NC STATE

Industry Expansion Solutions

NCMCO

NATIONAL CONSORTIUM FOR MISSION CRITICAL OPERATIONS

Final Evaluation Report

Round 3 TAACCCT Grant: Mission Critical Operations

Grant Consortium Partners: Cleveland Community College, Wake Technical Community College, Nash Community College, Southern Regional Technical College, University of North Carolina at Charlotte

Cleveland COMMUNITY COLLEGE

Nash COMMUNITY COLLEGE

WAKE TECH

UNC CHARLOTTE

SRTC SOUTHERN REGIONAL TECHNICAL COLLEGE

Table of Contents

List of Tables and Figures

Section I: Introduction and Overview

1. Acknowledgements

The NC State University Industry Expansion Solutions (NC State IES) Evaluation Team would like to express our deepest appreciation to administrators, faculty, and staff who provided support for the completion of the formative and summative evaluation. A special thanks to Cleveland Community College for facilitating the final review of the report between the consortium partners. Furthermore, we extend appreciation to all participating faculty and staff who provided information throughout the four-year grant period on behalf of the grant partners: Nash Community College, Wake Technical Community College, Southern Regional Technical College, and the University of North Carolina Charlotte. Finally, we would like to thank our colleagues at NC State IES who contributed to the review of this evaluation report.

2. Structure of Report

This report is the summative evaluation report for the DOL funded TAACCCT project titled Mission Critical Operations (MCO). The prior formative evaluation reports focused on the implementation of the work plan outlined in the grant proposal. The Year 1 evaluation report focused primarily on the work plan activities (WPAs) and initial progress towards implementing the WPAs (later referred to as project activities). The Year 2 and 3 evaluation reports focused on a series of evaluation questions in consideration of the WPAs. This final report completes the formative analysis and takes into account the cumulative achievement of project activities, summative review, and hypothesis tests using institutional data. Table 1 provides a description of the various sections that comprise this report, and a linkage to the particular audiences to which each section is most pertinent.

Table 1: Overview of Report Sections, Audiences, and Overall Contents

Section of Report	Intended Audience(s)	Description of Contents
SECTION I – Introduction and Overview	**N/A - this section of the report**	
SECTION II – Description of MCO Approach and Activities	***Funder / Funding Agencies, Policy-makers, Grantees, Employers***	Provides an overview of MCO is and what the grant funded program set out to accomplish via the project work plan.
SECTION III – Overview of Evaluation Design and Dissemination	***Funder / Funding Agencies, Policy-makers, Grantees***	Outlines the formal research methodologies that were applied throughout the grant evaluation, and the limitations of the evaluation.
SECTION IV – Evaluation of Implementation / Process	***Grantees, WFD System, Funder / Funding Agencies***	Each chapter in this section is aligned to a WPA area (e.g. Articulation, Course Design, Telepresence) and provides: the relevant logic model component; an overview of current literature; process observations; and observed strengths and challenges for each.
SECTION V – Evaluation of Participant Outcomes/Impact	***WFD System, Funder / Funding Agencies, Researchers***	Includes several chapters that provide outcome evaluation findings for each of the MCO partner colleges and descriptive statistics at the consortium level.
SECTION VI – Evaluation Findings and Limitations	***Funder / Funding Agencies, Policy-makers***	Summarizes the findings from the implementation and outcomes evaluation sections and provides overall limitations of the evaluation study
SECTION VII – Implications for Policy and Practice	***Funder / Funding Agencies, Policy-makers, Grantees, WFD System, Employers***	A conclusion to the evaluation report that outlines the broader implications of: the MCO program; funders/funding agencies, and others (employers, other grantees, workforce systems, etc.)

Section II: Description of MCO Approach and Activities

3. Looking Across Consortia Institutions: Different Needs and Perspectives

As stated in the original project narrative, the National Consortium for Mission Critical Operations (MCO) was formed to address two important issues: (1) the increasing vulnerability of the national infrastructures, and (2) the disappearance of traditional manufacturing and skilled service jobs from American industry (MCO Program Narrative). The following table provides a high-level overview of each partner's latticed framework for training programs as outlined in the original grant proposal.

Table 2: Grant Proposal Latticed Training Programs

College	Training Programs MCO Lattices Into
Cleveland Community College (Lead)	*Automation Engineering Technology, Industrial Management, Mechanical Drafting, Industrial Systems, Electrical Systems, Computer Information Technology, Networking, Information Systems Security, Web Technologies,* ***NEW: Mission Critical Operations***
Southern Regional Technical College (formerly Moultrie Technical College)	*Industrial Systems Technology, Electronics Technology, Electrical Systems Technology, Mechatronics*
Nash Community College	*Electric Line Construction, Electrical Systems, Electronics Engineering, Emergency Management, Healthcare Business Informatics, Networking Technology, Computer Information Technology*
Wake Technical Community College	*Electronics Engineering, Biopharmaceutical Technology, Automation Technology, Mechatronics, Computer Technology Integration, Simulation and Game Development*
University of North Carolina at Charlotte	*Engineering, Engineering Technology, Software and Information Systems*

During the grant implementation phase, Cleveland Community College (Cleveland CC) and Wake Technical Community College (Wake Tech CC) each created courses for new MCO

Associate's degree programs. In the original proposal, Cleveland CC was the only college poised to create the new MCO degree program, but during implementation phase, Wake Tech CC and Nash CC decided to establish the degree program at their own colleges. Similar to Cleveland CC, Wake Tech CC was able to gain the necessary approval to offer the MCO Associate's degree program. Nash CC originally pursued the degree program in MCO, but based on industry feedback, later decided to develop and offer an MCO certificate option that can supplement existing degree options. Southern Regional Technical College considered MCO as a degree program but, at the time of this report, has not decided to offer the MCO degree program.

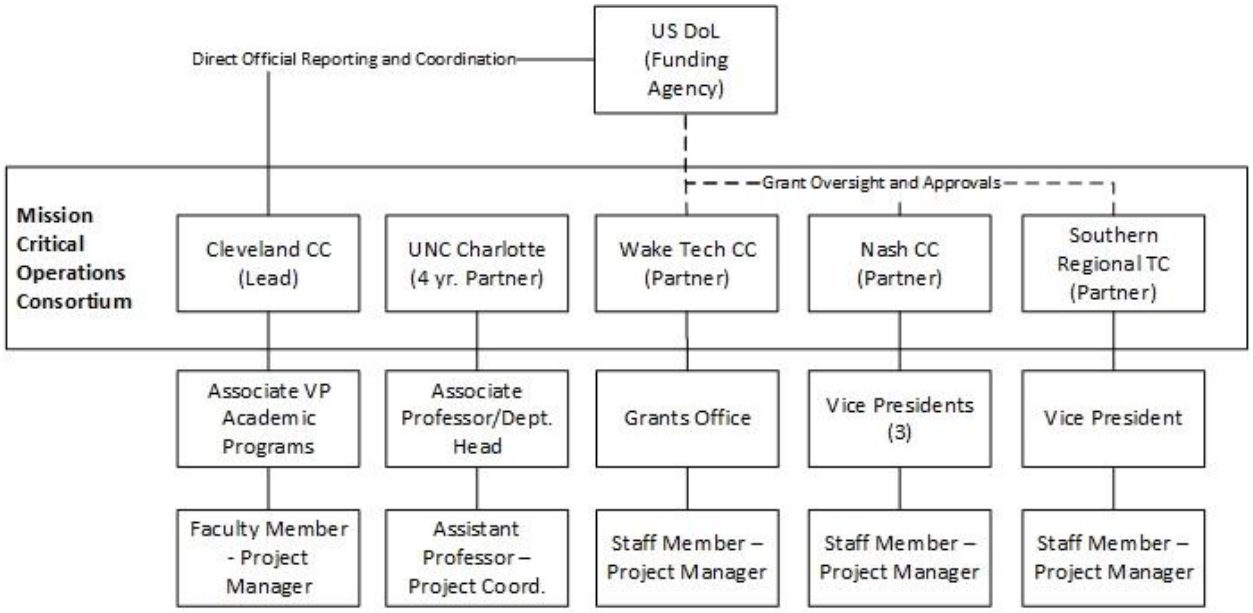
Table 3: Grant Partner High-level Roles and Contributions

Institutional Partner	Brief Description of Role / Contribution
Cleveland Community College	Served as lead grantee and fiscal oversight entity. Created new MCO courses. Lead articulation discussion with UNCC. Led Telepresence collaboration efforts. Led tutoring/online support platform development. Approved MCO degree path at college, system, and accreditation levels. Ensured facility and equipment upgrades. Enhanced existing courses with MCO concepts and resources.
Wake Technical Community College	Approved MCO degree path at college, system, and accreditation levels. Designed simulation. Ensured facility and equipment upgrades. Created new MCO program courses. Enhanced existing courses with MCO concepts and resources.
Nash Community College	Approved MCO certificate-path at the college level. Supported telepresence implementation and collaboration. Enhanced existing courses with MCO concepts and resources.
Southern Regional Technical College	Enhanced existing courses with MCO concepts and resources. Supported telepresence implementation and collaboration.
University of North Carolina Charlotte	Coordinated articulation discussions for Bachelor's degree transfer. Integrated MCO concepts into university courses. Supported telepresence implementation and collaboration. Conducted research on technology-enabled course delivery in support of telepresence embedding into course settings.

4. Structure of MCO Program Administration

The programmatic structure of the TAACCCT MCO grant included multiple layers of staffing from each of the partnering institutions. Figure 1 depicts the administrative and project management hierarchy of the MCO program.

Figure 1: Organizational Chart of the MCO Consortium



Cleveland CC led the proposal development process for the MCO grant and served as the lead grantee since the grant was awarded in 2013. Each partner college established a similar organizational structure by which to administer the program at its respective institution. Upon the launch of the grant, Cleveland CC assigned two project managers to address the two unique disciplines of focus at its institution: Information Technology and Operations Technology. In Year 3, after a separation of employment by one of the project managers, the Cleveland CC team restructured to accommodate a single project manager. One difference among the partner colleges was that Cleveland CC assigned faculty members to manage the project, while the other partners hired new staff members to lead the project.

Section III: Overview of Evaluation Design and Dissemination

5. Evaluation Design

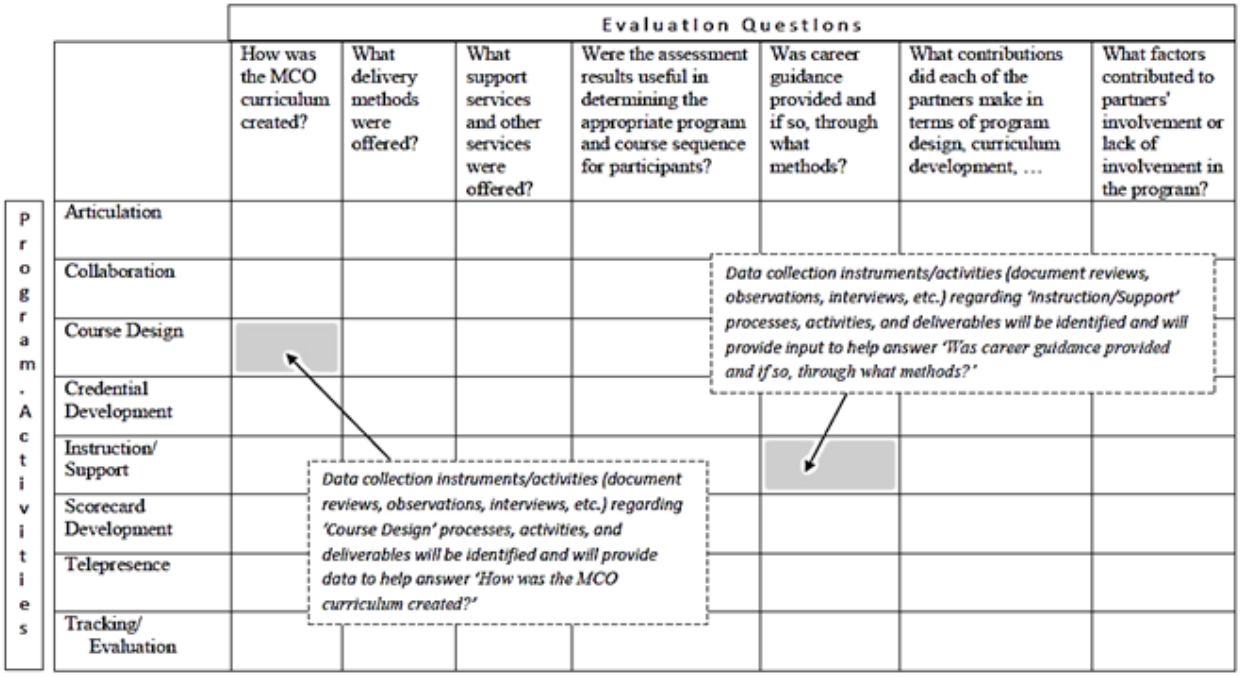
General Overview of Evaluation and Formative Component

The evaluation of the MCO program was focused on achieving three major goals: (1) **Reporting** interactions among the stakeholders at the operational level through interviews, focus groups, surveys, document analysis, and observations of meetings; (2) **Assessing** program implementation and process management from initial design through final delivery of all phases; and (3) **Evaluating** program impacts through a broad-based comparison of institutional achievement following implementation of the MCO program. To this end, the evaluation team, as third-party evaluator assumed three roles in the MCO grant evaluation:

1. *Identifying the appropriate qualitative and quantitative evaluative methods to put into place*. Qualitative methods were deployed through surveys, interviews, team meetings, and documents produced during the grant period.
2. *Designing a comprehensive plan for capturing, cleansing, analyzing and presenting outcomes data* - In the evaluation reports for Years 2 and 3, the evaluation team detailed specific steps it would take for the summative evaluation, including the hypothesis tests for the outcomes analysis. In Year 3, the team developed a spreadsheet that further outlined the level of data needed to fully execute the data analysis plan and shared it with all partners.
3. *Modeling the application of best practices in project evaluation in its partnership with the client institutions* - The evaluation team focused on maintaining objectivity and presenting information in evaluation reports that the client institutions could apply to continuously improve the implementation of the program. Detailed explanations of evaluation methodology, evaluator perspectives, and processes with the intention of

providing transparency of our evaluation process, and with the hope of helping grantee institutions enhance their internal evaluation skills. The evaluation team organized this project's evaluation activities based on a two-dimensional framework that included evaluation questions and the program's WPAs. This framework is derived from two evaluation approaches: objectives-oriented and participant-oriented. The team chose a composite approach to ensure that full attention was given to the interests of the MCO sponsor (U.S. DOL), and the needs and activities of the MCO Consortium partner institutions. To effectively evaluate the progress and successful completion of the program's WPAs, the program evaluation research questions were linked to each WPA, as illustrated by Figure 2.

Figure 2: Evaluation Question & Work Plan Activity Cross Reference

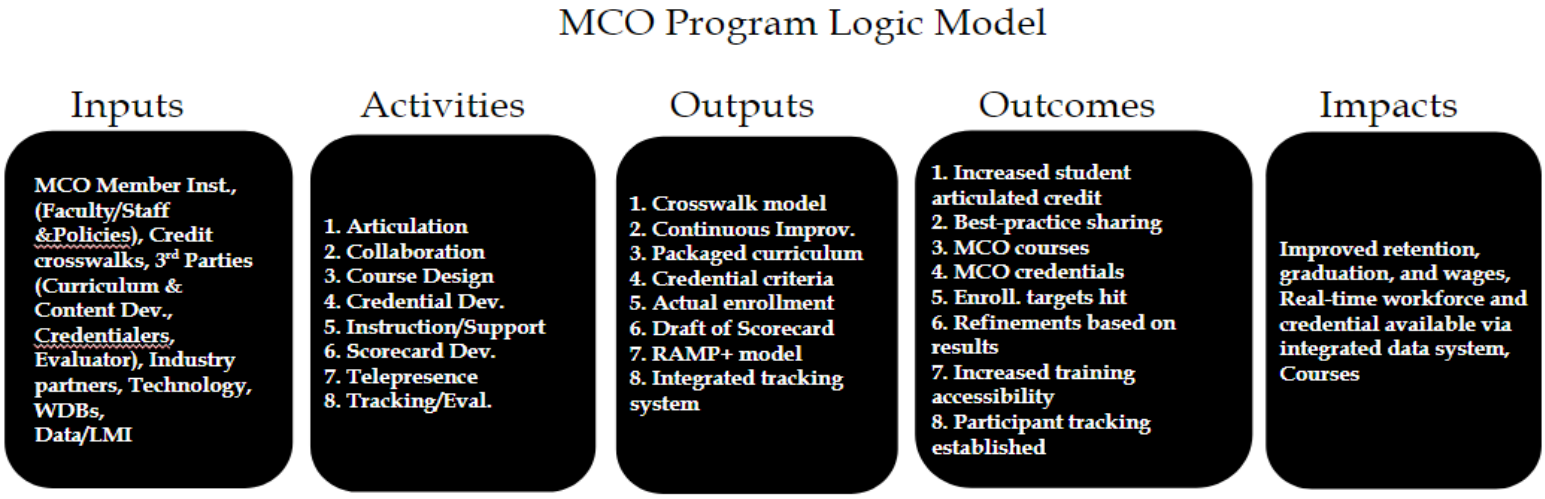


According to Worthen, Sanders, and Fitzpatrick (1997), "The distinguishing feature of an objectives-oriented evaluation approach is that the purposes of some activities are specified, and then evaluation focuses on the extent to which those purposes are achieved" (p. 81). The

objectives-oriented approach is most clearly reflected by the evaluation plan elements that focus on collecting and analyzing data to evaluate achievement of the nine objectives described in the participant outcomes section of the MCO Project Narrative. Supplementing the nine outcome objectives is a formative assessment of process-focused objectives tied to a set of evaluation questions. Each of the evaluation questions provide a specific focus that is characteristic of an objectives-oriented approach. Therefore, in applying the objectives-oriented approach, the evaluation questions will be the first dimension by which the evaluation plan activities will be organized.

The targeted focus on evaluation questions ensured the evaluation met the criteria that the U.S. DOL deemed critical in assessing the value of the MCO program. However, as noted by Worthen, Sanders, and Fitzpatrick (1997), an objectives-oriented approach "ignores important outcomes other than those covered by the objectives (the unintended outcomes of the activity)" and "omits evidence of program value not reflected in its own objectives" (p. 92). Therefore, to produce an evaluation that ensures an appropriate awareness of activities and outcomes not constrained by the evaluation questions, a second approach was incorporated into the evaluation

Figure 3: MCO Logic Model



framework. This second approach focused more on program activities, as shown in the MCO Program Logic Model (see Figure 3).

To ensure that the evaluation adequately considers the activities and perspectives of the MCO Consortium and participants, the evaluation team incorporated a responsive approach into the evaluation. Stake (1975) states that a responsive evaluation "orients more directly to program activities than to program intents; responds to audience requirements for information…and the different value-perspectives are referred to in reporting the success and failure of the program" (p. 14). Therefore, the set of WPAs stated in the MCO project narrative is the second dimension by which the team organized the evaluation. Table 4 below provides an overview of evaluation activities throughout the grant period.

Table 4: Evaluation Activities and Timeline

Evaluation Activity	Description of Activity Timeline / Frequency
Kick-off meeting with all partners	Led a face to face meeting in Year 1 of the grant to provide an overview of the evaluation design and set expectations
Evaluation Site Visits	Led interviews and focus groups in the Fall and Spring semesters at partner colleges – some site visits were held virtually to provide more flexibility for schedules.
Interim Evaluation Reports	Yearly reports were produced and delivered in November, focusing mostly on the formative, implementation-focused, evaluation for the interim reports, while laying the groundwork for the summative, outcomes-focused, evaluation in Year 3.
Observations	Observed regular project team meetings, mostly on a quarterly basis. Took note of progress, major decisions made, partner involvement/collaboration, and program management.

Periodic Evaluation Requests	Mostly related to data collection – this was ongoing, beginning in Year 1 with defining participants and the Comparison Groups, and extended through the mid-year mark of Year 4 with collecting data files to be processed for the outcomes analysis. This effort required several face to face meetings with MCO partners as well as dozens of email correspondence and phone conversations to ensure the data needs were understood (content and deadlines).
Final Evaluation Report	Production of a compiled evaluation report that takes into account the formative, implementation-focused, data and information from past reports, as well as summative, outcomes-focused, data collected via the activity above.

Summative Evaluation Overview

The summative evaluation included the presentation and review of descriptive statistics, as well as calculation of inferential statistics based on a quasi-experimental model designed to determine the extent to which grant activities appear to affect performance measures for MCO participants in each institution. MCO participant (treatment group) characteristics and outcomes data were compared with a comparable historical (comparison) group after adjusting for selection bias using propensity scoring.

The summative evaluation focuses on how the MCO program and specific interventions have impacted the degree to which retention, graduation (completion), program progress, *employment, and wages*[1] have improved over the Comparison Group. Other MCO Program impacts, such as creation of MCO credentials and courses, were explored as part of the formative

[1] Employment and wage data was not available by the end of the grant for the summative evaluation, despite efforts by the partners to retrieve this data from other state agencies.

evaluation since they are implementation deliverables and ultimately lead to the impacts on which the summative evaluation is focused. An overview of the data collection and analysis plan is provided below. Any deviation from this plan will be noted in the outcomes analysis chapter of the report with respect to specific data availability issues unique to each institution.

- **Data Collection**: The summative evaluation plan included collecting data in order to measure the degree to which retention, graduation (completion), and wages have improved, with emphasis on variable changes related to MCO Program participation and specific MCO Program interventions. The evaluation team began discussions with consortium partners early in the grant regarding data collection, and met with the consortium partners in Year 3 Quarter 1 to further discuss specific data elements needed for the summative outcome evaluation. At this meeting, the evaluation team requested an initial mock data set to be extracted and sent to the evaluation team. The team shared a spreadsheet with the partners to outline all student characteristic and course/program progress data.
- **Data Analysis:** Descriptive statistics deemed to be noteworthy or beneficial to evaluation of the program have been generated for each group (Treatment vs. Comparison). As appropriate, these statistics include the mean, median, standard deviation, and confidence interval for participant characteristics that were measured on an interval or ratio scale. Frequencies, proportions, percentages and/or percentiles (ordinal scale only) were the primary descriptive statistics used for participant characteristics that were measured on an ordinal or a nominal scale.
- **Inferential Statistics:** Based on data provided by the consortium institutions, statistical hypothesis tests were performed in order to determine if the data suggests MCO program

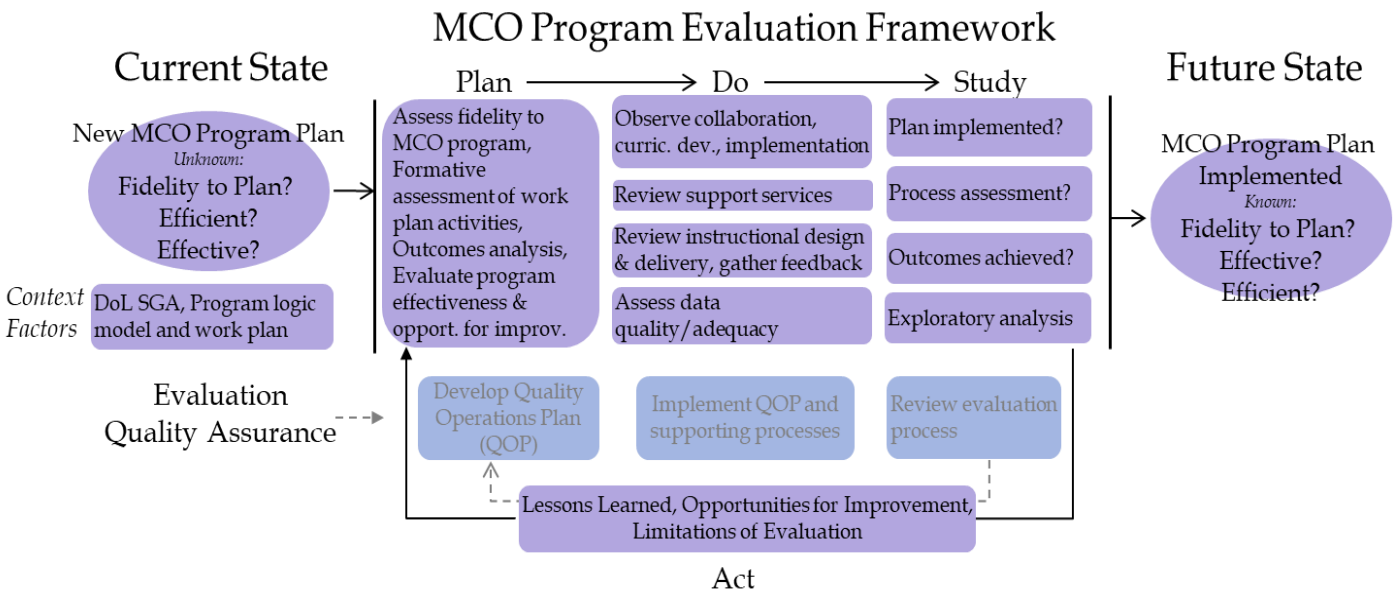
participation or a specific intervention is associated with any anticipated positive outcomes that were achieved. The outcomes analysis plan for exploring MCO program impact involved outcomes that are: (1) Employment-related: Analysis of employment and wage advancement outcomes associated with program participation; and (2) Education-related: Analysis of program retention, completion, and progress outcomes associated with other MCO program components, such as course enhancements and student support services.

Identifying Comparison Group and Treatment Group for analysis of ‘MCO program’ impact*:* To perform an analysis of MCO program impact, a historical (comparison) group of students was identified at each institution to compare with the more recent MCO participants (treatment group). The historical data consisted of students enrolled during the period Fall 2010 through Summer 2013 (prior to the beginning of the MCO program) who participated in any of the courses that were later affected by MCO funds (see Table 17 for list of courses identified by the institutions as being affected by MCO funds). The treatment data consisted of students who were enrolled in courses that were identified by the institutions as being affected by MCO funds.

Guiding Framework for Evaluation Design Implementation and Quality Assurance

In order to properly implement the MCO evaluation design outlined above, and to integrate its key components, many of which occurred simultaneously, a program evaluation framework was developed. This framework, shown below in Figure 4, served to provide a vision, mission, and continuous improvement focus that guided the evaluation team throughout the project.

Figure 4: MCO Program Evaluation Framework



6. Audiences and Dissemination Plan for Evaluation Results

The results of this Round 3 DOL TAACCCT grant evaluation will be disseminated on the NC State IES, Urban Institute TAACCCT Evaluation, and Skills Commons websites, via presentations at conferences (such as workforce development and community college system conferences - local and nationwide), and through related articles published in journals. As described in Chapter 5, the grantee's proposed work plan activities and the funder-focused evaluation questions provide the broad two-dimensional framework for the evaluation, thus providing an evaluation driven by both perspectives. Such an approach is continued in this report in order to address the unique needs and interests of each audience (MCO Institutions/partners and funding organization (DOL)). Accordingly, Section IV focuses on evaluation of implementation and process information designed to assist the MCO Institutions/partners in their continuous improvement efforts, and Section V focuses on evaluation of participant

outcomes/impact, which would likely be of interest to the funder (DOL).

Table 5: Audiences and Key Benefits of this Report

Audience	Benefits / Key Takeaways of Evaluation Report
Grantee	● Helps to tell the story of the program from start to finish. ● Provides input for continuous improvement / sustainability beyond the life of the grant. ● Provides an initial analysis of outcomes using descriptive statistics and statistical inference.
Funder (US DOL)	● Evaluates grantee fidelity to the original work plan. ● Provides insight on implications to future funding and research for this type of program.
Others (grantees, workforce system, etc.)	● Provides insight on scalability and replicability of the program at other sites. ● Goes into detail on specific areas of research that are aligned to the project work plan.

Section IV: Evaluation of Implementation / Process

7. Overview of Methodology for Evaluation of Implementation / Process

Purpose

The purpose of the implementation/process evaluation was two-fold: 1) Evaluate the fidelity of the grantees to the activities described in the proposal funded by the U.S. Department of Labor; and 2) Assess the implementation and operational processes related to the Work Plan Activities in order to identify process strengths, challenges, and opportunities for improvement.

Unit of Analysis

Each MCO institution brought a different set of resources to the project that, when combined with unique operational processes, resulted in a unique contribution to the project. However, each of the eight major Work Plan Activities specified in the proposal was designed to involve more than one MCO consortium member. For example, Table 6 below shows the roles/responsibilities matrix for the 'Instruction and Support Services' Work Plan Activity (the complete set of matrices for all Work Plan Activities can be found in Appendix A).

Table 6: Sample Roles/Responsibilities Matrix for 'Instruction and Support Services'

Work Plan Activity	Deadline	Responsibility (stated in Work Plan)	Cleveland CC	Southern Regional TC	Nash CC	Wake Tech CC	UNCC
1. Develop Crosswalk CE>Curriculum>University	4/1/2014	led by Nash and UNCC	*Active Participant*	*No Involvement*	*Lead*	*No involvement*	*Lead*
2. Accrediting bodies approve articulated credit, prior learning, competency based, and other	12/31/2014	led by Cleveland	*Lead*	*No Involvement*	*No involvement*	*No involvement*	*Active Participant*
3. Develop draft SOPs for articulated credit	12/31/2015	led by Cleveland	*Lead*	*No involvement*	*Active Participant*	*No involvement*	*Active Participant*
4. MCO college partners implement SOPs	9/30/2016	led by Cleveland	*Lead*	*No involvement*	*Active Participant*	*No involvement*	*Active Participant*

Therefore, while the data collection unit was each MCO institution, the MCO consortium was the unit of analysis for the evaluation of the MCO implementation and related processes. Individual MCO institutions are mentioned primarily to note exceptional activities, or as an illustration of a particular point.

Subjects from which data were gathered included faculty and/or staff from the five MCO Consortium partner institutions. Having been the operational staff and/or having participated in MCO Consortium meetings, all subjects were very familiar with various aspects of the MCO program operations. Furthermore, the NC State IRB-approved protocols (Appendices F-J) for gathering information from persons involved with the program was followed and provided additional information regarding the purpose of the study, and detailed the extent to which responses would be kept confidential.

The interviews and focus groups were conducted at each MCO community college institution, and in a setting familiar to the participants, such as their office or other meeting locations on their campus. The experience level of, or training provided to, the Evaluation Team interviewers ensured the demonstration of an appreciative inquiry, as opposed to a corrective, disposition during the interview or focus group session. In the spirit of an appreciative, collaborative approach, and in order to enable the participants to be best prepared to provide informative responses, the questions were provided to the institution prior to the session.

Method for Collecting Qualitative Data

The case study design was the primary method by which qualitative information about the program was gathered. According to Worthen, Sanders, & Fitzpatrick (1997), "Case studies typically make use of many methods of data collection but lean most heavily toward qualitative methods such as observations, interviews, and the study of documents." and is "…responsive to the case and the circumstances at hand. It is adaptive and continues to adapt until the evaluator believes he has a good understanding of the case" (p. 374). Therefore, a semi-standardized structure for gathering qualitative data from MCO program staff and faculty was followed in order to allow for probing questions that could adapt to, or expand upon, responses during interviews or focus groups.

The rationale for using a case study approach was that it would provide the depth of information necessary to accurately assess the implementation/process operations of the MCO institutions. However, the case study approach provides an additional benefit, as described by Guba and Lincoln (1981): "It presents a picture credible to the actual participants in a setting, and it can easily be cast into the 'natural language' of the involved audiences" (p. 376). Such an in-depth, credible picture of the processes found in a case study "can lead to greater utilization

because the report is both more easily understood and more compelling than the typical report" (Worthen, Sanders & Fitzpatrick, 1997, p. 375).

While assessment and evaluation conclusions have been made by the Evaluation Team based on evidence gathered, the level of process detail provided is intended to enable the reader to judge, to some degree, the accuracy of these conclusions. With that purpose in mind, the number of transcript phrases contributed by each respondent to a content category is provided in the 'Data Analysis' section of this chapter to reflect the degree of representation each functional perspective (administrator, manager, specialist, student support, faculty) had in the generation of the qualitative data analyzed.

This information served as a quality-check to ensure that while information was sought from multiple perspectives, adequate attention was paid to input from perspectives expected to be most familiar with the particular issue being discussed. Furthermore, the absence of input from a perspective that would be expected to provide substantial input would have alerted the Evaluation Team to possible process deficiencies, misaligned staff roles, lack of staff capacity or management, and other issues to be further investigated.

Data Collection

Evaluation of the MCO implementation and program processes involved the collection and analysis of qualitative data, primarily gathered via interviews and focus groups, which were recorded and then transcribed for analysis. Evaluation Team observations of program activity also contributed significantly to the evaluation of the program implementation/processes. Protocols for Evaluation Team deployment of data collection instruments approved by the NC State Institutional Review Board (IRB) were developed and implemented as part of the data collection process (Appendices F-J). The standard practice involved having two Evaluation

Team members at initial interviews and focus groups for each institution, and to record these sessions. For subsequent sessions, depending on staff schedules, some interviews and focus group sessions were conducted by one Evaluation Team member, with other pertinent conditions remaining the same as for the initial sessions.

Observation of MCO program activity, such as quarterly consortium meetings, served as an important source of information for the evaluation, with each observed meeting being considered what Wilcox (1982) calls a "key incident." While these observations could most accurately be described as unstructured observations, the Evaluation Team was particularly observant of staff interaction (within and between institutions), as well as the program staff preparation for, and participation in, the consortium meetings. Several of these meetings were attended by at least two Evaluation Team members, and a debriefing session was held by the Evaluation Team members to compare observed behavior, and start drawing tentative conclusions and connections between other behavior and conditions noted from other data sources, such as interviews and focus groups.

Document review (including any applicable records generated) also served as an informative source of data for the evaluation. Documents such as quarterly narrative progress reports (QNPRs), website content, and MCO literature were reviewed as part of the effort to understand how the MCO consortium was presenting the program to the U.S. Dept. of Labor, as well as to employers and students.

The topics/questions included in the data collection instruments were shaped by the issues brought to light from the literature review for each Work Plan Activity, as well as the Work Plan Activity linkage to the Implementation/Process Research Questions (as described in the Detailed Evaluation Plan submitted to DOL – Appendix B). These linkages were particularly

helpful in maintaining the appropriate focus on evaluation-related issues while observing program work plan activities or talking with program staff who were naturally more aligned with the work plan activity perspective.

The above focus on evaluation questions and work plan activities was a driving force for how the data collection protocols were developed throughout the grant. For interviews and focus groups, the participants were given the questions ahead of time, and those questions were directly aligned to the overall evaluation questions. Other than minor modifications for clarity, the questions used for the evaluation were generated during the proposal phase after providing them to the MCO consortium members for feedback and additional input.

Over time, the evaluation made note of changes in progress, perception, and general understanding of the evaluation questions in the regular evaluation reports. Interviews were recorded and the transcripts were then coded using a qualitative analysis tool (Atlas.ti), paired with rounds of interrater reliability tests, as appropriate. The following table shows how the work plan activities and the focus areas of the implementation/process evaluation questions align. This table can also provide the reader a quick reference for learning more about a particular evaluation focus area or project activity.

Table 7: Crosswalk of Evaluation Questions and High-level Work Plan Activities

Evaluation Question Focus Areas	***Project Activity Areas***							
	Articulation	***Project Collaboration and Evaluation***	***Course Design***	***Credential Development***	***Support Services***	***Scorecard***	***Telepresence***	***Evaluation / Performance Tracking***
Curriculum Development Focus		*Ch. 9*	*Ch. 8*					*Ch. 14*
Curriculum Delivery Focus		*Ch. 9*	*Ch. 8*		*Ch. 11*		*Ch. 13*	*Ch. 14*
Curriculum and Career Pathway Alignment Focus	*Ch. 7*	*Ch. 7, 8, 9, 13*		*Ch. 10*	*Ch. 11*			*Ch. 14*
Partner Contribution Focus	*Ch. 7*		*Ch. 8*	*Ch. 10*		*Ch. 12*	*Ch. 13*	*Ch. 14*

Data Analysis

The 'Work Plan Activity – Evaluation Research Question' linkages and the literature review not only shaped the data collection process; they informed the analysis of the collected data as well. Transcripts from interviews and focus groups provided much of the data used to evaluate the program implementation/processes.

The process for analyzing the transcripts involved an "open" process component that was designed to be responsive to themes not constrained by the evaluation questions, and then categories based on a fixed component (activity-based for Spring 2015, and evaluation-question-based for Fall 2015). The "open" process began in a manner similar to what Legewie (1994) describes as "global analysis." Keeping the purpose of the implementation/process evaluation in

mind, as well as the related research questions, the transcripts from the 2015 interviews and focus groups were reviewed in order to note keywords and phrases that could be aggregated into themes.

The MCO program was well into the implementation phase, and fully staffed by Spring 2015, so the interviews and focus groups were oriented toward broad activities with which program staff would be familiar. Table 8 below describes four overarching categories of program activities (curriculum development, curriculum delivery, curriculum and career pathway alignment, and partner contribution), as well as additional themes (current process, improvement, and future issues) that emerged from the initial review of the transcripts. The body of the table shows the number of phrases contributed by each respondent to a content category, which demonstrates the degree of representation each functional perspective (administrator, manager, specialist, student support) had in the generation of the qualitative data analyzed.

Table 8: Categories used to organize content for analysis of Spring 2015 data

Content Category: Type of Information	**Respondents (Cell contents show the frequency of respondent phrases providing information for a particular category)**				
	Administrators	**Managers**	**Specialists**	**Staff**	**Total**
Curriculum Development	9	13	6	0	**28**
Curriculum Delivery	0	9	0	0	**9**
Curriculum and Career Pathway Alignment	2	6	1	6	**15**
Partner Contribution	18	7	8	1	**34**
Current Process	6	1	3	3	**13**
Improvement Focused	7	2	0	0	**9**
Future Issues	0	1	1	0	**2**
TOTAL	**42**	**39**	**19**	**10**	**110**

With a firm understanding of the program staff roles and activities, and with a degree of rapport established with program staff, the Fall 2015 interview and focus group sessions (conducted in September 2015) were intentionally oriented more toward the evaluation

questions. Similar to the Spring 2015 approach, the coding process in Fall 2015 involved a balance of predetermined categories and a more organic emergence of additional categories during initial review of the transcripts. The resulting themes (appropriate level of resources, current process, data availability, data quality, and MCO staff professional development) supplemented the domains derived from the seven process evaluation questions in order to provide the basis by which the content analysis was conducted. Such content analysis followed the approach best described by Mayring (1983) in which:

> *Material can be extracted and condensed to certain domains of content (structuring as regards content). One can look for single salient features in the material and describe them more exactly (typifying structuring); finally, the material may be rated according to dimensions in the form of scales (scaling structuring) (pp. 53-54).*

The scales for the domains were primarily categorical, but in some cases the domain scale was ordinal (where specific categories were related to conditions viewed along a negative/positive continuum). For illustration, Table 9 below shows the organic categories that emerged during an initial review of the transcripts. These categories, along with the predetermined categories based on the evaluation questions (detailed in Chapter 16) were used to extract and organize information provided in the transcripts. The counts shown in the table represent the number of respondent phrases associated with the displayed category, as determined during analysis of the Fall 2015 interviews. Counts related to the evaluation question categories are shown in Chapter 16.

Table 9: Organic categories used to organize content for analysis of Fall 2015 data

Content Category: Type of Information	Respondents (Cell contents show the frequency of respondent phrases providing information for a particular category)				
	Administrators	**Managers**	**Specialists**	**Faculty**	**Total**
Appropriate Level of Resources	2	0	3	1	**6**
Current Process	4	5	9	2	**20**
Data Availability	0	1	4	0	**5**
Data Quality	0	1	3	0	**4**
MCO Staff Professional Development	7	6	4	7	**24**
Total	**13**	**13**	**23**	**10**	**59**

The transcripts were coded according to the established content categories, after an initial pilot coding of content was performed to increase coding reliability. With the more subjective process of coding completed, the coded phrases were reviewed by category in order to extract and summarize the salient features of the phrases regarding the category. A second member of the Evaluation Team reviewed the transcripts and coding, and a comparison of the summarized results was made in order to increase reliability of the summarized results.

The transcripts were analyzed through a phenomenological process of review, coding, and synthesis of interview and focus group transcripts, and the results considered along with key artifacts, and regular MCO progress reports as part of the data analysis process. This process resulted in the identification of core program strengths, opportunities for improvement and areas of future exploration found in evaluation reports for years 1-3 of the grant. In this report, strengths and opportunities are noted at the end of each Work Plan Activity Implementation / Process evaluation chapters (8-16) and areas of future exploration are found in the Implications chapter (26).

Reporting Results

Results of the analysis are organized by Work Plan Activity. Each of the following eight chapters is focused on one Work Plan Activity, and the contents of each chapter are organized as follows: Logic Model Component; Literature Review; Process Evaluation; Process Outputs; and, Strengths and Challenges. The results reported for each of the Work Plan Activities provide evidence on which answers to the Implementation/Process Research Questions are based. Answers to these questions are provided in the chapter following the Work Plan Activity chapters. Please note, the Course Design and Support Services chapters (10 and 12 respectively) will include findings from a student survey that was sent by several of the partner colleges who chose to participate. The survey only received 55 responses, with wide variation in participation across the institutions. Such a sample size is deemed too small of a sample to yield definitive conclusions. However, the data provided helpful insight into the student experience with MCO, and those insights have been noted in those chapters as considerations / areas for future research.

