the staffing plan and approved equipment list. From the onset, OCCC hired qualified personnel, including individuals with experience working in the local one-stop workforce system. This provided an initial capacity to partner with the one-stop system and other community organizations. Equipment and supplies purchased were essential to implementation and operations of the program, and modifications to the statement of work that included expansion

of the equipment purchased (such as refrigeration equipment) were appropriate and aligned to employer demand.

While not quantifiable, staff turnover ultimately hampered program results. Challenges with filling the Education and Employment Coach position and time that the position went unfilled diminished the role of community and workforce partners in the program. More importantly, participant outreach, recruitment, and persistence was impacted due to gaps in attention and services paid to these activities by program staff.

Assigning the Dean of Business and Information Technology, who also serves as Director of the OCCC PDI, as the CFEST Project Director provided important institutional support and vision to the CFEST program. During the last year of the program, OCCC made some organizational management changes that simultaneously occurred at the time the original CFEST Project Manager left for other employment. With a renewed focus on PDI and workforce-focused training overall, assigning the Dean/Director to the CFEST Project Manager role placed a level of priority for CFEST in the hierarchy of education and training programs at OCCC. As a result, a sustainable transition for CFEST occurred and a commitment to enhancing the program as part of an OCCC technician training portfolio.

Outreach and recruitment of participants presented an ongoing challenge that will require creative solutions as a sustainability strategy. The issue of outreach and recruitment of students to CFEST and other technical training programs will take continued effort and focus. OCCC, as an institution, should develop an outreach and marketing plan in support of the PDI and technical training program portfolio.

4.3 Assessment Tools and Processes

Research Questions: Was an in-depth assessment of participants' skills, abilities and interests conducted, and how was it conducted? What assessment tools and processes were used? Who conducted the assessment? 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 CFEST program did not conduct up-front skills assessments of participants upon program entry using a formal assessment instrument such as TABE or WorkKeys. However, a self-developed pre- and post-test instrument was utilized informally to assess effectiveness of instruction related to specific food equipment service industry skills. Because many CFEST participants were low-skill individuals with various barriers to employment, job readiness and workplace skills components were embedded into each of the modules, i.e., electric, refrigeration, gas, etc.

Because the PDI provides non-credit instruction, CFEST participants were not required to take Accuplacer or COMPASS to assess math or reading levels. If a participant was deficient in needed math or reading for CFEST training, CFEST faculty spent additional time working with participants, or referrals were made to adult education services.

Prior leaning assessment (PLA) implementation became a focus for the CFEST program as part of strategies to implement industry-recognized credentials and promote upward mobility in connection with initial job placement. As part of the budget modification approved in 2017, CFEST received further training and guidance on use of PLA and how to conduct PLA assessments for credit. OCCC administration provided increased support for PLA through college policy enhancements aligned to Higher Learning Commission (HLC) accreditation standards.

EVALUATION FINDINGS-ASSESSMENT

As part of the new PDI Technical Training Portfolio, OCCC will want to continue enhancing its PLA capabilities and opportunities for students. Throughout the CFEST period of performance, OCCC was institutionally evaluating the role of non-credit training as part of its overall mission and offerings. The CFEST program received accreditation by the American Council on Education (ACE), which recommended eighteen (18) credit hours of college credit. The culmination of this evaluation was a commitment to enhancing PDI workforce training and elements that make non-credit training viable to employers and the market. Therefore, a continuing improvement and evolution of PLA practices should be a focus and a pathway for students to transition to associate degree education, if appropriate and desired.

Faculty played the primary role in helping CFEST participants connect with employer partners, so OCCC PDI will want to formalize career guidance services. The full-time CFEST faculty member played an important role in referring participants to employer partners and providing a reference and assessment as to skills and progress. Participants also saw faculty as helpful resources. OCCC PDI will want to institutionalize career guidance services and ensure those services are not dependent on one or two faculty members to help participants.

4.4 Partner Contributions

Research Questions: What contributions did partners make? What factors contributed to partners' involvement or lack of involvement? Which contributions from partners were most critical to the success of the program? Which contributions from partners had less of an impact?

The CFEST program started with 10-12 employer partners during the application process, and staff reported that 4-5 employers stayed actively engaged. Employer partners provided curriculum guidance, assisted OCCC PDI with outreach and engagement of the national

industry association, Commercial Food Equipment Service Association (CFESA), and hired participants upon completion of course sequences. Hagar and other employer partners demonstrated commitment to the program and continually reported the need for additional technicians and ongoing employment opportunities.

At the onset of the CFEST program, the local one-stop system/workforce development board served as a key partner. The commercial food equipment technician occupation—the target CFEST occupation—was an approved in-demand job, eligible for Individual Training Account (ITA) provision. In addition, the local workforce development board partner was tasked with providing referrals of participants to the program and job search assistance upon program completion by participants. However, as the CFEST grant period came to a conclusion, there is little evidence of active engagement with the local one-stop system. A single one-stop employee was communicating with CFEST staff, and she reported one participant had been referred to CFEST with an ITA. As stated earlier, the original CFEST Education and Employment Counselor had direct relationships with one-stop staff, but once this CFEST employee left, the work between the local one-stop system and PDI was sporadic.

Participant outreach and referral was originally conducted in conjunction with a host of program partners, but this partnership had modest results. Recruitment and outreach efforts during the first half of the CFEST period of performance included presentations and information at local workforce offices, Urban League, and local community service organizations. Any referrals were recorded in the participant database with follow-up and outcomes also noted. Intake was conducted onsite at PDI or remotely at Urban League in some instances. The original intake process conceived included a determination of eligibility, identification of needs and barriers (referrals made as needed), completion of an Individual Employment Plan, completion of the CFEST pre-enrollment industry assessment, and a scheduling referral with the local one-stop center for co-enrollment into the WIOA Adult program and ITA eligibility. However, as time passed, the intake process simplified to a focus on what participants needed to successfully enter and complete training and gain employment. CFEST staff and faculty report that one frustration was participants sounding interested at the onset of training, but then not being serious about finishing or understanding the commitment for being a qualified technician in the commercial food equipment repair field.

