IMPACT EVALUATION OF THE GREATER MEMPHIS ALLIANCE FOR A COMPETITIVE WORKFORCE (GMACW) TAACCCT PROGRAM

RAY MARSHALL CENTER FOR THE STUDY OF HUMAN RESOURCES

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GREATER MEMPHIS ALLIANCE FOR A COMPETITIVE WORKFORCE (GMACW) TAACCCT ROUND 4 GRANT

Impact Evaluation Final Report

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TABLE OF CONTENTS

Executive summary i

Introduction 1
- Overview 1
- Evaluation design 3
- Data sources 5
- Data collection 6
- Report organization 7

Participant characteristics 8
- Enrollment 8
- Demographics 9
- Program of study 10
- Enrollment status 11

Program outcomes 12
- Program completion 12
- Credit hour accumulation 15
- Credential attainment 16
- Credential stacking 19
- Employment outcomes 20

Program impacts 24
- Impact analysis design 24
- Impact analysis implementation 25
- Impact findings 29
- Limitations 30

Discussion 32
- Findings 32
- Challenges 33
- Lessons learned 34

References 38

LIST OF TABLES

Table 1. Grant-funded programs of study 2
Table 2. Demographic characteristics of participants 9
Table 3. Current program of study at intake, by college 10
Table 4. Target GMACW TAACCCT grant outcomes 12
Table 5. Program completion status by program of study 14
Table 6. Average number of credits earned 15
Table 7. Credential attainment, by college 18
Table 8. Credential attainment, by program of study 18
Table 9. Credential stacking 19
Table 10. Employment outcomes, by college 22
Table 11. Employment outcomes, by program of study 23
Table 12. Cohort groups for the DID impact analysis design 24
Table 13. Cohort groups for the retrospective impact analysis design 25
Table 14. Demographic characteristics of participants 27
Table 15. Comparison of education outcomes 28
Table 16. Program impacts 29

LIST OF FIGURES

Figure 1. Enrollment by college 8
Figure 2. Enrollment over time 8
Figure 3. Current enrollment status at intake, by college 11
Figure 4. Program completion status by college 14
Figure 5. Credential attainment for program participants 16
Figure 6. Employment outcomes 20

LIST OF APPENDICES

Appendix 1. Program of study launch dates 40
Appendix 2. Target grant outcomes 41
Appendix 3. GMACW TAACCCT participant intake form 42
Appendix 4. Data elements requested for the evaluation 44
Appendix 5. Employment outcome definitions 45
Appendix 6. Propensity score matching 46

EXECUTIVE SUMMARY

The Greater Memphis Alliance for a Competitive Workforce (GMACW) program was funded through a Trade Adjustment Assistance Community College and Career Training (TAACCCT) grant from the U.S. Department of Labor Employment and Training Administration (DOL/ETA). The grant focused on creating or enhancing programs for the advanced manufacturing and transportation, distribution and logistics (TDL) industries in the greater Memphis area. The goal of the grant was to prepare students for the labor market so that they would be able to obtain employment after program completion as well as to help employers meet their hiring needs. The grant sought to collaborate with employers in the manufacturing and TDL industries in order to develop programs to train students.

The evaluation of the GMACW TAACCCT program was focused on both process and outcomes/impacts and used both qualitative and quantitative data. A quasi-experimental design was used to assess the impacts of the program on student outcomes. A historical comparison cohort was used and comprised of individuals who enrolled in similar programs of study at the consortium colleges from a time period prior to the program implementation period.

The evaluation found that the grant met and exceeded its target enrollment goal of 1500 participants enrolled. The grant also met and exceeded its target goals for 1,050 participants completing their grant funded program of study. Nearly two-thirds of all program participants completed their program of study, while a tenth were still retained in their program of study. The Truck Driving, Finishing, and Process Control technology programs had the strongest completion rates. A fifth of all program completers enrolled in further education.

Although the grant fell just short of its target goal of 1200 participants earning a credential, credential attainment rates were strong. More than half of all program participants earned at least one for-credit credential, over a third earned an industry credential, and a little over a tenth earned a non-credit credential. The Truck driving and Process control technology programs had the strongest for-credit credential attainment rates.

Although program completion outcomes and credential attainment outcomes were

strong, employment outcomes were mixed. Employment placement rates for non-incumbent program completers and wage gain rates for incumbent program participants were strong, but retention rates for non-incumbent program completers were relatively weaker. Due to challenges in obtaining employment data, labor market outcomes were missing for about a quarter of all program completers. Focusing only on participants for whom employment data is available, the evaluation found that overall, three-quarters of non-incumbent program completers entered employment. The Truck driving and Aviation Technology programs had the highest placement rates for non-incumbent program completers. Of those non-incumbent program completers who entered employment, only about half were retained in employment. The Finishing and Truck Driving programs had the highest retention rates for non-incumbent program completers. Overall, the vast majority of incumbent program participants had a wage increase, with the highest wage gain rates in the Finishing program.

Although this evaluation report was prepared in September 2018, the grantee continued to collect data, particularly employment follow-up data, until the grant ended on September 30, 2018. Thus, the actual employment outcomes are expected to improve slightly between the writing of this report and the end of the grant period.

Program impacts were also examined using a quasi-experimental approach. The evaluation team used a historical cohort approach and employed propensity score matching to construct a matched comparison group for the impact analyses. The evaluation team found that overall, GMACW TAACCCT program participation had a significant positive impact on credential attainment. Variations in program impacts by college were also noted.

The evaluation found that the grant effectively focused on continuous improvement and successfully used data to inform programmatic decisions. Despite challenges early in the implementation period, the grant effectively used creative approaches to addressing challenges like high dropout rates and missing employment follow-up data. Key innovative approaches include using National Student Clearinghouse to track students who appeared to have dropped out of the program, but in reality had gone on to enroll in other institutions; and, using Equifax to obtain verified employment history and employment outcomes for program participants.

INTRODUCTION

OVERVIEW

In 2009, the American Recovery and Reinvestment Act amended the Trade Act of 1974 to authorize the Trade Adjustment Assistance Community College and Career Training (TAACCCT) Grant Program. The Department of Labor (DOL) implemented the TAACCCT program in partnership with the Department of Education. TAACCCT provided community colleges and other eligible institutions of higher education with funds to expand and improve their ability to deliver education and career training programs that prepare program participants for employment in high-wage, high-skill occupations. Through these multi-year grants, DOL tried to help ensure that institutions of higher education were helping adults succeed in acquiring the skills, degrees, and credentials needed for high-wage, high-skill employment while also meeting the needs of employers for skilled workers. While building capacity to provide model educational and training programs and creating innovative methods of instruction were some of the activities encouraged by the TAACCCT grant program, the primary outcome for the TAACCCT initiative was the labor market success of dislocated workers.

The Greater Memphis Alliance for a Competitive Workforce (GMACW), led by Arkansas State University Mid-South, was awarded $9,814,818 in the fourth round of the Trade Adjustment Assistance Community College Career Training (TAACCCT) grants on October 1, 2014. The GMACW TAACCCT grant represented a consortium of four colleges including Arkansas State University Mid-South (ASU Mid-South) as the lead college, Southwest Tennessee Community College (Southwest), William R. Moore College of Technology (Moore Tech), and Tennessee College of Applied Technology (TCAT-Memphis).

The GMACW TAACCCT grant was focused on creating or enhancing programs for the advanced manufacturing and transportation, distribution and logistics (TDL) industries in the greater Memphis area. The grant-supported programs of study at each college are listed in Table 1. The goal of the grant was to prepare students for the labor market so that they would be able to obtain employment after program completion as well as to help employers meet their hiring needs. The grant sought to collaborate with employers in the manufacturing and

TDL industries in order to develop programs to train students.

The period of performance spanned October 1, 2014 through March 31, 2018. The first few months of the grant were dedicated to setting up systems and contracts to implement the grant. Grant-funded programs of study began to be implemented in January 2015. Programs at the four consortium colleges varied in their launch dates (see Appendix 1).

Table 1. Grant-funded programs of study

Manufacturing	
Machining	ASU Mid-South/Moore Tech/TCAT/
Welding	ASU Mid-South/Moore Tech/TCAT/Southwest (non-credit)
Process Control	ASU Mid-South
Mechatronics	ASU Mid-South
Finishing	Southwest (non-credit)
Transportation/Distribution/Logistics	
Diesel	ASU Mid-South/TCAT
Aircraft Maintenance	ASU Mid-South/TCAT
Truck Driving	TCAT

The consortium hired Corporation for a Skilled Workforce (CSW) and the Ray Marshall Center (RMC) of The University of Texas at Austin as the third party evaluation team for this TAACCCT-funded effort. The purpose of the evaluation was to assess the extent to which the GMACW grant addressed the U.S. Department of Labor's intentions for these TAACCCT grants, which are to "*ensure that our nation's institutions of higher education are able to help the targeted population succeed in acquiring the skills, degrees, and credentials needed for high-wage, high-skill employment while also meeting the needs of employers for skilled workers*".

CSW and RMC evaluated the ongoing implementation of grant activities and conducted an outcome evaluation at the end of the grant period. CSW and RMC provided comprehensive evaluation services (Corporation for a Skilled Workforce 2015) including collecting, analyzing, and interpreting data that met USDOL reporting requirements, informing continuous program

improvements and determining the extent to which the various interventions were associated with positive outcomes and impacts. The evaluation consists of two components: (1) an implementation (formative) evaluation, conducted by CSW and RMC; and (2) an impact (summative) evaluation, conducted by RMC.

EVALUATION DESIGN

The impact evaluation conducted by the Ray Marshall Center included three components: a descriptive analysis, an outcomes analysis, and an impact analysis. Research questions guiding the impact evaluation included:

- Do participants persist in the program at higher rates than similar non-participants, measured in terms of credit hours completed?
- Do participants complete the program at higher rates than similar non-participants, measured in terms of certificates and degrees attained?
- How do participants' employment rates compare to the employment rates of similar non-participants, measured at program completion and up to three quarters post-completion?
- How do participants' quarterly earnings compare to similar non-participants' earnings post-program completion, measured at program completion up to three quarters post completion?

Outcomes analysis

The GMACW TAACCCT program was expected to lead to a number of significant and measurable outcomes. The Ray Marshall Center documented and analyzed the outcomes by assembling data on education and employment outcomes over the evaluation period. In alignment with program outcomes reported to DOL, the Ray Marshall Center monitored, examined and reported the following outcomes:

- Number of program participants served
- Number of program participants completing program of study

- Number of program participants completing credit hours
- Number of program participants earning credentials
- Number of program participants employed after program completion
- Number of program participants retained in employment after completion
- Number of program participants who received wage increase post-enrollment

Impact analysis

The impact analysis was designed to address the question: what impact did the GMACW TAACCCT program have on student education and employment outcomes? The main goal of the impact analysis was attribution – isolating the effect of the GMACW TAACCCT program from other factors and potential selection bias. The main challenge of any impact analysis is to determine what would have happened to program participants if the program had not existed (i.e. the counterfactual). While a program's impact can truly be assessed only by comparing the actual and counterfactual outcomes, the counterfactual is not observed. Without information on the counterfactual, the next best alternative is to compare outcomes of program participants with those of a comparison group of non-participants. Successful impact analyses hinge on finding a good comparison group (Khandker, Koolwal et al. 2010).