8. Work Plan Activity 1: Articulation

Logic Model – Framing the Chapter on Articulation

Figure 5 represents the original logic model for work plan activity 1 (Articulation). Revisiting the logic model helps frame this chapter. After the logic model, Table 10 shows the original budget allocation for this work plan activity, as well as each institution's percentage of effort towards this activity (out of all 8 activities).

Figure 5: Logic Model for Work Plan Activity 1: Articulation

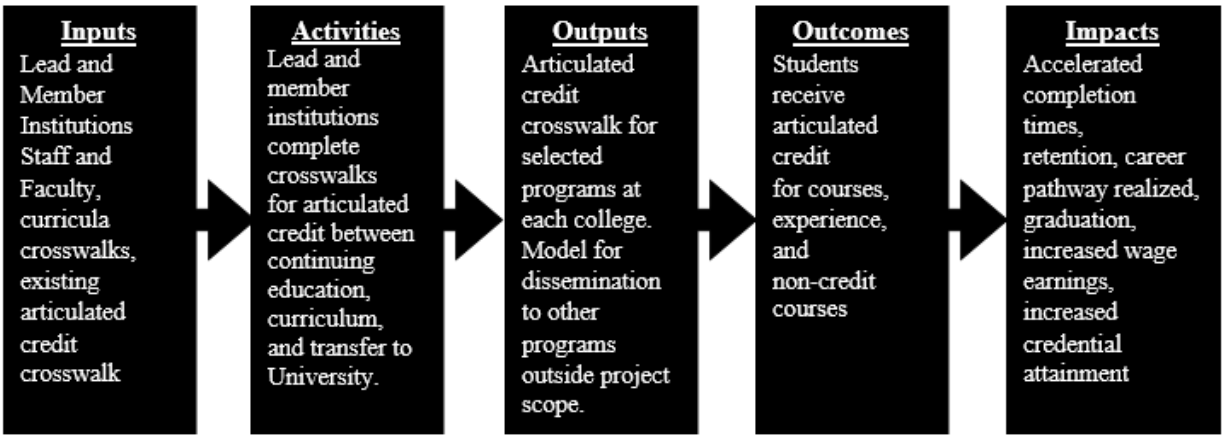


Table 10: Work Plan Activity 1 Effort Distribution

Work Plan Activity 1: Articulation *2.70% of Total Planned MCO Budget*	
MCO Partner Institution	**Percent of Institutional Total Effort for this Work Plan Activity**
Cleveland CC	2.43%
Wake Tech CC	2.02%
Nash CC	1.44%
Southern Regional TC	0.03%
UNC Charlotte	13.41%

Literature Review

The core purpose of an articulation agreement is to develop and implement policies and governance structures that encourage and facilitate the process of students transferring between

institutions (Senie, 2016). Articulation agreements serve as a way to document and negotiate degree requirements in support of transfer students (Anderson et al., 2006). During the 1970s and 1980s, there was a significant decrease in the number of students transferring from community colleges to 4-year institutions (Vertical Transfers), which spurred growth in the number of states that put articulation agreements in place to make the transfer process easier for students. In 1960, there were no records of articulation agreements in state legislation, and by the early 2000s, more than 30 states had implemented legislation regarding the movement of students between higher education institutions (Stern, 2016). There were more than 100 initiatives to restructure higher education governance systems that were implemented between the years of 1985 and 2002 (Senie, 2016). Successful agreements include fully developed pathways, which are specific to majors, and/or 'transfer maps' that clearly outline course sequences, prerequisites and extracurricular activities students will need to seamlessly transfer to a 4-year institution (Wyner, Deane, Jenkins, & Fink, 2016).

Articulation agreements alone, may not be sufficient in advancing the shared vision of credential attainment among institutions of higher education, but faculty (and staff) members acting as 'transfer champions' can have a big impact on the promotion of successful transfers (Stern, 2016). Many higher education institutions openly support articulation, but a study by Fincher, et. al. (2014) noted that the visibility of support to current and potential students regarding articulation is 'inconsistent at best,' and without a clear pathway to a Bachelor's degree, there may be negative impacts on new enrollment. The current literature on articulation agreements also notes several challenges that institutions of higher education commonly face. University faculty must trust that the faculty at community colleges are teaching articulated courses at a level of rigor that is sufficient to prepare the students for university-level instruction

(Wyner, Deane, Jenkins, & Fink, 2016). A study by Senie (2016) noted that some university faculty want 'complete control' over students' academic programs, which can result in fewer credits being articulated for transfer. When considering student support, transfer students have similar anxiety both prior to, and upon arrival, at a university as incoming first-year freshmen. Thus, transfer students need a high-touch personalized support from community college staff and faculty to be successful (Wyner, Deane, Jenkins, & Fink, 2016).

As pointed out in the literature review, the goal of developing articulation and other transfer-related agreements between community colleges and universities is to enhance the overall success of transfer students. The literature review also identified issues related to these agreements that affect their success in achieving this goal. These issues include developing and clearly communicating a roadmap for students interested in a transfer track, and building a level of trust between the university and community college regarding quality of instruction. Such issues helped shape the focus of the process evaluation provided below.

Process (Formative) Evaluation

For the MCO colleges in North Carolina, the Comprehensive Articulation Agreement (CAA) was established prior to the MCO TAACCCT grant program and focused efforts on a set of general education transfer credits that could be articulated from the North Carolina Community College System to all University of North Carolina institutions. The MCO program was able to capitalize on this statewide effort when planning articulation agreements between the MCO Associate in Science degree program and the UNC Charlotte Bachelor of Science in Engineering programs. Articulation efforts in Year 1 of the grant period included conversations around general transferability of the proposed MCO Associate's in Applied Science (A.A.S.) program coursework to the UNC Charlotte Bachelor's in Engineering program. An initial framework was developed by Cleveland CC, proposing a crosswalk of Cleveland CC's MCO

program to Mechanical and Electrical Engineering programs at UNC Charlotte. The partners decided to use MOU agreements rather than official articulation agreements to transfer community college credits to UNC Charlotte because of the time it takes to have an approved articulation agreement, and the limited time available during this project to put such an agreement in place.

Department leadership from the UNC Charlotte reviewed the MCO courses that were originally proposed and identified several deficiencies with the math and science prerequisites that did not allow for a seamless transition to a Bachelor's degree program. Cleveland CC and UNC Charlotte discussed how their prerequisite requirements related to the Associate's in MCO program (which required a total of 75 credits to meet the transferability requirements put forth by UNC Charlotte) could impact future students in multiple ways. For example, being ineligible for financial aid due to exceeding the allowable number of credit hours for a credential could lead to low completion rates. The NC Community College System also has policies that prevent Associates' degrees from exceeding 64 credit hours, with very few exceptions allowed. Cleveland CC suggested a blended Associate's degree and certificate option to satisfy the prerequisite requirements set forth by UNC Charlotte. It was determined that the added certificate would make it so that the transfer prerequisite requirements would not have an effect on non-transfer-bound MCO students, only those who opt for a transfer-track would be affected. In Years 2 and 3 of the grant period, Cleveland CC created and deployed the aforementioned STEM certificates (STEM 1 and STEM 2) that filled the math and science prerequisite gaps identified by UNC Charlotte. Outside of the partnership with UNC Charlotte, the other MCO partners have sought articulation options with other institutions of higher education in North Carolina.

As stated in the MCO grant narrative "... those competencies [MCO] will then be developed into assessments that each MCO college partner can use to award prior learning credit. Prior learning assessments will range from basic computer concepts and applications to industrial control networking and cybersecurity. These assessments will be developed by third-party non-profit organizations with a reputable history of assessment development." (p. 22). Although this was mentioned in the MCO grant narrative, a policy framework for awarding credit for prior learning was not formalized during the grant period in a systematic way. Each college has reviewed and awarded prior learning credit on a case-by-case basis, and dependent on their specific institution's policies.

Process Outputs

Table 11: Summary of Final Status / Outputs for Articulation

Task	Final Status / Comments
Activity #1: ***Articulation*** Lead and MCO college partners complete crosswalks for articulated credit between continuing education, curriculum, and transfer to University.	
1. Crosswalk CE>Curriculum>University	**Output**: Initial articulation crosswalks were developed for the MCO A.A.S. program and East Carolina University as well as UNC Charlotte. Gaps in MCO A.A.S and UNC Charlotte were later filled via the STEM 1 and STEM 2 certificate pathways for transfer-bound students. There were crosswalks completed for Continuing Education-to-Curriculum so credit can be awarded from Continuing Education to Curriculum. **Comments**: UNC Charlotte worked with the MCO partners to figure out the best option for articulating credit from the MCO A.A.S. to their B.S. programs, but challenges with the prerequisites and their accrediting body made it more difficult than originally anticipated at the time of the proposal development.

2. Accrediting bodies approve articulated credit, prior learning, competency based, and other	**Output**: With the STEM 1 and 2 certificates in place, accrediting bodies overseeing the UNC Charlotte B.S. in Engineering programs (ABET) will be satisfied with the math and science prerequisite matching. The Southern Association of Colleges and Schools (SACS) has approved the MCO A.A.S. degree program at Cleveland CC and Wake Tech CC. **Comments**: A systematic process for reviewing and awarding credit for prior learning did not exist by the end of the grant period. Each institution had their own processes in place to deal with reviewing and awarding credit for prior learning.
3. Develop draft SOPs for articulated credit	**Output**: Discussion between the North Carolina MCO partner schools (Wake Tech CC, Nash CC, and Cleveland CC) and 4-year institutions in the state led to several established crosswalk models. A curriculum crosswalk agreement was finalized with East Carolina University, all MCO A.A.S. degree-offering institution will benefit from this crosswalk. **Comments**: None.
4. Full implementation of SOPs at MCO college partners	**Output**: MCO A.A.S. degree is being offered at Cleveland CC and Wake Tech CC. The Associate's degree is a major component of the Articulation activity for the MCO grant because it is directly related to the articulation crosswalk developed with East Carolina University, and the STEM 1 / 2 option for UNC Charlotte transfers. **Comments**: Cleveland CC was instrumental in the efforts that led to a full articulation crosswalk with East Carolina University that will benefit MCO A.A.S. degree-granting institutions in NC (currently just Wake Tech CC and Cleveland CC).

Strengths and Challenges

Table 12: Strengths and Challenges for Articulation

Strength / Challenge	Description
Strength	The choice to use MOU agreements (as opposed to official articulation agreements) to transfer credit between colleges provided flexibility to

	accommodate different faculty credentialing requirements of the partners involved. This decision was intended to expedite the articulation activities, although the prerequisite gaps mentioned above and the creation of the STEM 1 and STEM 2 certificates, resulted in articulation efforts falling slightly behind schedule.
	The MCO A.A.S. program was implemented at two partner sites (Cleveland CC and Wake Tech CC). Nash CC is choosing to explore an MCO certificate option rather than the Associate's degree in response to feedback received by their local employer partners.
Challenge	Although not a primary focus of the MCO work plan, the program should consider future initiatives (post-grant) to establish a clear process for awarding credit for prior learning to incentivize students with past work or military experience to enroll and be on an accelerated credential pathway.

9. Work Plan Activity 2: Project Collaboration and Evaluation

Logic Model – Framing the Chapter on Project Collaboration and Evaluation

Figure 6 represents the original logic model for work plan activity 2 (Project Collaboration and Evaluation). Revisiting the logic model helps frame this chapter. Following the logic model, Table 13 shows the original budget allocation for this work plan activity, as well as each institution's percentage of funded effort towards this activity (out of all 8 activities).

Figure 6: Logic Model for Work Plan Activity 2: Project Collaboration and Evaluation

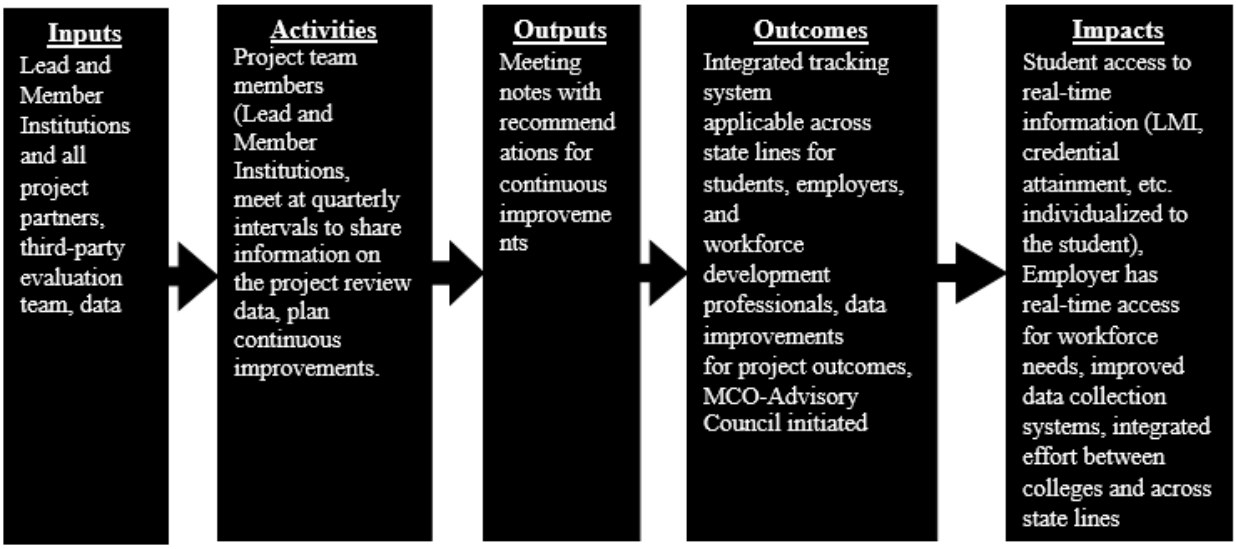


Table 13: Work Plan Activity 2 Effort Distribution

Work Plan Activity 2: Project Collaboration and Evaluation *4.12% of Total Planned MCO Budget*	
MCO Partner Institution	**Percent of Institutional Total Effort for this Work Plan Activity**
Cleveland CC	2.74%
Wake Tech CC	2.64%
Nash CC	1.98%
Southern Regional TC	6.55%
UNC Charlotte	17.20%

Literature Review

As Smith, Opp, Armstrong, Stewart, and Isaacson (1999) noted, a growing problem faced by institutions of higher education is a continued decrease in funding from traditional sources. Therefore, colleges and universities seeking to improve the quality of course and support service delivery need to explore new avenues for funding. Increasingly, the grant landscape places more emphasis on partnerships, making collaboration among institutions of higher education and other agencies the only means of overcoming a challenging fiscal environment (Strempel, 2014).

When considering the MCO program, without the TAACCCT grant funds as a convening resource, the MCO consortium would likely not have been formed to address the identified workforce gaps in 24/7 industries.

Consortia are described as 'imaginative cooperative relationships' (Smith, Opp, Armstrong, Stewart, and Isaacson, 1999) that consist of organizations who, in creating an alliance, are able to achieve more collectively than they would have been able to do individually (Strempel, 2014). The concept of 'thinking together' is described as a collective process occurring in consortia partnerships that allows participants to share and strategize on common issues they are facing (Burley, Gnam, Newman, Straker, Babies, 2012). Consistent and open-communication between the institutional leadership involved and the ground-level faculty and staff in the consortium is critical to the partnership development process. Communication from this level is necessary to set expectations for consortium development and ongoing collaboration (Burley, Gnam, Newman, Straker, Babies, 2012). In many cases, collaborating with peer institutions on a new, large-scale, initiative can bring about mixed emotions. From one angle, feelings of excitement are induced when considering the opportunities of the collaboration and the mutual benefits offered to each of the institutions involved. On the other hand, leading and participating in a large-scale collaborative effort among several colleges and external partners can generate a general sense of anxiety (Grandgenett, Thiele, Pensabene, & McPeak, 2015). The general feelings and desire of colleges and universities to preserve their institutional autonomy is noted as the principal impediment to effective inter-institutional cooperation (Smith, Opp, Armstrong, Stewart, Isaacson, 1999).

The literature provides at least one reason for why there is a greater focus on collaboration among institutions in recent years, noting that it is partly because of a decrease in

more traditional funding opportunities, which has produced more funding that is focused on collaborative partnerships. This necessity to collaborate may produce feelings of anxiety when faced with a large scale multi-institutional initiatives. The literature noted communication across all levels of the project to be an important aspect of successful collaborative partnerships. Furthermore, the institutions involved will begin to realize the power of thinking collectively about how to address common issues. These are some of the aspects that will be focused on in the process evaluation outlined below.

Process Evaluation

The partners spent a significant portion of Year 1 of the grant period getting to know one another and establishing expectations and clear delineations of responsibility for the project's WPAs. A responsibility matrix was used to organize and manage each of the work plan activities. The matrix identified each partner as being the *Lead*, an *Active Participant*, or having *No Involvement* on a particular task. Part of Year 1 was also spent establishing a data collection method for outcome measures. Although this was not initially a coordinated effort, the partners worked together towards a solution. Based on guidance set forth by DOL, Cleveland CC led discussions with the consortium to define student participants. Initially, the colleges planned to identify students according to their major, or program code, and later decided on a greater level of precision with their definition of participants by identifying all program participants according to their enrollment in specific course sections that were either enhanced, or newly implemented, using TAACCCT funds (see Table 17). This shift from course program code to course prefix code was a substantive decision that was agreed upon by grant partners and had a major impact on data collection and analysis.

Southern Regional Technical College (Southern Regional TC) and Cleveland CC began

to establish data collection systems and processes for their institutions early in the program implementation. Although initially this process was not communicated well to Wake Tech CC and Nash CC, eventually the partners shared common definitions of participants, retention, completion, and other factors that define the student records used for both DOL reporting purposes and for the evaluation plan. Recognizing the need for uniform reporting practices among the North Carolina partners, Cleveland CC shared their process of identifying and tracking student participants and committed to helping consortium members set up parallel student tracking processes. In regards to the Comparison Group selection, since there were no similar programs from which to gather comparison students from, the partner colleges agreed on a historical Comparison Group that would pull students from the same list of courses mentioned in Chapter 9 (those that were not new courses) to create the Comparison Group.

As part of the Year 2 evaluation, the evaluation team solicited responses to questions regarding quality assurance of program management. As the lead institution, Cleveland CC worked diligently to show MCO Consortium college compliance with the grant requirements. In order to demonstrate continued diligence and improve effectiveness of monitoring and tracking MCO Consortium college programmatic, administrative, and fiscal compliance, Cleveland CC developed a process for monitoring financial activity, and continued that process through the end of the grant. This approach was consistent with the TAACCCT Round 3 SGA (2013), which states that "The Lead Institution will track programmatic and fiscal progress against goals and flag problems related to achievement of programmatic and fiscal goals of the consortium projects, in accordance with appropriate systems to receive and compile outcome measures and fiscal reports. Problems will be identified and reported to the Department for review and action" (p. 21). For non-Lead Institutions in the MCO Consortium, of note is that while Cleveland CC

had the monitoring and tracking responsibilities outlined above, the SGA also states that "Consortium members are direct grantees, as evidenced by their grant award, and are therefore responsible for meeting all rules and regulations associated with federal grants" (p. 22). It also states that "…each institution is responsible for ensuring their individual institution is in compliance with grant requirements" (TAACCCT Round 3 SGA, 2013, p. 23). Fiscal monitoring occurred throughout the rest of the grant period once this process was defined and implemented.

During grant implementation there was an increased focus on employer collaborations, both with those employers outlined in the grant narrative as well as with a set of employers identified separately by each of the partner institutions. During meetings and interactions throughout the grant, employers showed interest in fields that include the MCO program, some seeking students for employment and others seeking ways to begin partnering with the respective colleges. Partners experienced varying levels of employer contributions to curriculum development, but generally reported good communications and engagement with employers. Although many of the employers originally identified did not follow through with the level of support anticipated, the colleges sought additional employer partners who were better aligned with MCO objectives. Cleveland CC was successful in recruiting volunteers from local employers to participate in the MCO Digital Learn platform, where they interacted with students in a chat/forum environment,

> *"…with the MCO funding, we have been able to buy equipment that extends across the campus and works within seven specific areas that we said it would, so it is enhancing what we are already doing. We have been able to offer classes and teachings that we would not have been able to do without the enhancement from the MCO grant." - MCO Administrator*

> *"…we've asked our local factories, 'Hey, what are you looking for in your employee?' 'When they come out of the tech school what do they need to know?' and then we develop our curriculum around that. " - Faculty Member*

responding to their questions as they could. Employers also contributed to the program's overall recruitment strategy, sending their employees to take MCO courses and credentials. Career recruitment, another factor of employer engagement, resulted in the employers sending recruiters to campus to speak with students; several employers also hosted college representatives at industry association meetings. The initial commitments of the eight original employers in the proposal narrative were important to establish a network of potential MCO program employers. However, throughout the grant it was found that there were more opportunities outside of the original list of employers to engage for input on curriculum development and work-based learning. Several quotes were gathered from new employer partners:

- *"For me personally and for my company* ***(Company name redacted)****, this program will become the foundation for our very needed future employees. It could not be getting off to a better start and I am very proud to be part of its beginning."*
- *"****(Company name redacted)*** *has been heavily involved in its support of the MCO program. We were first introduced to the MCO curriculum in 2013 …. (Faculty member) shared an initial draft of the MCO curriculum and solicited feedback from our engineering and operations team which we provided. We have since participated as a member of the advisory team. In May of 2015,* ***(Company name redacted)*** *was requested to interface with the MCO program for the development and design of the Mission Critical Operations (MCO) simulations for the MCO grant project to Virtual Heroes… As part of this initiative* ***(Company name redacted)*** *met with the team, provided a tour of our data center, and supplied information on the operation of our enterprise data center.* ***(Company name redacted)*** *has also helped promote awareness of the MCO program by providing marketing resources including online*

and through PR efforts "

In Year 3 of the grant, the evaluation team conducted semi-structured interviews with representatives from each of the MCO partner colleges to gain a better understanding of their industry engagement process. The two questions of focus were: 1) *What is your industry partner/employer engagement process?*; and, 2) *How were 'new' partners (not in the grant proposal) engaged?*. In response to the first question about their overall industry partner / employer engagement process:

- Some noted the importance of their program advisory board (consisting of employers) to their engagement process.
- Others reported reaching out to their industry partners individually via phone or email.
- Instructors and department heads were another avenue for industry engagement.
- A common theme for this question was the focus on job placement / matching student's skills with openings shared by employers.

As for the second question about engaging partners who were not in the original grant proposal, a summary of responses can be found in the list below:

- Campus events, such as job fairs, were noted by several MCO colleges as an effective way to establish new industry connections.
- Faculty presentations at regional/national conferences has also attracted new industry and employer partners.
- Several MCO colleges noted their connectedness with their local workforce development boards, and how several industry/employer connections were established using the workforce development board as a conduit.

- Other groups, such as the NC 7x24 Exchange, provided direct connections to local / regional employer partners.

In Year 4 of the grant, the Evaluation Team was able to collect several responses from SME / employer partners to a brief questionnaire (Appendix J). Most respondents indicated they were SMEs involved in the identification of competencies for the curriculum and certification development. Others were involved in co-authoring MCO textbook material with community college faculty. All respondents mentioned that they interacted with the MCO program staff at least quarterly. When asked 'W*hat was an aspect of your involvement with the MCO program that went well?'* responses included: Meetings / events were well organized; MCO program staff professionalism; and, good facilitation and management of meetings and interactions. The SME respondents did not offer opportunities for improvement, but noted that one limitation to their involvement was the amount of time they were able to commit, being busy at their job. Several of the SMEs in the respondent pool were involved in the MCO Advisory Board for Cleveland CC, but we did not receive any responses to the MCO Advisory Board questions.

Outputs

Table 14: Summary of Final Status / Outputs for Collaboration and Project Evaluation

Task	Final Status / Comments
Activity #2: ***Collaboration and Project Evaluation*** Project team members meet at quarterly intervals to share information on the project, review data, plan continuous improvements.	
1. Establish a data collection method for outcome measures	**Output**: Consortium came to agreement on tracking of participants (by course prefix of enhanced/new courses funded by the grant). The evaluation team worked with MCO partners on collecting participant level data for the outcomes analysis. **Comments**: None.
2. Consult public workforce agencies on new Virtual OneStop system	**Output**: After conversations with the NC workforce development system, the MCO degree program was added to an online repository of training programs used to communicate to job seekers. Partners received training and access to the Virtual OneStop system. **Comments**: Conversations related to this activity ended up with a successful result, but the relationship with NC Commerce / the workforce system can be enhanced in regards to accessing wage and employment data.
3. Project evaluation and final evaluation to DOL	**Output**: Ongoing interactions with the evaluator throughout the grant period. Yearly evaluation reports produced. Cleveland CC played instrumental role in encouraging timely submission of data for outcomes analysis - data provided by partner colleges. **Comments**: Interactions with the evaluator in Years 1-4 were positive, and partners were usually prompt to respond to requests. Although data was requested at the end of Year 2 / beginning of Year 3, it took much longer to gather the data for the outcomes analysis; some partners did not provide final data files until mid-way through Year 4, and incomplete data sets were provided.

4. Evaluation of deliverables	**Output**: Cleveland CC worked closely with industry SMEs on the evaluation of deliverables. This activity continued into Year 4 of the grant, but Cleveland CC made changes to content/delivery based on the feedback gathered from the SMEs. **Comments**: None.

Strengths and Challenges

Table 15: Strengths and Challenges for Project Collaboration and Evaluation

Strength / Challenge	Description
Strength	The consortium partners have improved their communication about data definition and data collection issues
	Additional employers in the partners' local proposal areas were engaged (apart from the list of employers in the grant narrative) and actively participated in curriculum development, work-based learning, and commitments to sponsor employment opportunities.
	The advisory board and participation in local MCO-related organizations helped build awareness of the grant program among industry (locally and regionally).
	Over the course of the grant, face-to-face engagement was the most effective means of communication, resulting in a more cohesive cross-institution team. Cleveland CC scheduled face-to-face meetings at least once per year, and convened WebEx meetings with video and screen sharing capability for other meetings.
Challenge	Employment outcomes data was a big challenge for the consortium. Access to public workforce systems was the initial approach taken, but the workforce system partners were not able to provide the level of employment data needed for the outcomes analysis.
	The consortium met face to face several times throughout the four year grant period, but scheduling and attendance remained a challenge. Some partners claimed to have no budget for travel to these face to face meetings and joined remotely.

10. Work Plan Activity 3: Course Design

Logic Model – Framing the Chapter on Course Design

Figure 7 represents the original logic model for work plan activity 3 (Course Design). Revisiting the logic model helps frame this chapter. Following the logic model, Table 16 shows the original budget allocation for this work plan activity, as well as each institution's percentage of effort towards this activity (out of all 8 activities).

Figure 7: Logic Model for Work Plan Activity 3: Course Design

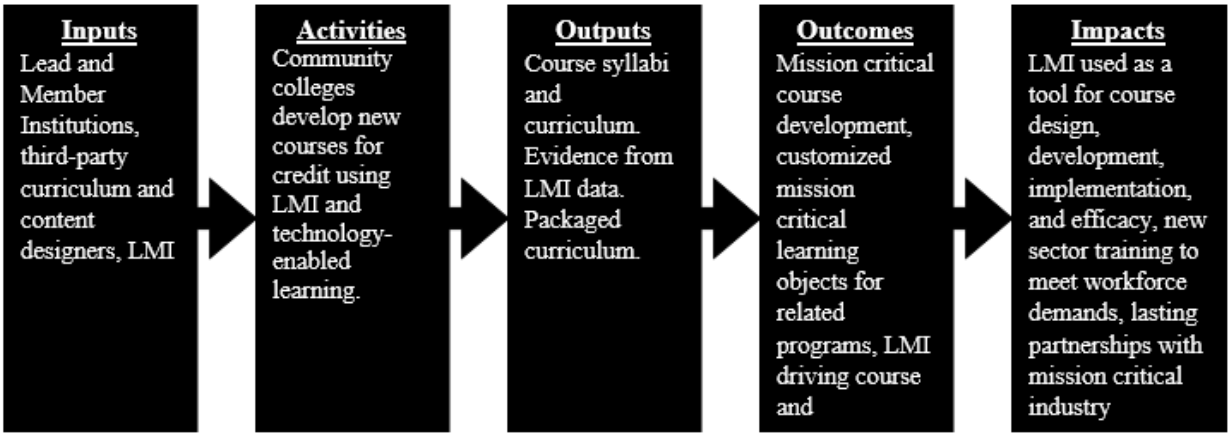


Table 16: Work Plan Activity 3 Effort Distribution

Work Plan Activity 3: Course Design *12.51% of Total Planned MCO Budget*	
MCO Partner Institution	**Percent of Institutional Total Effort for this Work Plan Activity**
Cleveland CC	10.37%
Wake Tech CC	33.95%
Nash CC	2.18%
Southern Regional TC	0.03%
UNC Charlotte	31.47%

Literature Review

A main focus of the Department of Labor TAACCCT grant program has been the development and/or redesign of courses and education programs that are aligned to industry

needs. These learning events lead to credential or degree programs and sustainable employment. Regarding alignment to industry needs, a main focus of the Course Design activity for MCO was employer engagement and collaboration. Employers were heavily involved during the course and credential design process, to include input on the identification of competencies and test questions. As Major & Major (2011) noted, any course or program ('event') must be designed in a way that meets or exceeds the needs of the various stakeholders (employers and 4-year schools) who benefit from the knowledge and skills gained by the course or program. Inclusion of employers in the design of the 'event' (course or program) ensures direct alignment to the stakeholder needs.

Along with new courses, the program also enhanced or expanded a total of 58 existing courses (see Table 17 for description of enhancements) through the incorporation of MCO concepts and components. Over 70% of the new or MCO-enhanced course sections were offered via online or hybrid (blended) formats. One of the factors that must be considered in the development of, or transition to, online and hybrid courses is deciding which pieces of course content to put online (Klotz & Wright, 2017). MCO program partners converted lecture materials into online-ready components for inclusion in online and hybrid courses. These digital resources were developed as open educational resources (OER) to promote widespread access and sharing across programs and colleges while also allowing for updates to occur quickly and regularly. Although unique learning features and functionalities are offered by web-enabled learning content (in MCO hybrid and online courses), instructors are encouraged to keep the learning outcomes and contexts of those learning outcomes in mind, which can have an effect on the learning environment that best fits the course material (Mirriahi, Alonzo, & Fox, 2015).

Integrating technology into existing courses has been a core tenent of the MCO program.

Apart from online and hybrid course design, simulation and telepresence were two ways in which the MCO partners used technology to enhance the learning experiences. Telepresence will be discussed more in Chapter 14, but as for simulation, it is one technological component that serves as an effective learning supplement for online, hybrid, and face to face courses. McLaughlin, Starobin & Santos (2010) noted that one of the greatest advantages of using simulations in technical training is the exposure students get to 'unpredictable and unusual events.' Simulators allow for specific course concepts and techniques to be practiced by the student in a repetitious manner. The format can be either alone at their own pace, or under supervision of an instructor. Another advantage of simulations over physical hands-on experience is in the margin for error. If an error is made during a simulated procedure, the program will finish running through the procedure while keeping track of any errors made so that the student (operator) can go back in time to understand when the error was made and how it was made in a low stakes environment. High quality simulators include features to allow the student to go back to the point at which a mistake was made to learn how to avoid making the same mistake during the next run (McLaughlin, Starobin & Santos, 2010). Working through a simulation provides students with a virtual sandbox, without physical consequences, in which they can experiment and learn to adapt in ways that a physical hands-on experience would not allow.

As mentioned before, with a vast majority of courses being offered in online or blended settings, it is encouraging to hear that well designed, online experiences have shown similar-or-greater learning gains when compared to a face-to-face setting (Mirriahi, Alonzo, & Fox, 2015). Sidman, D-Abundo, and Bullard (2014) noted that some traditional face-to-face courses rely too heavily on assessing knowledge, and more attention is needed on considering what the best

delivery format is in order to produce the intended learning outcomes. Web-enhanced learning opportunities may be particularly effective for community college students who are not living on campus. Not dissimilar to a traditional university student, community college students are often juggling multiple aspects of their busy lives on top of their academic career. When considering hybrid settings specifically, Mirriahi, Alonzo, & Fox (2015) noted that it is important to ensure that the online and face to face activities are supplementing each other, rather than overlapping and being repetitious.

A strength of web-enabled learning is the ability to provide individualized feedback to the student, tailored to fit their needs (Fonolahi, Khan, Johkan, 2014). Interactions between student and instructor play a major role in these types of self-directed learning environments. It is important for instructors of web-enabled courses to consider the level of interaction necessary, and make a plan for sustaining that level of interaction with the student. This can be a challenge for some. With MCO in mind, the availability of the online OER cartridges reduces the amount of development time needed by the instructor. When possible, it is also helpful for students in web-enabled learning environments to have access to other faculty members and subject matter experts in the field (Mirriahi, Alonzo, & Fox, 2015). Cleveland CC led efforts to build the MCO Digital Learn platform, which includes an interface for other faculty and industry experts to interact with students in a question and answer style forum. Blended learning instructors can face challenges particular to that learning environment, such as how to design engaging, meaningful learning experiences for their students. To overcome this, the instructional design and development process must anticipate how different learning styles will be interacting with the online components in an online or hybrid learning format, and consider how those learning styles will encounter strengths or challenges within the web environment (Shea, Joaquin, Gorzycki,

2015).

In regards to Course Design, the literature noted the importance of meeting stakeholder needs as part of the design and development process, and how SMEs from local and regional industry should be involved in this process to ensure their interests and needs were considered. Also, with the increased focus on web enhanced and web enabled learning opportunities, the literature noted the benefits of these non-traditional formats, as well as key considerations when determining what content should be included in face to face versus online delivery methods. These are key focus areas of the MCO program and provide a frame of reference for the process evaluation below.

Process Evaluation

Course development discussions began early in the grant in Year 1, with the initial list of MCO core competencies identified by industry partners. The main outcome of the Course Design activities was the development and implementation of three new MCO courses for the MCO A.A.S. program: 1) MCO 110 *Introduction to Mission Critical Operations*, 2) MCO 115 *Introduction to Critical Infrastructure*, and 3) MCO 210 *Critical Site Operations*. These MCO courses are different from applied technology courses, because they focus more on applying theoretical principles to technology, as opposed to having the learner focus on specific elements of technology on the job. The targeted student for the MCO program includes incumbent workers such as current, and aspirational, plant operators or managers. The nature of these jobs and/or advancements the students are pursuing assume their ability to work with independence, autonomy, and the ability to make informed decisions 'in the moment.'

Open Educational Resources (OER) materials were another key output of the program. These OER materials can provide benefit to many other programs across the nation, because they

were designed in a way that was not too specific to one industry, designed in a way that the content could be readily applied to multiple disciplines / training programs. Cleveland CC developed and uploaded 120 OER materials (course cartridges, or learning modules) that can be transferred from one learning management system to another. These were created for the new MCO courses mentioned above (Cleveland CC also created OER content for their MAT 171 [Pre-calculus Algebra] course).

The Evaluation Team engaged the William and Ida Friday Institute for Educational Innovation in 2014 to provide an evaluation of the MCO Open Educational Resources produced by Cleveland CC. This evaluation included the following rubric constructs: Content quality; Motivation; Presentation design; Usability; Accessibility; and Educational value. Each of these constructs was rated on a 5-point scale, with 5 being the most positive rating. All of the constructs rated above 3.0, with 'Presentation Design' being the construct with the lowest rating (3.04), and 'Accessibility' being the construct with the highest rating (4.20). Additional details of this evaluation can be found in Appendix C.

Several other OER materials were created by the MCO partners. Wake Tech CC developed three OER modules, but has not yet uploaded them to SkillsCommons. The three modules are: Power Efficiency, Variable Frequency Drives, and Cyber Security for Industrial Control Systems. The wide-applicability of the downloadable course modules makes it easy for instructors in various disciplines to pick and choose which MCO components to insert into their courses. These modules were not designed to be full courses, only representative of the lecture content of the course. It was made clear to instructors utilizing the OER modules that they would be responsible for developing their own lab supplements to compliment the OER content. Subject Matter Expert (SME) input was reported to be extremely valuable in determining the

critical aspects of MCO to the development of the course content. SMEs included local, regional, and even national industry experts in the mission critical field. Input from SMEs provided a level of legitimacy that was important in establishing credibility for the newly developed program.

By the end of the grant, a total of 69 courses were enhanced, expanded, or newly created through the use of MCO grant funds (See Table 17 below). Over 70% of those courses were offered in online or hybrid delivery methods.

Table 17: Courses Developed and Enhanced by TAACCCT Funds

College	Course	Enhancement via TAACCCT Funding
Cleveland CC	ATR 112 - Introduction to Automation	Improved course design/organization, added multimedia content, embedded MCO competencies, added learning objectives, created vocabulary to be used in study tools (e.g. flashcards or quizzes), and created presentation materials.
	ELN 133 - Digital Electronics	Improved course design/organization, added multimedia content.
	SEC 220/210 - Defense-in-Depth	Improved course design/organization, added multimedia content, embedded MCO competencies, redesign of Certified Ethical Hacking (CEH) certification, created vocabulary to be used in study tools (e.g. flashcards, quizzes), created video "Buffer Overflow Basics" and "How To Use Wireshark,"study questions created for SQL Injections, Networking Protocols and Ports flashcards, and SSH (Secure Shell).
	ISC 112 - Industrial Safety	Improved course design/organization, added multimedia content, embedded MCO competencies, updated PowerPoint presentations, and addressed accessibility issues.

	MCO 110 - Introduction to Mission Critical Operations	New courses for MCO program
	MCO 115 - Introduction to Critical Infrastructure	
	MCO 210 - Critical Site Operations	
	Work-Ready Certificate Program	Unit introductory videos created: "How We Communicate" learning object, and "Responding" learning object
Wake Tech CC	PCI 262 - Introduction to Process Control	New courses for MCO program
	PCI 172 - SCADA Systems	
	PCI 170 - DAQ and Control	
	MNT 130 - Control Systems	
	MCO 266 - ICS Cyber Security	
	BAT 117 – Principles of Heat and Fluids	
	MNT 110– Introduction to Maintenance Procedures	

	PCI 170 – DAQ and Control	
	ISC 112– Industrial Safety	Enhanced by course materials purchased using MCO funds.
	MCO 110 – Introduction to MCO	These new MCO Courses created in previous semester are now being enhanced (Fall 2016) by the new simulation created by Virtual Heroes.
	MCO 115-Introduction to Critical Infrastructure	
	Supervisory Control & Data Acquisition	Added MCO components into these stackable/latticed certificate programs.
	Process Control & Instrumentation	
Nash CC	EPT 120 - Sociology of Disaster	Information from the MCO Blackboard site and open educational resources identified by the MCO committee were incorporated and align with each of these focus areas.
	EPT 130 - Mitigation & Preparedness	
	SEC 110 - Security Concepts	
	CTS 120 - Hardware/Software Support	
	NET 226 - Routing & Switching II	Information from the MCO Blackboard site was incorporated into the course taught through the Cisco Networking Academy. Added course content from Unit 1 (smart grids), Unit 3 (communications and IT), Unit 5 (all areas), and Unit 6 (all areas).
	NET 289 - Networking Project	

	CTS 289 - Systems Support Project	These areas were targeted to reflect real-world situations in industry.
	NET 125 - Networking Basic	NetLabs being implemented to simulate hands-on lab configurations outside of class, information from the MCO Blackboard site was incorporated into the course taught through the Cisco Networking Academy. Added course content from Unit 3 (communications and IT).
	NET 225 - Routing and Switching I	NetLabs being implemented to simulate hands-on lab configurations outside of class, information from the MCO Blackboard site was incorporated into the course taught through the Cisco Networking Academy. Will use industry perspectives from the Critical Infrastructures course that relate to Network Technology.
	NOS 110 - Operating System Concepts	Using VMware Workstation 11 to allow students the ability to practice operating system installation, troubleshooting, and configurations in a "sandbox" environment.
	NOS 230 - Windows Admin I	
	CTS 220 - Advanced Hardware / Software Support	Using VMware workstation 11 to provide students with experience in virtualized hardware/software, incorporating topics from the MCO Blackboard site.
	CTS 287 - Emerging Technologies	Topics from the MCO Blackboard site will be incorporated as to how it relates to IT. Course undergoing restructuring to include up to date emerging technology content and inclusion of content from Critical Infrastructure course.
	CSC 139 - Visual Basic Programming	Printers were purchased using MCO funds for students to use.
	WBL 111 - Work-Based Learning I	

	ELC 111 - Introduction to Electricity	Purchased software to transition this course from a face-to-face to a hybrid delivery. Transformers were also purchased with grant funds to be used in the classroom.
	ELC 126 - Electrical Computation	This course was enhanced due to the purchase of the computer (used by instructor) in the classroom.
	ELN 111 - Introduction to Electric Line Construction	Transformers were purchased with grant funds to be used in the classroom.
	ELN 111A - Introduction to Electric Line Construction Lab	Purchased rope and climbing gear.
	ELN 114 - Overhead Line Construction I	
	AHR 110 - Intro. To Refrigeration	Purchased Captivate software to redesign course from face-to-face (F2F) format to hybrid delivery. A smartboard was also purchased to assist with student instruction.
	ELC 111 - Introduction to Electricity	
	ELC 115 - Electrical Systems Technology and Industrial Systems Technology	
	ELC 231 - Electric Power Systems	
	HYD 110 - Hydraulics/Pneumatics I	

	ELT 111-Electric Lineman Technology Third Class Certificate	Purchased transformer training modules enabling students to practice banking three-phase transformers found on distribution systems in the field. Replaced old and worn out climbing equipment that was becoming a safety hazard. *Figure 8: Nash CC Electrical Lineman Training Ground* 
	ELT 114 - Electric Lineman Technology Third Class Certificate	Purchased tools and material used to construct overhead electrical line allowing students to have a much broader understanding of common construction practices.
	ELT 211 - Underground Line Construction I	Purchased materials used in underground residential distribution systems; allowing student's hands-on training on how to correctly make up components used to deliver underground service.
	ATR 280 - Electronics Engineering Technology and Electrical Systems Technology	Purchased ELVIS boards, engineering lab workstations allowing students to have hands-on experience with multiple tools needed to conduct engineering experiments in analog, digital circuits, communications, and controls.