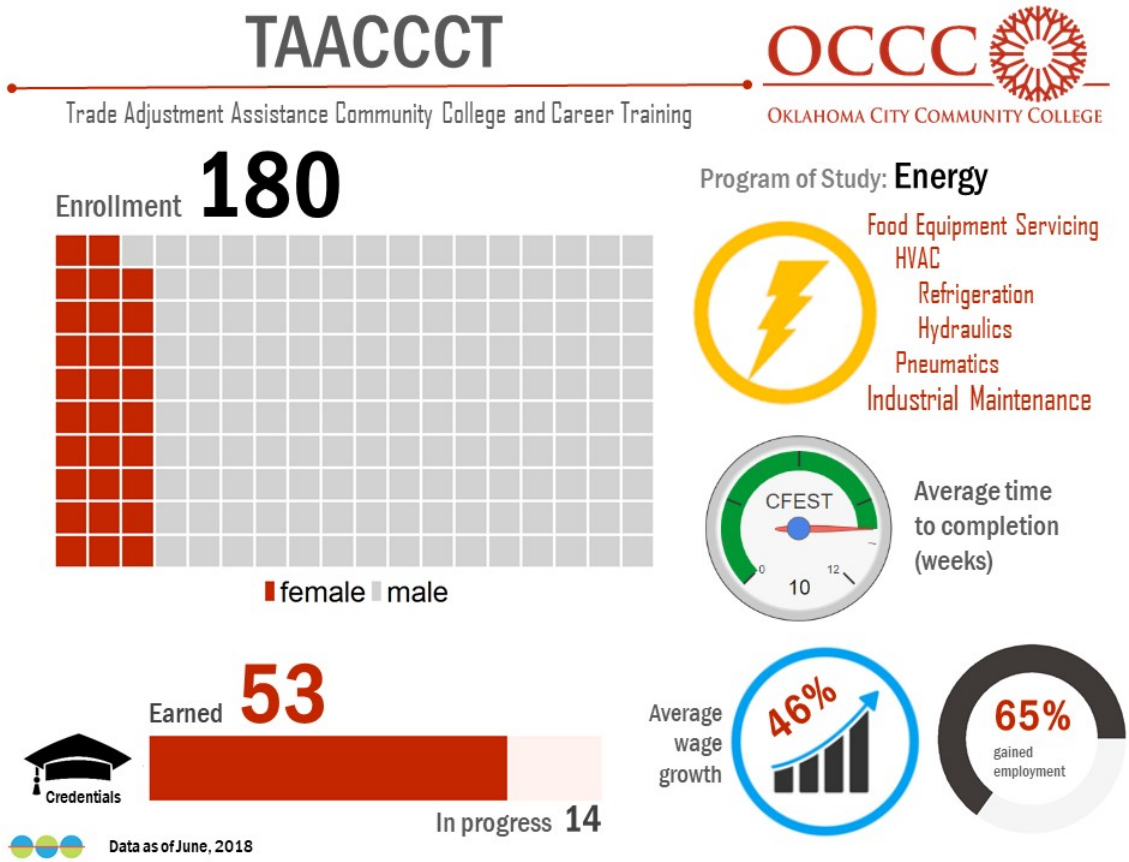
EVALUATION FINDINGS-PARTNER CONTRIBUTIONS

CFEST demonstrated a strong core of employer partners committed to the program throughout the four-year period. CFEST's employer partners were an important resource and strength that allowed the program to grow and be sustained. Employers assisted with curriculum development and hiring of participants. PDI should be able to build on this core group of employers to build a robust technical training portfolio ongoing.

While promising at the beginning of the project, impact of the local one-stop/workforce system was negligible. With the initial CFEST staff having professional experience working within the local one-stop/workforce system, it seemed as though contributions would be significant, including ITA's to pay for participants' tuition and post-training job placement services. However, by the close of the grant period of performance, the local one-stop/workforce system did not refer individuals for training, and CFEST staff report that individuals sent to the local one-stop center for ITA eligibility determination never came back to PDI for training as they were sometimes assessed and told, "they did not have proficiency for CFEST training." OCCC does not plan on devoting extensive time to the organizational relationship in the near future.

Urban League is a community partner that saw value in the CFEST program and provided support to a cohort of participants. Urban League assessed and referred individuals to the CFEST program and supported participants with transportation and housing services. Urban League staff were positive about the CFEST program and valued it as an option for its customers needing skills training and higher wage employment.

5.0 Outcomes and Impact Findings



CFEST student participant data, such as demographics (e.g., age, gender, race/ethnicity, education level), special status (e.g., veteran, social assistance, TAA-eligible), and program performance (e.g., credits received, completion), were made available to the evaluators in excel spreadsheets. Individual-level data were aggregated by the WorkED team across the four-years of the grant period of performance. Due to the process of aggregating quarterly and semi-annual data submissions, data such as the last date of participation and certificates earned in the sample may not reflect what was included in the Annual Performance Report to the Employment and Training Administration (ETA).

CFEST program administrators drew a random sample of participants in OCCC's pharmacy technology program to form the comparison group. A quasi-experimental matching technique, called Genetic Matching, was employed to match the comparison group with the CFEST participants. The detailed methodological narrative of the technique and the balance statistics obtained from the model output can be found in Appendix. Participant wages were collected through self-reported surveys.

Analyses of data pertaining to the CFEST evaluation consisted of a variety of qualitative and quantitative methods. Data from each collection source were analyzed separately, and then compared for consistent or conflicting findings. Advising case management data from over 500 case notes from all years of the program were coded manually for common themes. Statistical analyses were conducted using the software package R. Statistical tests were conducted to make inference(s) about the difference in post-completion mean wages between the treatment and control groups.

5.1 Persistence and Educational Outcomes

A key aim of CFEST was to provide individuals with training that would lead to high paying jobs. This included people building career-relevant skills and earning credentials that demonstrated their competencies to potential employers. Within the program, participants were able to earn different types of credentials including college certificates and industry-recognized credentials. This section presents findings on persistence in the program, such as completion of a program and receipt of credentials from training.

The data analyses presented below were completed and shared by the CFEST Program Director on June 11, 2018. CFEST's final outcome numbers will be slightly different as final reporting will incorporate all results through September 2018. In addition, some counts in Table 4 may differ from those presented in Section 5.1 onwards, since these data were obtained from the CFEST administrative database.

Table 4: Actual to Target Comparison (Y1-Y4)				
	Outcome Measure	Goal	Numbers as of Evaluation Reporting	Status (Met/Not Met)
1	Total unique participants served	Year 1: 90 **530** Year 2: 180 Year 3: 260 Year 4: 445	24 **117** 34 27 32	**Not Met**
2	Total number of participants completing a TAACCCT-funded program of study	Year 1: 60 **340** Year 2: 130 Year 3: 150 Year 4: 296	9 **53** 28 7 9	**Not Met**
3	Total number of participants still retained in their program of study or other TAACCCT-funded program	Year 1: 52 **179** Year 2: 70 Year 3: 57 Year 4: 179	0 **14** 0 0 14	**Not Met**
4	Total number of participants completing credit hours	Year 1: 80 **340** Year 2: 120 Year 3: 140 Year 4: 338	1 **2** 1 0 0	**Not Met**
5	Total number of participants earning credentials	Year 1: 65 **170** Year 2: 95 Year 3: 110 Year 4: 13	18 **97** 56 14 9	**Not Met**
6	Total number of participants enrolled in further education	Year 1: 19 **89** Year 2: 30 Year 3: 40 Year 4: 86	2 **4** 1 0 1	**Not Met**
7	Total number of participants employed after TAACCCT-funded program of study completion	Year 1: 31 **219** Year 2: 80 Year 3: 72 Year 4: 36	5 **28** 4 11 8	**Not Met**
8	Total number of participants retained in employment after program of study completion	Year 1: 25 **190** Year 2: 75 Year 3: 60 Year 4: 30	5 **28** 4 11 8	**Not Met**
9	Total number of those participants employed at enrollment who received a wage increase post-enrollment	Year 1: 25 **133** Year 2: 31 Year 3: 37 Year 4: 40	4 **23** 5 6 8	**Not Met**

NOTE: The data in this table reflect the most recent outcomes prior to submission of this Final Evaluation Report. However, the data analysis in the sections below was conducted using data provided by CFEST on June 11, 2018.