The Ray Marshall Center used a quasi-experimental evaluation methodology to estimate the impacts of the GMACW TAACCCT program on key education and employment outcomes. A quasi-experimental design was appropriate since the program did not easily lend itself to a random assignment evaluation. Three of the four GMACW consortium colleges are open-access community colleges with limited resources to serve students in targeted programs; randomly assigning these students to different systems of programs and services would have been resource intensive and would have jeopardized the successful implementation of the programs. Recent research has demonstrated that, when carried out under the right conditions, quasi-experimental estimation produces impact estimates that are similar in direction and magnitude to those resulting from more expensive and intrusive experimental evaluation methods (Greenberg, Michalopoulos et al. 2006).

DATA SOURCES

Salesforce database

GMACW used a customized common Salesforce database for tracking participant data across the four consortium colleges. The Salesforce database included data from intake forms administered to all GMACW TAACCCT program participants. The intake forms collected a wealth of demographic and background information (see Appendix 3). The Salesforce database also tracked course enrollment, course outcomes, credential attainment and employment outcomes for all program participants. The Ray Marshall Center received data from the Salesforce database on a regular basis and the evaluation was thus able to examine demographic and background characteristics, academic progression, education outcomes and employment outcomes for all GMACW TAACCCT program participants.

Institutional research data systems

Institutional research (IR) data systems at the consortium colleges include information on student demographics, enrollment status, course performance, credit hour attainment, program completion and credential attainment. The Ray Marshall Center obtained data from the IR data systems at the four consortium colleges for non-participants in the comparison pool. The Ray Marshall Center was thus able to examine demographic and background characteristics, academic progression and education outcomes for non-participants in the comparison pool.

Unemployment Insurance (UI) records

The Ray Marshall Center had hoped to obtain matched individual-level employment outcome data from the Unemployment Insurance (UI) quarterly earnings records, available through each state's employment data system. These records provide individual-level data on earnings, employers of record, and new-hire dates. These data would have helped the evaluation team track job placement, job retention, and earnings gains. However, despite numerous efforts by the GMACW implementation team to set up access to the data, the Ray Marshall Center was unable to obtain UI earnings data for TAACCCT program participants and non-participants in the comparison pool. Fortunately, in the final two years of grant

implementation, the GMACW implementation team was able to use Equifax to track job placement, job retention, and earnings gains for program participants.

National Student Clearinghouse data

The GMACW implementation team was able to use National Student Clearinghouse (NSC) data to determine if students who exited the GMACW program had enrolled at another institution to continue their education or pursue further education. The National Student Clearinghouse is a non-profit organization founded by the higher education community that maintains a comprehensive electronic registry of student records that provides a single, automated point-of-contact for organizations and individuals requiring timely, accurate verification of student enrollment, degree, and loan data. The NSC is a trusted source for student degree and enrollment verification.

DATA COLLECTION

The Ray Marshall Center worked with the consortium to develop tools and protocols for collecting, matching, and aggregating the data obtained from the sources described above. At the beginning of this grant, the Ray Marshall Center entered into data sharing agreements with the four colleges in the consortium in order to access data from their institutional research data systems.

Towards the end of Year 1 of the grant, the Ray Marshall Center reviewed the data elements available in the institutional data systems and the state wage data systems to identify the specific list of variables needed for the evaluation (see Appendix 4). During the baseline site visits conducted at the end of Year 1, the evaluation team met with institutional research staff to assess each college's capacity for data collection (Corporation for a Skilled Workforce 2015) and determined that overall, the consortium appeared well positioned to meet the data needs of the evaluation. Following the Fall 2015 site visits, the Ray Marshall Center finalized the impact evaluation plan at the start of Year 2 (Ray Marshall Center 2016). The evaluation team began collection of Salesforce data in Year 2. Following a series of test data transfers, the evaluation team worked with GMACW staff to ensure that the Salesforce dataset had all the information needed for the evaluation. The Ray Marshall Center received Salesforce data on a

semi-annual basis.

The final Salesforce dataset received by the evaluation team on September 14, 2018 covers the entire grant implementation period, from the start of program implementation in late 2014 through the end of grant implementation on March 31, 2018, and includes a total of 1,710 participants. However, the grantee continued to collect data, particularly employment follow-up data, until the grant ended on September 30, 2018. Thus, the actual employment outcomes are expected to improve slightly between the writing of this report and the end of the grant period.

The Ray Marshall Center began collection of institutional research data from the consortium colleges in Year 2, beginning with test data transfers in June 2016. The evaluation team then followed up with each individual college to address concerns and find solutions to data collection challenges. The Ray Marshall Center received complete data on comparison group students from ASU-Mid South, Moore Tech and TCAT-Memphis by the beginning of Year 3 of the grant. Since Southwest implemented newly designed programs of study, no suitable comparison group from the time period prior to grant implementation was available for the evaluation. Additionally, Southwest only offered non-credit programs through the grant and the college collects very limited data on its non-credit students. As a result, no comparison group data was available for Southwest.

REPORT ORGANIZATION

The purpose of this report is to address in a systematic and detailed manner the extent to which the GMACCW TAACCCT program achieved its key programmatic outcomes. Findings are based on analyses of (1) comprehensive data on the treatment group, made available from the Salesforce database to the evaluation team, and (2) narrow data on the comparison group, made available from the IR data systems at three of the four consortium colleges. The following chapter of the report describes the participants served by the program and examines participation patterns. The next chapter presents findings from the outcomes analysis, followed by a chapter outlining the impact analysis approach and presenting impact findings. The report concludes with a chapter summarizing key findings, challenges, and lessons learned.

PARTICIPANT CHARACTERISTICS

ENROLLMENT

A total of 1,710 individuals participated in the GMACW TAACCCT program. Thus, the grant not only met but also exceeded its target of serving 1,500 participants by the end of the grant implementation period. TCAT-Memphis served the highest number of participants, while Southwest served the lowest number of participants (see Figure 1). Overall, nearly half of all GMACW TAACCT participants were enrolled at TCAT-Memphis (44 percent).

Figure 1. Enrollment by college

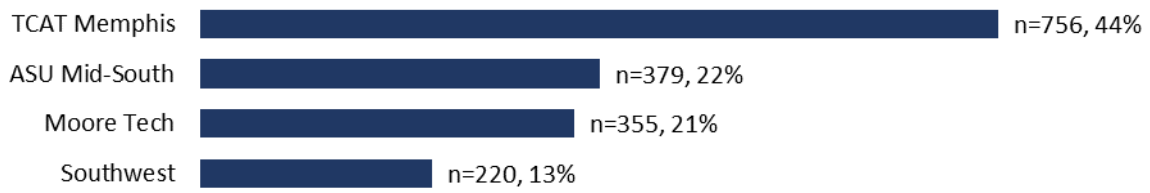
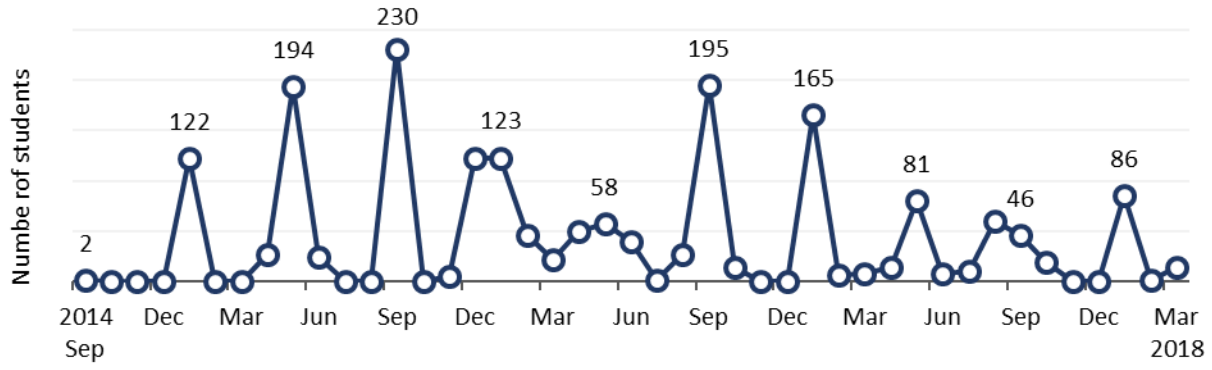


Figure 2 examines enrollment over time. The first participants in the GMACW TAACCCT program enrolled in January 2015. As expected, there were peaks in enrollment at the beginning of the semesters and trimesters at each college. Note that TCAT-Memphis has a continuous enrollment and competency based training model, with students able to enter and exit programs at any point in the year.

Figure 2. Enrollment over time



DEMOGRAPHICS

Table 2 lists the demographic characteristics of GMACW TAACCCT program participants, collected via the intake forms. GMACW TAACCCT program participants were young with a median age of just 25. Participants were mostly male. More than half of all participants were black and over a third were white. Only small proportions of participants were Hispanic or Asian. The demographic distribution among GMACW TAACCCT program participants aligns with the demographics of the Memphis Metropolitan Statistical Area: 46 percent black, 48 percent white, 2 percent Asian and 5 percent Hispanic (U.S. Census Bureau 2010).

Table 2. Demographic characteristics of participants

Characteristic		
Age	(Median)	25
Male		89%
Race	White	35%
	Black	56%
	Hispanic	4%
	Asian	2%
Education level	Less than high school	5%
	High school graduate	59%
	Some college	28%
	Associates degree or higher	9%

Characteristic	
U.S. Citizen	98%
Veteran	10%
Pell Grant eligible	48%
Employed	65%
TAA eligible	3%
Dislocated worker	2%
Referred by workforce center	6%
Registered at workforce center	10%

Nearly two-thirds of program participants had a high school degree or equivalent, while over a quarter had some college education and nearly a tenth had earned an Associate's or higher degree. A tenth of all participants reported that they were veterans. Nearly half of all participants self-reported that they were Pell-grant eligible. Two-thirds of all participants self-reported that they were employed at the time of intake. Only 2 percent of participants self-reported that they were dislocated workers. A tenth of participants were registered at a workforce center, but only 6 percent were referred to the program by a workforce center.