	ELC 228 - PLC Applications	
	ELC 131 - Circuit Analysis I	
	ELN 260 - Programmable Logic Controllers	
	CTI 141 - Cloud & Storage Concepts	Purchased yearly subscription (renewal) of Cisco Networking Academy curriculum
	CTS 120 - Computer Information Technology	Purchased a printer for student use in the classroom. MCO course content from Blackboard site added to this course.
	CTS 287 - Networking Technology	MCO course content from Blackboard site added to this course.
	DBA 115 - Computer Information Technology, Networking Technology	Purchased Netlabs; using to configure database virtual machines for remote student use.
	NET 125 - Networking Technology	Purchased VMware, Cisco Networking Academy, and NetLabs; using in course. Also, MCO course content from the Blackboard site was added to this course and printer purchased for student use in the classroom.
	NET 225 - Routing and Switching I	
	*SEC 150 - Information Systems Security (Program not a designated MCO program at NCC but closely related)	

Southern Regional Technical College	IDSY 1110 - Industrial Motor Controls	These courses used equipment that was purchased through the grant which enhanced the delivery of the courses allowing students to see the technology at work. The Netlabs system is set up where students were able to access the automation software remotely.
	IDSY 1210 - Industrial Motor Controls II	
	IDSY 1120 - Basic Industrial PLCs	
	IDSY 1220 - Intermediate Industrial PLCs	
	IDSY 1190 - Fluid Power Systems	
UNC Charlotte	ELET 2241 - Instrumentation and Controls	MCO example applications were embedded.
	ELET 2241L/ETME 4163L -Instrumentation and Controls	MCO example applications were embedded. Demonstrated the eRAMP setup.
	ELET 3292 - Junior Practicum	Use of the eRAMP remote laboratory setup.

	ITIS 6200 - Principles of Information Security and Privacy	Examples of PLC, industrial, and embedded systems protocols and applications have been included.

Several continuing education courses at Nash CC benefited from MCO enhancements that were not listed in the table above. Students in the Nash CC Emergency Dispatch Academy use MCO equipment in the Emergency Operations Control room shown in figure 9 below.

Figure 9: Nash CC Emergency Operations Control Room

Also at Nash CC, Law Enforcement students are using a realistic virtual simulator for handgun and active shooter training. Emergency Management and Law Enforcement are two areas of employment where the MCO certificate option being offered at Nash CC will be focused on. One program staff member indicated that the quality of the curriculum content has been enhanced through synergies that exist between the various academic departments through their interactions via this grant. While there are several disciplines applying MCO curriculum, each has a common focus on incorporating similar Mission Critical Operations concepts. Out of the students responding to a survey about MCO course materials, there was an overall positive response regarding the quality of MCO materials. Several respondents from the same survey noted an opportunity for improvement as ‘more hands on learning opportunities.’ Given some of the

partner colleges had later incorporations of telepresence, and the simulation was completed in the third year of the grant, the perceptions may change as those aspects of the courses are continuously integrated, where appropriate.

Wake Tech CC led contracting with Virtual Heroes to build a simulation that provides MCO students with an overview of facility operations while giving them experience with several on-the-job scenarios in various work environments. The simulation took approximately 10 months to complete and was deployed in May 2016. Wake Tech CC is currently using the simulation as a lab component of their MCO 110 course offering. The broad concept of the simulation includes three focus areas: (1) Normal states of operation, (2) Problem Response, and (3) False alarms. Virtual Heroes worked with Wake Tech CC to develop learning objectives around the following scenarios: Basic Control Room Operation, Basic Floor Maintenance, Basic Floor Mission Critical Response, and what they are calling 'Putting It All Together.' To accommodate the differences in mission critical facilities, the simulations were designed with a generalized application that concentrates on the management of power and air systems. Staff noted that students seem to be more willing to take risks in a simulation environment and by the simulation design they are able to learn from their mistakes during the procedure in a controlled (virtual) environment.

UNC Charlotte contributed to the Course Design activity through research and development of technology-enabled learning systems. UNC Charlotte used work-study and graduate students to develop technology-enabled learning systems on top of the eRAMP system that was initially designed by Southern Regional TC. UNC Charlotte created the means by which telepresence labs would be delivered. Two trainers were built on the UNC Charlotte campus (an elevator trainer and a 3-axis (Cartesian) robot). More recent activity includes the

addition of a laser cutter remote lab and remote accessed 3d printer. Telepresence and Course Design are closely linked activities, so the research and development done by UNC Charlotte into technology-enabled learning systems enabled the other MCO partners to implement and embed telepresence capabilities into Course Design efforts. While the MCO partners considered this work a success, they noted that there is still a great deal of work to be done in regards to the development of laboratory exercises and activities. As a continuation of the MCO program work, the partners anticipate co-developing a library of lab assignments and exercises. At UNC Charlotte, a lead faculty member noted that the research and development done as part of this grant led to further research in the area of cybersecurity in manufacturing networks.

Outputs

Table 18: Summary of Final Status / Outputs for Course Design

Task	Final Status / Comments
Activity #3: ***Course Design*** **-** Community colleges develop new courses and redesign courses for credit using LMI and technology-enabled learning.	
1. Identify MCO competencies to develop standardized course components and MOOCs	**Output**: Cleveland CC led development of a list of competencies early in the grant for the new MCO courses developed. Wake Tech CC led learning outcome and content development for a MOOC - yet to be deployed. **Comments**: None.
2. Develop two OER MCO courses	**Output**: MCO 110 (Intro. to MCO) and MCO 115 (Intro to Mission Critical Infrastructure) were developed as OERs. **Comments**: Additional OER content was developed during the grant period by Wake Tech CC, but was not uploaded to SkillsCommons. Cleveland CC uploaded 120 OER objects to the SkillsCommons repository. The other partners have been reminded to upload all

	learning objects, fliers/brochures, or other materials developed as part of the grant.
3. Launch new MCO components on NTER	**Output**: MCO 110 and 115 OERs mentioned above were launched on CourseSites (changed from NTER since narrative was written). **Comments**: None.
4. Consult public workforce agencies on LMI trends	**Output**: NC MCO partner CCs were successful in working with local workforce development boards on reviewing LMI trends. Wake Tech CC also deployed a survey to employers to get feedback on labor market trends. **Comments**: Success Coaches at each of the partner colleges were involved in regular meetings to discuss best practices in student support as well as labor market trends.
5. Implement MCO components in existing courses	**Output**: Each of the partners, including UNC Charlotte the university partner, embedded MCO components and concepts into existing courses. A list of all courses impacted by the grant is found in Table 12. **Comments**: None.
6. Offer new MCO courses in online or hybrid formats	**Output**: New MCO courses were offered in hybrid formats. **Comments**: None.
7. Use analytics to drive learning and continuous improvement of courses	**Output**: Cleveland CC used Quality Matters Certification of the new MCO courses to drive continuous improvement efforts. Wake Tech CC worked with the developers of the simulation to collect data that can contribute to continuous improvement of the simulation component. **Comments**: The Quality Matters Certification efforts at Cleveland CC exceeded expectations – this is now going to be rolled out to all online

	courses at Cleveland CC in a continuous improvement effort. A list of Cleveland CC courses that are now Quality Matters Certified includes: CIS 110 (Introduction to Computers), ENG 111 (Writing and Inquiry), SOC 210 (Introduction to Sociology), and ACA 115 (Success and Study Skills).

Strengths and Challenges

Table 19: Strengths and Challenges for Course Design

Strength / Challenge	Description
Strength	Course materials created or enhanced responded to local employer needs. Course competencies have been informed by job task analyses (JTA's) with input from industry experts, subject matter experts (SMEs), and contractors throughout the development process.
	MCO 110 and 115 were both Quality Matters (independent, non-profit quality assurance framework for online courses) certified by the end of the grant. These were the first courses at Cleveland CC to be certified by Quality Matters, and the college reportedly plans to expand the Quality Matters framework to other courses to get them certified as well.
Challenge	Several instructors who were interviewed during year 2 were not aware of the MCO OER content available for download. There appeared to be a lack of communication and understanding in regards to what content and curriculum were available and when, although portions of it have been online for almost a year. Furthermore, for some instructors and administrators, there was a sense that MCO content could not, or should not, be embedded into existing courses until the programs of study were approved for each individual partner.
	The perceptions of curriculum content continue to vary widely by MCO program role based on the role proximity to core grant planning and operations. Some of the faculty interviewed had a less comprehensive understanding of MCO curriculum development process (design and dissemination).

	Responses to a student survey indicated that although some students were considered MCO participants and their courses were enhanced or expanded with MCO funds (some including MCO content), they had a general low-level of awareness of MCO as a concept and a program.

11. Work Plan Activity 4: Credential Development

Logic Model – Framing the Chapter on Credential Development

Figure 10 represents the original logic model for work plan activity 4 (Credential Development). Revisiting the logic model helps frame this chapter. Following the logic model, Table 20 shows the original budget allocation for this work plan activity, as well as each institution's percentage of effort towards this activity (out of all 8 activities).

Figure 10: Logic Model for Work Plan Activity 4: Credential Development

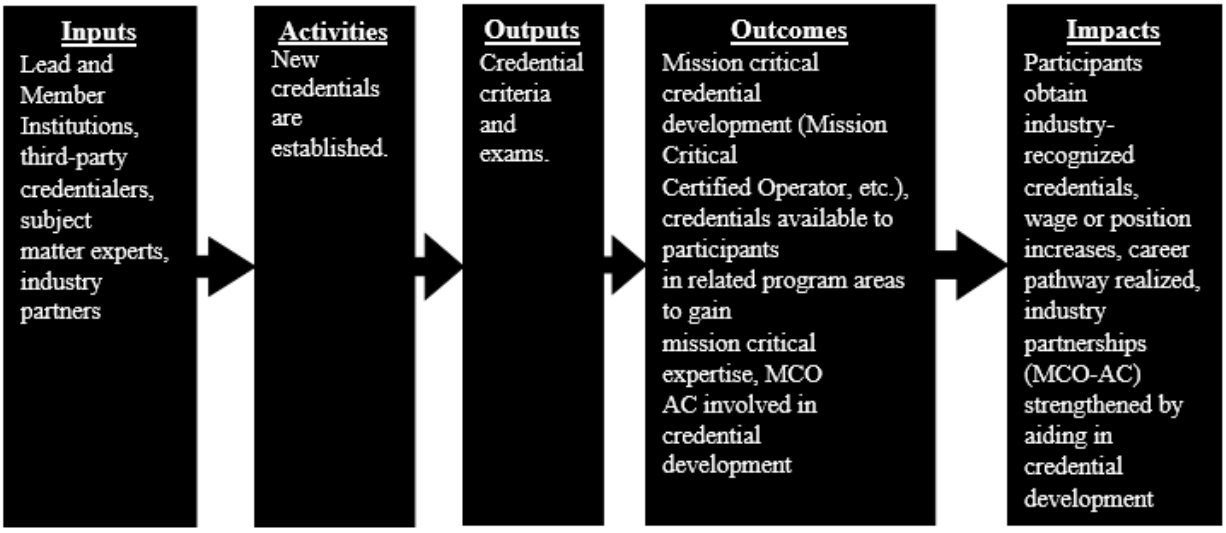


Table 20: Work Plan Activity 4 Effort Distribution

Work Plan Activity 4: Credential Development *14.20% of Total Planned MCO Budget*	
MCO Partner Institution	**Percent of Institutional Total Effort for this Work Plan Activity**
Cleveland CC	24.44%
Wake Tech CC	2.02%
Nash CC	1.43%
Southern Regional TC	0.03%
UNC Charlotte	0.00%

Literature Review

Starting in the 1990s, a shift occurred in the United States from a purely industrial society towards a more service-oriented one. Starting with fields such as Information Technology (IT), the shift required employees to gain new knowledge and skills in order to meet the expectations of the new work environment (Carter, 2005). In recent years, advanced technical industry jobs are making a comeback, which has also required a different set of skills to meet the demand set by industry. This increased demand for highly skilled workers has driven an increase in the number of skill certifications available at public and private educational institutions (Carter, 2005). The Lumina Foundation has provided definition for what a credential is - a 'documented award' by an 'authorized' body that shows an individual has gained knowledge around a specific set of standards (set by business and industry). Based on this definition, credentials can include: degrees, diplomas, licenses, certificates, 'badges' and professional or industry certifications (Connecting Credentials Report, 2015).

Stackable credentials are an emerging trend in higher education. Audant (2016) notes that 'the number of pre-baccalaureate certificates has grown by 800% over the last 30 years.' The study suggested that the reason for this substantial growth is because of collaboration with industry. With time-to-degree, and in turn, time-to-employment as key motivators, the

collaboration with industry drives a 'modular approach' to knowledge and skills gain that streamlines the student's academic and career pathway as a result (Audant, 2016). According to the Bureau of Labor Statistics (www.bls.gov), people with a certification or license earned about one-third more than those without these credentials. Although the credentials created in the MCO program were third-party accredited, less than 10% of non-MCO credentials were accredited or reviewed by third-party (Giani & Fox, 2017). Between 2000 and 2010, the number of short-term certificates awarded increased by 151% nationally, increasing the share of sub-baccalaureate credentials that are short-term certificates from 16% to 25% in only a decade (Dadgar and Trimble, 2014).

The literature attempts to explain the increase in credential programs over the years in response to several shifts in our economy, initially from industry to service oriented, now with a shift back based on technical and technological advances in both industry and service oriented sectors, which is what the MCO program addresses. Inclusion of industry experts in this process is paramount as their needs are the driving forces for programs that fulfill those needs through industry recognized credentials.

Process Evaluation

Cleveland CC contracted with third-party organizations to develop two 'high-stakes' MCO credentials, *Certified Mission Critical Operator* (CMCO) and *Certified Mission Critical Professional* (CMCP). In Year 1 of the MCO project, the foundation for credential development was laid through the definition of MCO competencies. Cleveland Community College contracted with Examplify and ISA to conduct two separate Job-Task Analysis (JTA) sessions. More than twenty subject matter experts from various industries participated in the sessions and identified a wide range of MCO competencies on which to build industry-recognized credentials. Examplify

conducted an item writing workshop with mission critical SMEs in November 2014, and the second contractor, ISA, conducted an item writing workshop in February 2015. The questions developed in these workshops directly correlate with the domains and competencies identified in the JTAs, and were then added to the question banks for the MCO certification exams.

CompTIA/Examplify were the organizations involved in the creation of the CMCO credential, leading the development of a test question bank around the identified domains of CMCO, and aligned with the MCO 110 curriculum course modules. One shift that occurred early in the development of the CMCO credential was a shift in the focus of MCO subject matter, originally around information technology. The SMEs involved in the job task analysis were from several different industries. Although the SMEs agreed that mission critical job elements related to IT needed to be included, they noted they should also include a broader level of focus than previously conceived, since MCO concerns overall site operations, with IT just being one aspect. Although the CMCO has evolved, it maintains a focus on key skills such as objective recall and identifying pertinent information, and includes equipment, practices, and procedures that are most common at mission critical facilities, not specific to a particular industry.

Cleveland CC shared the domains and competencies identified in the JTAs with all consortium partners. In collaboration with Examplify and ISA, Cleveland CC identified as many mission critical SMEs as possible. These SMEs were asked to serve on a Business and Industry Leadership Team (BILT) (a model developed by the NSF National Convergence Technology Center) that focused their efforts on the design and development of the MCO degree program, credentials, and course content. ISA/Castle Worldwide were third parties responsible for the creation of the CMCP high-stakes credential. A similar paradigm shift occurred with the development of the CMCP as it did with the CMCO. When the SMEs convened they also

determined that the CMCP test should be broader than the original Operations Technology (OT) focus entailed. The CMCP has been designed as an application-based, scenario-driven exam that tests knowledge of interdependent systems in MCO facilities. Updates were made to the CMCO based on a recent beta test to determine the passing score cut-off points. The beta-test was made available via PearsonVUE testing centers across the country through mid-October 2015. At the end of Year 3, the CMCO certification was publicly deployed and made available nationwide at Pearson testing centers. Examplify is currently managing the CMCO certification. The CMCP certification was later deployed in year 4. Cleveland CC worked with contractor ISA on the management of this certification, and ISA agreed to manage the certification for at least one year after the grant expiration.

As for the low-stakes credential, the MCO A.A.S. degree program, Cleveland CC worked directly with the North Carolina Community College System Office seeking guidance on the critical milestones that had to be met in order to submit the application for a new degree program. Cleveland CC first identified which *existing* courses from the North Carolina Community College Combined Course Library (CCL) would be applied to the MCO degree program, and which proposed new courses would fit into the program. In year 2, Cleveland CC received approval from the North Carolina State Board of Community Colleges for curriculum courses and a curriculum standard for the Mission Critical Operations (MCO) program of study, and later received approval from The Southern Association of Colleges and Schools Commission on Colleges (SACSCOC) for the Associates in Applied Science in Mission Critical Operations (A.A.S in MCO) degree. Wake Tech CC went through the same process as Cleveland CC, and later implemented their MCO degree program late in Year 3 of the grant. Based on feedback from employers in their area about what skills and credentials are needed, Nash CC decided not

to offer the full MCO degree program, but to develop and implement a *Critical Response Operations Certificate* that included MCO components embedded. Several of Nash CC's local employers sought to hire graduates with specialized credentials in fields such as emergency management, and noted that an added MCO-focused credential would be a valuable credential for their employees to have. Nash CC noted plans for developing and offering additional MCO-oriented certificates in the future.

Outputs

Table 21: Summary of Final Status / Outputs for Credential Development

Task	Final Status / Comments
Activity #4: ***Credential Development*** New credentials are established.	
1. Develop and receive approval to offer MCO degree (certificate, diploma, degree options)	Output: Cleveland CC and Wake Tech CC were both successful in getting a new MCO A.A.S. degree approved at the college, NC Community College system, and accreditor levels. Nash CC, in response to feedback from employers, decided not to pursue approval for the A.A.S. degree and instead offered an MCO certificate option to be added on to existing credentials. Comments: None.
2. Develop low stakes MCO credentials (2-6)	Output: An Operations Technology and Information Technology certificate option was created in the MCO program at Cleveland CC and Wake Tech CC. Comments: None.
3. Develop high stakes MCO credentials (1-2)	Output: The CMCO and CMCP certifications were developed and implemented. Comments: None.

Strengths and Challenges

Table 22. Strengths and Challenges for Credential Development

Strength / Challenge	Description
Strength	Strong employer involvement during the job task analysis and item writing workshops.
	The Credential Development activities were completed in a timely manner.
Challenge	None to report.

12. Work Plan Activity 5: Support Services

Logic Model – Framing the Chapter on Support Services

Figure 11 represents the original logic model for work plan activity 5 (Support Services). Revisiting the logic model helps frame this chapter. Following the logic model, Table 23 shows the original budget allocation for this work plan activity, as well as each institution's percentage of effort towards this activity (out of all 8 activities).

Figure 11: Logic Model for Work Plan Activity 5: Support Services

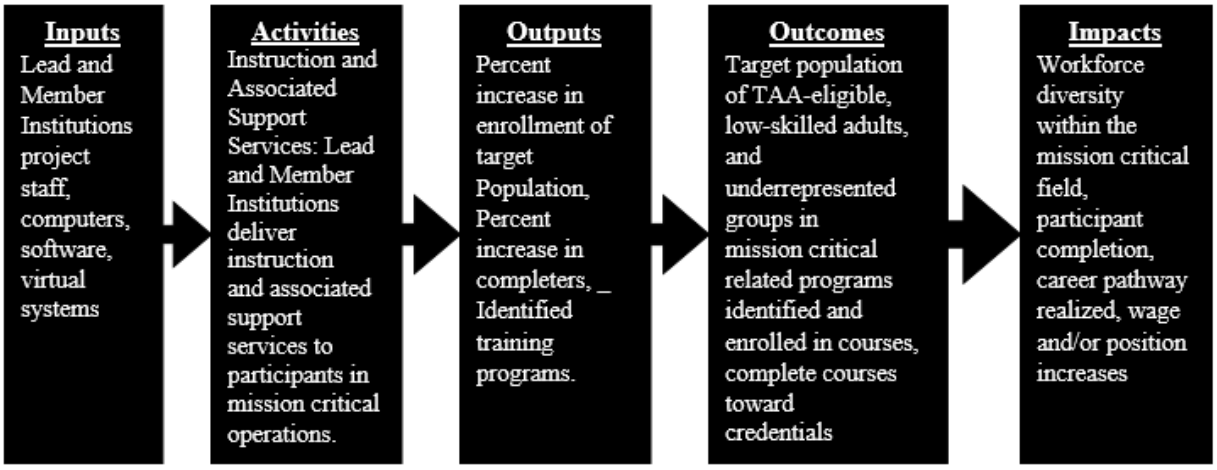


Table 23: Work Plan Activity 5 Effort Distribution

Work Plan Activity 5: Support Services *21.77% of Total Planned MCO Budget*	
MCO Partner Institution	**Percent of Institutional Total Effort for this Work Plan Activity**
Cleveland CC	9.22%
Wake Tech CC	31.67%
Nash CC	40.92%
Southern Regional TC	61.10%
UNC Charlotte	0.00%

Literature Review

Advising and student support services have evolved a great deal in the past few decades as more and more studies have been published on the topic of support services and how they are related to positive student outcomes. While some research has shown positive results of increased advising support, some community colleges report counselor-to-student ratios as high as 1 to 1,000 (Baker, 2016). The increased focus on advising has not been widespread, partially due to a shortage in funding that supports these types of support positions. Studies have shown that students generally have a positive perception of their academic program experience, but a more negative perception of the support services they are offered (e.g. career support, academic support, personal support); these findings are important to consider if there is in fact a linkage between positive perception (satisfaction) of advising and support services and student success outcomes such as retention and on-time graduation (Braun & Zolfagharian, 2016). Having a shortage of advisors impacts the level of personal connection with the students, but programs like the MCO (and other TAACCCT programs, for instance) have been able to fund support positions through supplementary grant funding in order to equip themselves with an infrastructure of intrusive/intensive advising and mentoring.

With their roles expanding beyond academic planning, and more into personal and career support, student support staff today have a number of different titles such as, success coaches, career mentors, and navigators, to name a few. Staff in these roles are responsible for 'empowering students,' helping them make decisions around their college *and* career pathways (Giani & Fox, 2017). A growing trend in student support services is termed 'intrusive advising,' which is an approach focused on establishing contact with students early in their college careers, and monitoring their progress regularly to help the students navigate through their degree or credential program (Smith, 2007). Intrusive advising is a proactive approach that involves getting to the student as soon as an issue is detected, sometimes through the use of 'early alert systems,' systems that are designed around an institution's learning management system to notify students, faculty, and support staff of issues with absences and performance. Combined with the enhanced personal level of interaction with the student, this intrusive advising approach is said to be a more 'holistic' way of providing advisement (Jones & Hansen, 2014). Smith (2007) noted that many students are aware of their own strengths and weaknesses, and are apt to use support resources if they are aware of their existence. Support services do not necessarily make an immediate-direct impact on the students, rather they refer the student to other resources on campus that are better suited to meet their specific needs (Jones & Hansen, 2014).

The literature shows that although positive results have been observed through an increased focus on advising and other student support services, traditional funding shortages make it difficult for many colleges to invest in these services without supplementing through outside resources. Intrusive advising is discussed as a more 'holistic' approach to advisement, but building awareness of student support services tends to be one of the bigger issues to address, ensuring the students know about the services available to them. These are several points to note

when reading through the process evaluation for the Support Services work plan activity. Although sample size was limited for this report, there has been evidence reported linking positive student perceptions of support services and their overall success in college. Some data will be explored in Section V related to the usage of support services and linkages to success metrics such as retention and completion.

Process Evaluation

As the original Solicitation for Grant Applications stated, the TAACCCT programs are able to use grant funds to 'expand' and 'improve' student services that 'support the goals of the grant' (Round 3 TAACCCT SGA, 2013). Each of the MCO community college partners took advantage of the opportunity to expand support services for the MCO participants, partly because the disciplines that were focused on as part of the MCO program were disciplines with high turnover / low success rates. Support services extended beyond the student's' academic needs, preparing them for gainful employment as well. Interactions between students and support services were supposed to be tracked closely at each of the partner colleges. Well-maintained records of student-level support service data contributed to the outcomes analysis as part of the evaluation. Institutions who did not keep track of these interactions will be noted in the limitations section. The following list contains the various types of support services offered by the MCO partner institutions as part of the TAACCCT grant:

- ***Advising and Counseling:*** MCO students were provided access to a Success Coach (some partners termed this position as 'Recruiter/Retention Specialist') to help with academic, personal, and career planning issues. Examples of the type of support students received include program major and course selection in regards to sequencing, assistance connecting with work based learning and employment opportunities, resume help, assistance preparing 4-year college applications, and referrals to departments on campus to assist with personal counseling. Other resources that the Success Coach might refer a student to include services developed or enhanced by TAACCCT funds, such as the MCO Digital Study and Digital Learn platforms (see below). MCO staff reported that the intended and intrusive advising approach has been viewed positively by students, with 60% of MCO participants responding to a survey indicating they were 'very satisfied' with the MCO support staff. If students are having difficulty in a course, the early alert tracking via intrusive advising helps student support staff target students who are in need of academic interventions in a timely manner. This close monitoring of the students' performance allows for earlier remediation during the semester.

> *"...probably the biggest help is the Success Coach having that one-on-one attention and you know, somebody that wants to make sure that they have everything in order so that they can be successful in their college journey." – MCO Administrator*
>
> *'My MCO / Success coach has been absolutely incredible with helping me with courses and providing me guidance throughout my semesters at Cleveland Community College.' - MCO Student*
>
> *"The Success Coach works with people on advising, registration, helping them with the graduation applications, and then just kind of general, being kind of a go-to person to connect them with other campus resources.' – MCO Faculty*

- ***Tutoring:*** Tutoring was made available across each of the MCO consortium colleges through multiple methods (several of which were established prior to the funding of the grant). The MCO grant afforded the impacted programs to offer tutoring in new and different ways through online resources such as MCO Digital Study and MCO Digital Learn. MCO Digital Study (http://study.ncmco.us) is a collection of interactive resources that students access for self-study resources such as flashcards, videos, and simulations. The MCO Digital Learn platform is an interactive approach to digital tutoring. MCO Digital Learn was designed as a platform for students, instructors, and SMEs to interact with one another in a Q&A/discussion forum-style resource. Students access the site and post questions about a particular course or concept, then their question is tagged, either by the student or by a site administrator. A notice is then sent to faculty and relevant SME volunteers from industry. The SME/faculty are then prompted to answer the student's question, and a discussion board feature allows other students and SMEs to participate in the conversation as well - also tracking which questions have already been answered. The measure of success for this model was to have all student questions answered by an SME within 48 hours of the original posting, which was achieved during the grant period while this resource was available (Years 3-4). Although the MCO Digital Study and MCO Digital Learn platforms were not able to track student usage on an individual level, the colleges using these platforms will be able to keep track of overall metrics for total website traffic in a given period of time.
- ***Assessment Preparation and Administration:*** Assistance with career-based assessments such as certification examinations and pre-employment screenings was provided to MCO participants as well - often by the Success Coach. One of the most commonly noted certification tests across the NC MCO partners was the North Carolina Career Readiness Certificate (CRC), which is a certificate put in place to show potential employers that the applicant has the required workplace skills to be successful. Prospective employees

receiving a passing score level on the CRC (either bronze, silver, or gold) is a pre-employment screening criterion for many employers in MCO-related fields. Third-party credentials were also among the types of assessments that the MCO students received help with, including preparation for (formal and informal) and administration of the assessments.

Several other means of supporting and recruiting students include: Wake Tech CC presentations to underemployed and unemployed potential students and creation of marketing collateral on the benefits of Mission Critical Operations careers; Wake Tech CC and Cleveland CC connected with their local area workforce development boards to add the MCO degree program to their list of credential options for the clients they serve; Cleveland CC's work with FIRST North Carolina (a state-level non-profit organization engaging students in robotics competitions with a goal of impacting STEM degree/career pathway interest of the youth participants); Cleveland CC's work with the Carolinas Chapter of the 7x24 Exchange Carolinas (a professional networking group focused on MCO) to launch a "Women in Mission Critical Operations" initiative with a goal of enhancing women and underrepresented enrollment in the program; Nash CC's work to engage underrepresented groups through presentations at the local workforce development office; and, broad participation by the partners in campus events (e.g. open house, registration events, tours). Lastly, in Year 4 of the grant, Wake Tech CC put on a Mini Maker Faire as an opportunity to build awareness of the MCO program (see Appendix D for flier). The Mini Maker Faire included several guest speakers, including a Women in STEM panel, including three mission critical-specific managers. Tours will also be provided of the Wake Tech CC MCO telepresence lab environment that was

funded by the grant.

Outputs

Table 24: Summary of Final Status / Outputs for Student Support

Task	Final Status / Comments
Activity #5: ***Instruction and Associated Support Services*** Lead and MCO college partners deliver instruction and associated support services to participants in mission critical operations.	
1. Evaluate evidence-based design models and create timeline for implementation	**Output**: A TEMOA rubric was selected as the evidence based design model to be used for the development of OER content. **Comments**: None.
2. Implement Basic Skills Plus for participants without a high school diploma	**Output**: Several of the partners were able to fully implement Basic Skills Plus to accommodate students without a high school diploma. A similar, but slightly different model was used in Georgia for Southern Regional TC. **Comments**: None.
3. Implement RAMP Plus	**Output**: Through renovations and equipment purchases, the partners were able to utilize RAMP and NETLABS for the telepresence component. These systems are continually being adapted to add additional functionality / equipment over time. **Comments**: This was a highly collaborative effort among all partners.
4. Digitize MCO resources to create a virtual, digital tutor	**Output**: MCO Digital Learn and Digital Study were two platforms created as part of the grant to address this work plan task. The Digital Study environment was the tutoring component, and the Digital Learn environment included the SME involvement with a forum-style approach to Q&A. **Comments**: None.

5. Target course offerings to underrepresented groups	**Output**: There were multiple efforts leading up to this activity. Cleveland CC worked with a Department of Ed. TRiO program to identify URM students as well as a local chapter of the 7x24 exchange. Wake Tech CC worked with the Minority Male Mentoring initiative (a statewide initiative at each college). All NC partners worked with local workforce development offices to establish a referral process for recruiting URM students. **Comments**: None.
6. Integrate MCO in entrepreneurship courses	**Output**: This activity was eventually eliminated. Originally it was changed to incorporate entrepreneurship into MCO courses, but was later addressed by a MOOC that Wake Tech CC is still in the process of launching around entrepreneurship. **Comments**: None.
7. Confirm work-based learning opportunities, develop strategic plan for participants	**Output**: Work based learning opportunities were offered to MCO participants – the success coaches and workforce development coordinators at the partner schools facilitated conversation between employers and the program to enhance the WBL pipeline. It was noted that a larger effort around Certified Career Pathways for Advanced Manufacturing will include MCO, and will have a WBL component built in for future students to benefit from. **Comments**: None.

Strengths and Challenges

Table 25: Strengths and Challenges for Student Support

Strength / Challenge	Description
Strength	At Cleveland CC, the Digital Study/Learn platform is expected to reach non-MCO courses in the future.
	Student survey respondents, overall at all partner colleges, indicated that the support they received has helped them in their career.

	The Success Coach model has been expanded at Cleveland CC (through resources leveraged by another grant) and will impact all students at the college.
	SMEs have participated in the Digital Learn platform on a voluntary basis. A mentoring program was also created by Cleveland CC to expand the depth of interactions between students at SMEs in local industry.
Challenge	Some of the MCO partners were diligent in tracking student interactions with support services, but others did not have ready-access to these records for the outcomes analysis.
	At Cleveland CC, over 90% of student respondents to a survey about support services indicated meeting with support staff in the last year (one or more times). A lower percentage of respondents from the other partner colleges indicated having met with an, 'MCO support staff member.' This could mean that the creation of the MCO degree program has an impact on how resources such as the Success Coach are communicated to students. The respondents from the other colleges may have met with support staff, but 'MCO support staff' may have been an unfamiliar term.

13. Work Plan Activity 6: Scorecard

Logic Model – Framing the Chapter on Scorecard

Figure 12 represents the original logic model for work plan activity 6 (Scorecard). Revisiting the logic model helps frame this chapter. Following the logic model, Table 26 shows the original budget allocation for this work plan activity, as well as each institution's percentage of effort towards this activity (out of all 8 activities).

Figure 12: Logic Model for Work Plan Activity 6: Scorecard

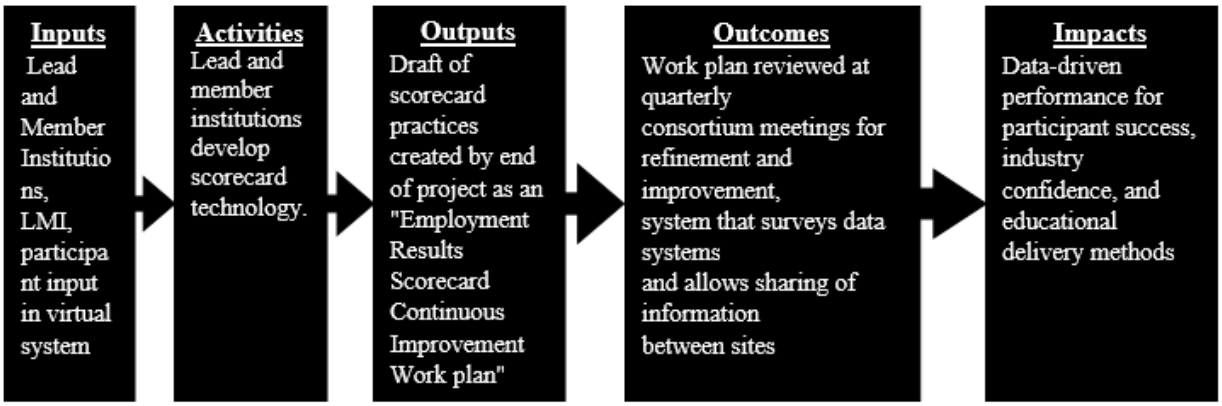


Table 26: Work Plan Activity 6 Effort Distribution

Work Plan Activity 6: Scorecard *2.93% of Total Planned MCO Budget*	
MCO Partner Institution	**Percent of Institutional Total Effort for this Work Plan Activity**
Cleveland CC	3.31%
Wake Tech CC	2.02%
Nash CC	1.46%
Southern Regional TC	0.03%
UNC Charlotte	9.44%

Literature Review

The Scorecard aspect of the MCO grant pertains to a mechanism by which colleges and college programs can be ranked and compared by students. The measures used to evaluate colleges are performance based, with employment results of graduates as a key outcome metric. The TAACCCT SGA stated these scorecards should provide "key information on the employment outcomes of graduates of these programs of study to determine whether these programs of study may be appropriate for their career goals" (Round 3 TAACCCT SGA, 2013). With the rise of private for-profit colleges, and a myriad of other training options for prospective learners, reputation and performance outcomes are very important. The diversion of resources towards activities that enhance institutional reputation may actually detract from the quality and

performance of educational activities that are likely to be of most interest to potential students and their families (Locke, 2014). It was also noted by Locke (2014) that one drawback to these ranking systems is that they do not include qualitative data from the student perspective. A shifting focus toward internal evaluation capacity, third-party reviews, and the voice of the customer (students) are additional factors to consider with continuous improvement and quality in mind (Kettunen,2010). Ranking systems for colleges and programs can serve as a tool to make complex comparative information more 'digestible' by non-experts.

Although limited, the literature explains the importance of presenting data and information to students to support their decision making process of colleges and degree programs. One of the drawbacks noted was around the focus of many scorecards and/or ranking systems. Typically these tools focus on quantitative data, which is often much easier for institutions to collect and report on. What is missing is a focus on qualitative data from the students that provides another dimension of data, directly from the student perspective. There has been some qualitative data collection as a part of the evaluation and other grant activities, but this is a possible area of exploration in future planning for implementing the scorecard system for MCO colleges.

Process Evaluation

Being a consortium grant program rather than a single institution program, the MCO was not required to fully implement a scorecard, rather it was required to develop a plan to implement a scorecard, which was completed early in the grant. Initially, Cleveland CC planned to use a set of established performance measures that are tracked by the North Carolina Community College System and reported annually. In Year 1, Cleveland CC worked with Southern Regional TC (then Moultrie Technical College) to review the scorecard developed by

the Technical College System of Georgia. Input and guidance were sought from the College System of Georgia into the development process used to create their scorecard. With help from the NC community college partners, Cleveland CC continued to design and develop what the MCO scorecard would look like and specific measures to include. Cleveland CC had a series of meetings with the North Carolina Community College System office and attended workshops on the, then new, NCTOWER reporting system, which is now North Carolina's main tool for measuring Workforce and Education program performance.

One shortfall of the NCTOWER system (and data collection for the evaluation's outcomes analysis) was the collection of employment data after the program participants exited the program. Although the plan for developing a scorecard was set early in the grant period, throughout the life of the grant, the MCO program was faced with obstacles obtaining an MOU with the NC Department of Commerce to enable wage data collection that would make the scorecard aspect of the program complete. By the end of the grant, the consortium did decide on using NCTOWER as the primary source of scorecard data for the partnering NC community colleges, despite the shortcomings the system has in presenting the level of employment wage and retention data required by the scorecard.

Outputs

Table 27: Summary of Final Status / Outputs for Scorecard

Task	Final Status / Comments
Activity #6: ***Scorecard*** Lead and MCO college partners develop scorecard technology.	
1. Develop employment results scorecard work plan	**Output**: The employment results scorecard work plan was completed in Year 1 of the grant. **Comments**: None.
2. Update and revise scorecard work plan each quarter	**Output**: Feedback was solicited by MCO partner colleges. The NC community college system office developed an MOU with NC Commerce, but did not include the MCO / DoL grantees in the state so the level of wage/employment data needed is not available. **Comments**: Although the MCO partner colleges worked diligently towards a solution via NC Commerce, they were not able to get the level of wage / employment data needed for reporting.
3. Identify virtual system or developer for scorecard technology	**Output**: For NC colleges in the MCO consortium, NCTOWER (state-level workforce and education outcomes reporting platform) was chosen as the scorecard technology. The Technical College System of Georgia already had a scorecard tool developed that will be used by Southern Regional TC. **Comments**: None.
4. Develop scorecard technology	**Output**: This was not a requirement of Round 3 grantees, but the NCTOWER system is functional and prospective students can use this tool to look at data for NC community colleges in order to choose a program/major. **Comments**: None.

Strengths and Challenges

Table 28: Strengths and Challenges for Scorecard

Strength / Challenge	Description
Strength	The lead institution, with participation from the partners, was persistent in their efforts to negotiate employment results into the scorecard solution. Although these data were not able to be integrated, an existing system was identified to be used for the NC partner college's scorecards.
	The Technical College System of Georgia had a scorecard already implemented and was able to serve as a model approach for the early planning efforts towards this activity.
Challenge	Although the partners worked diligently towards including employment results in the scorecard, data remained difficult to integrate into the scorecard solution. While the scorecard includes the required elements for employment data set forth for single-state consortia, the current system for NC does not include employment data beyond 2012. Organizations overseeing this system should work towards updating this information to be used by prospective students and other stakeholders (e.g. employers).

14. Work Plan Activity 7: Telepresence

Logic Model – Framing the Chapter on Telepresence

Figure 13 represents the original logic model for work plan activity 7 (Telepresence). Revisiting the logic model helps frame this chapter. Following the logic model, Table 29 shows the original budget allocation for this work plan activity, as well as each institution's percentage of effort towards this activity (out of all 8 activities).