While there were gains in enrollment and completion, target numbers were not met. A total of 97 credentials was awarded during the program period of Fall 2015 to Spring 2018. The number of participants earning credentials was 97 out of a target of 170 certificates and degrees. The average annual completion rate increased to 25 certificates or degrees awarded per year

(duplicated) during grant activities. The project staff needed to assist in the completion of approximately 17 more certifications per year to have reached this goal.

5.2 Program Enrollment

Table 5 shows the total number of program participants by year.

Table 5: Program Intake by Year

TAACCCT Program Areas	Y1	Y2	Y3	Y4	Total Number of Participants
1. Commercial Food Equipment Technician	24	34	27	32	117

Source: CFEST Administrative Data

CFEST enrolled a total of 117 unique participants in the program by the end of year 4. The program's goal was to enroll 530 participants.

5.3 Outcome Analysis

In this section, program outcomes are analyzed. By the end of year 4, 83% of the participants earned a credential. On average, participants took 10 weeks to complete CFEST programming. Average hourly wage of the participants, who were employed before completion, gained 46% after the program completion. Sixty-five percent of the participants, who reported being unemployed at the time of entering the program, gained employment after completion.

Program completion and credentials earned. Below are the charts showing cumulative number of participants earning credentials. A participant may have completed more than one program. Figure 2 shows that the number of completions increased consistently over time. At the end of year 4, completion rate of the CFEST participants was 83%. The completion rate of the comparison group was 89%.

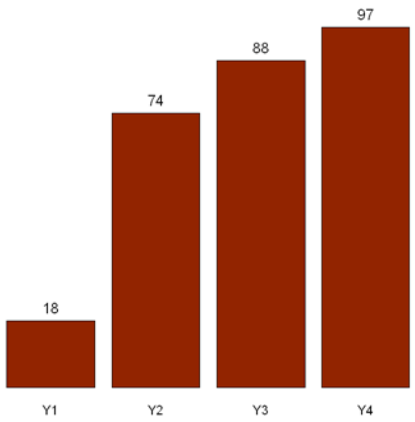


Figure 2: Cumulative Number of Participants Earning Credentials

Time to program completion. Figure 3 shows the comparison of average time taken by the CFEST participants and the comparison group to complete their program. On average, the CFEST participants took 9.5 weeks and the comparison group took 8.5 weeks to complete their programs. CFEST participants who started their training in Summer 2017 and Fall 2017 took the longest time (about 19 weeks) to complete their program.

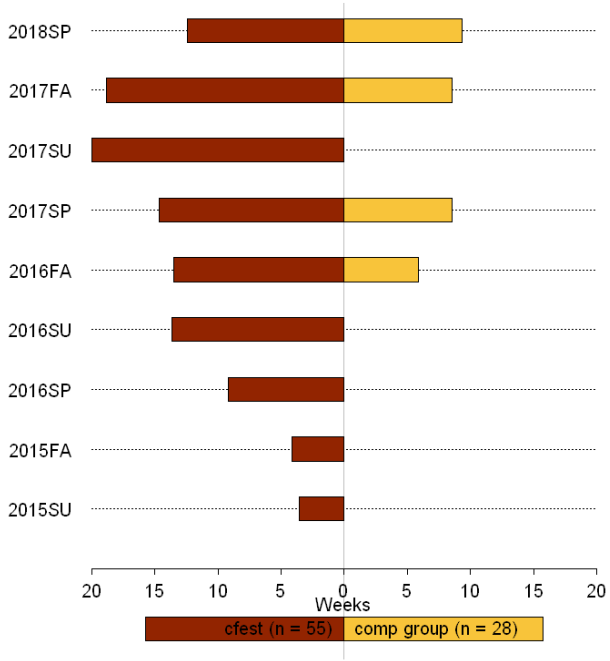


Figure 3: Time to Completion (in Weeks) – CFEST vs. Comparison Group

5.4 Subgroup Analysis

In this section, program outcomes are analyzed by demographic subgroups of the CFEST participants. The data presented in Table 6 were extracted in April 2018 and differ from those presented in Table 4, which was obtained in June 2018.

Participant demographics. Participant data analysis consisted of frequencies of outcome measures. The evaluators created variables for participants who completed their certificate or credential within the appropriate amount of time for their program and those who took longer. Evaluators cross-tabulated the completion rates by demographic characteristics of participants and comparison group including gender, education, race/ethnicity, and economic status.

The vast majority of the program participants were male (84%). One third of the participants were married. Racial/ethnic diversity of the group appeared to be diverse – Black (50%), White (28%), and Hispanic (12%). About two out of five participants received some sort of social assistance at the time of entry. Sixteen percent were veterans.

Table 6: Participants' Demographic Characteristics at Entry

Characteristics	Percentage
Participants	178
Female	16%
Married	29%
Education	
High School/GED	41%
Associate's or Higher	59%
Race	
Black	50%
White	28%
Hispanic	12%
Other	10%
Unemployed	70%
Social Assistance	36%
Veteran	16%

Source: CFEST Administrative Data

Credentials earned by demographic status. This section presents the percentage of participants who earned a certificate by their demographic status as reported at time of entering the program. It is observed that higher percentage (52%) of male participants earned a certificate than their female counterparts (40%). However, this difference is not statistically significant. Next, the completion rates (which is considered equivalent to earning a credential) are compared by racial/ethnic status. White participants show the highest rate of completion. However, between-group differences observed in the data are not statistically significant. Participants with college degrees (60%) show a significantly higher completion rate than those with high school diploma/GED (36%). Participants, who were unemployed or received some form of social assistance, show a higher rate of completion than their counterparts. Again, these differences are not found to be statistically significant.

Table 7: Credentials Earned by Gender

	Percent Earned Certificate	Test Stat.
Total Enrolled	110	
Female	40%	*Two-prop. z-test (p-value = 0.4045)*
Male	52%	
Black	44%	*Chi-squared test (p-value = 0.4718)*
Hispanic	41%	
White	67%	
High School/GED	36%	*Two-prop. z-test (p-value = 0.0117)*
Associate's or Higher	60%	
Employed	35%	*Two-prop. z-test (p-value = 0.0487)*
Unemployed	56%	
On Social Assistance		
Yes	61%	*Two-prop. z-test (p-value = 0.1040)*
No	45%	

Source: CFEST Administrative Data

Post-completion wage. In this section, self-reported pre- and post-program hourly wages of the participants were compared. Two-tailed paired t-test of sample means were conducted to measure the statistical significance of the program impact. To carry out this test, the paired sample of participants who reported both pre- and post-programs wages were extracted.