PROGRAM OF STUDY

GMACW TAACCCT program participants were also asked to report their program of study at the time of intake. Most GMACW TAACCCT program participants enrolled in the Welding (26 percent), Aviation Technology (25 percent), and Machine Technology programs (17 percent)

Table 3 examines the program of study at intake, broken down by college. Half of GMACW TAACCCT program participants at TCAT-Memphis enrolled in the Aviation Technology program while a fifth enrolled in the Truck Driving program. GMACW TAACCCT program participants at Moore Tech enrolled in the Welding and Machine Technology programs. At ASU-Mid South, about a third of GMACW TAACCCT program participants enrolled in the Welding program and a quarter enrolled in the Diesel Technology program. At Southwest, which had the smallest number of participants, half of GMACW TAACCCT program participants enrolled in the Finishing program, while 43 percent enrolled in the Welding program.

Table 3. Current program of study at intake, by college

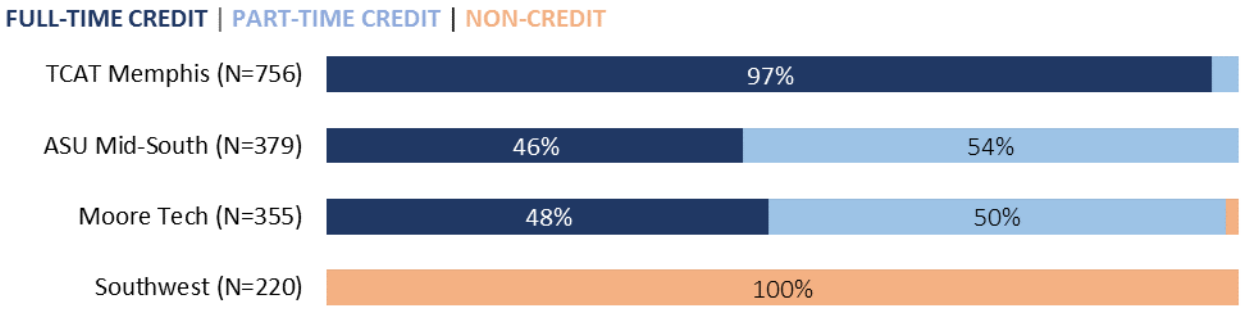
	Consortium (n=1,710)	TCAT-Memphis *(n=756)*	ASU Mid-South *(n=379)*	Moore Tech *(n=355)*	Southwest *(n=220)*
Aviation Technology	*25%*	50%	15%		
Diesel Technology	*11%*	12%	25%		
Finishing	*7%*				55%
Machine Technology	*17%*	11%	11%	48%	
Mechatronics	*2%*		7%		
Process Control Technology	*2%*		9%		
Truck Driving	*9%*	21%			
Welding	*26%*	6%	33%	52%	44%

ENROLLMENT STATUS

GMACW TAACCCT program participants were asked to report their enrollment status at the time of intake. Nearly two-thirds of GMACW TAACCCT program participants reported that they enrolled in full-time credit programs (63 percent); a quarter reported that they enrolled in part-time credit programs (24 percent); and, a little over a tenth reported that they enrolled in non-credit programs (14 percent).

Figure 3 examines current enrollment status by college. Nearly all of the GMACW TAACCCT program participants at TCAT-Memphis enrolled in full-time credit programs. In contrast, only about half of GMACW TAACCCT program participants at ASU-Mid South and Moore Tech enrolled in full-time credit programs while the other half enrolled in part-time credit programs. At Southwest, all GMACW TAACCCT program participants enrolled in non-credit programs.

Figure 3. Current enrollment status at intake, by college



PROGRAM OUTCOMES

This chapter of the report examines the outcomes of GMACW TAACCCT program participants. Outcomes examined include program completion; education outcomes such as credit hour accumulation and credential attainment; and employment outcomes such as placement, retention and wage increase. Outcomes are reported for all GMACW TAACCCT participants, and variations in outcomes by college and by program of study are also examined. Table 4 summarizes the target outcomes that the grant aims to achieve by the end of the grant period. Appendix 2 provides a breakdown of these outcomes by year, and by institution.

Table 4. Target GMACW TAACCCT grant outcomes

Outcome measures	N
Participants served	1500
Completing a funded program of study	1050
Participants completing credit hours	1350
Retained in program of study	600
Participants earning credentials	1200
Enrolled in further education	400
Participants employed after study completion	700
Retained in employment	600
Participants who received a wage increase	280

PROGRAM COMPLETION

Of the 1,710 GMACW TAACCCT program participants who entered the program , 1,088 participants completed the program (64 percent); this exceeds the grant's target goal of 1,050 program participants completing a grant funded program of study. The dropout rate across the consortium is 24 percent. About a tenth of participants (i.e. 174 participants) are still retained in their grant funded program of study, likely reflecting the long length of several grant funded programs of study - some programs are more than a year long and require students to

complete four or more trimesters or semesters. However, the grant fell short of their target goal of 600 participants still retained in their program of study[1]. A total of 208 program completers were enrolled in further education (19 percent); this is also short of the grant's target goal of 400 program completers enrolled in further education.

The vast gap between target goals and finals numbers for these outcomes can be explained by the context of the grant implementation. When these grant goals were written into the proposal, grant writers did not anticipate the short nature of program offerings and the emphasis on employment. For many students, their goal was to enter employment as quickly as possible. Combined with employers' urgent need for trained workers, this left few students with an interest in obtaining a lattice of credentials along a career pathway. Indeed, some students obtained enough skills to enter employment before completing their course of study.

Program completion by college

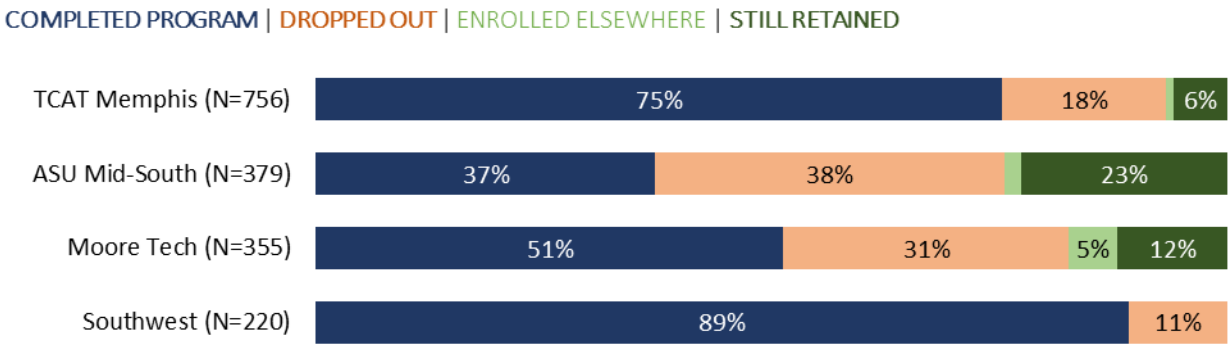
Figure 4 examines program completion by college. Southwest had the strongest completion outcomes, likely due to the short nature of their non-credit program offerings: the vast majority of program participants at Southwest completed their program of study (89 percent). Among the three colleges offering for-credit programs, TCAT-Memphis appeared to have the strongest completion outcomes, with three-quarters of program participants at TCAT-Memphis having completed their programs of study (75 percent). This was followed by Moore Tech, where half of all program participants completed their programs of study (51 percent). Finally, at ASU Mid-South, only about a third of program participants completed their programs of study (37 percent).

Notably, Moore Tech and ASU Mid-South had high dropout rates of 38 percent and 31 percent respectively. Dropout rates were much lower at TCAT-Memphis and Southwest - 18 percent and 11 percent respectively. A third of program completers at ASU Mid-South were identified as having enrolled in further education, compared to a fifth of program completers at

[1] Note that this count reflects the number of participants still retained in their grant funded program of study, at the end of the grant period. In contrast, in the Annual Performance Reports, the grantee reports the number of participants still retained at the end of each year of grant implementation.

TCAT and Moore Tech, and a tenth of program completers at Southwest.

Figure 4. Program completion status by college



Program completion by program of study

Table 5 examines program completion by program of study. The highest completion rates were in the Truck Driving program (offered at TCAT) where the vast majority of program participants completed the program (91 percent), likely because of the short nature of the program. The Finishing and Process Control Technology programs also appeared to be quite strong with completion rates of 82 percent and 73 percent respectively.

Table 5. Program completion status by program of study

Program	*Number of participants*	Completed program	Dropped out	Enrolled elsewhere	Still retained
Aviation Technology	*435*	63%	24%	1%	12%
Diesel Technology	*180*	56%	35%	2%	7%
Finishing	*120*	82%	18%	0%	0%
Machine Technology	*296*	51%	31%	2%	16%
Mechatronics	*27*	22%	30%	4%	44%
Process Control Technology	*33*	73%	15%	0%	12%
Truck Driving	*162*	91%	4%	0%	6%
Welding	*451*	63%	26%	4%	8%

The Welding, Aviation Technology, Machine Technology, and Diesel Technology

programs had moderate completion rates ranging from 51 percent to 63 percent, but these programs also had relatively high dropout rates, ranging from 24 percent to 35 percent. Completion rates were the lowest in the Mechatronics program – only a fifth of participants completed the program. Note that 44 percent of participants in the Mechatronics program were still enrolled in the program of study; thus, the completion rate for this program may yet increase, albeit after the end of the grant period.

A third of program completers in the Diesel technology program enrolled in further education, compared to a quarter of program completers in the Machine technology program, and a fifth of program completers in the Aviation technology and Welding programs.

CREDIT HOUR ACCUMULATION

Table 6 examines the average number of college credits earned per semester or trimester. Overall, GMACW TAACCCT program participants in for-credit programs earned an average of 9.4 college credits per semester or trimester. TCAT-Memphis had the highest credit hour accumulation rate - program participants at TCAT-Memphis earned an average of 13 credits per trimester. In contrast, program participants at ASU-Mid South and Moore Tech earned only an average of 5 to 6 college credits per semester or trimester.