Figure 13: Logic Model for Work Plan Activity 7: Telepresence

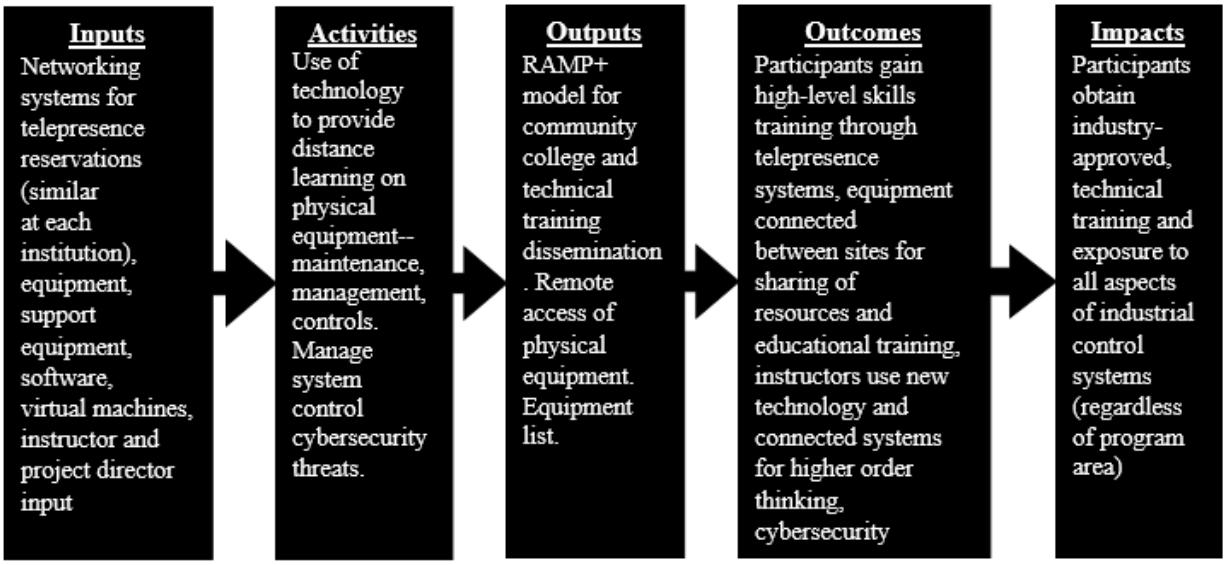


Table 29: Work Plan Activity 7 Effort Distribution

Work Plan Activity 7: Telepresence *28.42% of Total Planned MCO Budget*	
MCO Partner Institution	**Percent of Institutional Total Effort for this Work Plan Activity**
Cleveland CC	28.58%
Wake Tech CC	19.08%
Nash CC	49.16%
Southern Regional TC	24.21%
UNC Charlotte	19.03%

Literature Review

Marvin Minsky was the first to coin the term "telepresence," defined as the ability for an operator (student) to control aspects of a remote machine as if the operator were there controlling the machine physically (Beck, Kunert, Kulik, and Froehlich, 2013). Nalamwar, Kalhapure, Khatake, Gandhi, & Jain (2016) provide another definition of telepresence as "a set of technical methods which allows a person to feel as if he or she is present at a place other than his or her true location." The MCO partner colleges were involved in implementing physical machine

environments (e.g. water treatment, robotic arms/mechatronics) where students accessed and manipulated the machine environment remotely from anywhere with a high speed internet connection. These ‘fully immersive’ educational experiences have been shown to increase the participants’ feelings of their own capability and confidence performing new tasks, particularly as related to handling mission critical (potentially hazardous) situations (Higgins, 2017).

Practitioners in higher education have learned about what telepresence can offer in regards to simulated learning experiences. Several applications of telepresence in a learning environment are geological mapping, oceanography, oil/gas, emergency and disaster response, and robotics/co-robotics. The first ‘telepresence - enabled’ educational project was in 1989 (McIntyre & Stephens, 2016), so the application of this technology is not necessarily new to academia, but it is receiving more credibility as the capabilities of networked computing has accelerated and made virtual learning more feasible. With the MCO program in mind, high speed networks have allowed institutional collaboration of learning techniques and objects (Giraldo, Jiménez, Trefftz, Restrepo, & Esteban, 2010). Industry has also caught on to the benefits of using telepresence and other augmented or virtual reality systems for training purposes. From the industry perspective, these technologies have become increasingly popular in measuring and validating their employees’ skills - as a way of conducting quality assurance checks of the entering, and existing, workforce (Higgins, 2017). The real-time interactions that are involved with telepresence can be very helpful in teaching ‘complicated topics’ to learners (Smith & Louwagie, 2017). As hands-on experiential learning is often the most appropriate teaching style for advanced technical topics, telepresence an effective tool to allow the instructor to observe and interact with the students in a real-time virtual environment. From both an academic and industry perspective, telepresence offers a greater return on investment for the employers

because the student is experiencing and validating their skills in practice rather than theory (Higgins, 2017).

The literature around Telepresence helps to frame the history of the term and applications in academia and industry. The benefits of using a telepresence approach is to increase access to real-time hands on learning experiences for students who are participating at a distance as well as supplementing coursework for students on campus. Importance was also placed on the networks and technological infrastructure that enables this type of learning. This will frame the majority of process evaluation discussions around telepresence in the following section.

Process Evaluation

Cleveland CC led early conversations with the consortium partners around a prioritized list of telepresence equipment that would be brought online, including an acquisition plan for hardware and software. Telepresence labs were developed or expanded by each of the partner colleges to give students the ability to remotely access physical lab environments for course assignments. Telepresence labs enabled students to receive hands-on experiences through virtual interactions with equipment. Grant funding supported the development and enhancement of telepresence environments that allow content and experiential learning to be made available to students from anywhere via an internet connection. Technology acquired through the grant has also enabled a cross-disciplinary approach that has allowed the partner colleges the ability to maximize how their lab resources are used. Cleveland CC was able to track the total number of hours in telepresence labs since the start of the grant

> *"with the MCO funding, we have been able to buy equipment that extends across the campus and works within seven specific areas that we said it would, so it is enhancing what we are already doing. We have been able to offer classes and teachings that we would not have been able to do without the enhancement from the MCO grant." - MCO Administrator*

> *"…what they're (students) are learning to do in the classroom … they'll do in the workplace because you're not always going to be able to sit there next to the device you're working on. So they need to be able to access the material… through remoting in…" - MCO Instructor*

activity in Fall 2013; total usage neared 5,000 hours (~4,887 total student lab hours).

While the consortium initially agreed that the eRAMP system proposed by UNC Charlotte was the best solution for the telepresence system, it later became evident that eRAMP was not a viable option due to the planned implementation schedule. Cleveland CC, working with the other consortium partners, identified other viable telepresence systems that would work across the consortium, landing on a combination of Netlabs and RAMP systems. UNC Charlotte was a key partner in telepresence discussions, and configured their lab on a Virtual Computer Laboratory framework. UNC Charlotte's Automated Manufacturing Cell is a testing site for networked manufacturing systems, including a desktop CNC, a laser cutter/engraver, and two 3D printers. The alpha and beta versions of the UNC Charlotte telepresence system were tested in face-to-face and online environments, and were demonstrated at an IEEE Conference in Year 3 of the grant.

Outputs

Table 30: Summary of Final Status / Outputs for Telepresence

Task	Final Status / Comments
Activity #7: ***Telepresence*** **-** Use of technology to provide distance learning on physical equipment, maintenance, management, integration, and cybersecurity threats.	
1. Inventory existing equipment and IT infrastructure	**Output**: The inventory of equipment and infrastructure was complete in Year 1 of the grant. **Comments**: None.
2. Establish protocol for renovation and complete renovation (add network drops, etc.)	**Output**: Renovations were eventually completed by the end of Year 3 of the grant. **Comments**: As noted in the QNPRs to DOL, there were delays at the state and DOL levels that impacted the renovation timeline for the partners.
3. Procure equipment using each member's procurement standard	**Output**: Equipment purchases were completed by the end of the grant, although several modifications were submitted to DOL during the grant period. Examples of equipment purchased include: servers, computers, netbooks, cameras, telepresence equipment (misc.), and generators. **Comments**: This process was completed as planned, but delays in the approval of budget modifications impacted the anticipated timeline for procuring equipment.
4. Integrate equipment with software and IT network infrastructure	**Output**: A long process resulting in integrated equipment at each of the participating partner sites. As part of the renovations, infrastructure issues were resolved and the new IT environments were made compatible with the campus' infrastructure. Wake Tech CC is still working on finalizing the integration of

	telepresence equipment, awaiting a software release that will enhance the overall user experience. **Comments**: Cleveland CC has been instrumental in this process as a coordinator and mentor to the other colleges, assisting with the installation and integration activities of the new equipment.
5. Place telepresence in MCO courses/course components	**Output**: Telepresence systems are being used by all partners except for Wake Tech CC as they are awaiting the final integration of the telepresence system (noted above). Telepresence is being used in as many MCO related enhanced / new courses as possible at the partner sites. **Comments**: None.

Strengths and Challenges

Table 31: Strengths and Challenges for Telepresence

Strength / Challenge	Description
Strength	Although implementation was delayed by issues with purchasing approvals and budget modifications, the partners worked closely together to implement their telepresence systems, learning from one another and sharing best practices.
	Cleveland CC played a key leadership role in the telepresence planning and implementation processes by working directly with each of the partners on the setup and configuration of their telepresence systems.
Challenge	There were several challenges that partners faced related to delays in approval of budget modifications by DOL, resulting in purchasing, renovation, and installation setbacks.

	Several partners noted a gap in the development of lab materials and sought contractual support to supplement this activity.

15. Work Plan Activity 8: Evaluation and Performance Tracking

Logic Model – Framing the Chapter on Evaluation and Performance Tracking

Figure 14 represents the original logic model for work plan activity 8 (Evaluation and Performance Tracking). Revisiting the logic model helps frame this chapter. Following the logic model, Table 32 shows the original budget allocation for this work plan activity, as well as each institution's percentage of effort towards this activity (out of all 8 activities).

Figure 14: Logic Model for Work Plan Activity 8: Evaluation and Performance Tracking

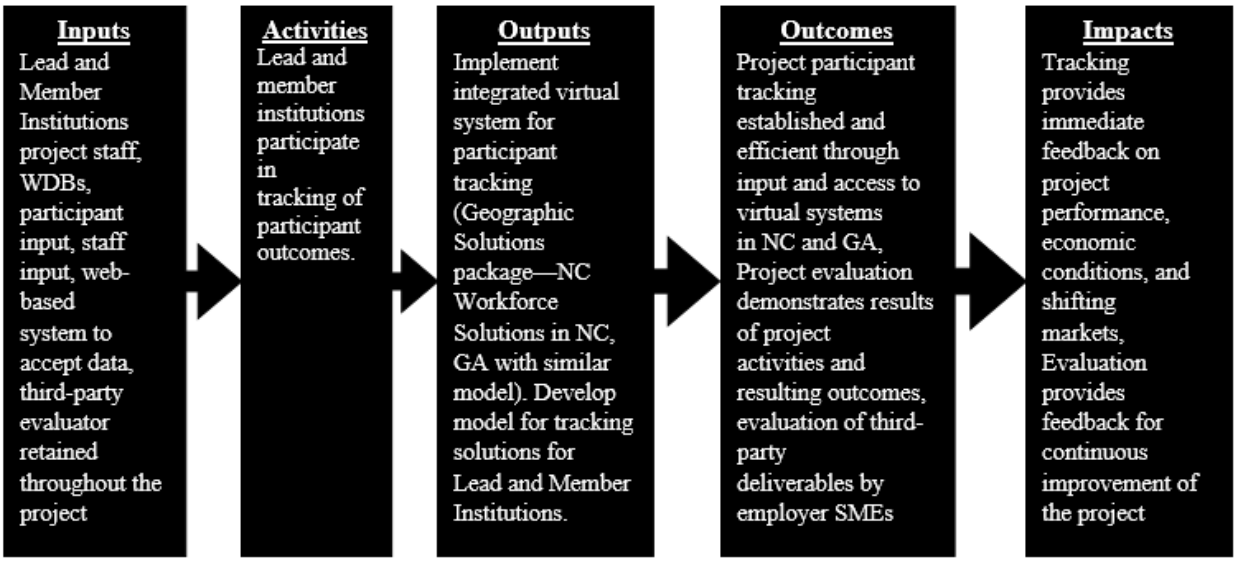


Table 32: Work Plan Activity 8 Effort Distribution

Work Plan Activity 8: Project Tracking and Evaluation *13.35% of Total Planned MCO Budget*	
MCO Partner Institution	**Percent of Institutional Total Effort for this Work Plan Activity**
Cleveland CC	18.90%
Wake Tech CC	6.59%
Nash CC	1.44%
Southern Regional TC	8.03%
UNC Charlotte	9.44%

Literature Review

When grant projects are focused solely on fulfilling a compliance obligation, there is a missed opportunity for learning and continuous improvement that can be realized through formative (process) and summative (outcomes) evaluation (Haeffele, Hood, & Feldmann, 2011). Evaluation is a contributor to the ongoing learning and improvement process during a grant project that involves reporting on objective observations through systematic and reflective inquiry around the assessment of a specific program or policy (Mattessich, 2012). Often described as a 'summative endeavor,' Picciotto (2012) noted that the evaluation of policies and programs ultimately report on how well the Principal Investigator ('authorities who were in charge') made good use of the funds in manner consistent with the mission of the grant program. Program evaluation efforts have grown significantly over the past decade. Prior to 2004, a steady rate of 20 or fewer evaluation studies were published per year, and in 2012, there were over 120 studies published around program evaluations (White, 2014).

When considering evaluation in a broad sense, Picciotto (2014) made note of several core tenets of evaluating programs that should be considered in preparation for an evaluation study: 1) the *merit* of the study, as related to the evaluation plan and the 'stakeholder's aspirations' (e.g.

objective feedback, continuous improvement, validation of progress towards the stated activities); 2) the *relevance* of the study, as it relates to the specific focus areas of the evaluation on outcomes and intervention activities that have an impact on the 'beneficiaries' (program participants) being evaluated; 3) the *worth* of the study, referring to an assessment of the legitimacy of the program activities, grounded by qualitative evidence from the participants; 4) the *efficacy* of the study, in relation to the project objectives that were achieved (as well as those that were not), taking into account the 'relative importance' of each; 5) the *value* that the study brings to the various project stakeholders, with their various perspectives in mind; and lastly, 6) the *efficiency* of the study, related to the assessment of project inputs and how easily they were converted to results. Establishing collaborative relationships with evaluation experts can be very beneficial to the program being evaluated, using the regular input and feedback of the evaluator as a means of steering and legitimizing a program, which is, often related to innovating and further developing the program to its fullest (Niiranen, 2008).

The process of generating evaluation information for different consumers is a difficult one (Niiranen, 2008), but evaluation experts know how to apply advanced assessment tools and analysis procedures in order to be able to synthesize the impact of the program in simple enough way to communicate with the project stakeholders. When effective, this process of continuous feedback through evaluation allows the agency or institution being evaluated the opportunity to use the evaluation results (e.g. reports) in the preparation of regular reporting to the funder (Roggow, 2014). Effective evaluation also imparts some of the evaluative knowledge onto the stakeholders being evaluated, which builds internal evaluation capacity. This process must be both intentional and continuous in order to sustain internal evaluation processes that support continuous improvement of a program (Haeffele, Hood, & Feldmann, 2011). When multiple

stakeholders of a program are involved, the evaluation will take into account each of the partners' responsibilities and obligations that must be fulfilled by the end of the program (Picciotto, 2014). It is also important to note that the evaluator is a stakeholder in the program being evaluated. Although not the primary stakeholder, in an evaluation, the reputation, credibility, and integrity of the evaluator is on the line (Mattessich, 2012).

Evaluation and Performance Tracking is an important practice related to program evaluation. The literature makes note of one of evaluation's core focus areas, continuous improvement, as well as the importance of providing a report out on the project's fidelity to the stated activities in the program work plan. Fidelity to the work plan includes project partners. This was noted because of the consortium partnership of NCMCO (National Consortium for Mission Critical Operations). Internal evaluation capacity carries a significant importance to sustaining evaluation activities beyond the program evaluation period. Evaluators must also be able to communicate, and grantees must be able to understand, the *merit, relevance, worth, efficacy, value, and efficiency* of the evaluation, as noted in the literature. These are several key points that will inform the focus of the process evaluation for the Evaluation and Performance Tracking work plan activity.

Process Evaluation

The Evaluation and Performance Tracking activity has been a major focus area of the grant activity from the onset. A kickoff meeting was held in Year 1 that included the evaluation team and the project partners. The goal of the kickoff was to operationalize the detailed evaluation plan and set expectations for the evaluation for the upcoming grant years. At the end of each grant year the evaluation team prepared official interim evaluation reports (Years 1-3) and this report, a final evaluation report, at the end of Year 4. The development of the evaluation

reports required a coordinated effort by the evaluator and each of the partners in the scheduling of site visits, phone calls, data collection, and observations of the project team meetings. During the first two years of the grant the main focus of the evaluation reports was on the formative evaluation, which recorded and reporting on the status of implementing the project work plan, as stated in the grant proposal. Apart from reporting on progress, the evaluation reports also served as a means of communicating objective feedback on the strengths and challenges faced by the partners in the implementation.

Beginning in the end of Year 2, the evaluation team increased its focus on data collection related to the outcomes analysis portion of the evaluation. Several conversations took place early in the grant period that fed into these discussions, one to note being the decision around defining MCO participants, which helped define the scope of data that would be requested from the institutions for the analysis. Although conversations were held mid-way through the grant regarding specific data elements, the receipt of files that contained the necessary data for analysis was ongoing through the middle of Year 4. Some partners were able to easily extract the data from their systems, and others had challenges communicating with the appropriate parties at their respective institutions to gather this data, resulting in partial or incomplete data sets. More on the limitations of the outcomes analysis is described in Section V.

Apart from the discussions that were held with the project partners on a regular basis to understand their contributions and progress towards implementing the work plan, the evaluator also engaged the employer partners and the university partner (UNC Charlotte) in discussions around their interactions with the MCO project team. In Year 4, an agreement was made on a survey tool to get feedback from students, and a process for deploying the tool at each of the partner institutions. 54 students responded to the survey from 3 of the project partners. The

responses provided insight into how the MCO program was communicated at the student-level since the program was both focused on building an MCO degree program, as well as enhancing existing courses with MCO content. Each of these activities had a slightly different impact on how the students viewed and understood MCO, which is good information to note for future programs that have a similar goal.

The third-party evaluation is one component of this activity, while the performance tracking was another that was largely focused on in the first two years of the grant. Performance tracking relates to how the institutions collected and reported data to the lead institution, then in turn to DOL. As mentioned before, the consortium was faced with an initial decision of how to count students as 'MCO participants.' Without a clear definition of this from the onset, the numbers being reported were at risk of being incomparable. Cleveland CC established a process by which the partner institutions reported their quarterly narrative updates on-time as well as the data to show progress towards the project objective measures. As a result of a desk-review conducted by the evaluation team, Cleveland CC also implemented a process for monitoring the fiscal performance of each of the partners in relation to spend-down of grant funds. Initially this was thought to be outside of the scope of their responsibility, but was later referred to by the evaluator in the SGA as an allowable activity. Although some of the partners continued to have trouble spending down the grant funds as planned, this helped open discussions around pooling and leveraging resources for the common-good of the program (e.g. funds for contracting content development). Outside of the third-party evaluation, it is also important to note that the partners also participated in national evaluation activities upon request.

Outputs

Table 33: Summary of Final Status / Outputs for Tracking and Evaluation

Task	Final Status / Comments
Activity #8: ***Tracking and Evaluation*** **-** Lead and MCO college partners participate in tracking of participant outcomes.	
1. Implement tracking system; led by Cleveland and Region C WDB	**Output**: Cleveland CC and Southern Regional TC were the first to define a tracking mechanism. Since the NC partner community colleges use the same system, Cleveland CC worked with them to outline how to track data for reporting / evaluation purposes. **Comments**: None.
2. Create and launch web portal	**Output**: A website was developed early in the grant (http://www.ncmco.us/) and updated throughout the life of the grant. **Comments**: None.
3. Submit quarterly reports to DOL using tracking system	**Output**: QNPRs submitted on-time. **Comments**: None.
4. Third-party evaluation of deliverables of the project matched to project work plan	**Output**: Third-party evaluation was conducted from two fronts – the third-party evaluator led evaluation of deliverables throughout the grant and reported regularly to the consortium with strengths/opportunities for improvement. SMEs were also involved in evaluating the deliverables when they were content-related. **Comments**: The consortium partners, led by Cleveland CC, were quick to respond to evaluation report findings and implement corrective actions when necessary.

5. Evaluation of project outcome measures and project work plan	**Output**: Project work plan has been evaluated in Years 1-4 (particular focus given in Years 1-3), and outcome evaluation is part of this report. Refer to Section V for more detail on the hypothesis test results related to participant outcomes and impact of the program. **Comments**: None.
6. Participate in national evaluation	**Output**: The consortium partners and evaluator have participated in several webinars related to the close-out of the grant. The MCO partners completed the national survey that was sent out in Year 4 of the grant – awaiting further details or needs by DOL and the national evaluator related to this activity. **Comments**: None.

Strengths and Challenges

Table 34: Strengths and Challenges for Tracking and Evaluation

Strength / Challenge	Description
Strength	All grant partners were eager to participate in the evaluation activities and were very helpful in coordinating meetings and site visits with the evaluator.
	The lead institution worked with the partners to discuss corrective actions related to the opportunities for improvement identified in the evaluation reports.
Challenge	The program partners faced challenges throughout the grant period working with the workforce system on aligning education and employment related data for outcomes analysis. This was never resolved, but Cleveland CC continues conversations with the NC Department of Commerce on incorporating employment results into the scorecard (NCTOWER).
	It was recommended that the consortium develop a series of technical materials to address consistent data collection. For the APR data reporting this was successful, but in regards to

	consistent transmission of participant data for the evaluation data analysis there was not a consistent approach. Although the evaluation team provided a data template to each of the partners, the level and quality of data received at the end of the grant was delivered late by multiple partners, and inconsistent at best.
	There was not a systematic way by which student support service data was tracked at each of the partner colleges - where there was a student support staff member in place. Cleveland CC and Nash CC were the only colleges to provide a comprehensive listing of student support interactions to the evaluation team.

16. Addressing Implementation / Process Research Questions

Responses to the process evaluation research questions are provided in this chapter, and are partially based on direct observations by the Evaluation Team of program activity, as well as review of pertinent documents. Complementing these sources of evaluation information were the multiple focus groups and interviews conducted with MCO staff and others, as discussed in the previous Work-Plan-Activity-focused chapters.

The information gathered from the focus groups and interviews provided an important perspective contributing to the process evaluation. Therefore, in order to provide some background for this data source, the number of phrases contributed by each respondent to a content category is provided in Table 25 to reflect the degree of representation each functional perspective (administrator, manager, specialist, student support, faculty) had in the generation of the qualitative data analyzed. This information served as a quality-check to ensure that while information was sought from multiple perspectives, adequate attention was paid to input from perspectives expected to be most familiar with the particular issue being discussed.

Table 35: Perspectives providing a basis for answers to Evaluation Research Questions

Evaluation Question	Respondents (Cell contents show the frequency of respondent phrases providing information for a particular evaluation question)				
	Administrators	Managers	Specialists	Faculty	Total
Evaluation Question 1	38	76	46	62	**222**
Evaluation Question 2	2	12	1	18	**33**
Evaluation Question 3	11	14	20	3	**48**
Evaluation Question 4	1	4	3	4	**12**
Evaluation Question 5	4	4	14	3	**25**
Evaluation Question 6	27	38	36	24	**125**
Evaluation Question 7	17	7	8	10	**42**
Total	**113**	**168**	**151**	**134**	**566**

Table 36: Answers to Address Process Evaluation Research Questions

Research Question	Research Sub-Questions	Response to Research Question
Evaluation Question 1: ***How was the MCO curriculum created?***	1.1) How was the particular MCO curriculum selected, used, and/or created?	Course materials created or enhanced continue to respond to local employer needs. Course competencies have been informed by job task analyses (JTA's) with input from industry experts, subject matter experts (SMEs), and development contractors throughout the development process.
	1.2) What are the Strengths and Weaknesses of the Course Materials Developed with Grant Funding?	The perceptions of curriculum content continue to vary widely by MCO program role based on the role proximity to core grant planning and operations. Some of the faculty interviewed had a less comprehensive understanding of MCO curriculum development process (design and dissemination).
	1.3) What was the process and the time frame for the development and full implementation of the Mission Critical Operations program?	The MCO A.A.S. program has been implemented at two partner sites (Cleveland CC and Wake Tech CC). Nash CC is choosing to explore a certificate option in response to feedback received by

		their local employer partners on their needs. Instructors at consortium partner sites continue to embed MCO concepts into MCO-related courses.
	1.4) How does the Mission Critical Operations program implementation compare to other programs in the Automation and Computer Information Technology programs?	With the primary support coming from the TAACCCT funding and other leveraged resources, the scale of implementation, especially at sites such as Cleveland CC, Nash CC, and Wake Tech CC, where new facilities were constructed or renovated to support the program, many other similar programs that are being implemented do not have this level of support for equipment and renovation/construction and may take longer to initiate due to the lack of formalized deadlines that, in this case, grant funding provides.
Research Question	**Research Sub-Questions**	**Response to Research Question**
Evaluation Question 2: What delivery methods were offered?	2.1) What percentage of courses were face to face?	Out of the courses reported to the evaluation team as having direct enhancements, expansions, or those that were newly created, **41.38%** were offered **face to face**, **59.32%** were offered as **hybrid**, and **31.04%** were offered **online**, although only 16.95% were offered solely (100%) online.
	2.2) What percentage of courses were hybrid?	
	2.3) What percentage of courses were 100% online?	
	2.4) How do participant outcomes compare between students in face to face, hybrid, and online courses?	Refer to Section V (Evaluation of Participant Outcomes / Impact)
	2.5) Which support services for students and best practices for online course offerings were instrumental in the implementation of the program?	The MCO Digital Tutor (Digital Learn and Digital Study) online resources may be considered a best practice in online / web enhanced courses. The two platforms cover test prep and study tools as well as interaction between students, faculty, and industry SMEs.
	2.6) Which best practices for online course offerings were followed?	The Temoa Open Educational Resources Portal rubric was used to evaluate and improve the OER course materials, and the Quality Matters framework was used at Cleveland CC as a quality and continuous

		improvement standard. After implementing Quality Matters and getting the new MCO courses certified, Cleveland CC adopted the Quality Matters framework for other courses and plans to continue using that framework for online courses.
	2.7) How do participant outcomes compare with students in the Comparison Groups?	Refer to Section V (Evaluation of Participant Outcomes / Impact)
Research Question	**Research Sub-Questions**	**Response to Research Question**
Evaluation Question 3: What support services and other services were offered?	3.1) What support services were made available to students?	As noted in Chapter 12, support services offered to students included intrusive / intensive advising through success coaches and/or recruitment/retention coordinators (names may differ by college). These student support staff were also locating and sharing work based learning and employment opportunities with MCO students.
	3.2) What other services were made available to students?	The telepresence labs and the simulation could be considered additional supports for students, as both enhance the learning experience for distance learners. As mentioned in Chapter 12, the MCO support staff were also instrumental in connecting students with other support resources on campus (e.g. personal counseling, financial aid) as appropriate.
Research Question	**Research Sub-Questions**	**Response to Research Question**
Evaluation Question 4: Were the assessment results useful in determining the appropriate program and course sequence for	4.1) Was an in-depth assessment of participants' abilities, skills, and interests conducted to select participants into the grant program?	Based on preliminary findings from Wake Tech CC in the outcomes analysis (Refer to Chapter 20), the additional, more intensive, student support provided to MCO participants by the support staff led to fewer program changes for MCO participants (as compared to the historical Comparison Group). Fewer program changes suggests that the support services were successful in mapping courses out for students in a way that contributed to
	4.2) What assessment tools and processes were used?	
	4.3) Who conducted the assessment?	

participants?	4.4) How were the assessment results used?	persistent progression through the MCO program.
Research Question	**Research Sub-Questions**	**Response to Research Question**
Evaluation Question 5: Was career guidance provided and if so, through what methods?	5.1) What types of career guidance was provided to students?	The MCO Student Support staff provided assistance with resume writing, identified opportunities (work-based learning and employment), and followed up with work-based learning sites and providing additional support to the students as needed.
	5.2) Through what methods was career guidance provided?	MCO Support Staff reported having both face to face and online interactions with the MCO participants to provide career guidance as well as other support – it often depends on the student's schedule and/or their proximity to campus.
Research Question	**Research Sub-Questions**	**Response to Research Question**
Evaluation Question 6: What contributions did each of the partners make in terms of: (1) program design, (2) curriculum development, (3) recruitment, (4) training, (5) placement, (6) program management, (7) leveraging of resources,	*Note: For the evaluation question and sub-questions regarding partner contributions, partners can be defined as MCO Consortium Partners and/or Employer Partners. This distinction will be noted in the responses below.*	
	6.1) How did partners contribute to the program design?	Program design for MCO included several components for the partners to be involved in. The Employers/SME partners were involved in the initial conversations and development work related to the MCO competency development, which led to high and low-stakes credentials being developed to support the stacked and latticed credential goal of the program. UNC Charlotte worked with the NC community college partners to contribute to the MCO degree program design. Their input was valuable to the transfer articulation goals of the program, and had an influence on how the course sequence / supplemental certifications for transfer students were designed.

and (8) commitment to program sustainability?	6.2) In what ways did partners contribute to curriculum development?	Several MCO colleges reported that some employer partners were heavily engaged in curriculum development activities, including test-writing, textbook writing, and content development. As for the MCO colleges' contributions to curriculum development, some OER material was reported by one of the colleges, but Cleveland CC was the lead in regards to curriculum development.
	6.3) How did partners enhance recruitment efforts?	MCO colleges noted that industry / employer partners contributed to recruitment and enrollment efforts by sending their current employees to MCO and MCO-related courses and programs. Industry organizations that may not be direct employers of MCO graduates also contributed to recruitment efforts through word of mouth efforts to engage other employers.
	6.4) What contribution did partners make to training and development?	Early in the grant, the MCO partners worked with their local workforce development boards to receive training on, and access to, a Virtual OneStop workforce development system. Employer partners contributed to faculty development through tours of facilities – in an environment where technology is changing rapidly, faculty industry experience is important to the relevance of their instruction to students.
	6.5) How did partners contribute to career placement?	The MCO colleges all reported some successful transitions of MCO students to work based learning and career opportunities. Employers contacted the MCO college representatives and the college staff also contacted employers, a two-way communication to enhance career placement of MCO students.
	6.6) How did partners make contributions to program management?	The MCO partner colleges contributed to the overall program management through regular meetings and communications between institutions in support of the grant activities. The industry and employer partners serving on the advisory boards also contributed to program management.

	6.7) In what ways did partners leverage resources?	Resources were leveraged through equipment donations made by industry/employer partners. Some of the MCO colleges were able to secure outside financial support to support the MCO program activity.
	6.8) What best practices were identified contributing to the sustainability of the program?	The main contributing factor to program sustainability was the development and implementation of official MCO degree and certificate programs. Building awareness to contribute to positive enrollment gains will be important factors to consider moving forward for all of the MCO partner colleges who implemented MCO as a credential.
Research Question	**Research Sub-Questions**	**Response to Research Question**
Evaluation Question 7: What factors contributed to partners' involvement or lack of involvement in the program? Which contributions from partners were most critical to the success of the program? Which contributions from partners had less of an impact?	7.1) What reasons were factored into partners' participation or non-participation during the program?	Regarding the original employer partners listed in the grant, the reasons for participating or not participating could be partially attributed to turnover within their own organizations. When the evaluation team followed up with employer partners, several reported not knowing about the MCO program, and that it was their predecessor who was involved with the grant submission. As for the MCO partner colleges, communication challenges that may have, at first, inhibited equal participation from all partners, were addressed later in the grant period. The eventual shift from two project managers to one at the lead institution may have streamlined some of the communications coming from the lead institution. Although at an expense for travel, face to face meetings were found to be more collaborative and team-building in nature. Although Cleveland CC preferred face to face meetings, several partners noted issues with travel authorizations and requested virtual options instead.

	7.2) Which factors of partners' participation were considered to have the least impact on the success of the program?	The process for engaging employer and industry partners was observed in both structured settings (e.g. advisory boards) and unstructured settings (e.g. sporadic communications and requests). When considering the unstructured approach, although these interactions were still impactful to the program, if a more structure process for regularly assessing the climate of local industry was implemented, a greater impact may have been realized through employer feedback as well as level of engagement.
	7.3) What factors of partners' participation were considered the greatest impact on the success of the program?	From the employer and industry partner perspective, their involvement had an impact on the quality of MCO course and credentials and alignment to true industry needs. When considering the MCO partner colleges, attending regular meetings (quarterly consortium or ad-hoc meetings for a specific issue) was a factor of their participation that had a positive impact on the program. Being a consortium grant, the relationships that were built over time were important to the success of the program.

SECTION V – Evaluation of Participant Outcomes / Impact

17. Overview of Methodology for Evaluation of Participant Outcomes/Impact

Purpose

The broad purpose of evaluating the MCO participant outcomes/impact was to gather evidence to determine the value of the MCO program in terms of its effectiveness in achieving specific outcomes stated in the proposal. In determining the value of the MCO program, data were gathered and analyzed in order to investigate the following issues:

- The nine outcomes measures as stated in the proposal submitted to the U.S. Department of Labor, and whether or not those target outcomes were achieved;
- Association between MCO intervention activities and achieved outcomes;
- Detection of any unintended outcomes that bear upon the value of the MCO program.

The Outcomes/Impact Research Questions (as described in the Detailed Evaluation Plan submitted to DOL) shaped the evaluation of participant outcomes/impact. However, additional exploration of the data regarding student characteristics, course delivery, and outcomes measures was also performed. This additional exploration was performed not necessarily to help evaluate the value of the MCO program, but to add to the value of the MCO program by providing additional insight into the dynamic of academic/industry efforts and the interaction of these efforts with the student population. Such insight can further inform other programs with goals similar to the TAACCT program.

Unit of Analysis

Each MCO institution brought a different set of resources to the project that, when combined with unique operational processes, resulted in a unique contribution to the project.

However, it is reasonable to expect that the MCO-related outcomes from each institution are affected by the uniqueness of the community in which it is located, by its student population, and by the collective impact (direct or indirect) of other unique factors of the institution. Therefore, the unit of analysis for evaluating participant outcomes/impact is the MCO institution. This unit of analysis is more narrowly focused than the unit of analysis for the implementation/process evaluation (due to collaboration between MCO institutions, and the overlap of roles/responsibilities for the implementation and process activities, which were the subject of that evaluation component).

Method for Analyzing Outcomes-Related Data and Evaluating Program Impact

The participant outcomes/impact evaluation employed multiple strategies to establish robust findings about both the outcomes and the impact of the MCO Program. The Evaluation Team compiled and analyzed data related to enrollment, student demographics, academic performance, and other sources to document the outcomes for program participants. Evaluation of the MCO participant outcomes/impact involved the collection and analysis of quantitative data from each of the four community college's Institutional Research departments.

The MCO consortium colleges were impacted by curricular changes, equipment enhancements, career services, or web-interface access, so all colleges within the MCO consortium were impacted by TAACCT funds. Therefore, it was not possible to randomize students into treatment and control groups. Furthermore, the use of Comparison Groups across non-MCO consortium schools in NC and GA was deemed to be too challenging due to data access issues. Such conditions presented threats to internal validity of the outcomes study, so the methodology involved use of a quasi-experimental design, with propensity scoring to reduce selection bias. This approach is described in more detail below.

A quasi-experimental comparison cohort study design was used to explore the factors giving rise to successful program outcomes in comparison to historical consortium degree programs (Shadish, Cook, and Campbell, 2002). The impact component of the evaluation involved evaluation team members constructing a historical Comparison Group (students enrolled in MCO-affected courses prior to TAACCCT funding) from each school in the consortium.

The analysis technique involved propensity score matching between the historical comparison students and the MCO participant students enrolling in each of the grant-affected courses. Propensity score matching is a technique that allows researchers to match individuals in the treatment group to others who did not participate but have comparable characteristics (Peikes, Moreno, & Orzol, 2008).

The chosen evaluation strategy helped reduce potential data consistency and completeness challenges since each college's data should be internally consistent for its treatment and historical Comparison Groups. The hypothesis tests performed were variations of the overall hypothesis that outcomes for the grant-affected students will differ significantly from those students who do not have access to the additional resources afforded by the TAACCCT grant, controlling for other factors.

Data Collection

Data were collected from all four of the community colleges participating in the MCO Consortium. The three North Carolina community colleges use the same Student Information System (SIS), which initially suggested the possibility of cross-institutional analysis, at least for these three institutions. However, as the program activities progressed, and as more detailed data discussions were held with each institution, it was discovered that the unique set of courses

enhanced at each institution, as well as unique operational practices regarding data collection and reporting, introduced significant confounding factors. Therefore, it was determined that analysis of each institution's data independently would be more appropriate than the anticipated merging of data across institutions for a cross-institution level of analysis. Whenever deemed appropriate, however, comparisons of analysis results from each institution may be performed as part of exploratory analysis or to identify issues for further study.

Due to the lack of employment and wage data, only outcomes related to retention, progress, and completion were analyzed for each institution. The statistical methods used to analyze these outcomes are described in the 'Data Analysis (Statistical Methods)' section below. These methods describe the general method applied to each of the institution's data.

Depending on the institution, a lack of sufficient data necessary to determine outcomes prevented all three of these outcomes (retention, progress, and completion) from being analyzed for every institution. These and other limitations unique to an institution's outcomes analysis will be noted in each institution's 'Outcomes Analysis - Limitations' section.

Data Analysis (Statistical Methods)

Analysis of Treatment vs. Comparison Groups

Initial analysis involved bivariate tabulation of student demographic characteristics between the treatment (participant students) and comparison (historical students) groups. Data were summarized in terms of frequencies and proportions for categorical variables (nominal and ordinal); Pearson's chi-square and Fisher's exact test were applied to compare categorical variables between groups. For continuous measurements, variables were characterized in terms of means, standard deviations, medians, 25th and 75th percentiles. The Shapiro-Wilk test was used to test each continuous variable for possible departure from normality. For normally

distributed variables, groups were compared by the Student's *t* test. The Wilcoxon's rank-sum test was used to compare rankings between two non-normally distributed groups. For all analyses, a p-value below 0.05 was considered statistically significant.

The analysis of student performance measures in the treatment and comparison periods is based on observational study. In contrast to randomized studies, where characteristic differences between groups are controlled via randomization, observational analyses may be affected by possible selection bias related to differences in observed and unobserved characteristics of the chosen sample. For this study, propensity score analysis was conducted through regression adjustment in an effort to account for such differences and to assist in balancing the effects of confounding covariates between the treatment and Comparison Groups. In a logistic regression model having demographic variables age, gender and race as covariates, a propensity score was computed for each student as the probability of being included in the treatment group. These probabilities were included as weights in regression models for testing hypotheses. In addition, double adjustment was applied by including the same three demographic variables in each regression model to remove any remaining imbalance due to confounding. While other covariates were considered for propensity score computation (e.g., education level, full/part-time status, disability status), these characteristics were either unavailable or incomplete in either the treatment or Comparison Groups.

Hypothesis Testing

Once the Treatment and Comparison Groups were balanced regarding covariates, specific hypotheses were examined to determine the impact of course enhancement on the following three outcome measures: 1) Program Retention; 2) Program Progress; and, 3) Program Completion. In each case, a regression model was constructed to determine the propensity score-

weighted association of Treatment group, after adjustment by age, gender and race, on outcome. For binary outcome measures (Program Retention and Program Completion), logistic regression models were fit. Odds ratios (OR) and their 95% confidence intervals (CI) were computed; confidence intervals that did not contain 1.00 were considered significantly associated with the corresponding outcome measure. For Program Progress, an Analysis of Variance (ANOVA) model was constructed and least square means were reported for the two treatment groups. For all models, a p-value below 0.05 was considered statistically significant.

Analysis of Support Services

The impact of student support services was explored for students who were deemed eligible for MCO-funded support services within the Treatment group (student support services data were unavailable in the Comparison Group). Comparisons were made between (a) students who did not use any support services and (b) students who took advantage of one or more support services (e.g., a face to face meeting, a phone call or an email contact). As with the Treatment vs. Comparison analyses, the impact of student services was investigated for outcome measures defined by Program Retention, Program Progress and Program Completion.

It is possible that some students who perform well academically may do so with little or no support services, whereas other high-performers may do so at least partially due to support services. Thus, the impact of student support services on Retention, Completion, and Progress may be confounded with a student's academic capability. In order to adjust for such an occurrence, the number of remedial courses taken by the student was controlled for in the regression model and thus used as a proxy for academic capability (if remedial course data sets were provided by the institution).