The null hypothesis assumes that the difference (μ_0) between pre- and post means is equal to zero.

$$H_0: \mu_0 = 0$$

$$H_a: \mu_0 \neq 0$$

Table 8 shows average pre- and post-wages of the CFEST participants who reported both wages. Average hourly wages of this subgroup increased by 46% after the program completion. Sixty-five percent of the participants, who reported being unemployed at the time of entering the program, gained employment after completion.

Although post-program wage gain was remarkable, the pre-post difference was found not to be statistically significant, given a sample size of 11.

In 2017, the latest year for which the wage data is available, the average hourly wage of electrician in the state of Oklahoma was in the range $23.48 - $17.28. The average post-completion wage of the CFEST participants was comparable to the state average.

Table 8: Pre- and Post-Program Average Hourly Wages

		Average Hourly Wage			
Group	N	Pre	Post	*p-value*	Oklahoma-Electrician[2]
CFEST	11	$12.30	$18.03	0.0627	$23.48 - $17.28

Source: CFEST Administrative and BLS Data

For the comparison group, self-reported wage data showed no gain in post-completion average wage. Based on the nine participants who reported both pre- and post-completion wages, it is estimated that the comparison group earned an average hourly wage of $11.29 pre-completion and $11.10 post-completion.

5.5 Program Satisfaction

Paper surveys from the CFEST participants—current and completers and comparison group (pharmacy tech) – have been collected by WorkED team since Fall 2016 to capture their level of satisfaction about the program. This section of the report summarizes the aggregated survey results.

Overall, the participants were very satisfied with the counselling services and academic support offered by the program. Participants who could not find employment after completion felt that the training was inadequate for them to meet employers' job requirements. In general, participants felt that the program duration should be longer and offer more in-depth training.

[2] source: Oklahoma Labor Statistics, https://www.bls.gov/oes/current/oes_ok.htm

Table 9: Program Satisfaction

Survey Items	Current Participants	Completers	Comparison Group (Pharmacy Tech.)
Were your expectations for obtaining a job after completing CFEST training fully met?	-	54%	60%
Program, Instruction, and Instructors[3] (% agreed or strongly agreed)	90%	100%	90%
Did anyone at OCCC guide you through program requirements or help you apply and enter the program? (% said yes)	100%	85%	45%
Would you have liked more help from the career navigator? (% said yes)	100%	46%	60%
General impression of the program (% said positive)	100%	100%	100%
Sample size (N)	18	26	27

Source: CFEST Survey Data

6.0 Final Conclusions

The following final conclusions are drawn from OCCC's TAACCCT-funded program:

1. ***Employer partners are key to the ongoing viability of the CFEST program.*** CFEST started due to specific and express human capital needs by commercial food equipment repair employers in the Oklahoma City region. Throughout the program, employer partners demonstrated support in a number of ways, including hiring participants, donating equipment, and providing input into curriculum and courses. Going forward, OCCC should look for ways to expand this support, including helping with outreach and recruitment initiatives.

[3] *Program* Overall length of program was right for me.
The training program was high quality.
Instruction Duration of courses was right.
Courses were scheduled at a convenient time of day for me.
The number of courses offered is what I needed for learning a new skill.
Equipment was readily available and was of high quality.
Instructors My instructor taught me the skills I need to find a job in the field.
My instructor provided timely and helpful feedback.

2. ***OCCC can utilize non-credit workforce training as a viable alternative for helping people transition to middle-skills jobs by integrating nationally-recognized industry standards and credentials into career pathways and utilizing Prior Learning Assessment (PLA).*** Non-credit workforce training has not been a learning methodology priority for OCCC, mainly due to the Career Tech Center system that exists in Oklahoma. However, through CFEST and related initiatives, OCCC has demonstrated that the Professional Development Institute (PDI) is a sustainable alternative to meet employer needs for a skilled workforce. In order to sustain CFEST long-term, OCCC PDI should ensure continued partnerships with industry associations to provide industry-recognized credentials and methods for articulating experiential learning to college credit.

3. ***OCCC should institutionally invest resources and time to outreach and marketing initiatives in support of CFEST and PDI training programs.*** Even with employer support and available jobs, the CFEST program suffered from underperformance. The evaluation demonstrates the need for comprehensive outreach and marketing to attract interested individuals to technical training programs. Other creative recruitment strategies with high schools and community partners should be instituted, especially with a tight labor market and competition for talent.

4. ***TAACCCT-allowable funded activities, such as equipment purchases and facilities renovation, were critical to the implementation of the CFEST program.*** CFEST training required applied learning and hands-on demonstration of techniques and repair processes. TAACCCT allowed OCCC to purchase a wide array of equipment in pneumatics, refrigeration, gas, and steam, among others, that provided the opportunity to train participants in a wide variety of equipment needing repair in employment settings.

5. ***Program staffing that was organizationally and strategically aligned with OCCC and PDI administration was a component missing until the final year of the CFEST program.*** During the first three years of the CFEST program, qualitative data indicated a "disconnect" between the CFEST program and the strategic priorities of OCCC administration, partly because OCCC was evaluating the role of PDI during this same timeframe. As a result, critical decisions with regard to CFEST were sometimes delayed, and CFEST staff expressed frustration to the evaluators, at times. With changeover in staff in the final year of the project and additional oversight of CFEST by PDI leadership, program deliverables were achieved and outcomes improved. Concurrently, the Director of PDI was also named Dean of Business and Information Technology as part of a reorganization on the College's academic side. This reorganization better emphasized workforce training and alignment of PDI with OCCC's traditional educational pathways.

7.0 Appendix

Multivariate Matching with Automated Balance Optimization of TAACCCT Observational Student Data Using Genetic Search Algorithm

1. Introduction

In this project, Genetic Matching,[4] a method of multivariate matching was applied which uses an evolutionary search algorithm to improve covariate balance.

Matching is being increasingly applied as a method of causal inference in many fields, including education and labor market studies. However, when we use matching methods to estimate treatment effects, the central problem relates to deciding how best to perform the matching. There is no consensus on how exactly matching ought to be done and how to measure the success of the matching procedure. Two common approaches are propensity score matching and multivariate matching based on Mahalanobis distance.[5] These methods have appealing theoretical properties if covariates have distributions such as the normal or *t*. If covariates are so distributed, the methods have the property of "equal percent bias reduction (EPBR)". When this property holds, matching will reduce bias in all linear combination of the covariates. However, a mis-specified propensity score model may increase the imbalance of some observed variables post-matching, especially if the covariates have non-normal distribution,[6] or in other words, if EPBR property does not hold. In general, under such circumstances, matching will increase the bias of some linear functions of the covariates even if all univariate means are closer to the matched data than the unmatched. Unfortunately, EPBR property rarely holds with real data.