Table 6. Average number of credits earned

Overall		By college		By program	
Overall (N=1440)	9.4	TCAT Memphis (N=743)	13	Aviation Technology (N=427)	13.3
		ASU Mid-South (N=344)	6.2	Diesel Technology (N=180)	9
		Moore Tech (N=353)	4.7	Machine Technology (N=290)	8.2
				Mechatronics (N=23)	6.7
				Process Control Technology (N=29)	9.7
				Truck Driving (N=152)	8.5
				Welding (N=337)	6.1

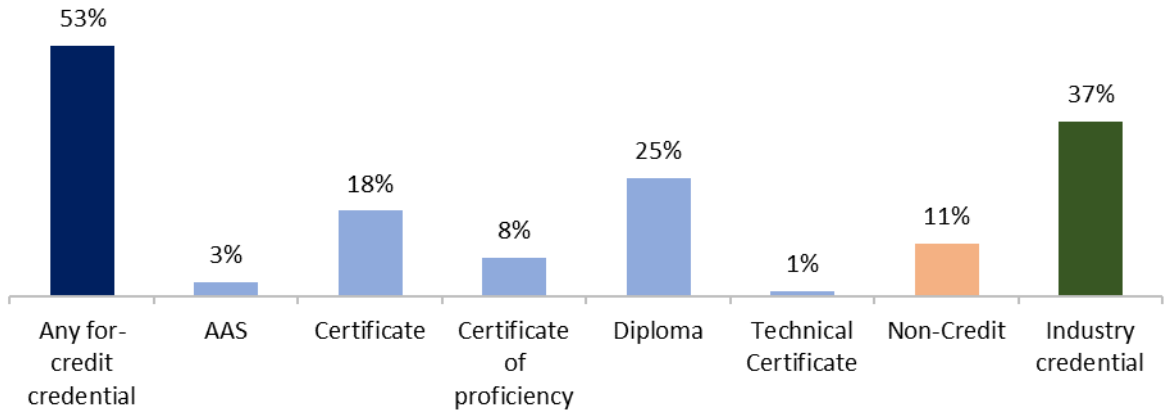
The Aviation Technology program had the highest credit hour accumulation rate -

program participants in this program earned an average of 13.3 college credits per semester or trimester. In contrast, GMACW TAACCCT program participants in the Machine technology, Diesel technology, Truck driving and Process control technology programs earned an average of 8 to 10 college credits per semester or trimester. Participants in the Mechatronics and Welding programs had the lowest credit hour accumulation and earned an average of only 6 to 7 college credits per semester or trimester.

CREDENTIAL ATTAINMENT

Figure 5 examines overall credential attainment for the 1,710 GMACW TAACCCT program participants. A total of 1,160 students (68 percent) earned either a for-credit credential or an industry credential. This is slightly short of the grant's target goals of 1,200 participants earning credentials. Overall, more than half of all program participants earned at least one for-credit credential while more than a third earned at least one industry credential. Half of all program participants earned a certificate or diploma (51 percent) while a small fraction earned an Associate's degree (3 percent). A little over a tenth of all participants earned at least one non-credit credential.

Figure 5. Credential attainment for program participants



Credential attainment by college

Table 7 examines credential attainment, broken down by college. For-credit credential attainment was strong at TCAT-Memphis where three-quarters of program participants earned at least one for-credit credential. At TCAT-Memphis, a little under half of all program

participants earned a diploma while a little over a quarter earned a certificate. For-credit credential attainment was relatively lower at Moore Tech, where only half of program participants earned at least one for-credit credential. At Moore Tech, a little over a quarter of program participants earned a certificate, 16 percent of participants earned a diploma and, notably, 8 percent of program participants earned an AAS degree. For-credit credential attainment was lowest at ASU Mid-South where only 40 percent of program participants earned at least one for-credit credential . At ASU Mid-South, more than a third of program participants earned a certificate of proficiency and, notably, 8 percent of program participants earned an AAS degree. Program participants at Southwest did not earn any for-credit credential since Southwest only-offered non-credit programs through the grant. A majority (86 percent) of program participants at Southwest earned at least one non-credit credential. Industry recognized credential attainment was highest at Southwest where two-thirds of program participants (68 percent) earned an industry recognized credential.

Credential attainment by program of study

Table 8 examines credential attainment, broken down by program of study. For-credit credential attainment was strongest in the Truck driving program, where the vast majority of program participants earned a for-credit credential. Credential attainment was also very strong in the Process Control Technology program, where three-quarters of program participants earned a for-credit credential. For-credit credential attainment was moderately robust in the Aviation technology, Machine Technology and Diesel Technology programs, ranging from 51 percent to 63 percent. For-credit credential attainment was lowest in the Welding and Mechatronics program, where less than half of program participants earned a for-credit credential (41 percent and 37 percent respectively). Notably, 11 percent of program participants in the Mechatronics program and 8 percent of program participants in the Machine Technology program earned an AAS degree.

Industry recognized credential attainment was highest in the Truck Driving program. Industry recognized credential attainment was also strong in the Finishing, Welding and Machine Technology programs, where about half of program participants earned an industry recognized credential.

Table 7. Credential attainment, by college

	Number of program participants	Any credential	Any for-credit credential	AAS	Certificate	Certificate of proficiency	Diploma	Technical certificate	Non-credit	Industry credential
TCAT-Memphis	*756*	76%	75%		27%		48%			29%
ASU Mid-South	*379*	57%	40%	8%	1%	37%		4%		39%
Moore Tech	*355*	63%	51%	8%	27%		16%			30%
Southwest	*220*	68%	0%						86%	68%

Table 8. Credential attainment, by program of study

	Number of program participants	Any credential	Any for-credit credential	AAS	Certificate	Certificate of proficiency	Diploma	Technical certificate	Non-credit	Industry credential
Aviation Technology	*435*	64%	63%	2%		3%	60%	3%		13%
Diesel Technology	*180*	64%	58%	3%	18%	17%	21%	3%		14%
Finishing	*120*	57%							78%	57%
Machine Technology	*296*	67%	51%	8%	20%	7%	16%			42%
Mechatronics	*27*	41%	37%	11%		37%				11%
Process Control Technology	*33*	73%	73%			73%				6%
Truck Driving	*162*	91%	90%		84%		6%			86%
Welding	*451*	70%	41%	3%	16%	9%	14%		21%	45%

CREDENTIAL STACKING

The evaluation team also explored any evidence of credential stacking, defined as GMACW TAACCCT program participants who exited the program and earned more than one for-credit credential (see Table 9). Note that credential stacking was not an explicit goal for the program. However, research has shown that credential stacking helps increase student persistence and motivation (Austin, Mellow et al. 2012), helps support completion by building momentum, and helps build up an individual's qualifications, and helps them to move along a career pathway.

Table 9. Credential stacking

Overall		By college		By program	
Overall (N=734)	8%	ASU Mid-South (N=379)	15%	Aviation Technology (N=57)	19%
		Moore Tech (N=355)	1%	Diesel Technology (N=93)	6%
				Machine Technology (N=215)	4%
				Mechatronics (N=27)	26%
				Process Control Technology (N=33)	0%
				Welding (N=307)	8%

It is important to note that while programs at TCAT are comprised of stacked credentials, the college may only award the highest credential earned; this prevents TCAT from awarding stacked credentials but supports a higher completion rate. TCAT-Memphis is hence excluded from this examination of credential stacking. Overall, 8 percent of program participants earned more than one credential. A small fraction of program participants at Moore Tech earned more than one credential. Stronger evidence of credential stacking was observed at ASU Mid-South where 15 percent of program participants earned more than one for-credit credential.

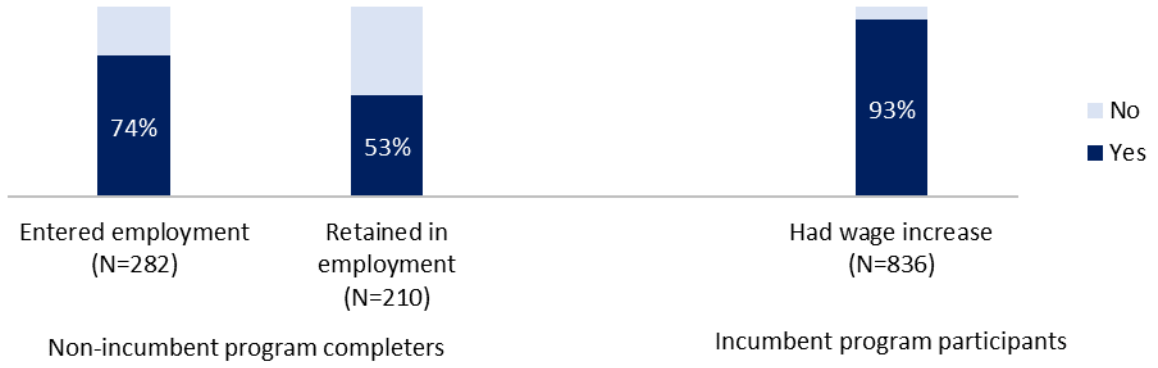
An examination of credential stacking by program at the two colleges reveals strong

evidence of credential stacking in the Aviation technology and Mechatronics programs (19 percent and 26 percent respectively) and some evidence of credential stacking in the Welding, Machine Technology and Diesel Technology programs.

EMPLOYMENT OUTCOMES

Figure 6 examines overall employment outcomes for the 1,087 GMACW TAACCCT participants who completed their grant-funded program of study. Employment outcomes are defined in accordance with DOL guidelines and can be found in Appendix 5. Employment outcomes were obtained either through self-report from participants obtained by Job Retention Coaches during follow-up, or from Equifax. Note that despite best efforts to obtain employment data, employment outcomes were not available for about a quarter of all completers. **Below, we discuss employment outcomes for only those completers for whom employment data was available**. Note also that analysis for this evaluation report was conducted in September 2018. However, the grantee continued to collect data, particularly employment follow-up data, until the grant ended on September 30, 2018. Thus, the actual employment outcomes are expected to improve slightly between the writing of this report and the end of the grant period.

Figure 6. Employment outcomes



Overall, three-quarters of non-incumbent program completers entered employment. Of those non-incumbent completers who entered employment, only about half were retained in

employment. Overall, the vast majority of incumbent program participants had a wage increase.

A total of 210 non-incumbent program completers entered employment - this is well below the grant's target goal of 700 non-incumbent program completers entering employment. Overall, 112 non-incumbent program completers were retained in employment - this is well below the grant's target goal of 600 non-incumbent workers being retained in employment. However, 781 incumbent program participants had a wage increase– this meets and exceeds the grant's target goal of 280 incumbent participants having a wage increase.

In comparing these employment outcomes to target goals, it should be noted that the grant writers had expected the grant to have a much larger proportion of non-incumbent workers than incumbent workers and hence the target goals for employment placement and employment retention, which are reported for non-incumbent workers only, are high. However, in reality, the grant included a much larger proportion of incumbent workers than non-incumbent workers (1,104 incumbent workers vs. 606 non-incumbent workers). As a result, it was mathematically impossible for the grant to meet the target goals as originally designed.

Employment outcomes by college

Table 10 examines employment outcomes, broken down by college. Although, employment outcomes at Southwest appear strong, note that employment outcomes were missing for half of program completers at Southwest – thus the employment outcomes should not be considered representative.

Employment placement rates were strongest at Moore Tech, where the vast majority of non-incumbent program completers entered employment. Employment placement rates were also strong at TCAT-Memphis where more than three-quarters of non-incumbent program completers entered employment. Employment placement rates were comparatively much lower at ASU Mid-South – just over half of all non-incumbent program completers at Mid-South entered employment. Employment retention was highest at TCAT-Memphis where over half of

non-incumbent program completers who entered employment were retained in employment. However, employment retention rates were notably lower at ASU Mid-South and Moore Tech. All three colleges also had strong wage increase outcomes for incumbent program participants.