Analysis of Crossover Group

Separate analyses were conducted for the group of students who had at least one record categorized as 'Historical' (comparison period) and at least one record categorized as 'MCO-Participant' (treatment period). These students were categorized as 'Crossover' students, with their outcomes evaluated in terms of a paired analysis, comparing the historical or comparison period to the later treatment period. Initial analyses of crossover students included univariate frequencies of categorical characteristics and means/medians and percentiles of continuous measurements. Because each student had a treatment and comparison period, there was no need to conduct propensity score matching. However, paired comparisons were made using McNemar's test to determine differences between the comparison and treatment periods in terms of Program Retention (among students who were retention eligible in both periods). A point estimate of the retention difference, and its corresponding 95% confidence interval, were computed by constructing a repeated measures binomial distribution model. For analysis of Program Progress, a paired *t* test was run to determine the paired difference between the proportion of all courses in which a student received a letter grade of A, B or C in the comparison versus treatment periods. To adjust for the possibility that a differential may exist in the number of courses taken by a student in the comparison versus treatment periods, a repeated measures ANOVA model was fit, yielding an adjusted point estimate of the student progress difference, along with its corresponding 95% confidence interval.

Reporting Results

Results of the outcomes analysis will be presented separately for each institution, as follows:

- *Background and unique features of institution's data set*

- *MCO interventions at institution*
- *Outcomes Analysis*
- *Exploratory Analysis*
- *Limitations*

The results reported for each of the institutions provide evidence on which answers to the Outcomes/Impact Research Questions are based. Answers to these questions are provided in the chapter following the consortium-level and institution-level chapters.

18. MCO Consortium-Level Outcomes

In order to provide context for the outcomes analysis, Table 36 provides institutional profile data for each of the four colleges for which outcomes will be discussed. The data shown in this table was obtained from the IPEDS database, and while it is not restricted to the MCO program, it provides context for the MCO program outcomes analysis in the following chapters. *Note:* Even though UNC-Charlotte was a partner in the MCO Consortium, the outcomes analysis was restricted to the four community colleges for which APR participant data sets were submitted.

Table 37: Data profile for MCO colleges (Reported for 2015)

Characteristic	MCO Partner College			
	Southern Regional TC	Nash CC	Cleveland CC	Wake Tech. CC
Institutional Characteristics				
% of full-time first-time undergraduates awarded Pell grants	*85%*	*63%*	*83%*	*36%*
% of full-time first-time undergraduates awarded state/local grant aid	*91%*	*18%*	*32%*	*14%*
Student-to-faculty ratio	*13*	*25*	*10*	*18*

Student Demographic Characteristics				
Gender				
Male	*629*	*243*	*199*	*1498*
Female	*898*	*276*	*275*	*1864*
Race				
American Indian or Alaska Native	*9*	*14*	*0*	*15*
Asian	*6*	*4*	*3*	*93*
Black or African American	*448*	*156*	*92*	*634*
Hispanic or Latino	*82*	*27*	*15*	*229*
Native Hawaiian or Other Pacific Islander	*1*	*0*	*0*	*4*
White	*951*	*304*	*345*	*1975*
Two or More Races	*10*	*8*	*8*	*59*
Race/ethnicity Unknown	*18*	*4*	*4*	*145*
Nonresident Alien	*2*	*2*	*7*	*208*
Age				
Adult age (25-64) Enrollment	*1094*	*1184*	*962*	*8787*
Student Performance Characteristics				
Credential Completion				
Number of students receiving an Associate's degree	*201*	*353*	*250*	*2090*
Number of students receiving a certificate of 1 but less than 4-years	*441*	*34*	*101*	*265*
Number of students receiving a certificate of less than 1-year	*1206*	*195*	*149*	*1437*
Retention (Returning Fall 2015)				
Full-time retention rate	*39%*	*49%*	*54%*	*66%*
Part-time retention rate	*16%*	*42%*	*48%*	*48%*

Frequencies (projections and actuals) for measures described in the MCO Project Proposal are shown in Table 37. The source of the 'Projection' data was the original proposal, and the source of the 'Actual' data was the Annual Performance Reports (APRs) submitted for Years 1 – 3.

Table 38: Outcome Indicators Included in MCO Proposal

Outcome Indicator	Year 1 Projection	Year 1 Actual	Year 2 Projection	Year 2 Actual	Year 3 Projection	Year 3 Actual
1. Total Unique Participants Served	322	**Total: 728** CCC: 694 NCC: -- WTCC: 34 SRTC: --	602	**Total: 8124** CCC: 386 NCC: 217 WTCC: 7477 SRTC: 44	695	**Total: 4869** CCC: 390 NCC: 425 WTCC: 3999 SRTC: 55
2. Total Number of Participants Completing a TAACCCT Program of Study	65	**Total: 51** CCC: 51 NCC: -- WTCC: -- SRTC: --	311	**Total: 253** CCC: 37 NCC: 55 WTCC: 153 SRTC: 8	451	**Total: 237** CCC: 46 NCC: 69 WTCC: 110 SRTC: 12
3. Total Number of Participants Still Retained in Their Programs of Study (or Other TAACCCT-Funded Programs)	112	**Total: 318** CCC: 284 NCC: -- WTCC: 34 SRTC: --	303	**Total: 837** CCC: 144 NCC: 132 WTCC: 531 SRTC: 30	425	**Total: 1282** CCC: 119 NCC: 148 WTCC: 996 SRTC: 19
4. Total Number of Participants Completing Credit Hours	252	**Total: 621** CCC: 587 NCC: -- WTCC: 34 SRTC: --	489	**Total: 6109** CCC: 307 NCC: 192 WTCC: 5585 SRTC: 25	593	**Total: 3115** CCC: 263 NCC: 399 WTCC: 2414 SRTC: 39
5. Total Number of Participants Earning Credentials	0	**Total: 112** CCC: 56 NCC: -- WTCC: 56 SRTC: --	291	**Total: 934** CCC: 46 NCC: 69 WTCC: 807 SRTC: 12	365	**Total: 438** CCC: 127 NCC: 121 WTCC: 177 SRTC: 13
6. Total Number of Participants Enrolled in Further Education After TAACCCT-funded Program of Study Completion	5	**Total: 13** CCC: 1 NCC: -- WTCC: 12 SRTC: --	24	**Total: 110** CCC: 9 NCC: 8 WTCC: 92 SRTC: 1	49	**Total: 64** CCC: 6 NCC: 15 WTCC: 42 SRTC: 1
7. Total Number of Participants Employed After TAACCCT-funded Program of Study Completion	25	**Total: 4** CCC: 4 NCC: -- WTCC: -- SRTC: --	110	**Total: 16** CCC: 10 NCC: -- WTCC: -- SRTC: 6	135	**Total: 4** CCC: 0 NCC: -- WTCC: -- SRTC: 4

8. Total Number of Participants Retained in Employment After Program of Study Completion	114	**Total: 4** CCC: 4 NCC: -- WTCC: -- SRTC: --	182	**Total: 4** CCC: 4 NCC: -- WTCC: -- SRTC: --	229	**Total: 3** CCC: 0 NCC: -- WTCC: -- SRTC: 3
9. Total Number of Participants Employed at Enrollment Who Received a Wage Increase Post-Enrollment	6	**Total: 200** CCC: 200 NCC: -- WTCC: -- SRTC: --	30	**Total: 203** CCC: 203 NCC: -- WTCC: -- SRTC: --	42	**Total: 77** CCC: 75 NCC: -- WTCC: -- SRTC: 2

In general, the outcomes analysis plan involved a Comparison (historical) group of students, and a Treatment (MCO Participant) group of students who were affected by grant-funded activities. Both Comparison and Treatment data sets included demographic data, as well as student performance data. Not all four institutions had the same intervention plan. For example, Southern Regional Technical College did not originally plan course enhancements. However, the Evaluation Team requested the same information from all four institutions in order to accommodate unanticipated changes in intervention activities that might occur during the grant period, and to facilitate the data collection process. The data request was based on the proposal's 'Outcomes Projections' shown above, as well as student demographic data, and course- and program-related outcomes at the student level.. See Appendix E for the data that the Evaluation Team requested from each MCO community college.

19. Evaluation of Participant Outcomes/Impact: Cleveland CC

Background and unique features of Cleveland Community College data set

Cleveland CC (CCC in some data tables) provided data for a comparison (historical) group of students and a Treatment (MCO Participant) group of students who enrolled in Fall 2013 or later. Both data sets included demographic data, as well as student performance data.

Descriptive statistics for both groups will be shown later in the 'Outcomes Analysis' section.

Year 1 of the grant began in Fall 2013 (October 1, 2013) when each institution started filling MCO staff positions. Cleveland CC, as the lead institution, had the most positions to fill, and was able to do so in sufficient time to serve 694 participants in Year 1, according to the APR. Of the other three community colleges, only Wake Tech recorded any participants (34) for Year 1. Therefore, 95.3% of the Year 1 participants were Cleveland CC students.

With Year 1 participant data being predominantly Cleveland CC data, outcomes analysis using Year 1 data was only feasible for Cleveland CC, which brought to mind several factors considered by the Evaluation Team in use of the Year 1 data. The obvious benefit of having more data was considered, but was counterbalanced by the confounding effect of a timeframe for the outcomes analysis data that would differ from the other three community colleges. Ultimately, the Evaluation Team made the decision to use Cleveland CC's Year 1 data in the Cleveland CC outcomes analysis. The deciding factor was the judgment that while substantial student demographic differences between institutions could be adjusted for, their interaction with, and single factor effects of, less tractable factors such as intervention environment, and scope and degree of intervention, presented confounding factors in comparing outcomes across institutions. Therefore, with the primary focus of the outcomes analysis being by institution, rather than aggregated across all institutions, the negative effect of using the Cleveland CC Year 1 on the overall analysis plan was deemed to be minimal compared to the value of including additional participant data when analyzing Cleveland CC's outcomes.

The outcomes analysis data presented in this chapter is based on data that Cleveland CC provided in response to the Evaluation Team's data request (as detailed in Appendix E). While the data that the Evaluation Team received was based on the same institutional research data

from which the APR statistics were generated, discrepancies between the APR statistics and the outcomes analysis statistics may differ somewhat for the following reasons:

- Differences in timing of data collection. The Evaluation Team's data-request format, common among all four institutions, required an unavoidable additional data processing operation that may have been performed at a time different from when the APR data was compiled. Any system updates occurring between APR-data generation and generation of data for the Evaluation Team that were not accounted for could contribute to a discrepancy.
- Different time period of analysis. While the APR data is a summary of one year, the outcomes data is on a semester basis. Therefore, counts of enrollment per semester, for instance, would not match a yearly unduplicated count of participants in the APR.
- For some students, important data elements used for propensity scoring were missing, resulting in those observations being dropped from the data set to be analyzed.
- For some students, performance-related data elements were missing, resulting in those observations being dropped from the data set to be analyzed.

Table 39 below provides enrollment statistics, according to the data provided to the Evaluation Team, as background for the analysis of outcomes data.

Table 39: Cleveland CC Enrollment for MCO-related courses

Semester	Count
Fall 2013*	507
Spring 2014*	344
Summer 2014*	57
Fall 2014	377
Spring 2015	305
Summer 2015	53
Fall 2015	143
Spring 2016	332
Summer 2016	74
Fall 2016	340
Spring 2017	282

MCO interventions at Cleveland CC

Analysis of the outcomes data provided by Cleveland CC was performed in order to explore the effects of their MCO program interventions and other activities funded by the MCO grant. Summary information regarding key interventions and activities undertaken as part of the MCO program is shown below in Table 40.

Table 40: Cleveland CC MCO Program Interventions/Activities

Program Interventions/Activities	% of CCC Effort	% of MCO Consortium Effort
Work Plan Activity 1: Articulation	2.43%	2.70%
Work Plan Activity 2: Project Collaboration and Evaluation	2.74%	4.12%
Work Plan Activity 3: Course Design	10.37%	12.51%
Work Plan Activity 4: Credential Development	24.44%	14.20%
Work Plan Activity 5: Support Services	9.22%	21.77%
Work Plan Activity 6: Scorecard	3.31%	2.93%
Work Plan Activity 7: Telepresence	28.58%	28.42%
Work Plan Activity 8: Evaluation / Performance Tracking	18.90%	13.35%
Total	99.99%*	100.00%
** Does not equal 100.00% due to rounding*		

Table 41: Cleveland CC Difference in Course Delivery Method: Pre-MCO (Comparison) period vs. MCO Program (Treatment) period

Course Delivery Method	# (%) of Courses in Comparison Period	# (%) of Courses in Treatment Period
Hybrid (Code: HY)	136 (20.96%)	114 (25.73%)
Online (Code: IN)	85 (13.10%)	109 (24.60%)
Independent Study (Code: IS)	22 (3.39%)	8 (1.81%)
Traditional (Code: TR)	203 (31.28%)	52 (11.74%)
Web-Based (Code: WB)	203 (31.28%)	160 (36.12%)
Total	100.01%*	100.00%
** Does not equal 100.00% due to rounding*		

Outcomes Analysis

The outcomes analysis approach primarily involved construction of two groups of students:

- A Comparison Group (may also be referred to as the historical group) comprised of students who only participated in pre-grant-period courses that were subsequently affected by MCO program interventions/activities and/or MCO-funded resources; and
- A treatment group comprised of students who had enrolled at the institution after the MCO program intervention/activities began at the institution (i.e. the treatment period).

The data set related to the students in the Comparison Group and the Treatment Group is referred to as the Primary Data Set.

While most students were classified as being in either the Comparison Group or the Treatment Group, there were also students who were in both the comparison (or historical) period <u>and</u> the treatment period. These students were categorized as Crossover students, and that subset of data, referred to as the Crossover Data Set, was analyzed separately. Separate analysis of the Crossover Data Set was performed in order to not only reduce the confounding effect of participating in both the comparison period and the treatment period, but in order to exploit the

"paired difference" nature of the data; the fact that each student in this data set had a comparison period of performance and a treatment period of performance. Analysis of the Crossover Data Set follows analysis of the Primary Data Set, shown in the next section.

Outcomes Analysis – Primary Data Set [Comparison Group vs. Treatment Group]

Descriptive Statistics - Participant Data

Descriptive statistics for the Primary Data Set are shown in Table 42 below in order to provide an overview of participants, and participant performance. These statistics have been divided into two sections as follows:

- Participant Characteristics (a snapshot of demographics, and other characteristics of the participating students)
- Participant Performance (performance-related statistics, some of which are related to outcomes analyzed in more detail in the 'Statistical Inference' section)

Participant Characteristics

Table 42: Cleveland CC Descriptive Statistics – Characteristics [Comparison Group vs. Treatment Group]

Participant Characteristics	Comparison			Treatment		
	Count (%)	At Program Entry		Count (%)	At Program Entry	
		Mean Age	Mean Highest Grade Level		Mean Age	Mean Highest Grade Level
Gender						
Female	913 (45.47%)	31.17	12.36	428 (34.00%)	31.06	12.35
Male	1095 (54.53%)	30.10	12.09	831 (66.00%)	26.91	12.14
Race/Ethnicity						
AN	8 (.40%)	*	*	5 (.40%)	*	*
AS	4 (.20%)	*	*	6 (.48%)	*	*
BL	629 (31.50%)	34.10	12.10	272 (21.78%)	30.91	12.19

HIS	41 (2.05%)	24.08	11.91	44 (3.52%)	24.29	11.86
MULTI	24 (1.20%)	27.50	11.95	22 (1.76%)	24.07	12.27
WH	1274 (63.80%)	29.55	12.29	890 (71.26%)	28.10	12.22
Other	16 (.80%)	*	*	7 (.56%)	*	*
<?>	1 (.05%)	*	*	3 (.24%)	*	*
Full-/Part-Time						
Full-Time	*	*	*	560	27.64	12.16
Part-Time	*	*	*	699	29.21	12.25
Veteran						
Yes	0	*	*	22	24.4	12.09
No	2008	30.62	12.21	1237	28.52	12.22
Pell grant eligible						
Yes	*	*	*	*	*	*
No	*	*	*	*	*	*
TAA-eligible						
Yes	*	*	*	*	*	*
No	*	*	*	*	*	*
Employed at Entry						
Yes	*	*	*	*	*	*
No	*	*	*	*	*	*
** Missing/Insufficient data*						
Legend for Race/Ethnicity: AN (American/Alaska Native); AS (Asian); BL (Black or African American); HIS (Hispanic); MULTI (Multi-racial); WH (White); <?> (Not Specified)						

Participant Performance

Table 43: Cleveland CC Descriptive Statistics – Performance [Comparison Group vs. Treatment Group]

Participant Performance	Comp. Grp	Trt. Grp
Course Progress/Completion		
# Courses taken	4608	4118
# Courses where student received a 'C' grade or better	3267	2918
% of courses where student received a 'C' grade or better	70.90%	70.86%
Student Retention		
Percent of students* retained	11.96%	24.20%

Credential Completion		
# Credentials awarded	947	786
# Diplomas	222	135
# Certificates	221	391
# Degrees	504	260
# Students awarded at least one credential	633	384
Student Support Services		
# (%) Students using support services:	*	337 (26.77%)
Mean # service interactions for students using services:	*	2.36
Employment-Related Activities		
# Students participating in work-based learning opportunities	*	*
* *Missing/Insufficient data*		

Statistical Inference – Association between Intervention and Performance [Comparison Group vs. Treatment Group]

Hypothesis tests were performed in order to detect any significant association between the following interventions and outcomes. The hypothesis test results are summarized in Table 44 below.

Table 44: Cleveland CC Summarized Results of Hypothesis Tests (for Primary Data Set Outcomes)

Is this Intervention…	…associated with this Outcome?	Hypothesis Test Results Suggest that…
MCO program participation	Retention	• MCO participants are approximately twice as likely to be retained as non-MCO-participants.
MCO program participation	Program progress	• The Treatment Group had a slightly lower proportion of grades A, B, or C than those in the Comparison Group. Therefore, MCO program participants are slightly less likely to progress through courses as non-MCO-participants.
MCO program participation	Program completion	• MCO program participants are no more likely to complete the program than non-MCO-participants.

Student support services	Retention	• MCO participants who used Support Services are more than five times as likely to be retained as MCO participants who did not use Support Services.
Student support services	Program progress	• MCO participants who used Support Services had a significantly higher proportion of grades A, B, or C than MCO participants who did not use Support Services.
Student support services	Program completion	• MCO participants who used Support Services are more than three and a half times as likely to complete the program as MCO participants who did not use Support Services.

The following tables provide more detailed results of the hypothesis tests that were summarized in Table 42 above.

Table 45: Cleveland CC Hypothesis Test of Program Retention

Retention: **Odds Ratio Estimate and Wald Confidence Interval [Treatment Group]**			
Parameter	Estimate	**95% Confidence Limits** **(Lower)**	**(Upper)**
Treatment (vs. Comparison)	2.094	1.668	2.627
Test Details: Among Students Eligible for Retention (N=1,316) Weighted Adjusted Logistic Regression Analysis of Treatment vs. Comparison			
Discussion of results: Students in Treatment Group were approximately twice as likely to be retained as those in the Comparison Group (Odds Ratio=2.094, 95% Confidence Interval: [1.668 – 2.627])			

Table 46: Cleveland CC Hypothesis Test of Program Progress

Progress: **Confidence Intervals for Proportion of Grades A, B, or C**			
Group	Proportion of Grades A, B, or C (Least Squares Mean)	95% Confidence Limits (Lower)	(Upper)
Comparison	0.647609	0.625699	0.669518
Treatment	0.610583	0.588664	0.632503
Test Details: Weighted Adjusted Analysis of Treatment vs. Comparison			
Discussion of Results: Students in the Treatment Group had a slightly lower proportion of grades A, B, or C (.6106) than those in the Comparison Group (.6476).			

Table 47: Cleveland CC Hypothesis Test of Program Completion

Completion: **Odds Ratio Estimate and Wald Confidence Interval [Treatment Group]**			
Parameter	Estimate	95% Confidence Limits (Lower)	(Upper)
Treatment (vs. Comparison)	0.948	0.853	1.054
Test Details: (N=3,241) Weighted Adjusted Logistic Regression Analysis of Treatment vs. Comparison			
Discussion of results: Students in Treatment Group were no more likely to complete the program than those in the Comparison Group (Odds Ratio=0.948, 95% Confidence Interval: [0.853 - 1.054]).			

Table 48: Cleveland CC Hypothesis Test of Program Retention (Effect of Student Support Service)

Retention: **Odds Ratio Estimate and Wald Confidence Interval [Some Support Service Usage]**			
Parameter	Estimate	95% Confidence Limits (Lower)	(Upper)
Some Support Service Usage (vs. No Support Service Usage)	5.254	2.887	9.562
Test Details: • Among Treatment Group Students Eligible for Retention (N=312) • Adjusted Logistic Regression Analysis of Some vs. No Support Service Usage			
Discussion of results: Students who used Support Services were more than five times as likely to be retained as those who did not use Support Services (Odds Ratio=5.254, 95% Confidence Interval: [2.887 - 9.562]).			

Table 49: Cleveland CC Hypothesis Test of Program Progress (Effect of Student Support Service)

Progress: **Confidence Intervals for Proportion of Grades A, B, or C**			
Group	Proportion of Grades A, B, or C (Least Squares Mean)	95% Confidence Limits (Lower)	(Upper)
Some Support Service Usage	0.689662	0.638555	0.740769
No Support Service Usage	0.583006	0.551719	0.614293
Test Details: • (N=1,246) • Adjusted ANOVA of Some vs. No Support Service Usage			
Discussion of results: Students who used Support Services had a significantly higher proportion of grades A, B, or C (.6897) than those who did not use Support Services (.5830).			

Table 50: Cleveland CC Hypothesis Test of Program Completion (Effect of Student Support Service)

Completion: **Odds Ratio Estimate and Wald Confidence Interval [Some Support Service Usage]**			
Parameter	Estimate	95% Confidence Limits (Lower)	(Upper)
Some Support Service Usage (vs. No Support Service Usage)	3.741	2.819	4.964
Test Details: • (N=1,246) • Adjusted Logistic Regression Analysis of Some vs. No Support Service Usage			
Discussion of results: Students who used Support Services were more than three and a half times as likely to complete the program as those who did not use Support Services (Odds Ratio=3.741, 95% Confidence Interval: [2.819 - 4.964]).			

Outcomes Analysis – Crossover Group [Comparison Period vs. Treatment Period]

Descriptive Statistics - Participant Data

Descriptive statistics for the Crossover data set are shown below in order to provide an overview of participants, and participant performance. These statistics have been divided into two sections as follows:

- Participant characteristics (a snapshot of demographics, and other characteristics of the participating students)
- Participant performance (performance-related statistics, some of which are related to outcomes analyzed in more detail in 'Outcomes Analysis' section)

Participant characteristics

Table 51: Cleveland CC Descriptive Statistics – Characteristics [Comparison Period vs. Treatment Period] for Crossover Group

Participant Characteristics	Count (%)	At Program Entry	
		Mean Age	Mean Highest Grade Level
Gender			
Female	75 (22.73%)	36.29	12.36
Male	255 (77.27%)	32.27	12.35
Race/Ethnicity			
AN	0 (0%)	*	*
AS	2 (0.61%)	*	*
BL	79 (23.94%)	35.66	12.30
HIS	3 (0.91%)	*	*
MULTI	6 (1.82%)	32.00	13.17
WH	233 (70.61%)	32.20	12.36
Other	4 (1.21%)	*	*
<?>	3 (0.91%)	*	*
Full-/Part-Time			
Full-Time	148 (44.85%)	32.5	12.30
Part-Time	182 (55.15%)	33.56	12.40
Veteran			
Yes	7 (2.12%)	32.83	12.00
No	323 (97.88%)	33.03	12.36
Pell grant eligible			
Yes	*	*	*
No	*	*	*
TAA-eligible			
Yes	*	*	*
No	*	*	*
Employed at Entry			
Yes	*	*	*
No	*	*	*
** Missing/Insufficient data*			
Legend for Race/Ethnicity: AN (American/Alaska Native); AS (Asian); BL (Black or African American); HIS (Hispanic); MULTI (Multi-racial); WH (White); <?> (Not Specified)			

Participant Performance

Table 52: Cleveland CC Descriptive Statistics – Performance [Comparison Period vs. Treatment Period] for Crossover Group

Participant Performance	Comp. Period	Trt. Period
Course Progress/Completion		
# Courses taken	1620	1669
# Courses where student received a 'C' grade or better	1299	1231
% of courses where student received a 'C' grade or better	80.19%	73.76%
Student Retention		
Percent of students* retained	36.54%	28.57%
Credential Completion		
# Credentials awarded	*	484
# Diplomas	*	101
# Certificates	*	219
# Degrees	*	164
# Students awarded at least one credential	*	190
Student Support Services		
# (%) Students using support services:	*	120 (36.36%)
Mean # service interactions for students using services:	*	2.65
Employment-Related Activities		
# Students participating in work-based learning opportunities	*	*
* *Missing/Insufficient data*		

Comment on Table 52: One line of reasoning suggests that the retention rate for the Comparison period and the retention rate for the Treatment period for the Crossover data set may not be comparable because it is the same person for both periods, and over time each person will eventually not return because they have achieved their education goals. In other words, there may be a natural tendency for a lower retention rate as time goes by, meaning the Treatment period may be expected to have a lower retention rate for the Crossover data set students.

Statistical Inference – Association between Intervention and Performance

The Crossover data set provided the opportunity to analyze paired difference data

because each crossover student had performance data in both the Comparison and the Treatment periods. Listed below is the result of the hypothesis test related to program progress.

Table 53: Cleveland CC Hypothesis Test of Program Progress for Crossover Group

Progress: **Confidence Interval for Treatment Period Proportion of Grades A, B, or C – Comparison Period Proportion of Grades A, B, or C**			
Group	Treatment Proportion – Comparison Proportion (Mean)	95% Confidence Limits (Lower)	(Upper)
Treatment - Comparison	-0.1341	-0.1835	-0.0846
Test Details: • (N=330) • Paired T-Test Treatment vs. Comparison			
Discussion of Results: During the Treatment period, the Crossover students had a significantly lower proportion of grades A, B, or C than during the Comparison period (Mean proportion 0.1341 lower during the Treatment period compared to the Comparison period).			

Exploratory Analysis

The exploratory analysis involved use of the same data sets as for the outcomes analysis. Whereas the outcomes analysis section focused on investigating the association between program intervention and outcomes, this section explores relationships between a wider variety of variables. The purpose of this analysis is to glean from the data any insights regarding the population of students enrolled in technical programs such as Mission Critical Operations. These insights can be very helpful in detecting issues that warrant further study. However, the study was not designed to reach conclusions regarding the factors examined in this section, so only insights, not conclusions, are suggested in this exploratory analysis.

Exploratory Analysis – Primary Data Set [Comparison Group vs. Treatment Group]

Statistical Inference – Other noteworthy hypothesis tests

Table 54: Cleveland CC Exploratory Analysis – Retention (for Primary Data Set Outcomes)

Is this Factor…	…associated with this Outcome?	Hypothesis Test	Hypothesis Test Results Suggest that…
Gender	Retention	Weighted Adjusted Logistic Regression Analysis of Treatment vs. Comparison (P-value<.001)	Males are approximately three times as likely to be retained as females.
Race	Retention	Weighted Adjusted Logistic Regression Analysis of Treatment vs. Comparison (P-value=.001)	Caucasians are 1.67 times more likely to be retained as non-Caucasians.
Age	Retention	Weighted Adjusted Logistic Regression Analysis of Treatment vs. Comparison (P-value=.03)	Older students are slightly more likely to be retained as younger students.
Gender [Treatment Students Only]	Retention	Adjusted Logistic Regression Analysis (P-value =.01)	Males were three times more likely than females to be retained.
Race [Treatment Students Only]	Retention	Adjusted Logistic Regression Analysis (P-value =.01)	Caucasians were more than twice as likely as non-Caucasians to be retained.
Age [Treatment Students	Retention	Adjusted Logistic Regression Analysis	Age had no significant effect regarding retention

Only]		(P-value =.37)	
Number of Remedial Courses [Treatment Students Only]	Retention	Adjusted Logistic Regression Analysis (P-value =.97)	The number of remedial courses taken by a student had no effect regarding retention.

Table 55: Cleveland CC Exploratory Analysis – Program Progress (for Primary Data Set Outcomes)

Is this Factor…	…associated with this Outcome?	Hypothesis Test	Hypothesis Test Results Suggest that…
Gender	Program progress	Weighted Adjusted ANOVA (P-value<.001)	Females had a significantly higher proportion of grades A, B, or C than males.
Race	Program progress	Weighted Adjusted ANOVA (P-value<.001)	Caucasians had a significantly higher proportion of grades A, B, or C than non-Caucasians.
Age	Program progress	Weighted Adjusted ANOVA (P-value<.001)	MCO program participants are no more likely to complete the program than non-MCO-participants.
Gender [Treatment Students Only]	Program progress	Adjusted ANOVA (P-value<.001)	Females had a significantly higher proportion of grades A, B, or C than males.
Race [Treatment Students Only]	Program progress	Adjusted ANOVA (P-value<.001)	Caucasians had a significantly higher proportion of grades A, B, or C than non-Caucasians.
Age [Treatment Students	Program progress	Adjusted ANOVA (P-value=.01)	Older students had a significantly higher proportion of grades A, B, or

Only]			C than younger students.
Number of Remedial Courses [Treatment Students Only]	Program progress	Adjusted ANOVA (P-value=.5)	The number of remedial courses taken by a student had no effect regarding proportion of grades A, B, or C.

Table 56: Cleveland CC Exploratory Analysis – Program Completion (for Primary Data Set Outcomes)

Is this Factor…	…associated with this Outcome?	Hypothesis Test	Hypothesis Test Results Suggest that…
Gender	Program completion	Weighted Adjusted Logistic Regression Analysis (P-value=.00+)	Females are 1.2 times more likely to complete the program than males.
Race	Program completion	Weighted Adjusted Logistic Regression Analysis (P-value<.001)	Caucasians are 1.5 times more likely to complete the program than non-Caucasians.
Age	Program completion	Weighted Adjusted Logistic Regression Analysis (Age 20-25: P-value=.03) (Age 26+: P-value=.02)	Older students [Age 20+] are slightly more likely to complete the program than younger students.
Gender [Treatment Students Only]	Program completion	Adjusted Logistic Regression Analysis (P-value <.001)	Females are 2.2 times more likely to complete the program than males.
Race [Treatment Students	Program completion	Adjusted Logistic Regression Analysis	Caucasians are 1.6 times more likely to complete the program than non-Caucasians.

Only]		(P-value =.002)	
Age [Treatment Students Only]	Program completion	Adjusted Logistic Regression Analysis (P-value =.14)	Age had no significant effect regarding program completion
Number of Remedial Courses [Treatment Students Only]	Program completion	Adjusted Logistic Regression Analysis (P-value =.01)	The higher the number of remedial courses taken, the lower the likelihood of completing the program.

Exploratory Analysis – Course Delivery

Table 57: Cleveland CC Hypothesis Test – Course Delivery vs. Comparison/Treatment Periods

Course Delivery Method: **Chi-Square Test (Course Delivery Method vs. Period)**			
Course Delivery Method	# (%) Courses with Delivery Method for each period		
Frequency (Column Pct)	Comparison Period	Treatment Period	Total
Hybrid (Code: HY)	136 (20.96%)	114 (25.73%)	250
Online (Code: IN)	85 (13.10%)	109 (24.60%)	194
Independent Study (Code: IS)	22 (3.39%)	8 (1.81%)	30
Traditional (Code: TR)	203 (31.28%)	52 (11.74%)	255
Web-Based (Code: WB)	203 (31.28%)	160 (36.12%)	363
Total	649 (100%)	443 (100%)	1092
Test Details: Chi-Square Test: DF=4; Test Statistic=69.562; P-value<0.0001			
Discussion of results: The two time periods differ significantly with respect to the proportion of each course delivery method used. Therefore, with the Traditional (TR) course delivery method being a lower percentage of the courses offered (Treatment Period: 11.74% vs. Comparison Period: 31.28%) in the Treatment Period, it appears that Cleveland CC has moved significantly to a more online (or web-enabled) approach for its MCO program courses.			

Table 58: Hypothesis Test – Course Delivery Effect on Proportion of Students Passing the Course

Course Delivery Method Effect on Proportion of Students Passing the Course: Hypothesis Test and Confidence Interval

Group	Test Results
Comparison	**Kruskal-Wallis Test: Proportion Passing versus Course Delivery Method**

```
Course Dlv.   N  Median  Ave Rank      Z
HY          136  0.8297     327.9   1.01
IN           85  0.7500     264.7  -2.70
TR          203  0.9167     388.3   7.11
WB          203  0.7143     251.0  -6.03
Overall     627             314.0

H = 67.46  DF = 3  P = 0.000  (adjusted for ties)
```

Group	Test Results
Treatment	**Kruskal-Wallis Test: Proportion Passing versus Course Delivery Method**

```
Course Dlv.   N  Median  Ave Rank      Z
HY          114  0.7500     194.9  -2.28
IN          109  0.7143     177.0  -3.94
TR           52  0.8397     253.3   2.16
WB          160  0.8571     250.9   4.17
Overall     435             218.0

H = 31.66  DF = 3  P = 0.000  (adjusted for ties)
```

Group	Individual 95% CIs For Median Proportion Passing a Course
Comparison	

```
Course Dlv. N<=   N>  Median -------+---------+---------+--------
HY           66   70   0.830                  (---*----)
IN           55   30   0.750 (----------*----)
TR           66  137   0.917                            (-----*--)
WB          135   68   0.714 (-----*----)
                              -------+---------+---------+--------
                                   0.720     0.800     0.880
```

Group	Individual 95% CIs For Median Proportion Passing a Course
Treatment	

```
Course Dlv. N<=  N>  Median ----+---------+---------+---------+--
HY           70  44   0.750  (-------*----)
IN           71  38   0.714 (----*---)
TR           20  32   0.840              (----*---------------)
WB           66  94   0.857                 (---*-------------)
                            ----+---------+---------+---------+--
                              0.70      0.80      0.90      1.00
```

***Test Details**:*
Anderson-Darling test of normality concluded (P-value<0.005) that the assumption of normality could not be made. Therefore, a Kruskal-Wallis Test was performed, and determined that the median proportion passing a course does differ significantly based on Course Delivery Method (at P-value<0.0001).

***Legend for Course Delivery Method**: HY = Hybrid; IN = Online; TR = Traditional; WB = Web-Based*

Note: Due to the unique nature of the Independent Study (IS) course delivery method, as well as the low number of such courses, the IS course delivery method data was excluded from the above analysis.

Discussion of results: According to the Kruskal-Wallis test results, the course delivery method has a significant effect on the proportion of students who pass the course (i.e. Grade of A, B, C, or D), with the Traditional (TR) method having the highest proportion of students passing in the Comparison period, and the Web-Based (WB) method having the lowest proportion of students passing in the Comparison period. These two methods moved in opposite directions when comparing the Comparison period to the Treatment period: The proportion passing TR courses dropped from .917 to .840, while the proportion passing WB courses increased from .714 to .857.

It is important to note that the proportion passing the WB courses went from the lowest of the course delivery methods in the Comparison period to the highest of the course delivery methods in the Treatment period. Such a dramatic change suggests that the WB course delivery method may have been improved (possibly due to MCO-funded activities) and is more effective in supporting student success. However, further exploration is needed to reach any firm conclusion.

Limitations

- The impact of the instructor factor on proportion of course grades A, B, or C was not investigated, but presumably could be a contributing factor to explain some variation in the proportions.
- Lack of available data regarding employment prevented any analysis of employment outcomes.

20. Evaluation of Participant Outcomes/Impact: Wake Tech CC

Background and Unique Features of Wake Tech Community College Data Set

Wake Tech CC (WTCC in some data tables) provided data for a comparison (historical) group of students and a Treatment (MCO Participant) group of students who enrolled in Fall 2014 or later. Both data sets included demographic data, as well as student performance data. Descriptive statistics for both groups will be shown later in the 'Outcomes Analysis' section.

Year 1 of the grant began in Fall 2013 (October 1, 2013) and each institution started filling MCO staff positions. For the Year 1 APR, Wake Tech CC recorded 34 participants. Cleveland CC, as the lead institution, was able to serve 95.3% of all MCO Year 1 participants (or 694 students), according to the APR. With there being so few Year 1 participants at Wake Tech CC, the data collected for outcomes analysis began with Fall 2014.

The outcomes analysis data presented in this chapter is based on data that Wake Tech CC provided in response to the Evaluation Team's data request (as detailed in Appendix E). While the data the Evaluation Team received was based on the same institutional research data from which the APR statistics were generated, discrepancies between the APR statistics and the outcomes analysis statistics may differ somewhat for the following reasons:

- Differences in timing of data collection. The Evaluation Team's data-request format, common among all four institutions, required an unavoidable additional data processing operation that may have been performed at a time different from when the APR data was compiled. Any system updates occurring between APR-data generation and generation of data for the Evaluation Team that were not accounted for could contribute to a discrepancy.

- Different time period of analysis. While the APR data is a summary of one year, the outcomes data is on a semester basis. Therefore, counts of enrollment per semester, for instance, would not match a yearly unduplicated count of participants in the APR.
- For some students, important data elements used for propensity scoring were missing, resulting in those observations being dropped from the data set to be analyzed.
- For some students, performance-related data elements were missing, resulting in those observations being dropped from the data set to be analyzed.

Table 59 below provides enrollment statistics, according to the data provided to the Evaluation Team, as background for the analysis of outcomes data.

Table 59: Wake Tech CC Enrollment for MCO-related courses

Semester	Count
Fall 2013*	0
Spring 2014*	0
Summer 2014*	0
Fall 2014	289
Spring 2015	389
Summer 2015	131
Fall 2015	330
Spring 2016	214
Summer 2016	68
Fall 2016	123
Spring 2017	113

MCO interventions at Wake Tech CC

Analysis of the outcomes data provided by Wake Tech CC was performed in order to explore the effects of their MCO program interventions and other activities funded by the MCO

grant. Summary information regarding key interventions and activities undertaken as part of the MCO program is shown below in Table 60.

Table 60: Wake Tech CC MCO Program Interventions/Activities

Program Interventions/Activities	% of WTCC Effort	% of MCO Consortium Effort
Work Plan Activity 1: Articulation	2.02%	2.70%
Work Plan Activity 2: Project Collaboration and Evaluation	2.64%	4.12%
Work Plan Activity 3: Course Design	33.95%	12.51%
Work Plan Activity 4: Credential Development	2.02%	14.20%
Work Plan Activity 5: Support Services	31.67%	21.77%
Work Plan Activity 6: Scorecard	2.02%	2.93%
Work Plan Activity 7: Telepresence	19.08%	28.42%
Work Plan Activity 8: Evaluation / Performance Tracking	6.59%	13.35%
Total	99.99%*	100.00%
** Does not equal 100.00% due to rounding*		

Table 61: Wake Tech CC Difference in Course Delivery Method: Pre-MCO (Comparison) period vs. MCO Program (Treatment) period

Course Delivery Method	# (%) of Courses in Comparison Period	# (%) of Courses in Treatment Period
Traditional	241 (41.99%)	301 (14.09%)
Web-Assisted	222 (38.68%)	657 (30.76%)
Hybrid	38 (6.62%)	348 (16.29%)
Online	73 (12.72%)	830 (38.86%)
Total	100.01%*	100.00%
** Does not equal 100.00% due to rounding*		

Outcomes Analysis

The outcomes analysis approach primarily involved construction of two groups of students:

- A Comparison Group (may also be referred to as the historical group) comprised of students who only participated in pre-grant-period courses that were subsequently affected by MCO program interventions/activities and/or MCO-funded resources; and
- A treatment group comprised of students who had enrolled at the institution after the MCO program intervention/activities began at the institution (i.e. the treatment period).

The data set related to the students in the Comparison Group and the Treatment Group is referred to as the Primary Data Set.

While most students were classified as being in either the Comparison Group or the Treatment Group, there were also students who were in both the comparison (or historical) period and the treatment period. These students were categorized as Crossover students, and that subset of data, referred to as the Crossover Data Set, was analyzed separately. Separate analysis of the Crossover Data Set was performed in order to not only reduce the confounding effect of participating in both the comparison period and the treatment period, but in order to exploit the "paired difference" nature of the data; the fact that each student in this data set had a comparison period of performance and a treatment period of performance. Analysis of the Crossover Data Set follows analysis of the Primary Data Set, shown in the next section.