Furthermore, building a propensity score model is an iterative process, in which many candidate models are estimated and sequentially learned from one specification to the next. Hence the process of iteratively modifying the propensity score to maximize balance is often challenging. Our adopted method, Genetic Matching, eliminates the need to manually and iteratively check the propensity score. It uses a search algorithm to iteratively check and improve covariate balance automatically, and it is a generalization of propensity score and Mahalanobis Distance matching methods. It is a multivariate matching method that uses an evolutionary search algorithm developed by Mebane and Sekhon (1998[7]; Sekhon and Mebane, 1998[8]) to maximize the balance of observed covariates across matched treated and control units.

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[4] Diamond, A., and J. S. Sekhon (2012). "Genetic Matching for Estimating Causal Effects: A General Multivariate Matching Method for Achieving Balance in Observational Studies." *Review of Economics and Statistics*, 95(3): 932-945.

[5] Rosenbaum, P. R., and D. B. Rubin (1985). "Constructing a Control Group Using Multivariate Matched Sampling Methods that Incorporate the Propensity Score." *The American Statistician*, 39(1): 33-38.

[6] Diamond, A., and J. S. Sekhon (2012).

[7] Mebane, W. R. Jr., and J. S. Sekhon (1998). "GENetic Optimization Using Derivatives (GENOUD)." Software Package. http://sekhon.berkeley.edu/rgenoud/

[8] Sekhon, J. S. and W. R. Mebane, Jr. (1998)."Genetic Optimization Using Derivatives: Theory and Application to Nonlinear Models." *Political Analysis*, 7: 189-203.

The genetic algorithm optimizes the balance as much as possible, given the data. The method is nonparametric and does not depend on knowing or estimating the propensity score.

The algorithm has shown better properties than the usual alternative matching methods both when the EPBR property holds and when it does not.[9] In both cases, the method has demonstrated superior performance in terms of the reduction of bias and mean squared error (MSE) – in finite samples. The only limitation of this method is that it is computationally intensive and consumes significant computer running time. Nevertheless, in the expense of computer time, it dominates the other matching methods in terms of MSE when assumptions required for EPBR hold and when they do not.

2. Matching between Control and Treatment Groups

This section presents the results of matching between the control and treatment groups.

As consistent with best practice, we match with replacement, which means that one treated observation matches more than one control observation. Therefore, the matched dataset includes multiple matched control observations and we weight the matched control data to reflect the multiple matches. The sum of the weighted control observations is still equal to the original number of observations.

We have employed Genetic Matching technique in this analysis using "Matching" package[10] in R statistical computing software.

2.1. Balance Statistics

Original number of controls	18
Original number of treated	111
Matched number of observations	111
Matched number of observations (unweighted)	111

Table 2.1 provides a summary of balance statistics for both before and after matching to check if the results from matching have actually achieved balance on a set of covariates. We found that balance between controls and treated was improved for most student characteristics after matching.

[9] Diamond, A., and J. S. Sekhon (2012).

[10] https://cran.r-project.org/web/packages/Matching/index.html

Table 2.1 Summary of Balance Statistics

	Before Matching	After Matching
Variable – Race/Ethnicity (Black)		
Mean Treatment	0.48649	0.48649
Mean Control	0.055556	0.30631
Variable - Race/Ethnicity (Hispanic)		
Mean Treatment	0.15315	0.15315
Mean Control	0.38889	0.16216
Variable – White		
Mean Treatment	0.31532	0.31532
Mean Control	0.44444	0.45946
Variable – Education Level at Entry (Associates Degree)		
Mean Treatment	0.054054	0.054054
Mean Control	0.16667	0.054054
Variable – Education Level at Entry (High School Diploma)		
Mean Treatment	0.40541	0.40541
Mean Control	0.22222	0.18018
Variable – Female		
Mean Treatment	0.14414	0.14414
Mean Control	0.72222	0.28829
Variable – Food Stamp Eligible		
Mean Treatment	0.33333	0.33333
Mean Control	0.33333	0.49550
Interaction Variable – White × Female		
Mean Treatment	0.081081	0.081081
Mean Control	0.33333	0.099099
Interaction Variable – Female × Food Stamp		
Mean Treatment	0.09009	0.09009
Mean Control	0.16667	0.09909
Interaction Variable – High School × Hispanic		
Mean Treatment	0.09009	0.09009
Mean Control	0.11111	0.10811
Interaction Variable – Some College × Hispanic		

	Before Matching	After Matching
Mean Treatment	0.027027	0.027027
Mean Control	0.16667	0.018018