Table 10. Employment outcomes, by college

	Number of non-incumbent program completers	Missing employment data	Entered employment	Retained employment
TCAT Memphis	*218*	19%	79%	56%
ASU Mid-South	*60*	40%	53%	42%
Moore Tech	*47*	13%	85%	43%
Southwest	*53*	47%	57%	69%
	Number of incumbent program participants	Missing employment data	Had wage increase	
TCAT Memphis	*460*	14%	92%	
ASU Mid-South	*227*	24%	95%	
Moore Tech	*255*	27%	95%	
Southwest	*162*	50%	95%	

Table 11 examines employment outcomes, broken down by program of study. The Truck Driving program had the strongest employment outcomes: 81 percent of non-incumbent program completers entered employment and 67 percent of non-incumbent program completers who entered employment were retained in employment. Employment placement rates for non-incumbent program completers were the lowest in the Finishing program. Retention rates for non-incumbent program completers were highest in the Finishing and Truck Driving programs. Retention rates for non-incumbent program completers were lowest in the Machine Technology and Diesel Technology programs. Wage increase outcomes for incumbent program participants were strong across all programs of study, with the highest wage gain rates observed in the Process Control technology and Finishing programs.

Table 11. Employment outcomes, by program of study[2]

	Number of non-incumbent program completers	Missing employment data	Entered employment	Retained employment
Aviation Technology	*77*	19%	81%	54%
Diesel Technology	*44*	34%	76%	41%
Finishing	*32*	38%	55%	73%
Machine Technology	*52*	19%	76%	38%
Mechatronics	*4*			
Process Control Technology	*14*			
Truck Driving	*65*	9%	81%	67%
	Number of incumbent program participants	Missing employment data	Had wage increase	
Aviation Technology	*305*	14%	91%	
Diesel Technology	*101*	17%	94%	
Finishing	*83*	34%	98%	
Machine Technology	*198*	22%	95%	
Mechatronics	*16*			
Process Control Technology	*16*			
Truck Driving	*92*	15%	94%	

[2] Employment outcomes are not presented for the mechatronics and Process Control technology programs because of the small counts of participants (<20).

PROGRAM IMPACTS

IMPACT ANALYSIS DESIGN

Proposed design

The Ray Marshall Center initially proposed using a difference-in-differences (DID) approach. The DID method compares treatment and comparison groups in terms of outcome changes over time, relative to the outcomes observed at the pre-intervention baseline. However, this approach relies on using cohorts of students from the redesigned programs (the "treatment group") coupled with parallel cohorts in similar, non-redesigned programs (the "comparison group pool"), both using grant period and earlier time periods (see Table 12). Similar, non-redesigned programs need to be chosen as comparison programs on the basis of several criteria: a) same department, b) same credit/non-credit status, c) similar duration, d) similar demographics, and e) enough available students.

Table 12. Cohort groups for the DID impact analysis design

Time period	Academic Year	Comparison (Similar programs in consortium colleges)	Treatment (Manufacturing/TDL programs in consortium colleges)
Prior Year	2014-15	Group 1	Group 3
Program Implementation	2015-16 2016-17 2017-18	Group 2	Group 4

During the baseline site visits conducted in September 2015, the evaluation team gained a better understanding of each college's program structures, as well as how the programs of study were being implemented. The four consortium colleges are relatively small, with a limited number of programs serving a small number of students. None of the colleges are offering concurrent non-grant funded, non-redesigned courses or programs in the same fields of study as the grant-funded redesigned programs. As a result, identifying a comparison group made up of similar non-grant funded non-redesigned programs in the grant implementation period was

not possible. The evaluation team thus determined that the difference-in-differences method was not appropriate for the impact analysis.

Final design

Ray Marshall Center instead implemented a historical cohort analysis. Outcomes for the treatment group that received the intervention during the program implementation period (GMACW TAACCCT program participants) were compared to the outcomes for a historical comparison group that did not receive the intervention from a time period prior to the program implementation period (see Table 13). Differences in outcomes between the two groups can be understood as the effect of the treatment. The evaluation team also used propensity score matching (PSM) to identify matches from the comparison group for the GMACW TAACCCT program participants. Although this design was the best approach considering the realities of program set-up and grant implementation, it should be noted that the historical cohort design is less rigorous than the original DID approach.

Table 13. Cohort groups for the retrospective impact analysis design

Time period	Academic Year	Group assignment (manufacturing/TDL programs in consortium colleges)
Prior Year	2014-15	Comparison
Program Implementation	2015-16 2016-17 2017-18	Treatment

IMPACT ANALYSIS IMPLEMENTATION

Selection of the comparison group pool

The comparison group pool was comprised of students enrolled in programs of study that are similar to grant-funded programs of study, from the time period beginning on January 1, 2014 and ending when the GMACW TAACCCT grant funding began for these programs. Data on the comparison group pool was obtained from the institutional research (IR) data systems at

the consortium colleges. The comparison group only comprises students from TCAT-Memphis, Moore Tech and ASU Mid-South, who are all participating in for-credit programs of study.

Southwest is not included in the comparison group pool because (1) Southwest is offering newly designed programs of study through the grant and thus a "pre=" comparison group of students from the time period prior to grant implementation cannot be identified; and, (2) Southwest is only offering non-credit programs through the grant and Southwest collects very limited data on students in its non-credit programs. The exclusion of Southwest from the impact analysis is deemed reasonable since (1) participants from Southwest make up about a tenth of all GMACW TAACCCT program participants; and, (2) the non-credit nature of Southwest's program offerings make them substantively distinct from the for-credit program offerings at the other three colleges.

Selection of the treatment group

The treatment group comprises all students enrolled in GMACW TAACCCT grant-funded programs of study at TCAT-Memphis, Moore Tech and ASU Mid-South, who are all participating in for-credit programs of study. Data on the treatment group was extracted by the evaluation team from the Salesforce data.

Comparison of observable characteristics

The impact analyses includes 508 students in the comparison group pool and 1,490 students in the treatment group. Of the 508 students in the comparison group pool, more than half are students from ASU Mid-South, over a quarter are students from TCAT-Memphis while about a tenth are students from Moore Tech. In contrast, of the 1,490 students in the treatment group, only a quarter of students are from ASU Mid-South while half are students from TCAT-Memphis and a quarter are students from Moore Tech.

Table 14 examines the differences between the treatment and the comparison group pool on a wide range of observable characteristics. In some ways, GMACW TAACCCT program participants (the treatment group) appear to be relatively similar to non-GMACW students in Manufacturing and TDL programs (the comparison group pool). Both the comparison group

pool and the treatment group are young with a median age of 25 and 24 respectively. Both groups are majority male. Racial distribution in both groups is similar, with black students comprising more than half of students in both groups and white students comprising about a third of both groups. Both the comparison and treatment groups had very small proportions of Hispanic students.

Table 14. Demographic characteristics of participants

		Comparison Group Pool	Treatment Group
Number of students		508	1,490
School	ASU Mid-South	27%	51%
	Moore Tech	59%	25%
	TCAT Memphis	14%	24%
Age (median)		25	24
Gender	Male	83%	92%
Race	White	34%	37%
	Black	61%	53%
	Hispanic	3%	4%
	Asian	1%	3%
	Other	1%	1%
Education level	Less than high school	0%	6%
	High school graduate or equivalent	27%	61%
	Some college	67%	26%
	Associates, Bachelors or advanced degree	5%	7%
Enrollment status	Full-time	32%	72%

There are, however, differences worth noting. Nearly two-thirds of students in the comparison group pool had some college education while about a quarter only had a high school degree. In contrast, a little over a quarter of students in the treatment group had some

college education while nearly two-thirds only had a high school degree. In the comparison group pool, only a third of students enrolled full-time in their programs of study. In contrast, the vast majority of students in the treatment group enrolled full-time in their programs of study. Given the differences documented between the treatment group and the comparison group pool on the observable characteristics, it is necessary to account for them as well as possible in order to attribute any differences in outcomes to the treatment (i.e. GMACW program participation).

Comparison of outcomes

Table 15 compares credential attainment across the two groups. The comparison group pool and treatment group appear to differ greatly on credential attainment; less than half of the comparison group earned a for-credit credential compared to more than two-thirds of the treatment group. However, these results are descriptive in nature and do not control for differences among individuals in the two groups. Given the differences documented in Table 14 between the treatment group and the comparison group pool on the observable characteristics, it is necessary to account for them as well as possible in order to attribute any differences in outcomes to the treatment (i.e. GMACW program participation).

Table 15. Comparison of education outcomes

		Comparison Group Pool	Treatment Group
Credential attainment	% earning at least 1 for-credit credential	46%	69%

Propensity Score Matching (PSM)

The evaluation team used the propensity score matching (PSM) approach to account for differences on the observable characteristics between the treatment group and the comparison group pool. See Appendix 6 for a detailed description of the application of this method. GMACW program participants in the treatment group were matched to individuals from the comparison group pool. The single nearest-neighbor technique was used; this technique

involves finding for each treated individual that non-treated individual with the most similar propensity score and so, the most similar characteristics. The evaluation team assessed and confirmed that this matching approach achieved satisfactory balance in all observables characteristics. Thus, the evaluation team can be quite confident that genuinely comparable individuals are being compared in the estimates of the causal impact of the GMACW TAACCCT Pathways program on education outcomes.

IMPACT FINDINGS

Overall program impacts

After matching, the evaluation team estimated the impacts of participation in the GMACW TAACCCT program on education outcomes (see Table 16). PSM models found that the GMACW TAACCCT program had a significant positive impact on credential attainment: less than half of the matched comparison groups earned a credential (46 percent), compared to nearly two-thirds of the treatment group (60 percent) – a 14 percentage point difference.

Table 16. Program impacts

Credential attainment					
	Matched Comparison Group Mean	Treatment Group Mean	Difference	Abadie Imbens Robust S.E.	P>|z|
Overall (%)	46.3%	60.2%	13.9%	0.038	0.000
TCAT-Memphis	49.4%	74.9%	25.6%	0.044	0.000
ASU Mid-South	38.5%	39.2%	0.7%	0.041	0.874
Moore Tech	65.5%	51.0%	-14.5%	0.078	0.064

Program impacts by college

Findings from the outcomes analysis suggest significant variations in outcomes by college. Hence, the evaluation team also examined program impacts broken down by college (see Table 16). PSM models indicate that the GMACW TAACCCT program had no significant

impacts on credential attainment at ASU Mid-South and Moore Tech. However, PSM models found that the GMACW TAACCCT program had a significant positive impact on credential attainment at TCAT-Memphis: only half of the matched comparison group earned a for-credit credential compared to three-quarters of the treatment group – a 25 percentage point difference.

LIMITATIONS

The impact analysis is clearly limited by its non-experimental design. While propensity score matching (PSM) controls for observed differences between the treatment group and the comparison group, it cannot control for selection bias that may be due to unobserved differences between the groups. As with all PSM approaches, the degree to which unmeasured sources of bias affect the comparability of groups is unknown. The limitation of any PSM approach is that, unlike an experiment, it is unable to ensure that the only difference between treatment and comparison group members is that the former received the treatment and the latter did not. In quasi-experimental designs, it is possible that individuals who have identical observable characteristics may differ on unobservable characteristics, such as their motivation to succeed. It is important to note that the limitations discussed here are common in quasi-experimental studies, and the design that the evaluation team used sought to mitigate them to the greatest extent possible.