Outcomes Analysis – Primary Data Set [Comparison Group vs. Treatment Group]

Descriptive Statistics – Participant Data

Descriptive statistics for the Primary Data Set are shown below in order to provide an overview of participants, and participant performance. These statistics have been divided into two sections as follows:

- Participant characteristics (a snapshot of demographics, and other characteristics of the participating students)

- Participant performance (performance-related statistics, some of which are related to outcomes analyzed in more detail in the 'Statistical Inference' section)

Participant characteristics

Table 62: Wake Tech CC Descriptive Statistics – Characteristics [Comparison Group vs. Treatment Group]

Participant Characteristics	Comparison			Treatment		
	Count (%)	At Program Entry		Count (%)	At Program Entry	
		Mean Age	Mean Highest Grade Level		Mean Age	Mean Highest Grade Level
Gender						
Female	141 (10.13%)	28.28		69 (17.08%)	30.13	*
Male	1251 (89.87%)	25.65		335 (82.92%)	28.72	*
Race/Ethnicity						
AN	13 (0.93%)	26.38		2 (0.50%)	51	*
AS	34 (2.44%)	26.65		18 (4.46%)	24.83	*
BL	247 (17.74%)	27.84		93 (23.02%)	32.78	*
WH	925 (66.45%)	25.6		254 (62.87%)	28.13	*
Other	173 (12.43%)	24.67		37 (9.16%)	25.84	*
Full-/Part-Time						
Full-Time	*	*	*	*	*	*
Part-Time	*	*	*	*	*	*
Veteran						
Yes	96 (6.90%)	32.38	*	45 (11.14%)	35.29	*
No	1296 (93.10%)	25.44	*	359 (88.86%)	28.17	*
Pell Grant Eligibility						
Yes	526 (37.79%)	25.92	*	197 (48.76%)	28.84	*
No	866	25.91	*	207	29.08	*

	(62.21%)			(51.24%)		
TAA-Eligibility						
Yes	10 (0.72%)	46.6	*	0 (0.00%)	*	*
No	1382 (99.28%)	25.77	*	404 (100.00%)	28.96	*
Employed at Entry						
Yes	*	*	*	*	*	*
No	*	*	*	*	*	*
** Missing/Insufficient data*						
Legend for Race/Ethnicity: AN (American/Alaska Native); AS (Asian); BL (Black or African American); Other//Multiple (include Hispanic ethnicity); WH (White)						

Participant performance

Table 63: Wake Tech CC Descriptive Statistics – Performance [Comparison Group vs. Treatment Group]

Participant Performance	Comp. Grp	Trt. Grp
Course Progress/Completion		
# Courses taken	6344	1320
# Courses where student received a 'C' grade or better	4395	1002
% of courses where student received a 'C' grade or better	69.28%	75.91%
Mean # courses per student	4.56	3.27
Mean # courses taken by a student per semester	2.11	1.93
Student Retention		
Percent of students* retained	31.58%	44.44%
Credential Completion		
# Credentials awarded	470	152
# Diplomas	4	0
# Certificates	309	130
# Degrees	157	22
# Students awarded at least one credential	209	52
Student Support Services		
# (%) Students using support services:	*	*
Mean # service interactions for students using services:	*	*
Employment-Related Activities		
# Students participating in work-based learning opportunities	*	*
** Missing/Insufficient data*		

Statistical Inference – Association between Intervention and Performance [Comparison Group vs. Treatment Group]

Hypothesis tests were performed in order to detect any significant association between the following interventions and outcomes. The hypothesis test results are summarized below:

Table 64: Wake Tech CC Summarized Results of Hypothesis Tests (for Primary Data Set Outcomes)

Is this Intervention…	…associated with this Outcome?	Hypothesis Test Results Suggest that…
MCO program participation	Retention	• The two student groups differ significantly with respect to the proportion retained. Therefore, with the students in the Treatment group having a higher proportion, MCO program participation is associated with a higher retention rate. • MCO participants are approximately twice as likely to be retained as non-MCO-participants.
MCO program participation	Program progress	• Students in the Treatment Group had a significantly higher proportion of grades A, B, or C (.6527) than those in the Comparison Group (.5227).
MCO program participation	Program completion	• The two student groups do not differ significantly with respect to the program completion rate. • Students in Treatment Group are no more likely to complete the program than those in the Comparison Group. • Students in the Treatment Group had significantly fewer program changes than those in the Comparison Group.

The following tables provide more detailed results of the hypothesis tests that were summarized in Table 62 above.

Table 65: Wake Tech CC Hypothesis Test of Program Retention

Retention: **Chi-Square Test (Retained vs. Group)**			
Retained?	Student Groups		
Frequency (Row Pct) (Column Pct)	Comparison Group	Treatment Group	Total
(Missing)	670 (.) (.)	89 (.) (.)	
No	494 (73.84%) (68.42%)	175 (26.16%) (55.56%)	669
Yes	228 (61.96%) (31.58%)	140 (38.04%) (44.44%)	368
Total	722	315	1037
Test Details: Chi-Square Test: DF=1; Test Statistic=15.8564; P-value<0.0001			
Discussion of results: The two student groups differ significantly with respect to the proportion retained. Therefore, with the students in the Treatment group having a higher proportion, MCO program participation is associated with a higher retention rate.			

Table 66: Wake Tech CC Hypothesis Test of Program Retention

Retention: **Odds Ratio Estimate and Wald Confidence Interval [Treatment Group]**			
Parameter	Estimate	95% Confidence Limits (Lower)	(Upper)
Treatment (vs. Comparison)	1.879	1.563	2.258
Test Details: Among Students Eligible for Retention (N=937) Weighted Adjusted Logistic Regression Analysis of Treatment vs. Comparison			
Discussion of results: Students in Treatment Group were almost twice as likely to be retained as those in the Comparison Group (Odds Ratio=1.879, 95% Confidence Interval: [1.563 – 2.258])			

Table 67: Wake Tech CC Hypothesis Test of Program Progress

Progress: **Confidence Intervals for Proportion of Grades A, B, or C**			
Group	Proportion of Grades A, B, or C (Least Squares Mean)	95% Confidence Limits (Lower)	(Upper)
Comparison	0.522724	0.484510	0.560938
Treatment	0.652741	0.614271	0.691212
Test Details: Weighted Adjusted Analysis of Treatment vs. Comparison			
Discussion of results: Students in the Treatment Group had a significantly higher proportion of grades A, B, or C (.6527) than those in the Comparison Group (.5227).			

Table 68: Wake Tech CC Hypothesis Test of Program Completion

Completion: **Chi-Square Test (Completion vs. Group)**			
Completed Program?	Student Groups		
Frequency (Row Pct) (Column Pct)	Comparison Group	Treatment Group	Total
No	1183 (77.07%) (84.99%)	352 (22.93%) (87.13%)	1535
Yes	209 (80.08%) (15.01%)	52 (19.92%) (12.87%)	261
Total	1392	404	1796
Test Details: Chi-Square Test: DF=1; Test Statistic=1.1579; P-value=0.2819			
Discussion of results: The Comparison group and Treatment group do not differ significantly with respect to the program completion rate.			

Table 69: Wake Tech CC Hypothesis Test of Program Completion

Completion: **Odds Ratio Estimate and Wald Confidence Interval [Treatment Group]**			
Parameter	Estimate	95% Confidence Limits (Lower)	(Upper)
Treatment (vs. Comparison)	0.827	0.675	1.013
Test Details: Among Students Eligible for Retention (N=937) Weighted Adjusted Logistic Regression Analysis of Treatment vs. Comparison			
Discussion of results: Students in Treatment Group were no more likely to complete the program than those in the Comparison Group (Odds Ratio=0.827, 95% Confidence Interval: [0.675 – 1.013]).			

Table 70: Wake Tech CC Hypothesis Test of Program Changes

Program Changes: **Confidence Intervals for Proportion of Program Changes**			
Group	Proportion of Program Changes (Least Squares Mean)	95% Confidence Limits (Lower)	(Upper)
Comparison	0.555286	0.495735	0.614838
Treatment	0.339900	0.274534	0.405267
Test Details: PROGACTIVE: The number of programs in which the student is active PROGCHANGE: The number of programs for which the student exited because of changing to some other program PROGGRAD: The number of programs in which the student graduated. Proportion of program changes = PROGCHANGE / (PROGACTIVE+PROGCHANGE+PROGGRAD) Weighted Adjusted Analysis of Treatment vs. Comparison			
Discussion of results: Is the proportion of program changes [i.e. PROGCHANGE / (PROGACTIVE+PROGCHANGE+PROGGRAD)] for the Treatment group significantly lower than the comparable proportion for the Comparison group? Reviewing the above 95% confidence intervals for the proportion of program changes, we see that there is no overlap between the confidence interval for the Comparison Group and the confidence interval for the Treatment Group, and the Treatment Group confidence interval has an upper bound that is lower than the lower bound for the Comparison Group. Therefore, the students in the Treatment Group had a significantly lower mean number of program changes than those in the Comparison Group.			

Outcomes Analysis – Crossover Group [Comparison Period vs. Treatment Period]

Descriptive Statistics – Participant Data

Descriptive statistics for the Crossover data set are shown below in order to provide an overview of participants, and participant performance. These statistics have been divided into two sections as follows:

- Participant characteristics (a snapshot of demographics, and other characteristics of the participating students)
- Participant performance (performance-related statistics, some of which are related to outcomes analyzed in more detail in 'Outcomes Analysis' section)

Participant Characteristics

Table 71: Wake Tech CC Descriptive Statistics – Characteristics [Comparison Period vs. Treatment Period] for Crossover Group

Participant Characteristics	Count (%)	At Program Entry	
		Mean Age	Mean Highest Grade Level
Gender			
Female	20 (11.24%)	27.9	*
Male	158 (88.76%)	24.72	*
Race/Ethnicity			
AN	1 (0.56%)	52	*
AS	9 (5.06%)	23.89	*
BL	23 (12.92%)	29.91	*
WH	128 (71.91%)	24.19	*
Other/Multiple	17 (9.55%)	24.24	*
Full-/Part-Time			
Full-Time	*	*	*
Part-Time	*	*	*
Veteran			
Yes	8 (4.49%)	32.75	*
No	170 (95.51%)	24.71	*
Pell Grant Eligibility			
Yes	59 (33.15%)	25.02	*
No	119 (66.85%)	25.1	*
TAA-Eligibility			
Yes	1 (0.56%)	42	*
No	177 (99.44%)	24.98	*
Employed at Entry			
Yes	*	*	*
No	*	*	*

** Missing/Insufficient data*
Legend for Race/Ethnicity: AN (American/Alaska Native); AS (Asian); BL (Black or African American); Other//Multiple (include Hispanic ethnicity); WH (White)

Participant Performance

Table 72: Wake Tech CC Descriptive Statistics – Performance [Comparison Period vs. Treatment Period] for Crossover Group

Participant Performance	Comp. Period	Trt. Period
Course Progress/Completion		
# Courses taken	1322	980
# Courses where student received a 'C' grade or better	1037	739
% of courses where student received a 'C' grade or better	78.44%	75.41%
Mean # courses per student	7.43	5.51
Mean # courses taken by a student per semester	2.25	1.99
Student Retention		
Percent of students* retained	74.51%	41.83%
Credential Completion		
# Credentials awarded	289	266
# Diplomas	1	0
# Certificates	247	216
# Degrees	41	50
# Students awarded at least one credential	80	91
Student Support Services		
# (%) Students using support services:	*	*
Mean # service interactions for students using services:	*	*
Employment-Related Activities		
# Students participating in work-based learning opportunities	*	*
** Missing/Insufficient data*		

Comment on Table 72: One line of reasoning suggests that the retention rate for the Comparison period and the retention rate for the Treatment period for the Crossover data set may not be comparable because it is the same person for both periods, and over time each person will eventually not return because they have achieved their education goals. In other words, there

may be a natural tendency for a lower retention rate as time goes by, meaning the Treatment period may be expected to have a lower retention rate for the Crossover data set students.

Statistical Inference – Association between Intervention and Performance

The Crossover data set provided the opportunity to analyze paired difference data because each crossover student had performance data in both the Comparison and the Treatment periods.

Table 73: Wake Tech CC Test for Significance of Changes in Retention from Comparison Period to Treatment Period

Retention: Chi-Square Test (Retained vs. Period)			
Retained in Comparison Period?	Retained in Treatment Period?		
Frequency (Row Pct) (Column Pct)	No	Yes	Total
No	6 (13.95%) (60.00%) (20.00%)	4 (9.30%) (40.00%) (30.77%)	10 (23.26%)
Yes	24 (55.81%) (72.73%) (80.00%)	9 (20.93%) (27.27%) (69.23%)	33 (76.74%)
Total	30 (69.77%)	13 (30.23%)	43 (100.00%)
Test Details: % Retained Among Those Eligible in Both Periods			

McNemar's Test	
Statistic (S)	14.2857
DF	1
Pr > S	0.0002

Discussion of Results: Among the students who were eligible to have retention determined, the retention rate during the Comparison period was significantly higher than the retention rate during the Treatment period.

Table 74: Wake Tech CC Hypothesis Test of Program Progress

Progress: **Confidence Interval for Treatment Period Proportion of Grades A, B, or C – Comparison Period Proportion of Grades A, B, or C**			
Group	Treatment Proportion – Comparison Proportion (Mean)	95% Confidence Limits (Lower)	(Upper)
Treatment - Comparison	-0.0752	-0.1281	-0.0223
Test Details: Paired T-Test Treatment vs. Comparison			
Discussion of Results: During the Treatment period, the Crossover students had a significantly lower proportion of grades A, B, or C than during the Comparison period (Mean proportion 0.0752 lower during the Treatment period compared to the Comparison period).			

Table 75: Wake Tech CC Hypothesis Test of Program Progress (after adjusting for number of courses in each period)

Progress: **Confidence Interval for Treatment Period Proportion of Grades A, B, or C – Comparison Period Proportion of Grades A, B, or C**		
Group	Treatment Proportion – Comparison Proportion (Mean)	Pr > |t|
Treatment - Comparison	-0.06146	0.0764
Test Details: Paired Comparison of % ABCs Between Treatment & Comparison Periods Adjusted by Number of Courses in Each Period		
Discussion of Results: During the Treatment period, the Crossover students had a lower proportion of grades A, B, or C than during the Comparison period that was marginally		

significant (Mean proportion 0.06146 lower during the Treatment period compared to the Comparison period).

Exploratory Analysis

The exploratory analysis involved use of the same data sets as for the outcomes analysis. Whereas the outcomes analysis section focused on investigating the association between program intervention and outcomes, this section explores relationships between a wider variety of variables. The purpose of this analysis is to glean from the data any insights regarding the population of students enrolled in technical programs such as Mission Critical Operations. These insights can be very helpful in detecting issues that warrant further study. However, the study was not designed to reach conclusions regarding the factors examined in this section, so only insights, not conclusions, are suggested in this exploratory analysis.

Exploratory Analysis – Primary Data Set [Comparison Group vs. Treatment Group]

Statistical Inference – Other noteworthy hypothesis tests

Table 76: Wake Tech CC Exploratory Analysis – for Primary Data Set Outcomes

Factor	Comment
Gender	Chi-Square Test (P-value=.0001) shows that the Comparison Group and the Treatment Group have a significant difference in proportion of males and females [Treatment Group has higher % females]
Race	Chi-Square Test (P-value=.0206) shows that the Comparison Group and the Treatment Group have a significant difference in racial distribution [Treatment Group has lower % white students and higher % black students]
Veteran	Chi-Square Test (P-value=.0053) shows that the Comparison Group and the Treatment Group have a significant difference in proportion of veterans [Treatment Group has higher % veterans]
Pell Grant	Chi-Square Test (P-value<.0001) shows that the Comparison Group and the Treatment Group have a significant difference in proportion of students who are eligible for a Pell Grant [Treatment Group has higher % Pell Grant eligible students]

Traditional Course Delivery	Chi-Square Test (P-value<.0001) shows that the Comparison Group and the Treatment Group have a significant difference in proportion of courses where the traditional course delivery method (lecture/face-to-face) is used [Treatment Group has lower % of courses with a traditional course delivery approach].

Exploratory Analysis – Course Delivery

Table 77: Wake Tech CC Hypothesis Test – Course Delivery vs. Comparison/Treatment Periods

Course Delivery Method: **Chi-Square Test (Course Delivery Method vs. Period)**			
Course Delivery Method	# (%) Courses with Delivery Method for each period		
Frequency (Column Pct)	Comparison Period	Treatment Period	Total
Hybrid	38 (6.62%)	348 (16.29%)	386 (14.24%)
Online	73 (12.72%)	830 (38.86%)	903 (33.32%)
Traditional	241 (41.99%)	301 (14.09%)	542 (20.00%)
Web-Assisted	222 (38.68%)	657 (30.76%)	879 (32.44%)
Total	574 (100.01%*)	2136 (100%)	2710 (100.00%)
Test Details: Chi-Square Test: DF=3; Test Statistic=307.246; P-value<0.0001 ** Not equal to 100% due to rounding*			
Discussion of results: The two time periods differ significantly with respect to the proportion of each course delivery method used. The percentage of courses with a Traditional delivery method and the percentage of courses with an Online delivery method essentially switched from the Comparison period to the Treatment period. The percentage of courses with a Traditional delivery method decreased from 41.99% in the Comparison period to 14.09% in the Treatment period while the percentage of courses with an Online delivery method increased from 12.72% in the Comparison period to 38.86% in the Treatment period. Such a shift indicates that WTCC has moved significantly toward more online accessibility of MCO-program-related courses.			

Table 78: Wake Tech CC Hypothesis Test – Course Delivery Effect on Proportion of Students Dropping the Course (for Courses Offered in Treatment Period)

Course Delivery Method Effect on Proportion of Students Dropping the Course:

Hypothesis Test and Confidence Interval

Test Results

Kruskal-Wallis Test: Proportion Dropping versus Course Delivery Method

Course Deliv.	N	Median	Ave Rank	Z
Traditional	301	0.1111	825.0	-7.39
Web-Assisted	657	0.1923	1162.0	4.67
hybrid	348	0.1364	924.6	-4.76
online	830	0.1957	1143.1	4.46
Overall	2136		1068.5	

H = 93.22 DF = 3 P = 0.000 (adjusted for ties)

Individual 95% CIs For Median Proportion Dropping a Course

Course Deliv.	N<=	N>	Median	Q3-Q1	Individual 95.0% CIs
Traditional	205	96	0.111	0.190	(---*------)
Web-Assisted	295	362	0.192	0.190	(----*----)
Hybrid	216	132	0.136	0.182	(--*-----)
Online	364	466	0.196	0.172	(-----*--)

```
-------+---------+---------+---------
     0.120     0.150     0.180
```

Test Details: Anderson-Darling test of normality concluded (P-value<0.005) that the assumption of normality could not be made. Therefore, a Kruskal-Wallis Test was performed, and determined that the median proportion dropping a course does differ significantly based on Course Delivery Method (at P-value<0.0001).

Discussion of results: According to the Kruskal-Wallis results, the median proportion of students dropping a course does differ significantly based on Course Delivery Method (i.e. the course delivery method has a significant effect on the proportion of students who drop the course). The Traditional method has a significantly lower drop rate, suggesting that students prefer the traditional course delivery method. The Online method has the highest drop rate (with a close tie to the Web-Assisted course delivery method). One issue to be explored further

is that the two course delivery methods with presumably the most face-to-face contact (Traditional and Hybrid) have the lowest drop rate.

Table 79: Wake Tech CC Hypothesis Test – Course Delivery Effect on Proportion of Students Passing the Course

Course Delivery Method Effect on Proportion of Students Passing the Course: Hypothesis Test and Confidence Interval

Period	Test Results
Comparison	**Kruskal-Wallis Test: Proportion Passing versus Course Delivery Method** Course Deliv. N Median Ave Rank Z Traditional 241 0.8571 321.5 4.18 Web-Assisted 222 0.8182 264.4 -2.65 hybrid 38 0.8750 325.4 1.46 online 73 0.7500 225.7 -3.41 Overall 574 287.5 H = 26.70 DF = 3 P = 0.000 (adjusted for ties)
Treatment	**Kruskal-Wallis Test: Proportion Passing versus Course Delivery Method** Course Deliv. N Median Ave Rank Z Traditional 301 1.0000 1231.4 4.94 Web-Assisted 657 0.8889 1050.8 -0.88 hybrid 348 1.0000 1186.3 3.90 online 830 0.8571 974.0 -5.64 Overall 2136 1068.5 H = 57.61 DF = 3 P = 0.000 (adjusted for ties)

Period	Individual 95% CIs For Median Proportion Passing a Course
Comparison	Course Deliv. N<= N> Median ---------+---------+---------+------- Traditional 108 133 0.857 (--*----) Web-Assisted 125 97 0.818 (----*--) hybrid 16 22 0.875 (----------*----------) online 46 27 0.750 (-----*--------) ---------+---------+---------+------- 0.770 0.840 0.910
Treatment	Course Deliv. N<= N> Median ---+---------+---------+---------+--- Traditional 110 191 1.000 * Web-Assisted 334 323 0.889 (----------*------) hybrid 148 200 1.000 (----------* online 484 346 0.857 (-*--) ---+---------+---------+---------+--- 0.850 0.900 0.950 1.000

Test Details:
Anderson-Darling test of normality concluded (P-value<0.005) that the assumption of normality could not be made. Therefore, a Kruskal-Wallis Test was performed to determine

that the median proportion passing a course does differ significantly based on Course Delivery Method (at P-value<0.0001).
Discussion of results: According to the Kruskal-Wallis test results, the course delivery method has a significant effect on the proportion of students who pass the course (i.e. Grade of A, B, C, or D), with the Hybrid and Traditional methods having a relatively high proportion of students passing in both the Comparison and the Treatment periods. These two methods also show the greatest increase in proportion from the Comparison period to the Treatment period. One issue to be explored further is that the two course delivery methods with presumably the most face-to-face contact (Traditional and Hybrid) have the highest proportion passing rate. This positive effect aligns with the positive effect that face-to-face contact was found to have on the course drop rate.

Limitations

- Due to missing or incomplete data regarding remedial courses, this factor was not considered in the analysis of retention, progress, and completion outcomes;
- Due to missing data regarding student services, the impact of this intervention on retention, progress, and completion outcomes could not be investigated;
- The impact of the instructor factor on proportion of course grades A, B, or C was not investigated, but presumably could be a contributing factor to explain some variation in the proportions.
- Lack of available data regarding employment prevented any analysis of employment outcomes.

21. Evaluation of Participant Outcomes/Impact: Nash CC

Background and Unique Features of Nash Community College Data Set

Nash CC (NCC in some data tables) provided data for a comparison (historical) group of

students and a Treatment (MCO Participant) group of students who enrolled in Fall 2014 or later. Both data sets included demographic data, as well as student performance data. Descriptive statistics for both groups will be shown later in the 'Outcomes Analysis' section.

Year 1 of the grant began in Fall 2013 (October 1, 2013) and each institution started filling MCO staff positions. Nash CC did not record any participants for Year 1. Cleveland CC, as the lead institution, was able to serve 95.3% of all MCO Year 1 participants (or 694 students), according to the APR. Of the other three community colleges, only Wake Tech CC recorded any participants (34) for Year 1. With there being no Year 1 participant data for Nash CC, the data collected for outcomes analysis began with Fall 2014.

The outcomes analysis data presented in this chapter is based on data that Nash CC provided in response to the Evaluation Team's data request (as detailed in Appendix E). While the data the Evaluation Team received was based on the same institutional research data from which the APR statistics were generated, discrepancies between the APR statistics and the outcomes analysis statistics may differ somewhat for the following reasons:

- Differences in timing of data collection. The Evaluation Team's data-request format, common among all four institutions, required an unavoidable additional data processing operation that may have been performed at a time different from when the APR data was compiled. Any system updates occurring between APR-data generation and generation of data for the Evaluation Team that were not accounted for could contribute to a discrepancy.
- Different time period of analysis. While the APR data is a summary of one year, the outcomes data is on a semester basis. Therefore, counts of enrollment per semester, for instance, would not match a yearly unduplicated count of participants in the APR.

- For some students, important data elements used for propensity scoring were missing, resulting in those observations being dropped from the data set to be analyzed.
- For some students, performance-related data elements were missing, resulting in those observations being dropped from the data set to be analyzed.

Table 80 below provides enrollment statistics, according to the data provided to the Evaluation Team, as background for the analysis of outcomes data.

Table 80: Nash CC Enrollment for MCO-related courses

Semester	Count
Fall 2013*	0
Spring 2014*	0
Summer 2014*	0
Fall 2014	202
Spring 2015	342
Summer 2015	76
Fall 2015	303
Spring 2016	301
Summer 2016	26
Fall 2016	292
Spring 2017	-

MCO Interventions at Nash CC

Analysis of the outcomes data provided by Nash CC was performed in order to explore the effects of their MCO program interventions and other activities funded by the MCO grant. Summary information regarding key interventions and activities undertaken as part of the MCO program is shown below in Table 81.

Table 81: Nash CC MCO Program Interventions/Activities

Program Interventions/Activities	% of NCC Effort	% of MCO Consortium Effort
Work Plan Activity 1: Articulation	1.43%	2.70%

Work Plan Activity 2: Project Collaboration and Evaluation	1.98%	4.12%
Work Plan Activity 3: Course Design	2.18%	12.51%
Work Plan Activity 4: Credential Development	1.43%	14.20%
Work Plan Activity 5: Support Services	40.92%	21.77%
Work Plan Activity 6: Scorecard	1.46%	2.93%
Work Plan Activity 7: Telepresence	49.16%	28.42%
Work Plan Activity 8: Evaluation / Performance Tracking	1.43%	13.35%
Total	100.02%*	100.00%
** Does not equal 100.00% due to rounding*		

Outcomes Analysis

The outcomes analysis approach primarily involved construction of two groups of students:

- A Comparison group (may also be referred to as the historical group) comprised of students who only participated in pre-grant-period courses that were subsequently affected by MCO program interventions/activities and/or MCO-funded resources; and
- A Treatment group comprised of students who had enrolled at the institution after the MCO program intervention/activities began at the institution (i.e. the treatment period).

The data set related to the students in the Comparison Group and the Treatment Group is referred to as the Primary Data Set. While most students were classified as being in either the Comparison Group or the Treatment Group, there were also students who were in both the comparison (or historical) period <u>and</u> the treatment period. These students were categorized as Crossover students, and that subset of data, referred to as the Crossover Data Set, was analyzed separately. Separate analysis of the Crossover Data Set was performed in order to not only reduce the confounding effect of participating in both the comparison period and the treatment period, but in order to exploit the "paired difference" nature of the data; the fact that each student in this data set had a comparison period of performance and a treatment period of performance.

Analysis of the Crossover Data Set follows analysis of the Primary Data Set, shown in the next section.

Outcomes Analysis – Primary Data Set [Comparison Group vs. Treatment Group]

Descriptive Statistics - Participant Data

Descriptive statistics for the Primary Data Set are shown below in order to provide an overview of participants, and participant performance. These statistics have been broken into two sections as follows:

- Participant characteristics (a snapshot of demographics, and other characteristics of the participating students)
- Participant performance (performance-related statistics, some of which are related to outcomes analyzed in more detail in the 'Statistical Inference' section)

Participant Characteristics

Table 82: Nash CC Descriptive Statistics – Characteristics [Comparison Group vs. Treatment Group]

Participant Characteristics	Comparison			Treatment		
	Count (%)	At Program Entry		Count (%)	At Program Entry	
		Mean Age	Mean Highest Grade Level		Mean Age	Mean Highest Grade Level
Gender						
Female	80 (8.39%)	35.58	*	90 (12.43%)	30.45	*
Male	873 (91.61%)	28.44	*	634 (87.57%)	26.45	*
Race/Ethnicity						
AN	30 (3.16%)	25.27	*	30 (4.14%)	28.73	*
AS	3 (0.32%)	25.67	*	7 (.97%)	22.71	*
BL	215 (22.66)	31.88	*	151 (20.86%)	28.88	*

HIS	25 (2.63%)	28.56	*	25 (3.45%)	22.80	*
WH	664 (69.97%)	28.43	*	491 (67.82%)	26.49	*
Other/Multiple	16 (1.69%)	23.48	*	20 (2.76%)	26.28	*
Full-/Part-Time						
Full-Time	*	*	*	*	*	*
Part-Time	*	*	*	*	*	*
Veteran						
Yes	*	*	*	*	*	*
No	*	*	*	*	*	*
Pell Grant Eligibility						
Yes	*	*	*	*	*	*
No	*	*	*	*	*	*
TAA-Eligibility						
Yes	*	*	*	*	*	*
No	*	*	*	*	*	*
Employed at Entry						
Yes	*	*	*	*	*	*
No	*	*	*	*	*	*
** Missing/Insufficient data*						
Legend for Race/Ethnicity: AN (American/Alaska Native); AS (Asian); BL (Black or African American); HIS (Hispanic); WH (White)						

Participant Performance

Table 83: Nash CC Descriptive Statistics – Performance [Comparison Group vs. Treatment Group]

Participant Performance	Comp. Grp	Trt. Grp
Course Progress/Completion		
# Courses taken	3,257	2,659
# Courses where student received a 'C' grade or better	2,357	2,134
% of courses where student received a 'C' grade or better	72.37%	80.26%
Mean # courses per student	3.42	3.67
Mean # courses taken by a student per semester	2.00	2.27
Student Retention		
Percent of students* retained	21.85%	34.92%
Credential Completion		

# Credentials awarded	*	*
# Diplomas	*	*
# Certificates	*	*
# Degrees	*	*
# Students awarded at least one credential	*	*
Student Support Services		
# (%) Students using support services:	*	171 (23.62%)
Mean # service interactions for students using services:	*	2.44
Employment-Related Activities		
# Students participating in work-based learning opportunities	*	*
* *Missing/Insufficient data*		

Statistical Inference – Association between Intervention and Performance [Comparison Group vs. Treatment Group]

Hypothesis tests were performed in order to detect any significant association between the following interventions and outcomes. The hypothesis test results are summarized below:

Table 84: Nash CC Summarized Results of Hypothesis Tests (for Primary Data Set Outcomes)

Is this Intervention…	…associated with this Outcome?	Hypothesis Test Results Suggest that…
MCO program participation	Retention	• MCO program participation is associated with a higher retention rate. • MCO participants are approximately twice as likely to be retained as non-MCO-participants.
MCO program participation	Program progress	• Students in the Treatment Group had a significantly higher proportion of grades A, B, or C (.7633) than those in the Comparison Group (.6761).
Student support services	Retention	• The two student groups differ significantly with respect to the proportion retained. Therefore, with the students from the "No Support Service Usage" group having a higher proportion, support services appear to be associated with a lower retention rate.
Student support services	Program progress	• Treatment Group students who had some usage of support services had a significantly lower mean proportion of grades A, B, or C than Treatment Group students who did not use support services.

The following tables provide more detailed results of the hypothesis tests that were summarized in Table 82 above.

Table 85: Nash CC Hypothesis Test of Program Retention

Retention: **Chi-Square Test (Retained vs. Group)**			
Retained?	Students		
Frequency (Row Pct) (Column Pct)	Comparison Group	Treatment Group	Total
(Missing)	651 (.) (.)	429 (.) (.)	
No	236 (55.14%) (78.15%)	192 (44.86%) (65.08%)	428
Yes	66 (39.05%) (21.85%)	103 (60.95%) (34.92%)	169
Total	302	295	597
Test Details: Chi-Square Test: DF=1; Test Statistic=12.5436; P-value=0.0004			
Discussion of results: The two student groups differ significantly with respect to the proportion retained. Therefore, with the students in the Treatment group having a higher proportion, MCO program participation is associated with a higher retention rate.			

Table 86: Nash CC Hypothesis Test of Program Retention

Retention: **Odds Ratio Estimate and Wald Confidence Interval [Treatment Group]**			
Parameter	Estimate	95% Confidence Limits (Lower)	(Upper)
Treatment (vs. Comparison)	1.971	1.517	2.562
Test Details: Among Students Eligible for Retention (N=596) Weighted Adjusted Logistic Regression Analysis of Treatment vs. Comparison			
Discussion of results: Students in Treatment Group were approximately twice as likely to be retained as those in the Comparison Group (Odds Ratio=1.971, 95% Confidence Interval: [1.517 – 2.562])			

Table 87: Nash CC Hypothesis Test of Program Progress

Progress: **Confidence Intervals for Proportion of Grades A, B, or C**			
Group	Proportion of Grades A, B, or C (Least Squares Mean)	95% Confidence Limits (Lower)	(Upper)
Comparison	0.676104	0.642231	0.709976
Treatment	0.763292	0.729442	0.797142
Test Details: Weighted Adjusted Analysis of Treatment vs. Comparison			
Discussion of Results: Students in the Treatment Group had a significantly higher proportion of grades A, B, or C (.7633) than those in the Comparison Group (.6761).			

Table 88: Nash CC Hypothesis Test of Program Retention: (Effect of Student Support Service)

Retention: **Chi-Square Test (Within Treatment: Retention vs. Level of Support Service Usage)**			
Retained?	Students in Treatment Group		
Frequency (Row Pct) (Column Pct)	No Support Service Usage	Some Support Service Usage	Total
(Missing)	346 (.) (.)	83 (.) (.)	
No	123 (64.06%) (59.42%)	69 (35.94%) (78.41%)	192
Yes	84 (81.55%) (40.58%)	19 (18.45%) (21.59%)	103
Total	207	88	295
Test Details: Chi-Square Test: DF=1; Test Statistic=9.7979; P-value=0.0017			
Discussion of results: The two student groups differ significantly with respect to the proportion retained. Therefore, with the students from the "No Support Service Usage" group having a higher proportion, support services appear to be associated with a lower retention rate.			

Table 89: Nash CC Hypothesis Test of Program Progress: (Effect of Student Support Service)

Progress: **Confidence Intervals (Within Treatment Group) for Proportion of Grades A, B, or C** **Grouped by Level of Support Service Usage**			
Group	Proportion of Grades A, B, or C (Least Squares Mean)	95% Confidence Limits for Proportion of Grades A, B, or C (Lower)	(Upper)
Some Support Service Usage	0.708553	0.646542	0.770564
No Support Service Usage	0.779538	0.740837	0.818240
Test Details: Weighted Adjusted Analysis of Some Support Service Usage vs. No Support Service Usage; P-value=0.0199			
Discussion of results: Treatment Group students who had some usage of support services had a significantly lower mean proportion of grades A, B, or C than Treatment Group students who did not use support services.			

Outcomes Analysis – Crossover Group [Comparison Period vs. Treatment Period]

Descriptive Statistics - Participant Data

Descriptive statistics for the Crossover data set are shown below in order to provide an overview of participants, and participant performance. These statistics have been broken into two sections as follows:

- Participant characteristics (a snapshot of demographics, and other characteristics of the participating students)
- Participant performance (performance-related statistics, some of which are related to outcomes analyzed in more detail in 'Outcomes Analysis' section)

Participant Characteristics

Table 89: Nash CC Descriptive Statistics – Characteristics [Comparison Period vs. Treatment Period] for Crossover Group

Participant Characteristics	Count (%)	At Program Entry	
		Mean Age	Mean Highest Grade Level
Gender			
Female	19 (17.12%)	32.68	*
Male	92 (82.88%)	30.16	*
Race/Ethnicity			
AN	1 (0.90%)	18.00	*
AS	1 (0.90%)	25.00	*
BL	39 (35.14%)	33.03	*
HIS	1 (0.90%)	20.00	*
WH	64 (57.66%)	30.41	*
Other/Multiple	5 (4.50%)	19.80	*
Full-/Part-Time			
Full-Time	48 (43.24%)	27.83	*
Part-Time	63 (56.76%)	32.70	*
Veteran			
Yes	13 (11.71%)	36.77	*
No	98 (88.29%)	29.78	*
Pell Grant Eligibility			
Yes	54 (48.65%)	29.63	*
No	57 (51.35%)	31.51	*
TAA-Eligibility			
Yes	*	*	*
No	*	*	*
Employed at Entry			
Yes	*	*	*
No	*	*	*
** Missing/Insufficient data*			
Legend for Race/Ethnicity: AN (American/Alaska Native); AS (Asian); BL (Black or African American); HIS (Hispanic); WH (White)			

Participant Performance

Table 90: Nash CC Descriptive Statistics – Performance [Comparison Period vs. Treatment Period] for Crossover Group

Participant Performance	Comp. Period	Trt. Period
Course Progress/Completion		
# Courses taken	481	499
# Courses where student received a 'C' grade or better	383	417
% of courses where student received a 'C' grade or better	79.63%	83.57%
Mean # courses per student	4.33	4.50
Mean # courses taken by a student per semester	1.65	1.91
Student Retention		
Percent of students* retained	46.67%	58.62%
Credential Completion		
# Credentials awarded	*	*
# Diplomas	*	*
# Certificates	*	*
# Degrees	*	*
# Students awarded at least one credential	*	*
Student Support Services		
# (%) Students using support services:	*	9 (8.11%)
Mean # service interactions for students using services:	*	2.56
Employment-Related Activities		
# Students participating in work-based learning opportunities	*	*
* *Missing/Insufficient data*		

Comment on Table 90: One line of reasoning suggests that the retention rate for the Comparison period and the retention rate for the Treatment period for the Crossover data set may not be comparable because it is the same person for both periods, and over time each person will eventually not return because they have achieved their education goals. In other words, there may be a natural tendency for a lower retention rate as time goes by, meaning the Treatment period may be expected to have a lower retention rate for the Crossover data set students. Therefore, a retention rate that is higher in the Treatment period than in the Comparison period

(or even about the same) could suggest a positive program effect on the retention rate.

Statistical Inference – Association between Intervention and Performance

The Crossover data set provided the opportunity to analyze paired difference data because each crossover student had performance data in both the Comparison and the Treatment periods.

Table 91: Nash CC Regression Model for Program Progress for Crossover Group

Progress: **Regression Model for Proportion of Grades A, B, or C**					
Variable	DF	Parameter Estimate	Standard Error	t-value	P-value
Intercept	1	0.57031	0.08909	6.40	<.0001
CP_ABC	1	0.30617	0.10261	2.98	0.0035
Regression Model: TP_ABC = f(CP_ABC) *where:* TP_ABC: Treatment Period Proportion of ABCs; CP_ABC: Comparison Period Proportion of ABCs					
Discussion of Results: With a P-value of 0.0035, the independent variable (CP_ABC) contributes significantly to the above regression model. Furthermore, the Parameter Estimate being 0.30617 indicates that the students who were performing poorly in the Comparison Period tended to improve during the Treatment Period.					

Table 92: Nash CC Test for Significance of Changes in Retention from Comparison Period to Retention Period for Crossover Group

McNemar's Test	
Statistic (S)	34.5714
DF	1
Pr > S	<.001
Discussion of Results: Among the students who were eligible to have retention determined, the retention rate during the Treatment period was significantly higher than the retention rate during the Comparison period.	

Participant Data – Exploratory Analysis

The exploratory analysis involved use of the same data sets as for the outcomes analysis. Whereas the outcomes analysis section focused on investigating the association between program intervention and outcomes, this section explores relationships between a wider variety of variables. The purpose of this analysis is to glean from the data any insights regarding the population of students enrolled in technical programs such as Mission Critical Operations. These insights can be very helpful in detecting issues that warrant further study. However, the study was not designed to reach conclusions regarding the factors examined in this section, so only insights, not conclusions, are suggested in this exploratory analysis.

Exploratory Analysis – Primary Data Set [Comparison Group vs. Treatment Group]

Statistical Inference – Other noteworthy hypothesis tests

Table 93: Nash CC Exploratory Analysis – for Primary Data Set Outcomes

Factor	Comment
Gender	Chi-Square Test (P-value=.0067) shows that the Comparison Group and the Treatment Group have a significant difference in proportion of males and females [Treatment Group has higher % females].

Race	Chi-Square Test (P-value=.3136) shows that the Comparison Group and the Treatment Group have no significant difference in racial distribution.

Limitations

- Due to missing or incomplete data regarding veteran status, disability, Pell Grant eligibility, TAA eligibility, and remedial courses, these factors were not considered in the analysis of retention and progress outcomes;
- Due to missing data regarding credential completion, the impact of the MCO interventions on program completion outcomes could not be investigated;
- The impact of the instructor factor on proportion of course grades A, B, or C was not investigated, but presumably could be a contributing factor to explain some variation in the proportions;
- Lack of available data regarding employment prevented any analysis of employment outcomes.

22. Evaluation of Participant Outcomes/Impact: Southern Regional TC

Background and Unique Features of Southern Regional Technical College Data Set

The level of analysis of Southern Regional TC (SRTC in some data tables), known as Moultrie Technical College at the beginning of the grant period, will be limited due to the following circumstances: a) Since Southern Regional TC was more of a technical resource for the RAMP technology (for telepresence), there were minimal interventions provided and recorded that related to student outcomes; b) Details regarding the level of course enhancements were insufficient and varied between indicating that no MCO-funded course enhancements were made and that minimal MCO-funded course enhancements were made; and c) The small sample

size and missing data elements. Due to these factors, the outcomes analysis will be minimal, and limited to the reporting of descriptive statistics.

Southern Regional TC provided data for students who took a set of courses that, according to the lead instructor, were enhanced by MCO funds. The data set was divided into a comparison (historical) group of students who only enrolled between Fall2010 and Summer 2014, and a Treatment (MCO Participant) group of students who enrolled in Fall 2014 or later. Both data sets included demographic data, as well as student performance data. Descriptive statistics for both groups will be shown later in the 'Outcomes Analysis' section.

Year 1 of the grant began in Fall 2013 (October 1, 2013) and each institution started filling MCO staff positions. Southern Regional TC did not record any participants for Year 1. Cleveland CC, as the lead institution, was able to serve 95.3% of all MCO Year 1 participants (or 694 students), according to the APR. Of the other three community colleges, only Wake Tech CC recorded any participants (34) for Year 1. With there being no Year 1 participant data for Southern Regional TC, the data collected for outcomes analysis began with Fall 2014.