Detailed Output

The balance of each variable can be judged by several matching statistics – such as absolute mean difference, standardized mean difference, mean difference in the empirical-QQ plot between the treatment and control. After matching the magnitude of these statistics are significantly reduced. Whether the mean difference in the empirical-QQ plot is statistically significant is indicated by paired *t*- and KS-stats which test for significant difference across the entire distribution. Other KS test statistics also indicate similar results. Note that KS statistics are not relevant for indicator (dummy) variables, such as female, race/ethnicity etc.

```
*****     OUTPUT    ******************************

***** (V1) Black *****
                         Before Matching        After Matching
mean treatment........     0.48649           0.48649
mean control..........    0.055556           0.30631
std mean diff.........      85.828            35.886

mean raw eQQ diff.....     0.44444           0.18018
med  raw eQQ diff.....           0                 0
max  raw eQQ diff.....           1                 1

mean eCDF diff........     0.21547           0.09009
med  eCDF diff........     0.21547           0.09009
max  eCDF diff........     0.43093           0.18018

var ratio (Tr/Co).....      4.5376            1.1757
T-test p-value........ 3.9108e-07         2.249e-05


***** (V2) Hispanic *****
                         Before Matching        After Matching
mean treatment........     0.15315           0.15315
mean control..........     0.38889           0.16216
std mean diff.........     -65.162           -2.4903

mean raw eQQ diff.....     0.22222          0.009009
med  raw eQQ diff.....           0                 0
max  raw eQQ diff.....           1                 1

mean eCDF diff........     0.11787         0.0045045
med  eCDF diff........     0.11787         0.0045045
max  eCDF diff........     0.23574          0.009009
```

```
var ratio (Tr/Co).....    0.52011           0.9546
T-test p-value........   0.069973          0.73939


***** (V3) White *****
                        Before Matching       After Matching
mean treatment........    0.31532           0.31532
mean control..........    0.44444           0.45946
std mean diff.........    -27.666           -30.883

mean raw eQQ diff.....    0.11111           0.14414
med  raw eQQ diff.....          0                 0
max  raw eQQ diff.....          1                 1

mean eCDF diff........   0.064565          0.072072
med  eCDF diff........   0.064565          0.072072
max  eCDF diff........    0.12913           0.14414

var ratio (Tr/Co).....    0.83329           0.86928
T-test p-value........    0.32559       0.00046991


***** (V4) Associates *****
                        Before Matching       After Matching
mean treatment........   0.054054          0.054054
mean control..........    0.16667          0.054054
std mean diff.........    -49.576                 0

mean raw eQQ diff.....    0.11111                 0
med  raw eQQ diff.....          0                 0
max  raw eQQ diff.....          1                 0

mean eCDF diff........   0.056306                 0
med  eCDF diff........   0.056306                 0
max  eCDF diff........    0.11261                 0

var ratio (Tr/Co).....    0.35086                 1
T-test p-value........    0.24043                 1


***** (V5) Degree *****
                        Before Matching       After Matching
mean treatment........   0.036036          0.036036
mean control..........    0.11111           0.21622
std mean diff.........    -40.099           -96.237

mean raw eQQ diff.....   0.055556           0.18018
med  raw eQQ diff.....          0                 0
max  raw eQQ diff.....          1                 1

mean eCDF diff........   0.037538           0.09009
med  eCDF diff........   0.037538           0.09009
max  eCDF diff........   0.075075           0.18018
```

```
var ratio (Tr/Co).....     0.3352          0.20498
T-test p-value........    0.34956        4.927e-05


***** (V6) HS *****
                         Before Matching        After Matching
mean treatment........    0.40541          0.40541
mean control..........    0.22222          0.18018
std mean diff.........     37.142           45.666

mean raw eQQ diff.....    0.16667          0.22523
med  raw eQQ diff.....          0                0
max  raw eQQ diff.....          1                1

mean eCDF diff........   0.091592          0.11261
med  eCDF diff........   0.091592          0.11261
max  eCDF diff........    0.18318          0.22523

var ratio (Tr/Co).....     1.3292           1.6319
T-test p-value........    0.11194       8.2529e-05


***** (V7) Some.College *****
                         Before Matching        After Matching
mean treatment........    0.38739          0.38739
mean control..........        0.5          0.54955
std mean diff.........    -23.012          -33.137

mean raw eQQ diff.....    0.11111          0.16216
med  raw eQQ diff.....          0                0
max  raw eQQ diff.....          1                1

mean eCDF diff........   0.056306          0.081081
med  eCDF diff........   0.056306          0.081081
max  eCDF diff........    0.11261          0.16216

var ratio (Tr/Co).....    0.90469          0.95869
T-test p-value........    0.39508       0.00015409


***** (V8) female *****
                         Before Matching        After Matching
mean treatment........    0.14414          0.14414
mean control..........    0.72222          0.28829
std mean diff.........    -163.84          -40.854

mean raw eQQ diff.....    0.55556          0.14414
med  raw eQQ diff.....          1                0
max  raw eQQ diff.....          1                1

mean eCDF diff........    0.28904          0.072072
med  eCDF diff........    0.28904          0.072072
```

```
max  eCDF diff........    0.57808          0.14414

var ratio (Tr/Co).....    0.58605          0.60127
T-test p-value........  5.367e-05       3.3845e-05


***** (V9) foodstamp *****
                        Before Matching       After Matching
mean treatment........    0.33333          0.33333
mean control..........    0.33333           0.4955
std mean diff.........          0           -34.244

mean raw eQQ diff.....          0          0.16216
med  raw eQQ diff.....          0                0
max  raw eQQ diff.....          0                1

mean eCDF diff........          0         0.081081
med  eCDF diff........          0         0.081081
max  eCDF diff........          0          0.16216

var ratio (Tr/Co).....    0.95303          0.88896
T-test p-value........          1       2.9946e-05


***** (V10) Vet *****
                        Before Matching       After Matching
mean treatment........    0.15315          0.15315
mean control..........    0.22222          0.35135
std mean diff.........    -19.092          -54.786

mean raw eQQ diff.....   0.055556           0.1982
med  raw eQQ diff.....          0                0
max  raw eQQ diff.....          1                1

mean eCDF diff........   0.034535         0.099099
med  eCDF diff........   0.034535         0.099099
max  eCDF diff........   0.069069           0.1982

var ratio (Tr/Co).....    0.71515          0.56909
T-test p-value........     0.5237       3.1194e-05


***** (V11) unemploy *****
                        Before Matching       After Matching
mean treatment........    0.72072          0.72072
mean control..........    0.55556          0.88288
std mean diff.........     36.648          -35.982

mean raw eQQ diff.....    0.16667          0.16216
med  raw eQQ diff.....          0                0
max  raw eQQ diff.....          1                1

mean eCDF diff........   0.082583         0.081081
```

```
med  eCDF diff........    0.082583          0.081081
max  eCDF diff........     0.16517           0.16216

var ratio (Tr/Co).....      0.7769            1.9466
T-test p-value........     0.21023       0.00077256


***** (V12) I(Black * female) *****
                         Before Matching       After Matching
mean treatment........    0.045045          0.045045
mean control..........           0                 0
std mean diff.........      21.621            21.621

mean raw eQQ diff.....    0.055556          0.045045
med  raw eQQ diff.....           0                 0
max  raw eQQ diff.....           1                 1

mean eCDF diff........    0.022523          0.022523
med  eCDF diff........    0.022523          0.022523
max  eCDF diff........    0.045045          0.045045

var ratio (Tr/Co).....         Inf               Inf
T-test p-value........    0.024667          0.024037


***** (V13) I(Hispanic * female) *****
                         Before Matching       After Matching
mean treatment........    0.009009          0.009009
mean control..........     0.33333           0.15315
std mean diff.........      -341.7            -151.87