The evaluation team made efforts to incorporate all available and important characteristics such as age, gender, race, enrollment status and prior education level. However, some important characteristics such as prior labor market experience, household size and family characteristics could not be included in the analysis, since data on these characteristics was not available to the evaluation team.[3] The lack of data on prior labor market experience is significant, since prior labor market experience is an important characteristic in considering selection bias; evaluations of job training programs in the US have found the employment

[3] Note that while rich data on additional characteristics were available for the treatment group from the intake data, no data on these characteristics were available in the IR data for the comparison group.

histories of individuals to be good predictors of program participation (Friedlander and Robins 1995, Friedlander, Greenberg et al. 1997). Prior unemployment and earnings are important when using propensity score matching because they are important predictors of program entry and employment outcomes; they also help capture otherwise unobservable characteristics, such as motivation, which can also influence participation and outcomes (Bryson, Dorsett et al. 2002).

Finally, the evaluation team was unable to examine program impacts on labor market outcomes since no employment data for the comparison group was available to the evaluation team.

DISCUSSION

FINDINGS

The evaluation found that the grant met and exceeded its target enrollment goal. However, enrollment varied considerably by college and by program of study. Specific colleges and specific programs of study faced under-enrollment and recruitment challenges that were difficult to address. However, other colleges and other programs of study had a high demand and even had waitlists in some instances. All consortium colleges used grant funds to build and expand capacity by investing in equipment and instructors. In particular, grant support allowed Moore Tech to vastly expand their Welding and Machining programs and serve many more students than they did prior to grant implementation,

The grant also met and exceeded its target goal for participants completing their grant funded program of study. Nearly two-thirds of program participants completed their program of study, while a tenth were still retained in their program of study. The Truck Driving, Finishing, and Process Control technology programs had the strongest completion rates. A fifth of all program completers enrolled in further education.

However, a quarter of all program participants dropped out, and dropout rates varied significantly by college and program of study. Highest dropout rates were observed in the Diesel technology, Machine technology and Mechatronics programs. The grant made efforts to address high dropout rates through an increased focus on supporting students through tutoring and remediation, as well as increasing entrance exam requirements and revamped screening procedures to ensure students entering programs were capable of handling the workload.

The grant fell just short of its target goal of participants earning a credential. Overall, more than two-thirds of all program participants earned a credential. More than half of all program participants earned at least one for-credit credential, over a third earned an industry credential, and a little over a tenth earned a non-credit credential. The Truck driving and Process control technology programs had the strongest for-credit credential attainment rates.

Although program completion outcomes and credential attainment outcomes were strong, employment outcomes were mixed. Employment placement rates for non-incumbent program completers and wage gain rates for incumbent program participants were strong, but retention rates for non-incumbent program completers were relatively weaker[4]. Due to challenges in obtaining employment data, labor market outcomes were missing for about a quarter of all program completers. Focusing only on participants for whom employment data is available, the evaluation found that overall, three-quarters of non-incumbent program completers entered employment. The Truck driving and Aviation Technology programs had the highest placement rates for non-incumbent program completers. Of those non-incumbent program completers who entered employment, only about half were retained in employment. The Finishing and Truck Driving programs had the highest retention rates for non-incumbent program completers. Overall, the vast majority of incumbent program participants had a wage increase, with the highest wage gain rates in the Process Control technology and Finishing programs.

Program impacts were also examined using a quasi-experimental approach. The evaluation team used a historical cohort approach and employed propensity score matching to construct a matched comparison group for the impact analyses. The evaluation team found that overall, GMACW TAACCCT program participation had significant positive impacts on credential attainment. Variations in program impacts by college were also noted.

CHALLENGES

Collecting labor market data

The Ray Marshall Center had hoped to obtain matched individual-level employment outcome data from the Unemployment Insurance (UI) quarterly earnings records, available through each state's employment data system. These records provide individual-level data on

[4] Note that while the evaluation team conducted analysis using data received on September 14, 2018, the grant continued to collect data, particularly employment follow-up data, until the grant ended on September 30, 2018. Thus, the actual employment outcomes are expected to improve slightly between the writing of this report and the end of the grant period.

earnings, employers of record, and new-hire dates. UI data remains the most reliable and consistent data source for tracking employment outcomes. These data would have helped the evaluation team track job placement, job retention, and earnings gains for participants, as well as non-participants in the comparison group. However, despite numerous efforts by the GMACW implementation team and the Ray Marshall Center, the evaluation team was unable to access UI data. As a result, employment outcomes are missing more than half of all participants.

Because the evaluation team could not access UI data, the evaluation team was also unable to assess program impacts on labor market outcomes, which are the key outcomes of interest for the Department of Labor. The inability to access UI wage records has been a common challenge for many TAACCCT evaluations across the country.

LESSONS LEARNED

Early data collection

Building on lessons learned from prior TAACCCT evaluations, the Ray Marshall Center worked quickly to establish data sharing agreements with the consortium colleges in the first year of the grant and begin data collection at the beginning of the second year. Over the second year, the evaluation team worked with the preliminary data to assess data quality and address gaps in data. As a result, by the end of the second year, the evaluation team was well positioned to conduct the necessary analyses.

Industry partnerships

The moderately strong employment outcomes of the GMACW TAACCCT program were partially the result of the grant's efforts to build relationships with a large number of Memphis area employers who were involved not simply in the hiring process, but also in creating the program structure and curriculum that increased the chance of employment for GMACW TAACCCT students.

Addressing dropout rates

Over the course of grant implementation and ongoing evaluation efforts, high dropout

rates were identified as a challenge for the grant. High dropout rates at certain colleges and certain programs were partially the result of challenges in identifying motivated enrollees during recruitment and screening. Some consortium colleges had under-enrolled programs and were unlikely to change screening or recruitment procedures; the GMACW implementation team worked with these colleges to step up efforts to support students through tutoring and remediation. At other consortium colleges that had high demand for their programs, the GMACW implementation team worked with the colleges to increase their entrance exam requirements and revamped screening procedures to ensure students entering their programs were capable of handling the workload.

The GMACW implementation team also turned to the National Student Clearinghouse (NSC) data to determine if students who appeared to have dropped out of the GMACW program had enrolled at another institution to continue their education or pursue further education. Although the number of such students was small[5], identifying these students allowed the grant to provide context to their dropout rates.

Collecting labor market data

In the first two years of the grant, the GMACW implementation team collected employment outcomes that were self-reported by participants. These self-reported employment outcomes were collected by Job Retention Coaches during follow-ups. However, challenges with conducting these follow-ups contributed to gaps in the self-reported employment data. Fortunately, in the last two years of grant implementation, the GMACW implementation team was able to use Equifax to track job placement, job retention, and earnings gains for program participants. The Equifax method of obtaining employment outcomes is cumbersome – the implementation team received a file for each individual; the file contained pages of detailed information, and a GMACW staff member had to painstakingly comb through the information to extract the necessary labor market information and then enter it into the database. Despite the inconvenience, the Equifax method was invaluable to the

[5] 37 participants who dropped out were identified as being enrolled at another institution.

program as it helped to greatly reduce the number of participants missing employment outcomes, particularly employment retention.

Setting feasible target goals in grant proposal

As described earlier, many of the target goals specified in the grant proposal do not accurately reflect the realities of the program design and offerings. For example, the grant writers had expected the grant to have a much larger proportion of non-incumbent workers than incumbent workers and hence set high target goals for employment placement and employment retention, which are reported for non-incumbent workers only. However, in reality, the grant included a much larger proportion of incumbent workers than non-incumbent workers (1,104 incumbent workers vs. 606 non-incumbent workers). As a result, it was mathematically impossible for the grant to meet the original target goals.

The grant writers also envisioned that program participants would be entering career pathways with a continuum of skills; specifically, an integral component of the program design was the articulation of non-credit programs at Southwest and "contact-hour" programs at Moore Tech and TCAT-Memphis with credit bearing pathways at ASU-Mid South and Southwest. As a result, the grant proposal set a high target for participants retained in program of study or continuing program of study. However, in reality, although efforts were made to put in place articulation agreements, there was limited success and this was one of several factors that contributed to the low numbers of participants retained in program of study or continuing program of study. Grant writers also did not anticipate the short nature of program offerings and the emphasis on employment - for many students, their goal was to enter employment as quickly as possible. Combined with employers' urgent need for trained workers, this left few students with an interest in obtaining a lattice of credentials along a career pathway.

Continuous improvement

GMACW used a customized common Salesforce database for tracking participant data across the four consortium colleges. The Salesforce database included data from the intake forms and also tracked course enrollment, course outcomes, credential attainment and

employment outcomes for all GMACW TAACCCT program participants. GMACW also ensured that a staff member served as a continuous improvement coordinator. The continuous improvement coordinator and GMACW staff monitored Salesforce data closely and tracked grant outcomes in real-time allowing for quick feedback to other GMACW staff and partner colleges, facilitating mid-course corrections.

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APPENDIX 1. PROGRAM OF STUDY LAUNCH DATES

College	Programs	Launch Date	How did funds support the students
Arkansas State University Mid-South	1) Welding Technology	1/27/2015	Instructor
	2) Machine Technology	6/1/2015	Equipment, case management
	3) Process Control	11/30/2015	Case Management
	4) Diesel Technology	7/13/2015	Instructor
	5) Aviation Technology	1/27/2015	Case Management
	6) Mechatronics	6/1/2015	Equipment
William R. Moore College of Technology	1) Machining Technology	1/5/2015	Instructor, Case Management
	2) Welding	1/5/2015	Instructor, Case Management
Tennessee College of Applied Technology	1) Machine Tool Technology	5/11/2015	Supplies, Instructor
	2) Diesel Powered Equipment Technology	4/1/2015	Instructor
	3) Aircraft Mechanics	5/18/2015	Case Management
	4) Welding, Brazing & Soldering	5/18/2015	Case Management
	5) Truck Driving	5/18/2015	Case Management
Southwest Tennessee Community College	1) Non-credit industry-specific training aligned with pathways		
	Finishing (Machining)	2/2/2016	Equipment
	Welding	9/27/2016	Adjunct
	Aha! (IRT completers)	9/8/2015	Contract fees, Case Management