The outcomes analysis data presented in this chapter is based on data that Southern Regional TC provided in response to the Evaluation Team's data request (as detailed in Appendix E). While the data the Evaluation Team received was based on the same institutional research data from which the APR statistics were generated, discrepancies between the APR statistics and the outcomes analysis statistics may differ somewhat for the following reasons:

- Differences in timing of data collection. The Evaluation Team's data-request format, common among all four institutions, required an unavoidable additional data processing operation that may have been performed at a time different from when the APR data was compiled. Any system updates occurring between APR-data generation and generation of

data for the Evaluation Team that were not accounted for could contribute to a discrepancy.

- Different time period of analysis. While the APR data is a summary of one year, the outcomes data is on a semester basis. Therefore, counts of enrollment per semester, for instance, would not match a yearly unduplicated count of participants in the APR.
- For some students, important data elements were missing, resulting in those observations being dropped from the data set to be analyzed.
- For some students, performance-related data elements were missing, resulting in those observations being dropped from the data set to be analyzed.

Table 94 below provides enrollment statistics, according to the data provided to the Evaluation Team, as background for the analysis of outcomes data.

Table 94: Southern Regional TC Enrollment for MCO-related courses

Semester	Count
Fall 2013*	-
Spring 2014*	-
Summer 2014*	-
Fall 2014	4
Spring 2015	9
Summer 2015	9
Fall 2015	9
Spring 2016	15
Summer 2016	11
Fall 2016	6
Spring 2017	3

MCO interventions at Southern Regional TC

Analysis of the outcomes data provided by Southern Regional TC was performed in order to explore the effects of their MCO program interventions and other activities funded by the MCO grant. Summary information regarding key interventions and activities undertaken as part of the MCO program is shown below in Table 95.

Table 95: Southern Regional TC MCO Program Interventions/Activities

Program Interventions/Activities	% of SRTC Effort	% of MCO Consortium Effort
Work Plan Activity 1: Articulation	0.03%	2.70%
Work Plan Activity 2: Project Collaboration and Evaluation	6.55%	4.12%
Work Plan Activity 3: Course Design	0.03%	12.51%
Work Plan Activity 4: Credential Development	0.03%	14.20%
Work Plan Activity 5: Support Services	61.10%	21.77%
Work Plan Activity 6: Scorecard	0.03%	2.93%
Work Plan Activity 7: Telepresence	24.22%	28.42%
Work Plan Activity 8: Evaluation / Performance Tracking	8.03%	13.35%
Total	100.01%*	100.00%
** Does not equal 100.00% due to rounding*		

Outcomes Analysis

The outcomes analysis approach primarily involved construction of two groups of students:

- A Comparison Group (may also be referred to as the historical group) comprised of students who only participated in pre-grant-period courses that were subsequently affected by MCO program interventions/activities and/or MCO-funded resources; and
- A treatment group comprised of students who had enrolled at the institution after the MCO program intervention/activities began at the institution (i.e. the treatment period).

For Southern Regional TC, the data set related to the students in the Treatment Group also includes what would, for the other institutions, be called the crossover students. These are

students who have taken courses in semesters that spanned the Comparison Group periods and the treatment group periods. However, since the number of students in the Southern Regional TC data set is small, and a more in-depth analysis is not being performed for the Southern Regional TC data, these few crossover students were included in the Treatment Group (applying the rationale that they were in at least one course affected by MCO funds).

Outcomes Analysis – [Comparison Group vs. Treatment Group]

Descriptive Statistics - Participant Data

Descriptive statistics for the data set are shown below in order to provide an overview of participants, and participant performance. These statistics have been broken into two sections as follows:

- Participant characteristics (a snapshot of demographics, and other characteristics of the participating students)
- Participant performance (performance-related statistics, some of which are related to outcomes)

Participant Characteristics

Table 96: Southern Regional TC Descriptive Statistics – Characteristics [Comparison Group vs. Treatment Group]

Participant Characteristics	Comparison			Treatment		
	Count (%)	At Program Entry		Count (%)	At Program Entry	
		Mean Age	Mean Highest Grade Level		Mean Age	Mean Highest Grade Level
Gender						
Female	2 (2.33%)	22	*	0 (0.0%)	*	*
Male	84 (97.67%)	28.79	*	27 (100.0%)	23.67	*
Race/Ethnicity						
AN	0	*	*	0	*	*

AS	0	*	*	0	*	*
BL	21 (24.42%)	30.1	*	6 (22.22%)	26.17	*
HIS	3 (3.49%)	29.67	*	3 (11.11%)	21.33	*
WH	61 (70.93%)	28.18	*	18 (66.67%)	23.22	*
Other/Multiple	0	23.48	*	20 (2.76%)	26.28	*
Full-/Part-Time						
Full-Time	71 (82.56%)	28.62	*	21 (77.78%)	23.33	*
Part-Time	15 (17.44%)	28.67	*	6 (22.22%)	24.83	*
Veteran						
Yes	4 (4.65%)	25.5	*	1 (3.85%)	49	*
No	82 (95.35%)	28.78	*	25 (96.15%)	22.68	*
Pell grant eligible						
Yes	63 (73.26%)	29.22	*	22 (81.48%)	24.32	*
No	23 (26.74%)	27	*	5 (18.52%)	20.8	*
TAA-eligible						
Yes	*	*	*	*	*	*
No	*	*	*	*	*	*
Employed at Entry						
Yes	*	*	*	*	*	*
No	*	*	*	*	*	*

** Missing/Insufficient data*

Legend for Race/Ethnicity: AN (American/Alaska Native); AS (Asian); BL (Black or African American); HIS (Hispanic); WH (White)

Participant Performance

Table 97: Southern Regional TC Descriptive Statistics – Performance [Comparison Group vs. Treatment Group]

Participant Performance	Comp. Grp	Trt. Grp
Course Progress/Completion		
# Courses taken	600	132
# Courses where student received a 'C' grade or better	533	131
% of courses where student received a 'C' grade or better	88.83%	99.24%
Mean # courses per student	6.98	4.89
Mean # courses taken by a student per semester	2.22	1.63
Student Retention		
Percent of students* retained	48.00%	7.69%
Credential Completion		
# Credentials awarded	*	*
# Diplomas	*	*
# Certificates	*	*
# Degrees	*	*
# Students awarded at least one credential	43	23
Student Support Services		
# (%) Students using support services:	*	*
Mean # service interactions for students using services:	*	*
Employment-Related Activities		
# Students participating in work-based learning opportunities	*	*
* *Missing/Insufficient data*		

Statistical Inference – Association between Intervention and Performance [Comparison Group vs. Treatment Group]

No hypothesis tests were performed for the SRTC data set. However, comments based on review of the above descriptive statistics are provided below.

Table 98: Southern Regional TC Comments on Descriptive Statistics shown above

Comments Regarding Treatment Group Students
• There were no female participants. The lowest level of female participation for the other three institutions was 13.05% (at NCC).

- SRTC has a much higher percentage of full-time students (77.78%) than the other two institutions reporting full-time/part-time status (CCC: 44.56% full-time; NCC: 43.24% full-time).
- SRTC had a much higher percentage of students who were Pell Grant eligible (81.48%) compared to the other two institutions reporting Pell Grant eligibility status (NCC: 48.65% Pell Grant eligible; WTCC: 43.99% full-time). Furthermore, the Pell Grant eligible students at SRTC are, on average, at least 3.5 years younger than the NCC and WTCC Pell Grant eligible students.
- At SRTC, the % of courses where students received a 'C' grade or better was substantially higher (at least 18 percentage points) than the other institutions.
- The retention rate was extremely low compared to the other institutions.

Exploratory Analysis

The purpose of this analysis is to glean from the data any insights regarding the population of students enrolled in technical programs such as Mission Critical Operations. These insights can be very helpful in detecting issues that warrant further study. However, the study was not designed to reach conclusions regarding the factors examined in this section, so only insights, not conclusions, are suggested in this exploratory analysis.

Exploratory Analysis – [Comparison Group vs. Treatment Group]

Descriptive Statistics - Participant Data

Table 99: Southern Regional TC Exploratory Analysis – Other Descriptive Statistics and Comments

Comments
• Course consolidation and reorganizing occurred at SRTC between the Summer 2011 semester and the Fall 2011 semester. A review of descriptive statistics regarding the proportion of Grades A, B, or C indicate a slight shift toward a higher proportion of Grades A, B, or C for the post-change semesters.

Limitations

- Due missing or incomplete data regarding course delivery methods, student support services, detailed outcomes analysis could not be performed.

- While the data provided did enable the calculation of some descriptive statistics, in-depth analysis of outcomes, such as any hypothesis testing, was not performed due to the low number of participants and level of data provided.
- Due to missing data regarding student services, the impact of this intervention on retention, progress, and completion outcomes could not be investigated;
- The impact of the instructor factor on proportion of course grades A, B, or C was not investigated, but presumably could be a contributing factor to explain some variation in the proportions.
- Lack of available data regarding employment prevented any analysis of employment outcomes.

23. Addressing Impact/Outcomes Research Questions

The detailed evaluation plan specified three research questions related to outcomes/impact analysis. Drawing from the previous four chapters containing institution-level descriptive statistics and/or hypothesis tests, the following table provides results that address these research questions.

Table 100: Research questions related to outcomes/impact analysis

Research Question	Characteristic / Issue	Analysis Results
1. What are the characteristics of the MCO program participants and how similar are these students to the students enrolled in the Comparison	Gender	For two of the four institutions, a higher percentage of the MCO participants were females.
	Age	For three of the institutions, the female MCO participants were, on average, older than the male MCO participants.(the 4th institution had no female MCO participants). This same age difference between females and males existed for the Comparison Group students as well.
	Race	For one of the four institutions, a higher percentage of the MCO participants were White, whereas for the other three institutions this percentage was roughly the same as the Comparison Group.

Group programs?		One institution had an increase in MCO participants who were Black, another institution had a decrease, while the percentage of MCO participants who were Black stayed roughly the same.
	Veteran	Only one institution reported a higher percentage of MCO participants who were veterans.
	Pell Grant eligibility	Both of the institutions that provided sufficient Pell Grant eligibility data reported a higher percentage of MCO participants who were Pell Grant eligible.
Research Question	**Characteristic / Issue**	**Analysis Results**
2. How do participant outcomes (credit, certificates, degree attainment, retention, employment, wages) compare with students in the Comparison Groups?	Retention	<u>Reviewing Descriptive Statistics:</u> For three of the four institutions, the retention rate for MCO participants was higher than for students in the Comparison Group. For the fourth institution, data quality issues may have resulted in what appeared to be an outlier value. <u>Hypothesis testing:</u> *See the institution-level outcomes analysis chapters for hypothesis testing results.*
	Progress (as measured by receiving Grade A, B, or C on a course).	<u>Reviewing Descriptive Statistics:</u> For three of the four institutions, the proportion of courses where the students received a 'C' grade or better was higher for the MCO students, while this rate for the fourth institution stayed approximately the same. <u>Hypothesis testing:</u> *See the institution-level outcomes analysis chapters for hypothesis testing results.*
	Completion	<u>Reviewing Descriptive Statistics:</u> One institution recorded a substantially higher percentage of students being awarded at least one credential, while the other two institutions that provided completion data recorded a slightly lower percentage of students being awarded at least one credential. Both of the institutions for which number of credentials awarded per student could be calculated showed a higher number of credentials awarded per student for the MCO participants. <u>Hypothesis testing:</u> *See the institution-level outcomes analysis chapters for hypothesis testing results.*

Research Question	Characteristic / Issue	Analysis Results
3. What program aspects promote progress and completion? What barriers affect student progress and completion?	Student support services	Student support service was found to be a key factor affecting progress and completion. For further details, *see the institution-level outcomes analysis chapters for hypothesis testing results.*
	Course delivery method	Course delivery method was found to be key a factor affecting progress and completion. For further details, *see the institution-level outcomes analysis chapters for hypothesis testing results.*

SECTION VI – Evaluation Findings and Limitations

24. Findings

This chapter will provide overall evaluation findings for the implementation/process analysis, as well as for the outcomes/impact analysis. Supplementing these findings will be a status review of progress made in addressing gaps identified in the MCO proposal. The chapter will conclude with a discussion of additional effects suggested by evaluation findings and observations.

Findings Based on Evaluation Observations and Analysis of Implementation/Processes

The implementation/process findings are presented below, and are organized by two focus areas: 1) the project's fidelity to the original work plan, and 2) the process efficiency and effectiveness, based on the completed outputs as well as strengths and challenges found for each of the eight work plan activity areas.

Fidelity to the Work Plan

Table 101 below shows an overall activity completion rating that was determined by examining the final outputs of each work plan activity task. The scoring for the process effectiveness rating was based on four categories related to the completion of the task: 1) Not Started, 2) Partially Complete, 3) Completed, and, 4) Completed Beyond Original Scope.

Table 101: Project Fidelity to the Work Plan

Work Plan Activity	% In Progress	% Completed	% Completed Beyond Scope	Comments
1. Articulation	**0%**	**100%**	**0%**	None – all tasks complete by the end of the grant.
2. Collaboration and Project Evaluation	**0%**	**100%**	**0%**	None – all tasks complete by the end of the grant.
3. Course Design	**0%**	**85%**	**15%**	The implementation of MCO concepts into existing courses exceeded the expectations set forth in the proposal.

4. Credential Development	**0%**	**100%**	**0%**	None – all tasks complete by the end of the grant.
5. Support Services	**0%**	**85%**	**15%**	The resources offered via the virtual Digital Tutor sites is beyond what was originally set forth in the proposal, particularly the integration of SMEs into the asynchronous communication channels.
6. Scorecard	**0%**	**100%**	**0%**	None – all tasks complete by the end of the grant.
7. Telepresence	**0%**	**100%**	**0%**	None – all tasks complete by the end of the grant.
8. Project Tracking and Evaluation	**15%**	**85%**	**0%**	Participation in the national evaluation is ongoing.

Process Efficiency

Table 103 below shows high-level thematic strength and challenge areas that were recorded for each of the work plan activities. Table 102 to the right provides an explanation for the color coding. Low frequency means that 1 strength or challenge was recorded. High frequency means 2 or more strengths or challenges were recorded. In some cases the same theme could have been a strength and a challenge.

Table 102. Legend for Project Work Plan Activities Heat Map

Description	Color Code
Low Freq. Strength	
High Freq. Strength	
Low Freq. Challenge	
High Freq. Challenge	
Both Strength and Challenge	

Table 103. Process Efficiency Heat Map with Strength and Challenge Themes

Strength / Challenge Themes	Project Work Plan Activities (WPAs)							
	WPA 1: Articulation	**WPA 2: Collab. And Project Evaluation**	**WPA 3: Course Design**	**WPA 4: Credential Development**	**WPA 5: Support Services**	**WPA 6: Scorecard**	**WPA 7: Telepresence**	**WPA 8: Evaluation and Performance Tracking**
Awareness of Grant Program								
Broader Institutional Impact								
Communication								
Content Development								
Continuous Improvement								
Coordination								
Data Collection								
Data Quality								
Employer Engagement								
Employer Feedback								
Adaptability of Program								
Partner Participation								
Program Sponsor Delays								
Quality Framework								
Standard Process								
Student Support and Success								
Timely Implementation								
Knowledge Sharing								

Findings Based on Evaluation Observations and Analysis of Participant Outcomes/Impact

The outcomes/impact findings are presented below, and are organized by two focus areas: 1) the overall impact of MCO participation on student retention, program progress, and program completion; and 2) the impact of MCO-funded student support services on student retention, program progress, and program completion.

Table 104: Summary of Key Results from Outcomes Analysis Related to Overall MCO Program Participation

Outcome Metric	CCC	NCC	WTCC	SRTC
Retention	MCO participants are approximately twice as likely to be retained as non-MCO-participants.	MCO program participation is associated with a higher retention rate. MCO participants are approximately twice as likely to be retained as non-MCO-participants.	MCO program participation is associated with a higher retention rate. MCO participants are approximately twice as likely to be retained as non-MCO-participants.	While the retention rate was extremely low compared to the other institutions, a more in-depth analysis was not performed, due to data limitations. Therefore, no firm conclusions can be drawn regarding retention.
Program progress	Treatment Group had a slightly lower proportion of grades A, B, or C.	Treatment Group had a significantly higher proportion of grades A, B, or C.	Treatment Group had a significantly higher proportion of grades A, B, or C.	<Not analyzed>
Program completion	MCO program participants are no more likely to complete the program than non-MCO-participants.	<Not analyzed>	MCO program participants are no more likely to complete the program than non-MCO-participants.	<Not analyzed>
Color-coding:				
A positive outcome associated with MCO program participation				
No outcome effect associated with MCO program participation				
A negative outcome associated with MCO program participation				

The MCO program clearly had a positive impact on student retention. Except for CCC, Student progress in the program progress was also positively impacted by MCO participation, with the exception of student progress at CCC. As far as the negative outcome regarding CCC student progress is concerned. However, it should be noted that program progress was significantly more positive for students at CCC who used support services (see test results below).

Table 105: Summary of Key Results from Outcomes Analysis Related to Student Support Services

Outcome Metric	CCC	NCC	WTCC	SRTC
Retention	MCO participants who used Support Services are more than five times as likely to be retained as MCO participants who did not use Support Services.	The students from the "No Support Service Usage" group had a higher retention rate.	<Not analyzed>	<Not analyzed>
Program progress	MCO participants who used Support Services had a significantly higher proportion of grades A, B, or C than MCO participants who did not use Support Services.	The students from the "No Support Service Usage" group had a significantly higher proportion of grades A, B, or C.	Students in the Treatment Group had significantly fewer program changes than those in the Comparison Group.	<Not analyzed>
Program completion	MCO participants who used Support Services were more than three and a half times as likely to complete the program as MCO participants who did not use Support Services.	<Not analyzed>		<Not analyzed>
Color-coding:				
A positive outcome associated with student support services				
No outcome effect associated with student support services				
A negative outcome associated with student support services				

The outcomes analysis related to support service usage provide strong evidence that student support services contribute to positive outcomes regarding program progress and completion. Additionally, for Cleveland CC the support services were associated with positive outcomes regarding retention. The negative impact of support services on retention and program progress at Nash CC suggests that further research is needed to determine if comparable services were provided or if there are other mitigating circumstances that explain the counterintuitive results.

Progress Made in Addressing Gaps Identified in MCO Proposal

The 'Gap Analysis' outlined in the MCO proposal was an important motivating factor for the inception of the MCO program. Therefore, a final perspective included in the evaluation findings is a status review at the end of the grant regarding progress made in addressing gaps in existing educational and career training programs and systems infrastructure. Table 106 below provides a 'Result at End-of-Grant' status review of these gaps, identified as 'Limitations and Other Issues Identified by MCO college partners' in the MCO proposal.

Table 106: Limitations and Other Issues Identified by MCO college partners

Limitations Regarding the Number of Students Successfully Served and Inability to Meet Demand	
Originally Stated Gap Pre-TAACCCT Funding	**Result at End-of-Grant**
Low representation of females and other underrepresented groups in MCO-related programs	At the end of the grant, the proportion of female students at Nash CC and Wake Tech CC increased over the Comparison Group (Nash CC: Comparison (8.4%) Treatment (12.4%); Wake Tech CC: Comparison (10.13%) Treatment (17.08%)). As for underrepresented groups, there were some slight differences among proportion of underrepresented groups in the treatment group. Wake Tech CC saw positive shifts in the proportion of Black students as MCO participants (Comparison (17.74%) Treatment (23.02%)). While some progress was made towards addressing this issue, there appeared to be little in regards to concerted planning efforts, and activities, focused on addressing this issue.
Lack of options to accommodate work and school conflicts	The technology-enabled learning environments that was afforded by the grant is one way that the consortium partners accommodate work and school conflicts. By offering more online and web-enabled learning experiences, the traditional attendance-based face to face environment is no longer a constraint for students. Tools such as the telepresence labs can be accessed from anywhere around the world as long as the student has an internet connection.
Lack of program options that afford staged career pathways	The stacked and latticed credential framework that was developed as part of the MCO grant program affords staged career pathways. With both high and low-stakes credentials created, students can decide between certifications, diplomas, and degrees (A.S. and B.S.).
Too few resources to initiate new programs	The TAACCCT funding supported full time positions to coordinate the development of the new MCO program.

Limitations Regarding Faculty Expertise and Facility Infrastructure	
Originally Stated Gap Pre-TAACCCT Funding	**Result at End-of-Grant**
Lack of faculty with expertise in emerging MCO concepts	The TAACCCT funding also supported faculty SME positions, where partner colleges were able to attract industry experts into faculty roles at the college, carrying with them expertise around MCO concepts.
Lack of physical lab facilities **Outdated facilities and equipment**	One critical component of the grant funding was to support construction and renovation of facilities for the MCO program. Although the budget modification process in relation to the construction and renovation activity was time consuming, all partners benefited from additional lab facilities to support the MCO and MCO-related programs at their respective colleges. In regards to equipment, the grant also afforded a plethora of equipment to support the MCO program. Examples include: • Data Center upgrades at Cleveland CC that offer students a real-world perspective of how a data center operates. The servers installed at Cleveland CC revamped the entire campus network and have allowed for the expansion of virtual computing space for all students. A smaller, separate section of the data center is a testing ground for students to work through scenarios that they might experience at a real-world data center environment. *Figure 15: Pictures of Cleveland CC Data Center Upgrades*  • The grant provided equipment for the Electrical Lineman program at Nash CC, as well as an emergency responder simulator (that can double as a real emergency response location for local county emergency response and public safety officials), and a law enforcement active shooter simulator. • Wake Tech CC was able to install a large water treatment simulator that has been integrated with the telepresence system for students to access remotely.

Limitations Regarding Content, Quality, and Availability of Applicable Courses	
Originally Stated Gap Pre-TAACCCT Funding	**Result at End-of-Grant**
Courses not keeping pace with current technology	The research performed by UNC Charlotte in technology-enabled learning systems built the foundation for the telepresence components of the MCO program to be integrated in to MCO and MCO-related courses.
Lack of course work in new/trend setting MCO concepts aligned with high demand jobs	As part of defining the core competencies for the MCO program, industry SMEs were gathered, and through facilitated conversations and exercises, the MCO competencies were created. These competencies informed the creation of the MCO certification programs (Certified Mission Critical Operator [CMCO] and Certified Mission Critical Professional [CMCP]) as well as new MCO courses. With many of the industry SMEs that were involved also being employers of high demand jobs in MCO, the alignment between new and 'trend setting' MCO concepts and MCO / MCO-related coursese was made.
No entry point for training in MCO	Entry points for MCO training were created via the stacked and latticed credential framework that includes the MCO certifications (CMCO and CMCP) and the MCO degree program.

Factors Contributing to Program Attrition (Across Discipline Areas)	
Originally Stated Gap Pre-TAACCCT Funding	**Result at End-of-Grant**
Inadequate transition and completion support	The grant afforded full time positions for success coach / intrusive advising support. The coaches worked directly with MCO participants to assist them with setting goals, coursework planning, and preparing for the workforce (e.g. resume help, mock interviews, work-based learning opportunities).
Hesitancy of students to use advising/tutoring	By going beyond traditional advising that may typically focus on registration and course planning, by being dedicated support for the MCO participants, the MCO Support Staff were able to establish closer relationships with students to understand their unique needs and provide more one-on-one support.

Lack of tools necessary to track graduates	*The consortium identified NCTOWER as the technology for the employment results scorecard system. This system does provide employment results of graduates at the institution and program levels, but the data is currently outdated. Other efforts to obtain employment and wage records were unsuccessful during the grant period.*
Specialized Equipment Needs (Across Discipline Areas)	
Originally Stated Gap Pre-TAACCCT Funding	**Result at End-of-Grant**
Available equipment is not sufficient to provide training	See comments above regarding facilities and equipment upgrades. The grant supported upgrades and, in some cases, replacements of systems and infrastructures to provide more distance learning opportunities for their training programs.
Equipment telepresence as a new skill area	Telepresence systems were installed or upgraded at each of the partner colleges. The telepresence labs were in response to local industry that the respective colleges support. Along with the MCO participants benefiting from the telepresence labs, MCO faculty gained new knowledge in the development of telepresence systems and labs that could benefit others who are seeking to upgrade or implement similar systems (inside and outside of the states of NC and GA).

Additional Effects of MCO Grant

In concluding this chapter on findings, a different and broader vantage point from which to view the MCO grant and its effects (both intended and unintended) is provided; one that is not restricted by work plan activities or evaluation questions, but that draws from the findings, the review of identified gaps that were addressed, and reflecting on the many points of interaction the Evaluation Team had with the MCO Consortium stakeholders. This synthesis of observations and findings suggests the following additional noteworthy effects.

Table 107: Additional noteworthy effects suggested by observations and findings

Theme	Comments

Innovation	A blended Associate's degree and certificate option was produced that satisfies the prerequisite requirements set forth by UNC Charlotte, complies with NC Community College System policies, and does not negatively affect non-transfer-bound MCO students.
Communication	In regards to evaluation and data collection, communication around data definitions and data quality issues were improved from the perspective of the APR reporting.
Institutional Impact	Cleveland CC developed the MCO Digital Learn and Digital Study platforms, which were first developed for MCO students, but Cleveland CC is planning to expand it to non-MCO students in the future.
	Cleveland CC's Success Coach model was deemed a success by the college, enough so that the Success Coach model is being expanded to all students at Cleveland CC through another grant funding opportunity.
Knowledge Sharing	The effectiveness of course delivery involving an online component seems to be having a positive impact on student enrollment and performance in the course.

25. Limitations to Performing the Evaluation

As with any planned program evaluation, there are limitations encountered during the execution of the plan that must be considered when interpreting the evaluation results. Some of the limitations were unique to a particular institution, and were identified in the pertinent institution-level outcomes analysis chapter. Other limitations, however, spanned several institutions, and are noted below because of their impact on achievement of the initial evaluation plan goals.

- Student participation in a survey regarding MCO was minimal. Therefore, even though the process evaluation and outcomes analysis focused on the student aspect of the grant, a more in-depth perspective provided by the students would have helped either validate, refute, or expand upon, the observations and findings related to student impact.
- Institutional changes (merging of Moultrie Technical College and Southwest Technical

Georgia College into Southern Regional Technical College), as well as MCO program management/staff changes, occurred during the grant period. The impact that these changes may have had on the grant performance was not examined as part of the MCO evaluation.

- Due to the lack of employment and wage data across all institutions, only outcomes related to retention, progress, and completion were analyzed. Therefore, while positive impact on employment and wages can be inferred from student performance analysis and engagement and support of employers, positive employment and wage impact of the MCO program cannot be confirmed.

SECTION VII – Implications for Policy and Practice

26. Implications of the TAACCCT-Funded Program

Drawing extensively from the evaluation findings stated earlier, implications of the TAACCCT MCO consortium are provided in this chapter in order to inform future MCO-related activities (and similarly-focused programs). Several detailed sources of information also contributed to considering the implications of the TAACCCT MCO consortium: work plan activity process observations (strengths and challenges), gaps originally stated in the grant needs section and status at the end of the grant, lessons learned from the implementation and evaluation of the grant program, and insights into efforts that will sustain the MCO program beyond the grant funding. Also, at the end of the Year 3 grant extension period, the evaluation team met with each of the MCO project managers to ask what some of their biggest challenges and lessons learned from the grant that they would be comfortable sharing with others (to include policymakers, other grantees/applicants, among others). The implications for the MCO consortium will be organized around *Lessons Learned*, and *Sustainability*; each of which are summarized in Tables 108 and 109 below.

Table 108: Implications of the MCO Program – Lessons Learned

Theme	Description	Relevant Audiences
Budget Modification Approval	Several of the MCO partner colleges had to submit budget modifications and they noted at the end of the grant that they would have planned more thoroughly to be able to submit the modification requests much earlier. In at least one case, the delays in modification approval led to unspent grant funds.	**MCO Consortium, Future Applicants/ Grantees, Funding Agencies**
Hiring Skilled Faculty	Some of the partner institutions reported challenges hiring faculty with relevant experience and skills for MCO. Salary was one factor that made this difficult, as many MCO-related industry jobs have much more competitive salaries for people with these skillsets.	**MCO Consortium, Future Applicants/ Grantees**
Project Management Skills	For Cleveland CC, the project management of the grant was led by a faculty member. As this is not completely out of the ordinary for a P.I. / project director to be a faculty member, a lesson learned that is being offered to other grantees in this position is to invest in some level of project management training for faculty	**Future Applicants/ Grantees, Funding Agencies**

	P.I. / project directors on grants.	
Data Collection	With impact evaluations on the rise, grantees should work closely with their research / evaluation team to define the data needs of the project from the onset, and execute a plan with data collection milestones to build the analysis data set over time. One challenge that was out of the consortium's control was the collection of employment data for the outcomes analysis. This was a topic discussed throughout the grant period, but required a partnership with another state entity to retrieve the data. Although an MOU was established to collect this data for the community colleges in NC, the level of data that was collected and reported was not granular enough to be used by the evaluation team for the outcomes analysis. There was not a standardized process by which student support services data (frequency and detail of student interactions with MCO support staff) was collected across the MCO partner colleges. This resulted in fragmented or insufficient data from some of the partner colleges, which meant that the outcomes analysis for those colleges would be limited by the missing factors.	**MCO Consortium, Future Applicants/ Grantees, Evaluation and Research Professionals, Funding Agencies**
Adaptability of the Program	Articulation efforts were expedited when the decision was made to implement Memoranda of Understanding (MOU) for transferable credit rather than official articulation agreements, which have to be approved by college/university leadership (e.g. President/Chancellor-level). Nash Community College displayed adaptability in their programming due to feedback received from local employers. They made the decision to implement an MCO certificate program instead of the Associate's degree because employers wanted a stackable MCO credential that could go along with other degree programs (e.g. Law Enforcement).	**MCO Consortium, Future Applicants/ Grantees, Funding Agencies**

Communication	The communication among the partners improved over the course of the grant. Face to face meetings were most effective in engaging all partners, but scheduling did not always permit for face to face meetings so virtual (Webex) options were provided. Some of the faculty interviewed during the grant period seemed to be unaware of the course and content development work taking place at other partner colleges. A more collaborative approach to content development may have been experienced by more frequently convening the faculty teaching MCO-related courses to discuss curriculum / content development.	**MCO Consortium, Future Applicants/ Grantees**
Student Support Services	While outcomes analysis suggests that student support services had a positive impact on student performance, retention at one of the colleges was lower for students using support services. This result suggests substantial variation in type of support services between institutions, as well as the importance of a thorough examination of how such services are designed and delivered.	**MCO Consortium, Future Applicants/ Grantees, Funding Agencies**
Knowledge Sharing	Throughout the grant the partners worked closely together to design and adapt the telepresence systems at each of their respective institutions. This process required a high level of collaboration and knowledge sharing, including discussions around lessons learned.	**MCO Consortium, Funding Agencies**
Time Availability of Subject Matter Experts	Some of the participating SMEs were interested in providing more assistance to the project but were challenged in finding available time to do so. Any process for involving SME participation that can reduce time demand would likely increase the number (or level of participation) of SMEs.	**MCO Consortium, Future Applicants/ Grantees**

Table 109: Implications of the MCO Program – Program Sustainability

Theme	Description	Relevant Audiences
Establishment of Credential Programs	The development and establishment of multi-layer credential programs (certifications and degrees) legitimized the MCO program efforts, as these credentials come with some sort of accreditation and/or markers of quality (e.g. Quality Matters Certifications). The legitimization of the program contributes to the sustainability – now based on an enrollment supply and demand model, the program will sustain itself as long as there is a demand for MCO graduates in the workforce.	**Employers, Funding Agencies, MCO Consortium, Future Applicants/ Grantees**
Building Program Awareness	Related to the establishment of credential programs, mentioned above, program sustainability is also attributed to varying degrees of outreach and awareness-building that took place through the MCO partners at different capacities. Most recently, Wake Tech CC put on a Mini-Maker Faire in Raleigh, North Carolina. This event is largely centered around MCO and building awareness of the program across all ages (weekend family event). Throughout the grant, career fairs, presentations at conferences, paper/online marketing collateral, and connections with the local workforce development boards were ways in which awareness was built around the MCO program.	**MCO Consortium, Funding Agencies, Employers, Future Applicants/ Grantees**
University Partnerships and Research	University partnerships contributed to the sustainability of the MCO program in two ways. The first is regarding the credential pathway that includes articulation to 4-year Bachelor's degree programs. Having this option built into the stacked and latticed credential framework for MCO attracts students with varying levels of aspiration and/or immediate education needs. The second contribution is in regards to research. As a result of the MCO consortium partnership, UNC Charlotte is conducting research that is tied to cybersecurity in MCO-related industry settings. The findings of this research could have positive impacts on the MCO partner colleges as well as MCO-related industries.	**MCO Consortium, Employers, Funding Agencies, Future Applicants/ Grantees**

Section VIII: References

27. List of References

Anderson, G., Sun, J. & Alfonso, M. (2006) Effectiveness of statewide articulation agreements on the probability of transfer: a preliminary policy analysis. *The Review of Higher Education* 29(3)261-291.

Audant, A. (2016) Stackable credentials and career/college pathways in culinary arts at Kingsborough Community College, CUNY, *Community College Journal of Research and Practice*, 40(4), 299-309, DOI: 10.1080/10668926.2015.1056918

Baker, R. (2016) The effects of structured transfer pathways in community colleges. *Educational Evaluation and Policy Analysis*. 38 (4), 626–646 DOI: 10.3102/0162373716651491 © 2016 AERA. http://eepa.aera.net

Bath, D., & Bourke, J. (2011). The blending of blended learning: An experiential approach to academic staff development. In G.Williams, P. Statham, N. Brown, B. Cleland (Eds.) *Changing Demands, Changing Directions.* Proceedings ascilite Hobart 2011.133-138. Retrieved from: http://www.ascilite.org/conferences/hobart11/downloads/papers/Bath-concise.pdf

Beck, Kunert, Kulik, and Froehlich, (2013) Immersive group-to-group telepresence. *IEEE Transactions on Visualization and Computer Graphics* 19(4).

Braun, J., & Zolfagharian, M. (2016). Student participation in academic advising: Propensity, behavior, attribution and satisfaction. Research in Higher Education, 57(8), 968-989. Doi:10.1007/s11162-016-9414-2

Bureau of Labor Statistics (2016). Retrieved from: https://www.bls.gov/cps/certifications-and-licenses.htm#highlights

Burley, D. Gnam, C., Newman, R., Straker, H., & Babies, T. (2012). Leveraging higher education consortia for institutional advancement, *International Journal of Educational Management*, 26(3), 274-283, https://doi.org/10.1108/09513541211213345

Carter, S. D. (2005). The growth of supply and demand of occupational-based training and certification in the united states. 1990-2003. *Human Resource Development Quarterly*, 16(1), 33-54.

Dadgar and Trimble (2014). Labor Market Returns to Sub-Baccalaureate Credentials: How Much does a Community College Degree or Certificate Pay? *Educational Evaluation and Policy Analysis*, (v.37- 4)

Fincher, M. (2014). Articulation visibility at two-year colleges. *Community College Journal of Research and Practice*, 38 (7), 684–692. DOI: 10.1080/10668926.2011.585111

Fonolahi, A., Khan, M., Jokhan, A. (2014) Are students studying in the online mode faring as well as students studying in the face-to-face mode? Has equivalence in learning been achieved? *Merlot Journal of Online Learning and Teaching*, 10(4).

Giani, M., Fox, H. (2017) Do stackable credentials reinforce stratification or promote upward mobility? An analysis of health professions pathways reform in a community college consortium, *Journal of Vocational Education & Training*, 69(1), 100-122, DOI: 10.1080/13636820.2016.1238837

Giraldo F., Jiménez Á., Trefftz H., Restrepo J., Esteban P. (2010) Distance Interaction in Education Processes using a Telepresence Tool. In: Iskander M., Kapila V., Karim M. (eds) *Technological Developments in Education and Automation*. Springer, Dordrecht.

Grandgenett, N, Thiele, L., Pensabene, T., & McPeak, B. (2015). It Takes a Village to Raise an Information Technology Project: Suggestions on Collaboration From Our 10-Community-College Consortium, *Community College Journal of Research and Practice*,39:7, 647-658, DOI: 10.1080/10668926.2014.883555

Guba, E.G., & Lincoln, Y.S. (1981). Effective Evaluation. San Francisco: Jossey-Bass.

Haeffele, L., Hood, L., & Feldmann, B. (2011). Evaluation capacity building in a school-university partnership grant program. *Planning and Changing*, 42(1), 87-100. http://proxying.lib.ncsu.edu/index.php?url=http://search.proquest.com.prox.lib.ncsu.edu/docview/909483870?accountid=1272

Higgins, V. (2017). Augmented & virtual reality: The future of work, not just play. *Professional Safety*, 62(6), 86.

Jones, S., Hansen, K. (2014) Technology Review: Virtual intrusive advising -- supporting community college students through web-based synchronous technologies. *The Community College Enterprise*, 88-92.

Kettunen, J. (2010) "Cross-evaluation of degree programmes in higher education", *Quality Assurance in Education*, Vol. 18 Issue: 1, pp.34-46, https://doi.org/10.1108/09684881011015981

Klotz, D., Wright, T. (2017). A best practice modular design of a hybrid course delivery structure for an executive education program. *Decision Sciences Journal of Innovative Education*, 15(1).

Legewie, H. (1994). "Globalauswertung," in A. Bohm, T. Muhr, and A. Mengel (eds)., Texte verstehen: Konzepte, Methoden, Werkzeuge. Konstanz: Universitatsverlag. pp. 100-114.

Locke, 2014. European Journal of Education, Vol. 49, No. 1, 2014DOI: 10.1111/ejed.12060

Lumina Foundation (2015). Connecting Credentials Report A Beta Credentials Framework. Retrieved from: http://connectingcredentials.org/wp-content/uploads/2015/05/ConnectingCredentials-4-29-30.pdf

Major, D., Major, H. (2011), A Systems Approach to Improving Community College Courses. , *The Community College Enterprise*.

Mattessich, P. W. (2012). Advisory committees in contract and grant-funded evaluation projects. *New Directions for Evaluation*, 2012(136), 31-48. doi:10.1002/ev.20032

Mayring, P. (1983). Qualitative Inhaltsanalyse. Grundlagen und Techniken (7th edn 1997). Weinheim: Deutscher Studien Verlag.

McLaughlin, M., Starobin, S., & Laanan, F. (2010) Medical simulation in the community college health science curriculum: a matrix for future implementation, *Community College Journal of Research and Practice*, 34(6), 462-476.

Mirriahi, N., Alonzo, D., & Fox, B. (2015). A blended learning framework for curriculum design and professional development. Research in Learning Technology, 23

Nalamwar, Kalhapure, Khatake, Gandhi, & Jain. (2016) Real Time Communication using Embedded System beyond Videoconferencing and towards Telepresence. *International Journal of Computer Applications* 134(14), 28-31.

NC Tower Website. Retrieved from: http://nctower.com/aboutnctower/

The Common Follow-up System Evaluation Report (2015). NC Department of Commerce. Labor and Economic Analysis Division. Retrieved from: https://www.nccommerce.com/Portals/47/Publications/COMMON%20FOLLOW-UP%20SYSTEM%20REPORT/CFS%20Evalution%20Report%20-%202015.pdf

Pallant, A., McIntyre, C., & Stephens, A. L. (2016). Transforming undergraduate research opportunities using telepresence. *Journal of Geoscience Education*, 64(2), 138-146. doi:http://dx.doi.org.prox.lib.ncsu.edu/10.5408/15-118.1

Peikes, Deborah N., Lorenzo Moreno, and Sean Michael Orzol. "Propensity score matching." *The American Statistician* 62.3 (2008).

Picciotto, R. (2014). Is impact evaluation evaluation? The European Journal of Development Research, 26(1), 31-38. doi:http://dx.doi.org.prox.lib.ncsu.edu/10.1057/ejdr.2013.44.

Roggow, M. J. (2014), Improving Student Performance Outcomes and Graduation Rates through Institutional Partnerships. *New Directions for Community Colleges*, 2014: 25–35. doi:10.1002/cc.20088

Ryan, S., Kaufman, J., Greenhouse, J., She, R. & Shi, J. (2016) The effectiveness of blended online learning courses at the community college level, 40(4), 285-298.

Senie, K. (2016) Implementing transfer and articulation: A case study of community colleges and state universities, *Community College Journal of Research and Practice*, 40:4, 269-284, DOI: 10.1080/10668926.2015.1038667

Shadish, W.R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference*. Wadsworth Cengage learning.

Shea, J., Joaquin E., & Gorzycki. (2015). Hybrid course design: Promoting student engagement and success. *Journal of Public Affairs Education*, 21(4), 539– 556.