mean raw eQQ diff.....     0.27778           0.14414
med  raw eQQ diff.....           0                 0
max  raw eQQ diff.....           1                 1

mean eCDF diff........     0.16216          0.072072
med  eCDF diff........     0.16216          0.072072
max  eCDF diff........     0.32432           0.14414

var ratio (Tr/Co).....    0.038288          0.068836
T-test p-value........    0.011502       3.3845e-05


***** (V14) I(White * female) *****
                         Before Matching       After Matching
mean treatment........    0.081081          0.081081
mean control..........     0.33333          0.099099
std mean diff.........      -91.997           -6.5712

mean raw eQQ diff.....     0.22222          0.018018
med  raw eQQ diff.....           0                 0
max  raw eQQ diff.....           1                 1
```

```
mean eCDF diff........    0.12613          0.009009
med  eCDF diff........    0.12613          0.009009
max  eCDF diff........    0.25225          0.018018

var ratio (Tr/Co).....    0.31953           0.83455
T-test p-value........   0.044675           0.15638


***** (V15) I(Hispanic * foodstamp) *****
                        Before Matching       After Matching
mean treatment........   0.045045          0.045045
mean control..........          0                 0
std mean diff.........     21.621            21.621

mean raw eQQ diff.....   0.055556          0.045045
med  raw eQQ diff.....          0                 0
max  raw eQQ diff.....          1                 1

mean eCDF diff........   0.022523          0.022523
med  eCDF diff........   0.022523          0.022523
max  eCDF diff........   0.045045          0.045045

var ratio (Tr/Co).....        Inf               Inf
T-test p-value........   0.024667          0.024037


***** (V16) I(Black * foodstamp) *****
                        Before Matching       After Matching
mean treatment........    0.15315           0.15315
mean control..........          0                 0
std mean diff.........     42.335            42.335

mean raw eQQ diff.....    0.16667           0.15315
med  raw eQQ diff.....          0                 0
max  raw eQQ diff.....          1                 1

mean eCDF diff........   0.076577          0.076577
med  eCDF diff........   0.076577          0.076577
max  eCDF diff........    0.15315           0.15315

var ratio (Tr/Co).....        Inf               Inf
T-test p-value........ 1.9845e-05       1.8319e-05


***** (V17) I(White * foodstamp) *****
                        Before Matching       After Matching
mean treatment........    0.10811           0.10811
mean control..........    0.22222           0.42342
std mean diff.........    -36.584           -101.09

mean raw eQQ diff.....    0.11111           0.31532
med  raw eQQ diff.....          0                 0
max  raw eQQ diff.....          1                 1
```

```
mean eCDF diff........   0.057057          0.15766
med  eCDF diff........   0.057057          0.15766
max  eCDF diff........    0.11411          0.31532

var ratio (Tr/Co).....    0.53166          0.39495
T-test p-value........    0.29042       4.0512e-10


***** (V18) I(Vet * foodstamp) *****
                        Before Matching       After Matching
mean treatment........   0.072072          0.072072
mean control..........   0.055556          0.036036
std mean diff.........     6.3579            13.872

mean raw eQQ diff.....   0.055556          0.036036
med  raw eQQ diff.....          0                 0
max  raw eQQ diff.....          1                 1

mean eCDF diff........  0.0082583          0.018018
med  eCDF diff........  0.0082583          0.018018
max  eCDF diff........   0.016517          0.036036

var ratio (Tr/Co).....     1.2147            1.9252
T-test p-value........    0.78813          0.044047


***** (V19) I(Vet * Black) *****
                        Before Matching       After Matching
mean treatment........   0.072072          0.072072
mean control..........   0.055556           0.30631
std mean diff.........     6.3579           -90.166

mean raw eQQ diff.....   0.055556           0.23423
med  raw eQQ diff.....          0                 0
max  raw eQQ diff.....          1                 1

mean eCDF diff........  0.0082583           0.11712
med  eCDF diff........  0.0082583           0.11712
max  eCDF diff........   0.016517           0.23423

var ratio (Tr/Co).....     1.2147           0.31474
T-test p-value........    0.78813       1.9564e-07

***** (V20) I(Vet * White) *****
                        Before Matching       After Matching
mean treatment........   0.063063          0.063063
mean control..........          0                 0
std mean diff.........     25.827            25.827

mean raw eQQ diff.....   0.055556          0.063063
med  raw eQQ diff.....          0                 0
max  raw eQQ diff.....          1                 1
```

```
mean eCDF diff........   0.031532          0.031532
med  eCDF diff........   0.031532          0.031532
max  eCDF diff........   0.063063          0.063063

var ratio (Tr/Co).....         Inf               Inf
T-test p-value........  0.0075678         0.0073076

***** (V21) I(female * foodstamp) *****
                       Before Matching        After Matching
mean treatment........    0.09009           0.09009
mean control..........    0.16667          0.099099
std mean diff.........    -26.625           -3.1324

mean raw eQQ diff.....   0.055556          0.009009
med  raw eQQ diff.....          0                 0
max  raw eQQ diff.....          1                 1

mean eCDF diff........   0.038288         0.0045045
med  eCDF diff........   0.038288         0.0045045
max  eCDF diff........   0.076577          0.009009

var ratio (Tr/Co).....    0.56249           0.91818
T-test p-value........     0.4268            0.5643

***** (V22) I(HS * Black) *****
                       Before Matching        After Matching
mean treatment........    0.18919           0.18919
mean control..........          0                 0
std mean diff.........     48.087            48.087

mean raw eQQ diff.....    0.22222           0.18919
med  raw eQQ diff.....          0                 0
max  raw eQQ diff.....          1                 1

mean eCDF diff........   0.094595          0.094595
med  eCDF diff........   0.094595          0.094595
max  eCDF diff........    0.18919           0.18919

var ratio (Tr/Co).....         Inf               Inf
T-test p-value........ 1.6485e-06        1.4948e-06

***** (V23) I(HS * Hispanic) *****
                       Before Matching        After Matching
mean treatment........    0.09009           0.09009
mean control..........    0.11111           0.10811
std mean diff.........    -7.3089           -6.2648

mean raw eQQ diff.....          0          0.018018
med  raw eQQ diff.....          0                 0
max  raw eQQ diff.....          0                 1

mean eCDF diff........   0.010511          0.009009
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med  eCDF diff........   0.010511          0.009009
max  eCDF diff........   0.021021          0.018018

var ratio (Tr/Co).....      0.791           0.85017
T-test p-value........     0.7976           0.48001

***** (V24) I(HS * White) *****
                        Before Matching       After Matching
mean treatment........    0.12613           0.12613
mean control..........    0.11111          0.072072
std mean diff.........     4.5023            16.208

mean raw eQQ diff.....   0.055556          0.054054
med  raw eQQ diff.....          0                 0
max  raw eQQ diff.....          1                 1

mean eCDF diff........  0.0075075          0.027027
med  eCDF diff........  0.0075075          0.027027
max  eCDF diff........   0.015015          0.054054

var ratio (Tr/Co).....     1.0635            1.6481
T-test p-value........    0.85722           0.10757

***** (V25) I(HS * foodstamp) *****
                        Before Matching       After Matching
mean treatment........    0.17117           0.17117
mean control..........   0.055556          0.045045
std mean diff.........     30.557            33.334

mean raw eQQ diff.....    0.11111           0.12613
med  raw eQQ diff.....          0                 0
max  raw eQQ diff.....          1                 1

mean eCDF diff........   0.057808          0.063063
med  eCDF diff........   0.057808          0.063063
max  eCDF diff........    0.11562           0.12613

var ratio (Tr/Co).....     2.5769            3.2981
T-test p-value........   0.089737         0.0013971

***** (V26) I(HS * female) *****
                        Before Matching       After Matching
mean treatment........   0.045045          0.045045
mean control..........    0.22222           0.18018
std mean diff.........    -85.041           -64.862

mean raw eQQ diff.....    0.16667           0.13514
med  raw eQQ diff.....          0                 0
max  raw eQQ diff.....          1                 1