APPENDIX 2. TARGET GRANT OUTCOMES

	Outcome Measure	Grant Total	ASU Mid-South	Moore Tech	Southwest	TCAT-Memphis
1	**Total Unique Participants Served:** Cumulative total number of individuals entering grant funded programs	1500	325	355	220	600
2	**Total Number of Participants Completing a TAACCCT-Funded Program of Study:** Number of unique participants having earned all of the credit hours needed for the award of a degree or certificate.	1050	227	249	154	420
3	**Total Number of Participants Still Retained in Their Program of Study or Other TAACCCT-Funded Program:** Number of unique participants who did not complete and are still enrolled in a program of study.	600	130	142	88	240
4	**Total Number of Participants Completing Credit Hours:** Total number of students enrolled that have completed any number of credit hours to date.	1350	292	320	198	540
5	**Total Number of Participants Earning Credentials:** Total number of participants completing degrees and certificates in grant funded programs of study.	1200	260	284	176	480
6	**Total Number of Participants Enrolled in Further Education After TAACCCT-funded Program of Study Completion:** Total number of students who complete a grant-funded program and enter another program of study.	400	86	95	59	160
7	**Total Number of Participants Employed After TAACCCT- Funded Program of Study Completion:** Total number of students (non-incumbent workers only) who completed a grant-funded program of study entering employment in the quarter after the quarter of program exit.	700	151	166	103	280
8	**Total Number of Participants Retained in Employment /after Program of Study Completion:** Total number of students (non- incumbent workers only) who completed a program and who entered employment after program exit who retain employment.	600	130	142	88	240
9	**Total number of Those Participants Employed at Enrollment Who Received a Wage Increase Post-Enrollment:** Total number of students who are incumbent workers who received an increase in wages after enrollment.	280	61	66	41	112

APPENDIX 3. GMACW TAACCCT PARTICIPANT INTAKE FORM

Greater Memphis Alliance for a Competitive Workforce
TAACCCT 4 Intake Form

For Office Use Only: ☐ Moore Tech ☐ MSCC ☐ TCAT-M ☐ Southwest Student ID # _____

BACK-GROUND

The US Department of Labor has awarded a grant to fund the improvement of education in the manufacturing and transportation, distribution, and logistics (TDL) sectors to the Partner Colleges of the Greater Memphis Alliance for a Competitive Workforce (GMACW).

IDENTIFYING INFORMATION

First Name:	Middle Initial:	Last Name:	
Street Address:			
City:	County:	State:	Zip:
SSN: - -	DOB: / /	Home Phone: ( ) -	
Cell Phone: ( ) -	E-mail:		
2nd E-mail:	Emergency/Alternate Contact Name: Relation:		
Emergency/Alternate Contact Phone: ( ) -	Emergency/Alternate Contact E-mail:		

PARTICIPANT INFORMATION

Authorized to work in the United States: (check only one box)
☐ Yes, U.S. Citizen ☐ Yes, Permanent Resident ☐ Yes, Permanent Non-resident Work Visa ☐ No

What is your highest Education Level Completed? (check only one)
- ☐ High School graduate or equivalent
- ☐ 1-2 years of college, technical or vocational school –Diploma or Certificate awarded
- ☐ 1-3 years of college, technical or vocational school no degree
- ☐ Associates Degree or Equivalent
- ☐ Bachelor's Degree or Equivalent
- ☐ Advanced Degree beyond Bachelor's

Gender:
☐ Female
☐ Male

Race (select all that apply):
☐ American Indian ☐ Native Hawaiian/Pacific Islander
☐ Asian ☐ White
☐ Black or African American

Hispanic/Latino:
☐ Yes ☐ No

ENROLLMENT STATUS

Are you currently enrolled: (Select one)
☐ Full-time credit ☐ Part-time credit ☐ Non-credit ☐ Not Yet Enrolled

Semester / Year First Enrolled:	Current Program of Study:	Type of Degree or Certificate:

Are you eligible to receive Pell grant funds for your training? ☐ Yes ☐ No ☐ Unknown

EDUCATIONAL ALTERNATIVES

If the training / education program you are registering for did not exist, what is your best guess about what you would have done? (Select one)
- ☐ I would not have pursued any training / education
- ☐ I would have enrolled in a similar program of study offered at this college.
  Which program? _____
- ☐ I would have enrolled in a similar program of study offered at another college.
  Which college?_____

STATUS

Check all that apply:
Individual with Disability: ☐ Yes ☐ No Employed: ☐ Yes ☐ No ☐ TAA Eligible ☐ Dislocated Worker

1 Greater Memphis Alliance for a Competitive Workforce Updated 7/7/2015

VETERAN STATUS	Select one: ☐ Not a Veteran ☐ Served on active duty for ≤ 180 days ☐ Served on active duty for more than 180 days (including reservists during a period of war) ☐ Spouse of an active duty veteran who was disabled, died, or captured while on active duty
WORKFORCE OFFICE	If you were referred by a Workforce Center, which one? _____ Are you currently registered with your local Workforce Career Center?: ☐ Yes ☐ No If yes, please indicate the month and year of your most recent registration: _____
EMPLOYMENT STATUS	If employed: Employer Name: _____ Address: _____ Contact Person: _____ Position: _____ Hours / week: _____ ☐ Working Part-time ☐ Working Full-time Work Phone: (____)_____ Start Date: _____ Salary: $_____
EMPLOYMENT HISTORY	List your two previous jobs: [1] Position:_____ Employer:_____ Start date:_____ End Date:_____ Hours /Week:_____ Hourly Wage:_____
	[2] Position:_____ Employer:_____ Start date:_____ End Date:_____ Hours /Week:_____ Hourly Wage:_____
CONSENT	The information being requested will be used to determine grant eligibility and report educational outcomes for the Department of Labor (DOL) Trade Adjustment Assistance Community College and Career Training (TAACCCT) 4 grant programs. Completion of all fields within the form is completely voluntary; however, failure to provide key eligibility information may result in incomplete information being reported which may affect program success. All information provided will be kept confidential and will only be used to determine program eligibility, referral to the appropriate training program, and evaluation of program progress. By signing below I am giving my consent to participate in this grant program and attest that the information provided is, to the best of my knowledge, complete and accurate. I authorize the disclosure of the information contained in this form to authorized third parties. I also authorize an employer to disclose information related to my employment to authorized third parties as required for evaluation of the grant as stated above and release my employers from liability for providing such information in good faith. This consent also includes authorization for the use of my photos, videos, and information in program publicity and student success stories. I certify that the information provided is to the best of my knowledge complete and accurate. In accordance with the Privacy Act of 1974 (Public Law No. 93-579, 5 U.S.C. 552a), you are hereby notified that the Department of Labor is authorized to collect information to implement the Trade Adjustment Assistance Community College and Career Training Program under 19 USC 2372 – 2372a. Participant's Signature:_____ Date: _____ Signature:_____ Date: _____ Program Counselor/Coordinator

This workforce product was funded by a grant awarded by the U.S. Department of Labor's Employment and Training Administration. The product was created by the grantee and does not necessarily reflect the official position of the U.S. Department of Labor. The U.S. Department of Labor makes no guarantees, warranties, or assurances of any kind, express or implied, with respect to such information, including any information on linked sites and including, but not limited to, accuracy of the information or its completeness, timeliness, usefulness, adequacy, continued availability, or ownership.

APPENDIX 4. DATA ELEMENTS REQUESTED FOR THE EVALUATION

FIELD	DEFINITION	EXAMPLES OF CODES
Student ID		
SSN		
Student demographics		
DOB	Student's date of birth	Date
Gender	Student's gender	Male, Female
Race	Student's race	Asian, American Indian or Alaskan native, Black, Native Hawaiian or other Pacific Islander, White, More than 1 race
Ethnicity	Student's ethnicity is Hispanic or Latino.	Yes, No
Highest Education Level Completed	Student's highest education level completed	Less than High School, High School, Some college without a degree, Associate degree, Bachelor degree, Graduate or professional degree
Enrollment Status		
Academic year		2014, 2015, 2016, 2017
Academic term		Spring, Fall, Summer
Enrollment Status/ Course Load	Course load	Full-time, part-time, Other
Degree level	The level of the degree/certificate that the student is pursuing.	Diploma, Certificate (one-year), Certificate (two-years), Associate (two-years), Baccalaureate, Non-degree Seeking Student
Major / CIP code /ONET code	U.S. Department of Education code for the major field of study.	e.g. 48.0503, 15.0613
Total credit hours / Total clock hours	Total credit hours or clock hours taken during the semester	
Academic outcomes - Degree/certificate completion		
Date Degree/Certificate was earned	Date	Either date e.g. 05/30/2015 or year-semester e.g. Spring 2015
Type / Level of Degree/Certificate earned	The level of the degree/certificate that the student earned	e.g. Diploma, Certificate (one-year), Certificate (two-years), Associate (two-years), Baccalaureate, Non-degree Seeking Student
Name of Degree/Certificate earned	Name	e.g. Aviation Maintenance Technology, Licensed Truck Driver
Major / CIP code / ONET code of Degree/Certificate earned	U.S. Department of Education code for the major field of study.	e.g. 48.0503, 15.0613

APPENDIX 5. EMPLOYMENT OUTCOME DEFINITIONS

Employment entry

Non-incumbent participants who complete the grant-funded program of study and are employed in the first quarter after program exit are identified as having entered employment.

$$\frac{\text{(\# of program completers who are employed in Q1 after the exit quarter)}}{\text{(Total \# of program completers)}}$$

Employment retention

Non-incumbent participants who complete the grant-funded program of study and were employed in the first quarter after program exit, and were employed in the second and third quarters after program exit are identified as having retained employment.

$$\frac{\text{(\# of program completers who are employed in both Q2 and Q3 after the exit quarter)}}{\text{(\# of program completers who were employed Q1 after the exit quarter)}}$$

Wage Increase

Incumbent participants who received a quarterly wage increase at any point in time post-enrollment are identified as having had a wage increase.

APPENDIX 6. PROPENSITY SCORE MATCHING

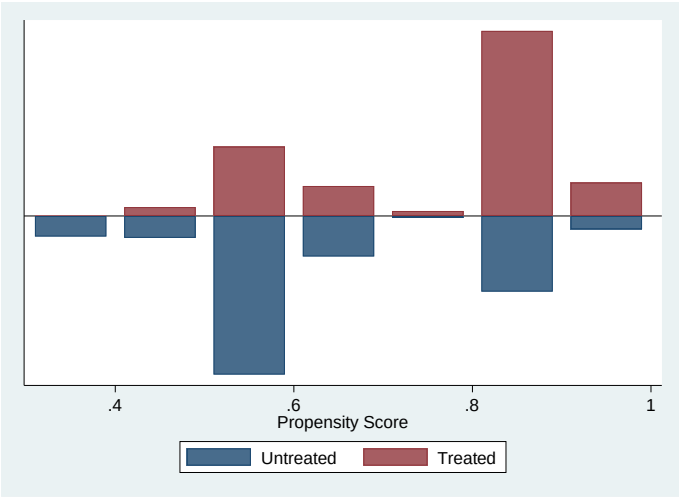
The Ray Marshall Center used the propensity score matching approach to account for differences on the observable characteristics between the treatment group and the comparison group pool. The aim of propensity score matching is to construct a balanced sample of treatment and comparison students who both participated in manufacturing and TDL programs, but are distinct only in their participation in the GMACW TAACCCT program. The PSCORE, PSMATCH2 and TEFFECTS modules in the Stata software package were utilized (Garrido, Kelley et al. 2014).

STEP 1: PROPENSITY SCORE ESTIMATION

First, a propensity score was constructed for each individual (in both the treatment group and the comparison group pool) that estimated the likelihood of participating in the GMACW TAACCCT program, using all the observable characteristics. This was done by using the pscore procedure in Stata (Becker and Ichino 2002) to perform a probit regression of the treatment dummy variable on all available covariates that, in the evaluation team's judgment, had the potential to influence the chances of being treated.

Overlap in the range of propensity scores across the treatment and comparison groups, called "common support", was ensured. This is important because no inferences about treatment effects can be made for a treated individual for whom there is not a comparison individual with a similar propensity score. Common support was subjectively assessed by examining a graph of propensity scores across treatment and comparison groups (Figure 5-a).

Figure 5-a. Common Support



STEP 2: MATCHING

Next, individuals in the treatment group were matched to individuals from the comparison group pool, using the psmatch2 procedure in Stata (Leuven and Sianesi 2014). Each treatment group individual can be matched to one or many comparison group individuals. When matching at the individual level, the first match is always best and will lead to the least biased estimates, but the decrease in bias from fewer matches needs to be weighed against the lower efficiency of the estimate that will occur with fewer observations. A broader one-to-many match will increase sample size and efficiency but can also result in greater bias from matches that are not as close as the initial match (Caliendo and Kopeinig 2008). The evaluation team selected to use the single nearest-neighbor technique was used; this technique involves finding for each treated individual that non-treated individual with the most similar propensity score and so, the most similar characteristics.

Matching with replacement was also used, which allows each comparison group individual to be used as a match more than once; matching with replacement improves the performance of the match and produces matches of higher quality than matching without replacement by increasing the set of possible matches (Dehejia and Wahba 1998, Abadie and Imbens 2006). Matching with replacement is also less demanding of the data than permitting comparison group individuals to be used only once. “Essentially, it avoids the problem of the

non-treatment group being 'used up'. Should a certain type of individual be common in the treatment group but relatively uncommon in the comparator group, the pool of comparators able to provide a close match would become exhausted were non treatment group members used only once" (Bryson, Dorsett et al. 2002). Also, if two or more observations had the same propensity score and were thus tied for "nearest neighbor", all ties were used for the match; including all the ties provides a more precise estimator (Abadie, Drukker et al. 2004).

Next, the evaluation team assessed if balance in the observable characteristics had been achieved, using the pstest procedure in Stata. Propensity score matching can only lead to viable estimates of the causal effects of treatment, if the desired balancing of observable covariates is achieved. The evaluation team found that covariate balance had been successfully achieved. Table 5-a lists overall measures of covariate balance and Table 5-b lists individual measures of covariate balance for the propensity score model examining impacts on employment placement. After matching, the measures indicate good covariate balance: (1) standardized bias[6] for all covariates is less than 5%, (2) t-tests for all covariates are non-significant, (3) the pseudo-R2 is very low[7], (4) the likelihood-ratio test[8] is non-significant, (5) the mean and median absolute bias are less than 5%, (6) Rubin's B[9] is close to 0, and (7) Rubin's R[10] is close to 1. Figure 5-b shows the distribution of the standardized percentage bias across covariates using a histogram. Figure 5-c shows the standardized percentage bias for each covariate using a dot chart.

[6] The standardized bias is the % difference of the sample means in the treated and non-treated (full or matched) sub-samples as a percentage of the square root of the average of the sample variances in the treated and non-treated groups 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..

[7] The pseudo-R2 indicates how well the regressors X explain the participation probability.

[8] the likelihood-ratio test of the joint insignificance of all the regressors

[9] Rubin's B is the standardized difference in mean of the linear prediction of the propensity score before and after matching

[10] Rubin's R is the ratio of variance of the treated and comparison group for the linear prediction of the propensity score.

Figure 5-b. Overall Covariate Balance

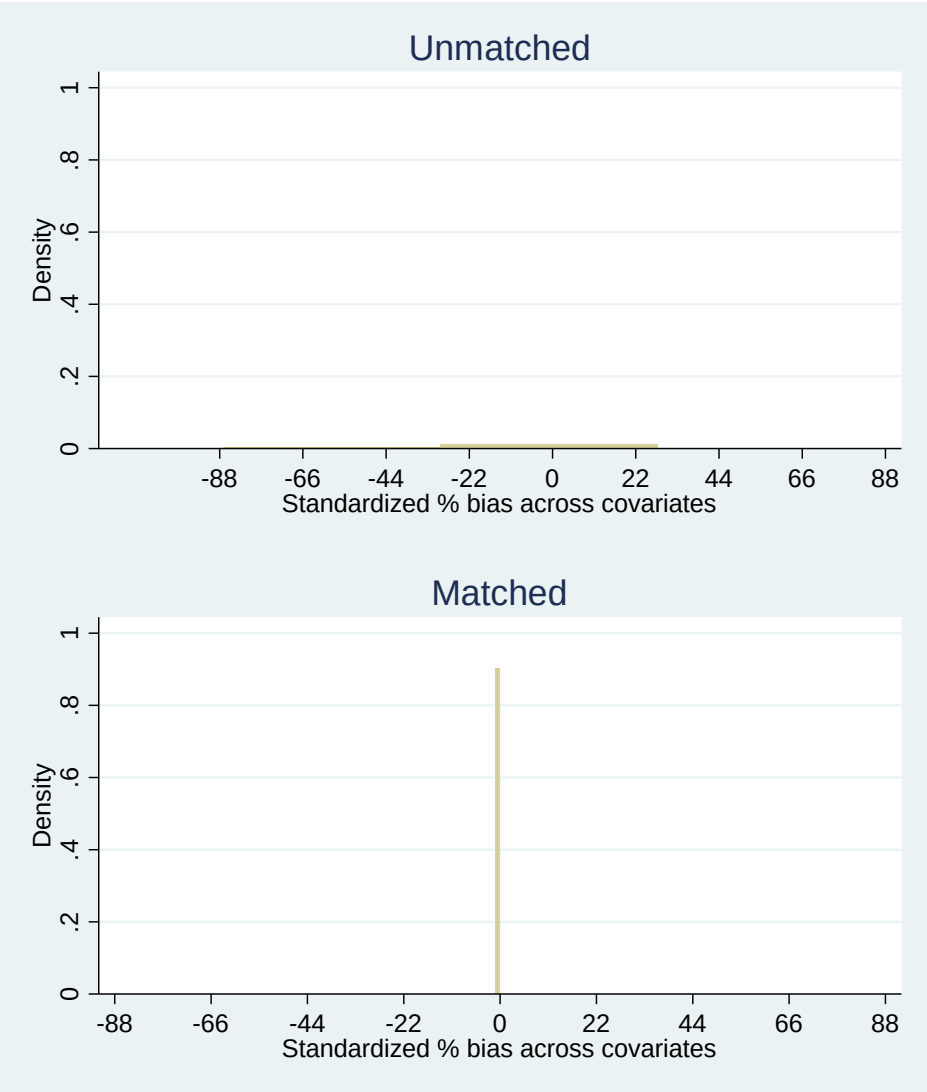


Table 5-a. Overall Balance

Sample	Ps R2	LR chi2	p>chi2	Mean Bias	Med Bias	B	R	%Var
Unmatched	0.120	266.91	0.000	33.6	20.7	90.2*	0.97	.
Matched	0.000	0.18	0.996	0.5	0.5	1.6	1.01	.

Figure 5-b. Individual Covariate Balance

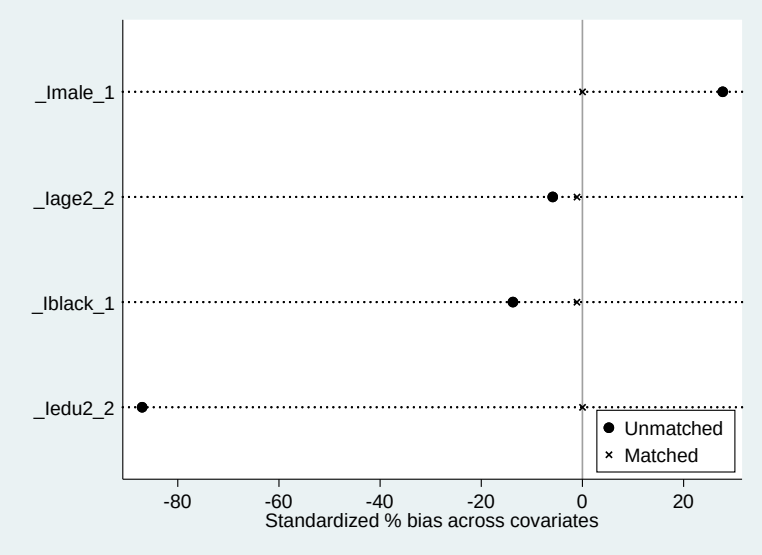


Table 5-b. Covariate Balance

Observable Characteristics		Mean		% bias	% reduct |bias|	t-test	
		Treatment	Comparison			t	p>|t|
Age	Unmatched	0.48361	0.51297	-5.9		-1.13	0.257
	Matched	0.48361	0.48907	-1.1	81.4	-0.30	0.767
Gender: Male	Unmatched	0.91667	0.82435	27.7		5.82	0.000
	Matched	0.91667	0.91667	0.0	100.0	-0.00	1.000
Race : White	Unmatched	0.54098	0.60878	-13.7		-2.64	0.008
	Matched	0.54098	0.54645	-1.1	91.9	-0.30	0.767
Prior education level:	Unmatched	0.32787	0.72655	-87.0		-16.61	0.000
	Matched	0.32787	0.32787	-0.0	100	-0.00	1.000

Thus, while the differences between the treatment group and the comparison group pool in observable characteristics were documented to be substantial in the unmatched sample, the evaluation team's matching approach (nearest neighbor matching with

replacement) achieved satisfactory balance in all observable characteristics. The evaluation team can be quite confident that in the estimates of the causal impact of the GMACW TAACCCT program on outcomes, genuinely comparable students are being compared.

STEP 3: TREATMENT EFFECT ESTIMATION

Finally, the average treatment effect on the treated (ATT) is estimated, which is the average difference on an outcome of interest between the matched treated and untreated observations. The ATT is the average effect of the treatment on the sort of person who participates in the program. The effectiveness of PSM is, in part, a function of having enough relevant information about the cases to accurately estimate the propensity score, and thus accurately estimate the ATT using the matching process that uses this score. The teffects psmatch procedure in Stata (StataCorp) calculates the treatment effect along with the Abadie Imbens corrected standard error calculation (Abadie and Imbens 2012).