mean eCDF diff........   0.088589          0.067568
med  eCDF diff........   0.088589          0.067568
max  eCDF diff........    0.17718           0.13514
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var ratio (Tr/Co).....    0.23719          0.29121
T-test p-value........    0.10148        6.225e-05

***** (V27) I(Some.College * Hispanic) *****
                        Before Matching        After Matching
mean treatment........    0.027027          0.027027
mean control..........    0.16667           0.018018
std mean diff.........    -85.722             5.5305

mean raw eQQ diff.....    0.11111           0.009009
med  raw eQQ diff.....          0                  0
max  raw eQQ diff.....          1                  1

mean eCDF diff........    0.06982          0.0045045
med  eCDF diff........    0.06982          0.0045045
max  eCDF diff........    0.13964           0.009009

var ratio (Tr/Co).....    0.18044             1.4862
T-test p-value........    0.14518            0.31733

***** (V28) I(Some.College * White) *****
                        Before Matching        After Matching
mean treatment........    0.13514           0.13514
mean control..........    0.16667           0.15315
std mean diff.........    -9.1817           -5.2467

mean raw eQQ diff.....          0           0.018018
med  raw eQQ diff.....          0                  0
max  raw eQQ diff.....          0                  1

mean eCDF diff........   0.015766           0.009009
med  eCDF diff........   0.015766           0.009009
max  eCDF diff........   0.031532           0.018018

var ratio (Tr/Co).....    0.80197            0.90113
T-test p-value........    0.74594             0.5643

***** (V29) I(Some.College * foodstamp) *****
                        Before Matching        After Matching
mean treatment........    0.13514           0.13514
mean control..........    0.16667           0.21622
std mean diff.........    -9.1817            -23.61

mean raw eQQ diff.....          0           0.081081
med  raw eQQ diff.....          0                  0
max  raw eQQ diff.....          0                  1

mean eCDF diff........   0.015766           0.040541
med  eCDF diff........   0.015766           0.040541
max  eCDF diff........   0.031532           0.081081

var ratio (Tr/Co).....    0.80197            0.68966
```

```
T-test p-value........    0.74594          0.018913


***** (V30) I(Some.College * female) *****
                         Before Matching        After Matching
mean treatment........     0.072072          0.072072
mean control..........      0.33333          0.063063
std mean diff.........      -100.57            3.4679

mean raw eQQ diff.....      0.22222          0.009009
med  raw eQQ diff.....            0                 0
max  raw eQQ diff.....            1                 1

mean eCDF diff........      0.13063         0.0045045
med  eCDF diff........      0.13063         0.0045045
max  eCDF diff........      0.26126          0.009009

var ratio (Tr/Co).....      0.28681            1.1319
T-test p-value........     0.037984           0.65531


***** (V31) I(unemploy * Black) *****
                         Before Matching        After Matching
mean treatment........      0.31532           0.31532
mean control..........     0.055556           0.30631
std mean diff.........       55.653            1.9302

mean raw eQQ diff.....      0.27778          0.009009
med  raw eQQ diff.....            0                 0
max  raw eQQ diff.....            1                 1

mean eCDF diff........      0.12988         0.0045045
med  eCDF diff........      0.12988         0.0045045
max  eCDF diff........      0.25976          0.009009

var ratio (Tr/Co).....       3.9214             1.016
T-test p-value........ 0.00069634           0.86211


***** (V32) I(unemploy * Hispanic) *****
                         Before Matching        After Matching
mean treatment........      0.10811           0.10811
mean control..........      0.16667           0.10811
std mean diff.........      -18.773                 0

mean raw eQQ diff.....     0.055556                 0
med  raw eQQ diff.....            0                 0
max  raw eQQ diff.....            1                 0

mean eCDF diff........     0.029279                 0
med  eCDF diff........     0.029279                 0
max  eCDF diff........     0.058559                 0
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var ratio (Tr/Co).....    0.66162                1
T-test p-value........    0.54479                1


***** (V33) I(unemploy * White) *****
                        Before Matching       After Matching
mean treatment........    0.25225           0.25225
mean control..........    0.27778           0.43243
std mean diff.........    -5.8508             -41.3

mean raw eQQ diff.....          0           0.18018
med  raw eQQ diff.....          0                 0
max  raw eQQ diff.....          0                 1

mean eCDF diff........   0.012763           0.09009
med  eCDF diff........   0.012763           0.09009
max  eCDF diff........   0.025526           0.18018

var ratio (Tr/Co).....    0.89604           0.76852
T-test p-value........    0.82822       0.00028067


***** (V34) I(unemploy * Vet) *****
                        Before Matching       After Matching
mean treatment........    0.12613           0.12613
mean control..........    0.11111           0.34234
std mean diff.........     4.5023           -64.833

mean raw eQQ diff.....   0.055556           0.21622
med  raw eQQ diff.....          0                 0
max  raw eQQ diff.....          1                 1

mean eCDF diff........  0.0075075           0.10811
med  eCDF diff........  0.0075075           0.10811
max  eCDF diff........   0.015015           0.21622

var ratio (Tr/Co).....     1.0635           0.48955
T-test p-value........    0.85722       9.8683e-06


***** (V35) I(unemploy * female) *****
                        Before Matching       After Matching
mean treatment........    0.12613           0.12613
mean control..........    0.33333           0.18018
std mean diff.........    -62.132           -16.208

mean raw eQQ diff.....    0.16667          0.054054
med  raw eQQ diff.....          0                 0
max  raw eQQ diff.....          1                 1

mean eCDF diff........     0.1036          0.027027
med  eCDF diff........     0.1036          0.027027
max  eCDF diff........    0.20721          0.054054
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```
var ratio (Tr/Co).....    0.47269          0.74615
T-test p-value........   0.096287          0.15638


***** (V36) I(unemploy * foodstamp) *****
                        Before Matching       After Matching
mean treatment........     0.2973            0.2973
mean control..........    0.27778           0.45946
std mean diff.........     4.2513           -35.319

mean raw eQQ diff.....          0            0.16216
med  raw eQQ diff.....          0                 0
max  raw eQQ diff.....          0                 1

mean eCDF diff........  0.0097598          0.081081
med  eCDF diff........  0.0097598          0.081081
max  eCDF diff........    0.01952           0.16216

var ratio (Tr/Co).....    0.99243           0.84118
T-test p-value........    0.86902         0.0002872


***** (V37) I(unemploy * HS) *****
                        Before Matching       After Matching
mean treatment........     0.2973            0.2973
mean control..........    0.11111           0.10811
std mean diff.........     40.551            41.205

mean raw eQQ diff.....    0.16667           0.18919
med  raw eQQ diff.....          0                 0
max  raw eQQ diff.....          1                 1

mean eCDF diff........   0.093093          0.094595
med  eCDF diff........   0.093093          0.094595
max  eCDF diff........    0.18619           0.18919

var ratio (Tr/Co).....     2.0159            2.1667
T-test p-value........     0.0425        0.00016725


***** (V38) I(unemploy * Some.College) *****
                        Before Matching       After Matching
mean treatment........    0.27027           0.27027
mean control..........    0.27778           0.51351
std mean diff.........    -1.6829           -54.525

mean raw eQQ diff.....          0           0.24324
med  raw eQQ diff.....          0                 0
max  raw eQQ diff.....          0                 1

mean eCDF diff........  0.0037538           0.12162
med  eCDF diff........  0.0037538           0.12162
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max  eCDF diff........  0.0075075           0.24324

var ratio (Tr/Co).....    0.93691           0.78947
T-test p-value........    0.94923         6.4115e-06


Before Matching Minimum p.value: 3.9108e-07
Variable Name(s): Black  Number(s): 1

After Matching Minimum p.value: 4.0512e-10
Variable Name(s): I(White * foodstamp)  Number(s): 17
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