Sidman, C., D'Abundo, M., Bullard, L. (2014) Comparison of college students' knowledge across delivery formats in a required physical activity and wellness course. *Merlot Journal of Online Learning and Teaching, 10(4).*

Smith, A., Opp, R., Armstrong, R., Stewart, G., & Isaacson, R. (1999) Community college consortia: an overview, *Community College Journal of Research and Practice*, 23(4), 371-385, DOI: 10.1080/106689299264774

Smith, J. (2007) Using data to inform decisions: intrusive faculty advising at a community college, *Community College Journal of Research and Practice*, 31:10, 813-831, DOI: 10.1080/10668920701375918

Smith, D., Louwagie, N. (2017) Delivering advanced technical education using online, immersive classroom technology, *Community College Journal of Research and Practice*, 41:6, 359-362, DOI: 10.1080/10668926.2016.1273152

Stake, R. (1975). Evaluating the arts in education: A responsive approach. Columbus, OH: Merrill (p.14).

Stern, J. (2016) The effect of articulation agreements on community college transfers and bachelor's degree attainment, *Community College Journal of Research and Practice*, 40(5), 355-369, DOI: 10.1080/10668926.2015.1065209

Strempel, E. (2014). Strategic collaboration in an increasingly interconnected world: a primer on the possibilities of consortium building. *Planning for Higher Education Journal*, 58-62.

TAACCCT Round 3 SGA (2013). Retrieved from: http://www.doleta.gov/grants/pdf/taaccct_sga_dfa_py_12_10.pdf(TAACCCT Round 3 SGA, 2013, p. 22)

Vuokko Niiranen (2008). The many purposes of performance evaluation, *International Journal of Public Administration*, 31:10-11, 1208-1222, DOI: 10.1080/01900690801973303

White, H. (2014). Current challenges in impact evaluation. *The European Journal of Development Research*, 26(1), 18-30 DOI:http://dx.doi.org.prox.lib.ncsu.edu/10.1057/ejdr.2013.45

Wilcox, K. (1982). Ethnography as a methodology and its application to the study of schooling. In G. Spindler (Ed.), Doing the Ethnography of schooling. New York: Holt, Rinehart & Winston.

Worthen, B., Sanders, J., & Fitzpatrick, J. (1997). *Program Evaluation* (2nd ed.). New York, NY: Longman. (p. 81 and 92).

Wyner, J., Deane, K. Jenkins, D. & Fink, J. The transfer playbook: essential practices for two- and four-year colleges aspen institute (2016) 60. ERIC: ED565894

Section IX: Appendices

28. Appendix Table of Contents

29. Appended Documents

THIS PAGE WAS INTENTIONALLY LEFT BLANK – APPENDIX A STARTS ON NEXT PAGE

Articulation

Work Plan Activity	Deadline	Responsibility (stated in Work Plan)	CCC	MTC	NCC	WT	UNCC
1. Develop Crosswalk CE>Curriculum>University	4/1/2014	led by Nash and UNCC	Active Participant	No Involvement	Lead	No involvement	Lead
2. Accrediting bodies approve articulated credit, prior learning, competency based, and other	12/31/2014	led by Cleveland	Lead	No Involvement	No involvement	No involvement	Active Participant
3. Develop draft SOPs for articulated credit	12/31/2015	led by Cleveland	Lead	No involvement	Active Participant	No involvement	Active Participant
4. MCO college partners implement SOPs	9/30/2016	led by Cleveland	Lead	No involvement	Active Participant	No involvement	Active Participant

Collaboration and Project Coordination

Work Plan Activity	Deadline	Responsibility (stated in Work Plan)	CCC	MTC	NCC	WT	UNCC
1. Establish a data collection method for outcome measures	6/30/2014	led by Cleveland	Lead	Active Participant	Active Participant	Active Participant	Active Participant
2. Consult public workforce agencies on new Virtual OneStop system	6/30/2014	led by Cleveland and Region C WDB	Lead	*Follow-up*	Active Participant	Active Participant	No involvement
3. Project evaluation	9/30/2017	led by Cleveland and external evaluator	Lead	Provide Input	Provide Input	Provide Input	Provide Input
4. Evaluation of deliverables	9/30/2017	led by Cleveland and third-party evaluator	Lead	Provide Input	Provide Input	Provide Input	Provide Input

Course Design

Work Plan Activity	Deadline	Responsibility (stated in Work Plan)	CCC	MTC	NCC	WT	UNCC
1. Identify MCO competencies to develop standardized course components and MOOCs	6/30/2014	led by Cleveland, Wake Tech	Lead	No Involvement	Active Participant	Lead	No involvement
2. Develop two OER MCO courses	7/31/2014	led by Cleveland, employer, agency partners, employer associations	Lead	No Involvement	No Involvement	Active Participant	No involvement
3. Launch new MCO components on NTER	12/31/2014	led by Cleveland	Lead	No Involvement	No Involvement	*Follow-up*	No involvement
4. Consult public workforce agencies on LMI trends	9/30/2017	led by all members	Lead	Lead	Lead	Lead	Lead
5. Implement MCO components in existing courses	5/31/2015	led by Cleveland with all partner colleges	Lead	No involvement	Active Participant	Active Participant	Active Participant
6. Offer new MCO courses in online or hybrid formats	5/31/2015	led by Cleveland	Lead	No involvement	Active Participant	Active Participant	*Follow-up*
7. Use analytics to drive learning and continuous improvement of courses	9/30/2017	led by Wake Tech	Active Participant	No involvement	Provide Input	Lead	No involvement

Credential Development

Work Plan Activity	Deadline	Responsibility (stated in Work Plan)	CCC	MTC	NCC	WT	UNCC
1. Develop and receive approval to offer MCO degree (certificate, diploma, degree options)	12/31/2014	led by Cleveland	Lead	No Involvement	Active Participant	Active Participant	No involvement
2. Develop low stakes MCO credentials (2-6)	12/31/2015	led by Cleveland	Lead	No involvement	No involvement	No involvement	No involvement
3. Develop high stakes MCO credentials (1-2)	9/30/2016	led by Cleveland	Lead	No involvement	No involvement	No involvement	No involvement

Instruction and Support Services

Work Plan Activity	Deadline	Responsibility (stated in Work Plan)	CCC	MTC	NCC	WT	UNCC
1. Evaluate evidence-based design models and create timeline for implementation	12/31/2014	led by Cleveland	Lead	Active Participant	Active Participant	Active Participant	No involvement
2. Implement Basic Skills Plus for participants without a high school diploma	12/31/2014	led by Cleveland	Lead	Active Participant	???	???	No involvement
3. Implement RAMP Plus	7/31/2015	led by Moultrie and Cleveland	Lead	Lead	Active Participant	Active Participant	No involvement
4. Digitize MCO resources to create a virtual, digital tutor	12/31/2015	led by Cleveland	Lead	No involvement	Active Participant	No involvement	No involvement
5. Target course offerings to underrepresented groups	12/31/2014	led by Cleveland and AF	Lead	Active Participant	???	???	No involvement
6. Integrate MCO in entrepreneurship courses	12/31/2014	led by Wake Tech		???	???	Lead	No involvement
7. Confirm work-based learning opportunities, develop strategic plan for participants	05/31/2015	led by Cleveland	Lead	Active Participant	Active Participant	Active Participant	No involvement

Scorecard Development

Work Plan Activity	Deadline	Responsibility (stated in Work Plan)	CCC	MTC	NCC	WT	UNCC
1. Develop employment results scorecard work plan	6/30/2014	led by Cleveland and public workforce agencies	Lead	No Involvement	No involvement	No involvement	No involvement
2. Update and revise scorecard work plan each quarter	9/30/2017	led by Cleveland	Lead	Provide Input	Provide Input	Provide Input	Provide Input
3. Identify virtual system or developer for scorecard technology	12/31/2014	led by Cleveland	Lead	No involvement	No involvement	No involvement	No involvement
4. Develop scorecard technology	9/30/2016	led by Cleveland and contracted staff	Lead	Provide Input	Provide Input	Provide Input	Provide Input

Telepresence

Work Plan Activity	Deadline	Responsibility (stated in Work Plan)	CCC	MTC	NCC	WT	UNCC
1. Inventory existing equipment and IT infrastructure	12/31/2013	led by Cleveland	Lead	Active Participant	Active Participant	Active Participant	Active Participant
2. Establish protocol for renovation and complete renovation (add network drops, etc.)	3/31/2015	led by Cleveland	Lead	Active Participant	Active Participant	Active Participant	Active Participant
3. Procure equipment using each member's procurement standard	12/31/2014	led by Cleveland	Lead	Active Participant	Active Participant	Active Participant	Active Participant
4. Integrate equipment with software and IT network infrastructure	5/31/2015	led by Cleveland and contracted staff	Lead	Active Participant	Active Participant	Active Participant	Active Participant
5. Place telepresence in MCO courses/course components	12/31/2015	led by Cleveland and Moultrie Tech	Lead	Lead	Active Participant	Active Participant	Active Participant

Tracking and Evaluation

Work Plan Activity	Deadline	Responsibility (stated in Work Plan)	CCC	MTC	NCC	WT	UNCC
1. Implement tracking system	12/31/2013	led by Cleveland and Region C WDB	Lead	Active Participant	Active Participant	Active Participant	Active Participant
2. Create and launch web portal	5/31/2014	led by Cleveland and contracted staff	Lead	No Involvement	No involvement	No involvement	No involvement
3. Submit quarterly reports to DOL using tracking system	12/31/2013	led by Cleveland	Lead	Active Participant	Active Participant	Active Participant	Active Participant
4. Third-party evaluation of deliverables of the project matched to project work plan	9/30/2017	led by Cleveland and contracted staff	Lead	Provide Input	Provide Input	Provide Input	Provide Input
5. Evaluation of project outcome measures and project work plan	9/30/2017	led by Cleveland and project evaluator	Lead	Active Participant	Active Participant	Active Participant	Active Participant
6. Participate in national evaluation	9/30/2017	led by Cleveland and project evaluator	Lead	Active Participant	Active Participant	Active Participant	Active Participant

North Carolina State University
Industrial Extension Service
Evaluation Team

Detailed Evaluation Plan for Mission Critical Operations

I. TABLE OF CONTENTS

II. INTRODUCTION

MCO Consortium Partners
Cleveland Community College (NC)
Nash Community College (NC)
Wake Technical Community College (NC)
Moultrie Technical College (GA)
UNC Charlotte

This Detailed Evaluation Plan outlines the design and execution of a rigorous evaluation for the Mission Critical Operations (MCO) program funded by the U.S. Department of Labor Trade Adjustment Assistance Community College and Career Training (TAACCCT) program, effective for the period beginning on October 1, 2013, and continuing through September 30, 2017. The plan reflects an expansion of the summary evaluation plan submitted on July 2, 2013 and incorporates feedback received from the U.S Department of Labor, while addressing the required components of the evaluation detailed in SGA PY12-10.

Cleveland Community College (CCC), lead institution for the National Consortium for Mission Critical Operations (hereafter referred to as "the MCO Consortium"), defined MCO as "Any operation requiring round-the-clock supervision of systems aimed at combating the evolving threat of critical infrastructure operations failure." MCO spans a breadth of industries, concentrating on the electrical/electronic, industrial, and information technology components that support the various enterprises. In 2013, subsequent to receiving official notification of the award, the MCO Consortium contracted with North Carolina State University's Industrial Extension Service (hereafter referred to as "the Evaluation Team") to conduct a formative and summative evaluation of the MCO Program. The contract was awarded in compliance with the established written guidelines for contracting services among public North Carolina entities. The goals of the evaluation are:

- Reporting: Present current status on the interactions among the stakeholders at the operational level--industry partners, college and university administrators, project leaders, faculty, student support staff, technology leaders and developers, credentialers, contractors and the third party evaluation team. Methods: the Evaluation Team will conduct interviews, focus groups, surveys, document analysis, as well as attend and report on meetings.
- Assessing: Through thorough and frequent formative evaluation activities, the Evaluation Team will chart the progress of program implementation through rigorous qualitative analysis, assessing steps in program implementation from initial design through final delivery of all phases.
- Evaluating: Through rigorous summative evaluation of program impacts, a broad-based comparison will be made showing differences in institutional achievement following implementation of the MCO program. Additionally, a quasi-experimental study will seek to identify associations evidenced in course

enhancement and development, use of support services (counseling and digital tutor), use of RAMP technology, and credentialing.

This Detailed Evaluation Plan is responsive to the goals, as well as the U.S. Department of Labor's feedback on the summary evaluation plan, as summarized in Table 1 below:

TABLE 1: RESPONSES TO U.S. DEPT OF LABOR FEEDBACK	
Feedback from USDOL	**Response by the Evaluation Team**
Factor 1 Assessment: Outcomes/Impact Analysis	
The statistical methods to be used for drawing a well-matched comparison group, such as propensity score matching, and a detailed discussion of the covariates to be used for matching treatment with comparison group members. A description of the statistical methods and outcomes used for estimating the impact of the program on students.	• A quasi-experimental comparison cohort study design will be used. • Propensity score matching will be used as the analysis technique between the historical comparison students and future students of the grant program • Reliability analyses will be used to exploit the different implementation strategies across schools in the consortium. *References:* Section V. D. 'Historical quasi-experimental analyses for all treatment types'; Section V. 'Rationale'
The appropriateness of using Electrical System students as a comparison to mission critical operations students served under the TAACCCT grant. While the plan mentions that the length and credentials earned from the programs are similar, there is no information on the similarity of labor market expectations for students who complete these programs (e.g., job availability and salary expectations).	• Enrollment, demographic (including TAA eligibility), academic, labor market data and other sources will be compiled and analyzed to document program outcomes. • A quasi-experimental comparison cohort study design will be used to explore the factors giving rise to successful program outcomes *References:* Section V. *'Rationale'*
The size of the comparison group is potentially too small for developing a well-matched comparison group. A large pool of comparison group individuals, at least several times or more than the treatment group size, is needed to successfully match treatment and comparison group members for the analysis.	• Two approaches discussed: 1) creating a historical comparison group by obtaining enrollments in IST and IT majors; and 2) creating a contemporaneous comparison group by identifying colleges in NC and GA that offer similar degree programs, but have not received grant funds. The historical comparison model was selected. *References:* Section V. D. *'Historical quasi-experimental analyses for all treatment types'*
Factor 2 Assessment: Implementation Analysis	
A conceptual framework (e.g., theory of change, logic model) is needed to guide the evaluation and assess fidelity to the model.	• A logic model has been developed. • The program theory of change is grounded in a sequence of stages to: 1) explore how to improve outcomes; 2) gather meaningful evidence; 3) discuss evidence broadly; 4) use

	evidence to inform change; and 5) measure the impact of change. • Data and information will be provided on a regular basis to support an evidence-based improvements towards attaining stated goals. *References:* Section IV. *'Logic Model and Conceptual Model';* Figure 1 *'MCO Program Logic Model'*
The plan needs to describe how program improvements will be made without interfering with the impact analysis.	• Quantitative impact analyses will be conducted by analyzing student demographic and performance data from the student information system and employment services. • Program Implementation Analysis for qualitative analysis of data from surveys, interviews, and focus groups with students, faculty, program managers, employers, and advisory boards. *References:* Section V. B. *'Outcomes Analysis';* Table 8 *'Outcomes/Impact Analysis Research Questions'*

Research Questions. Table 2 below summarizes the set of required program implementation research questions and outcomes and deliverables evaluation questions to be answered, supplemented by a set of additional questions that will be formative in nature to promote continuous improvement based on the intervention being tested and the efforts to expand institutional capacity.

TABLE 2: RESEARCH QUESTIONS	
Required Program Implementation	**Outcomes & Deliverables**
1. How was the particular curriculum selected, used, and/or created?	1. What are the characteristics of the MCO participants and how similar are the students enrolled in the comparison group programs?
2. How were programs and program designs improved or expanded using grant funds? What delivery methods were offered? What was the program administrative structure? What support services and other services were offered?	2. How do participant outcomes (credit, certificates, degree attainment, retention, employment, wages) compare with students in the comparison groups?
3. Was an in-depth assessment of participants' abilities, skills, and interests conducted to select participants into the grant program? What assessment tools and processes were used? Who conducted the assessment? How were the assessment results used? Were the assessment results useful in determining the appropriate program and course sequence for participants? Was career guidance provided, and if so, through what methods?	3. What program aspects promote progress and completion? What barriers affect student progress and completion?

4. What contributions did each of the partners (employers, workforce system, other training providers and educators, philanthropic organizations, and others as applicable) make in terms of: 1) program design, 2) curriculum development, 3) recruitment, 4) training, 5) placement, 6) program management, 7) leveraging of resources, and 8) commitment to program sustainability? What factors contributed to partners' involvement or lack of involvement in the program? Which contributions from partners were most critical to the success of the grant program? Which contributions from partners had less of an impact?	

Data and Methodology. Table 3 below provides an overview of the four categories of data that will be used in this evaluation process:

TABLE 3: CATEGORIES OF DATA	
Data	**Description**
Outcomes and Outputs Projections	The data presented in Section 3.i.(1) Outcome Projections Outcome Measures (Project Narrative p. 35) represent the annual and cumulative promise of the MCO consortium to serve students in enrollment, retention, completions, earning credentials, seeking further education, finding employment and advancement. These data mark the beginning point of the project's aims for student success, and their attainments are the targets of the two types of formative data presented below. The Consortium is accountable for reaching these projections.
Program Implementation Data	Research questions included above in the Program Implementation Measures and Analyses section anticipate qualitative analysis assessing how well the various program elements are implemented. Qualitative measures include course enhancement and development; student support services; and the degree of cooperation and collaboration among the college partners, employers, contractors, and other stakeholders. The singular quality of the questions, however, is that they are asked in the present, seeking knowledge about the past.
Work Plan Evaluation Data	The third type of data is operational—that is, generated to help partners meet their milestones in time to be evaluated and reported. These data, which mediate between the work plan and the evaluation plan, result from the TPE team's building a three-dimensional database to connect the logic model to the evaluation questions to the milestones in the work plan to the calendar. .
Quasi-experimental Summative Data	The evaluation process will also include a quasi-experimental model designed to determine the extent to which grant activities appear to change performance measures for IST and IT students in each institution. These data will compare (1) an historical comparison group for each college with the group of IST and IT students receiving the treatment afforded by grant activities beginning in Fall 2014, and (2) differences in primary treatment factors and outcomes/response variables within certain groups.

Data will be collected from each institution's student information system, from individuals via surveys, interviews, and focus groups, from document analysis, and observation of program processes, meetings, and other consortium member interactions. Administrative documentation/processes will also be reviewed for grant compliance purposes. For additional information regarding data sources please review Tables 5 and 9.

Observations, comments, and findings will be reported through periodic reports, in scheduled data submissions to the U.S. Department of Labor, in periodic meetings with the Consortium, in the Interim Reports and the Final Cumulative Report. A database has been developed by the Evaluation Team to link each workplan activity specified in the project narrative (see Table 10 in the original grant application) to detailed evaluation questions and activities. Such linkage is designed to facilitate communication between MCO consortium members and the Evaluation Team regarding evaluation expectations and the deadlines associated with evaluation activities and reporting schedules (see Table 10 revised timeline).

III. INTERVENTION

The MCO Program has three main objectives that are designed to effect change for the target population and build institutional capacity:

(1) Increase attainment of certificates, diplomas and other industry related credentials to better prepare TAA-eligible and other adults with high-skill, high wage employment or re-employment…;
(2) Introduce innovative and effective methods for curriculum development and delivery that address specific industry needs and lead to improved learning outcomes and retention rates for TAA workers and other adults;
(3) Demonstrate for TAA workers in particular improved employment outcomes. (p. 3, Project Narrative).

Table 4 below provides an overview of the project interventions that will be evaluated (including ancillary components), summarizing the changes anticipated as a result of the interventions, and specific sustainable outcomes and projected impact on institutional capacity. Column 1, TAACCCT Supported Intervention Activities, lists each of the Intervention Activities as outlined in Figure 1 MCO Program Logic Model; column 2, Effect on Target Populations, lists the effects that the intervention activities will have on students in the MCO program; and column 3, Outcomes/Increased Capacity, lists the long-term goals of the MCO program.

TABLE 4: IMPACT OF INTERVENTIONS*		
TAACCCT-Supported Intervention Activities	**Effect on Target Populations**	**Outcomes/ Increased Capacity**
1. Articulation	• Improved articulation agreements across institutions	• Increased student articulated credits • Increased number of certificates and diplomas • Increased institutional capacity to maintain enrollment • Processes in place to accommodate articulation agreements
2. Collaboration	• Enhanced curriculum that better positions students to be successful in workforce • New MCO career pathways that blend courses from MCO partner colleges	• More business and industry needs are met. • Increased employment outcomes for TAA workers and other adults • Increased demand for high skills jobs in North Carolina
3. Course Design	• Enhanced core curriculum • Innovative and effective curriculum development and delivery that address specific industry needs	• Improved learning outcomes • Improved retention rates for TAA workers and other adults
4. Credential Development	• Stacked and latticed credentials	• Increased attainment of industry related credentials
5. Instruction/ Support	• Enhanced student support services (counseling and advising, digital tutors, virtual labs, and other services) • Career coaching • Students develop plans that align to their interests	• Improved time to degree • Improved retention and graduation rates
6. Scorecard Development	• Enhanced processes to strengthen data collection and identify what data is important • Enhanced career pathways for students	• Expanded workforce development initiatives • Increased capacity to coalesce timely and accurate data • Increased capacity to use data to make informed decisions
7. Telepresence	• Upgrades to technology • Enhanced capacity to deliver instruction • Additional flexibility for students	• Increased training accessibility long-term • Continued increased presence of online and technology enabled learning in MCO college partner degree programs
8. Tracking/ Evaluation	• Enhanced data and information collection and sharing • Enhanced data and accountability systems	• Participant tracking established

Not all of the Community College partners are doing each intervention.

Evidence-Based Design. As outlined in the original grant proposal, the MCO Project is based on a number of excellent educational practices and models. These include virtualization as a model (Park, 2011), research done on the RAMP Plus project from Georgia, , the "small chunks" model for instructional delivery (Govindasamy, 2001), hybrid and/or blended learning approaches (emporium or buffet models) (Twigg, 2003), use of the Basic Skills Plus approach to accelerating mastery of developmental education subjects (North Carolina Community College System, 2013), and the Career Pathways Initiative as a model for career pathway development (Workforce3One, 2011).

IV. IMPLEMENTATION ANALYSIS DESIGN

Logic Model and Conceptual Model. To analyze the steps taken by the MCO Consortium to create and run the MCO program, a logic model (Figure 1) has been developed to engage the MCO Consortium in developing a shared vision and to integrate the model into implementation. The program theory of change, as shown in Figure 1, is that the MCO program, as designed, will: 1) increase attainment of certificates, diplomas, and other industry related credentials to better prepare TAA-eligible and other adults with high skill, high wage employment or re-employment in growth industry sectors; 2) introduce innovative and effective methods for curriculum development and delivery that address specific industry needs and lead to improved learning outcomes and retention rates and for TAA workers and other adults; and, 3) demonstrate for TAA workers in particular improved employment outcomes as a result of the funded program. Over the long-term, program completers will be well equipped to gain employment in well-paying jobs in many high-demand industries.

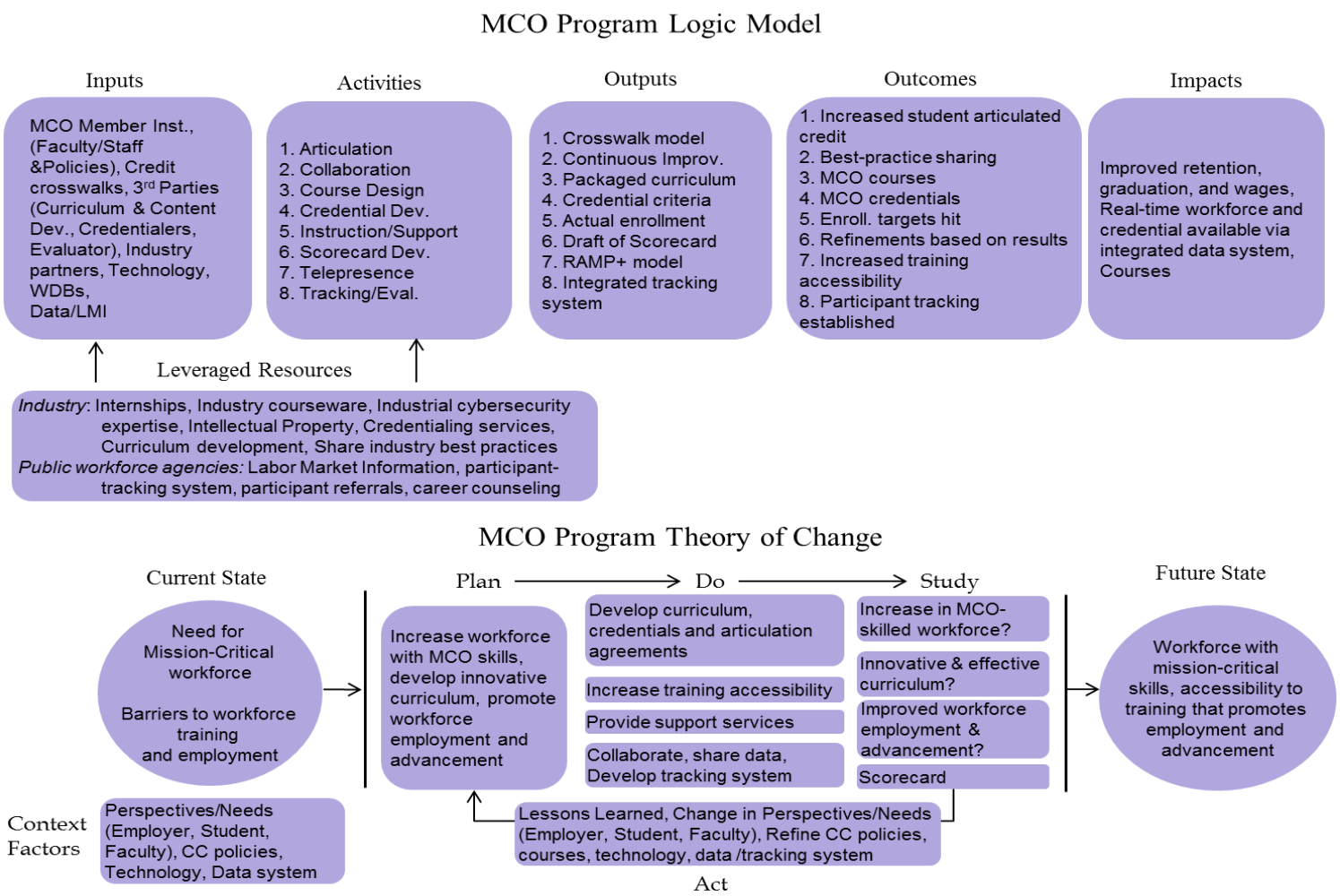


Figure 1. **MCO Program Logic Model**

NOTE: The above MCO Program Theory of Change will provide the context for development of the evaluation framework, but the detailed evaluation plan activities will be organized by the MCO Program Logic Model (LM) Activities. However, this approach to organize the evaluation activities does not imply a pre-determined acceptability of the LM, since its detailed content and rationale is also subject to assessment and evaluation

The MCO Logic Model presents a picture of how the MCO Program is designed to accomplish the stated outcomes and explains the alignment of the inputs and activities towards accomplishing the stated outputs and outcomes. The MCO Program Theory of Change supports and enhances this approach by requiring justifications at each step of the logic model process by using the model of Plan, Do, Study, Act (PDSA). The Logic Model developed by the MCO Consortium is designed to be an activity-based reflection of the "Plan" and "Do" elements of the MCO Program Theory of Change. The "Study" and "Act" elements are incorporated via a database that links each Logic Model activity (as detailed in the workplan) to the related evaluation activities.

The Evaluation Team will analyze the steps taken by the institution to create and run the MCO program by observing consortium meetings, reviewing documentation, and assessing implementations plans. The Evaluation Team will conduct a comprehensive evaluation of the project through observations of the implementation of the program and provide regular, ongoing, relevant feedback to program implementers while the program is still in the formative process. The operational strengths and weaknesses of the project after implementation will be assessed by reviewing fully developed content and curriculum and by conducting interviews and/or focus groups with consortium Partners, Subject Matter Experts, and Students.

The formative process will include review of implementation and early outcome data to allow early identification of any problems with the new MCO program or the project's implementation so that these can be proactively addressed. To that end, qualitative analysis of student, faculty, and employer feedback will be performed. Quantitative data will be summarized and charted as appropriate. Reports each semester will inform project planning and any modifications that may be needed in overall design. The chosen evaluation strategy will help reduce potential data consistency and completeness challenges since each college's data should be internally consistent for its treatment and historical control groups.

A. <u>Implementation Analysis Research Questions</u>

Table 5 below outlines each evaluation question and sub-questions, the data elements/sources necessary to address the question, data collection methods that will be utilized, and the time period for data collection.

TABLE 5: DETAILED EVALUATION PLAN			
1. How was the MCO curriculum created?			
Sub-questions	**Method**		**Time Period**
	Data Elements/Sources	**Data Collection & Analyses**	
1.1 How was the particular MCO curriculum selected, used, and/or created?	Deans, Project Director, Partners, Instructional Designer, Faculty	• Observation • Document review of curriculum development process • Review of curriculum documents • Interviews and/or focus groups • Qualitative analyses	Years 1 - 3
1.2 What are the Strengths and Weaknesses of the Course Materials Developed with Grant Funding?	Subject Matter Experts, Instructional Designers	• Content and curriculum reviews • Qualitative analyses	Years 1 – 4
1.3 What was the process and the time frame for the development and full implementation of the Mission Critical Operations program?	Deans, Project Director, Partners, Instructional Designer, Faculty, Recruitment and Retention Coordinator, Analytics Liaison	• Interviews and/or focus groups • Qualitative analyses	Years 1 - 2
1.4 How does the Mission Critical Operations program implementation compare to other programs in the Automation and Computer Information Technology programs?	Deans, Project Director, Partners, Instructional Designer, Faculty, Recruitment and Retention Coordinator, Analytics Liaison	• Interviews and/or focus groups • Qualitative analyses	Years 1 - 2

2.b What delivery methods were offered?			
Sub-questions	**Method**		**Time Period**
	Data Elements/Sources	**Data Collection & Analyses**	
2.b.1 What percentage of courses were seated (face to face)?	Faculty, Registrar Course Catalog	• Interviews • Number of seated (face to face) offerings • Number of enrollments in seated (face to face) offerings	Years 1 – 4 Each Semester
2.b.2 What percentage of courses were hybrid?	Faculty, Registrar Course Catalog	• Interviews • Number of hybrid offerings • Number of enrollments in hybrid offerings	Years 1 – 4 Each Semester
2.b.3 What percentage of courses were 100% online?	Faculty, Registrar Course Catalog	• Interviews • Number of 100% online offerings • Number of enrollments in 100% online offerings	Years 1 – 4 Each Semester
2.b.4 How do participant outcomes (e.g., credits, credentials, degree earned, employment, and wages) compare between students in the seated (face to face), hybrid, and online courses?	Registrar Enrollment and Registration Data, Current Enrollment Status, Credit Earned, Certificates Earned, Degree Earned, Current Employment and Wages	• Datatel System • Descriptive statistics • Statistical comparison of enrollees and outcomes	Years 1 – 4 Each Semester
2.b.5 Which support services for students and best practices for online course offerings were instrumental in the implementation of the program?	Deans, Project Director, Partners, Instructional Designer, Faculty, Recruitment and Retention Coordinator, Analytics Liaison Students (Treatment and Comparison Groups) Case management Software Reports	• Interviews and/or focus groups • Document reviews	Years 1 – 4 Each Semester

2.b.6 Which best practices for online course offerings were followed? (For example, was a Quality Matters Rubric used to evaluate new and existing online and hybrid courses? Were class assignments and activities engaging?)	Deans, Project Director, Partners, Instructional Designer, Faculty Course Rubrics Class Activities	• Interviews • Document reviews • Observations (online courses)	Years 1 – 4 Each Semester
2.b.7 How do participant outcomes (credit, certificates, degree attainment, retention, employment, and wages) compare with students in the comparison groups?	Enrollment and Registration Data, Current Enrollment Status, Credit Earned, Certificates Earned, Degree Earned, Current Employment and Wages	• Datatel System • Descriptive statistics • Statistical comparison of enrollees and outcomes	Years 2 – 4 Each Semester

2.d What support services and other services were offered?			
Sub-questions	**Method**		**Time Period**
	Data Elements/Sources	**Data Collection & Analyses**	
2.d.1 What support services (e.g., assessments, career guidance, etc.) were made available to students?	Deans, Project Director, Partners, Instructional Designer, Faculty, Recruitment and Retention Coordinator, Analytics Liaison Students (Treatment and Comparison Groups) Case management Software Reports	• Interviews and/or focus groups • Document reviews • Qualitative description • Quantitative description	Years 1 – 4 Each Semester
2.d.2 What other services were made available to students?	Deans, Project Director, Partners, Instructional Designer, Faculty, Recruitment and Retention Coordinator, Analytics Liaison Students (Treatment and Comparison Groups)	• Interviews and/or focus groups • Content analysis of qualitative data • Qualitative description • Quantitative description	Years 1 – 4 Each Semester

3.b Were the assessment results useful in determining the appropriate program and course sequence for participants?			
Sub-questions	**Method**		**Time Period**
	Data Elements/Sources	**Data Collection & Analyses**	
3.b.1 Was an in-depth assessment of participants' abilities, skills, and interests conducted to select participants into the grant program?	Deans, Project Director, Partners, Instructional Designer, Faculty, Recruitment and Retention Coordinator, Analytics Liaison Students (Treatment and Comparison Groups)	• Interviews • Content analysis of qualitative data • Focus Groups • Qualitative description	Years 1 – 3
3.b.2 What assessment tools and processes were used?	Deans, Project Director, Partners, Instructional Designer, Faculty, Recruitment and Retention Coordinator, Analytics Liaison Students (Treatment and Comparison Groups)	• Interviews and/or focus groups • Content analysis of qualitative data • Document reviews • Qualitative description	Years 1 – 3
3.b.3 Who conducted the assessment?	Deans, Project Director, Partners, Instructional Designer, Faculty, Recruitment and Retention Coordinator, Analytics Liaison Students (Treatment and Comparison Groups)	• Interviews and/or focus groups • Content analysis of qualitative data • Document reviews • Qualitative description	Years 1 – 3
3.b.4 How were the assessment results used?	Deans, Project Director, Partners, Instructional Designer, Faculty, Recruitment and Retention Coordinator, Analytics Liaison Students (Treatment and Comparison Groups)	• Interviews and/or focus groups • Content analysis of qualitative data • Document reviews • Qualitative description	Years 1 – 3

3.c Was career guidance provided and if so, through what methods?			
Sub-questions	**Method**		**Time Period**
	Data Elements/Sources	**Data Collection & Analyses**	
3.c.1 What types of career guidance was provided to students?	Deans, Project Director, Partners, Faculty, Recruitment and Retention Coordinator, Analytics Liaison, Career Coach	• Interviews and/or focus groups • Surveys • Qualitative description	Years 1 – 4 Each Semester

	Students (Treatment and Comparison Groups)		
3.c.2 Through what methods was career guidance provided?	Deans, Project Director, Partners, Faculty, Recruitment and Retention Coordinator, Analytics Liaison, Career Coach	• Interviews and/or focus groups • Case management software reports • Qualitative description	Years 1 – 4 Each Semester

4.a What contributions did each of the partners (Cleveland CC, Moultrie Technical College, Nash CC, Wake Technical CC, and UNC-Charlotte AND employers, workforce system, other training providers and educators, philanthropic organizations, and others as applicable) make in terms of : (1) program design, (2) curriculum devleopment, (3) recruitment, (4) training, (5) placement, (6) program management, (7) leveraging of resources, and (8) commitment to program sustainability?			
Sub-questions	**Method**		**Time Period**
	Data Elements/Sources	**Data Collection & Analyses**	
4.a.1 How did partners contribute to the program design?	Deans, Project Director, Partners, Faculty, Instructional Designers, Recruitment and Retention Coordinator, Analytics Liaison, Career Coach, Employers, Philanthropic Organizations, Principal Investigator	• Interviews and/or focus groups • Surveys • Comparison of progress reports to project plan • Rubric for assessing level of contribution of partners • Qualitative description	Years 1 – 2
4.a.2 In what ways did partners contribute to curriculum development?	Deans, Project Director, Partners, Faculty, Instructional Designers, Recruitment and Retention Coordinator, Analytics Liaison, Career Coach, Employers, Philanthropic Organizations, Principal Investigator	• Interviews and/or focus groups • Surveys • Comparison of progress reports to project plan • Rubric for assessing level of contribution of partners • Qualitative description	Years 1 – 2
4.a.3 How did partners enhance recruitment efforts?	Deans, Project Director, Partners, Faculty, Recruitment and Retention Coordinator, Analytics Liaison, Career Coach, Employers, Philanthropic Organizations, Principal Investigator	• Interviews and/or focus groups • Surveys • Comparison of progress reports to project plan • Rubric for assessing level of contribution of partners • Qualitative description	Years 1 – 4

4.a.4 What contribution did partners make to training and development?	Deans, Project Director, Partners, Faculty, Instructional Designers, Recruitment and Retention Coordinator, Analytics Liaison, Career Coach, Employers, Philanthropic Organizations, Principal Investigator	• Interviews and/or focus groups • Surveys • Comparison of progress reports to project plan • Rubric for assessing level of contribution of partners • Qualitative description	Years 1 – 4
4.a.5 How did partners contribute to career placement?	Deans, Project Director, Partners, Faculty, Recruitment and Retention Coordinator, Analytics Liaison, Career Coach, Employers, Philanthropic Organizations, Principal Investigator	• Interviews and/or focus groups • Surveys • Comparison of progress reports to project plan • Rubric for assessing level of contribution of partners • Qualitative description	Years 1 – 4
4.a.6 How did partners make contributions to program management?	Deans, Project Director, Partners, Faculty, Recruitment and Retention Coordinator, Analytics Liaison, Career Coach, Employers, Philanthropic Organizations, Principal Investigator	• Interviews and/or focus groups • Surveys • Comparison of progress reports to project plan • Rubric for assessing level of contribution of partners • Qualitative description	Years 1 – 4
4.a.7 In what ways did partners leverage resources?	Deans, Project Director, Partners, Faculty, Recruitment and Retention Coordinator, Analytics Liaison, Career Coach, Employers, Philanthropic Organizations, Principal Investigator	• Interviews and/or focus groups • Surveys • Comparison of progress reports to project plan • Rubric for assessing level of contribution of partners • Qualitative description	Years 1 – 4
4.a.8 What best practices were identified contributing to the sustainability of the program?	Deans, Project Director, Partners, Faculty, Recruitment and Retention Coordinator, Analytics Liaison, Career Coach, Employers, Philanthropic Organizations, Principal Investigator	• Interviews and/or focus groups • Surveys • Comparison of progress reports to project plan • Rubric for assessing level of contribution of partners • Qualitative description	Years 1 – 4

4b. What factors contributed to partners' involvement or lack of involvement in the program? Which contributions from partners were most critical to the success of the program? Which contributions from partners had less of an impact?			
Sub-questions	**Method**		**Time Period**
	Data Elements/Sources	**Data Collection & Analyses**	
4.b.1 What reasons were factored into partners' participation or non-participation during the program?	Deans, Project Director, Partners, Faculty, Instructional Designers, Recruitment and Retention Coordinator, Analytics Liaison, Career Coach, Employers, Philanthropic Organizations, Principal Investigator	• Interviews and/or focus groups • Rubric for assessing level of participation of partners • Qualitative description	Years 1 – 4
4.b.2 Which factors of partners' participation were considered to have the least impact on the success of the program?	Deans, Project Director, Partners, Faculty, Instructional Designers, Recruitment and Retention Coordinator, Analytics Liaison, Career Coach, Employers, Philanthropic Organizations, Principal Investigator	• Interviews and/or focus groups • Rubric for assessing level of participation of partners • Qualitative description	Years 1 – 4
4.b.3 What factors of partners' participation were considered the greatest impact on the success of the program?	Deans, Project Director, Partners, Faculty, Instructional Designers, Recruitment and Retention Coordinator, Analytics Liaison, Career Coach, Employers, Philanthropic Organizations, Principal Investigator	• Interviews and/or focus groups • Comparison of progress reports to project plan • Rubric for assessing level of contribution of partners • Qualitative description	Years 1 – 4

B. Implementation Analysis Data Strategies

The Consortium expects the MCO program not only to meet the targets stated in the Project Narrative, but to increase institutional capacity following the end of grant funding. The table below presents the outcomes stated earlier in Table 4, along with indicators that that offer evidence that institutional capacity has increased. The results expressed in the indicators are expected to come about following the end of the grant funding period.

TABLE 6: OUTCOME INDICATORS	
Outcome	**Indicator**
Articulation	
1. Increased student articulated credits 2. Increased number of certificates and diplomas 3. Increased institutional capacity to maintain enrollment 4. Processes in place to accommodate articulation agreements	1. Increased number of credit hours awarded. 2. Increased number of certificates and diplomas in IST and IT awarded. 3. Increased enrollment in enhanced courses 4a. Increased number of students advancing from certificate. 4b. Increased number of students transferring to UNCC in MCO courses or programs.
Collaboration	
1. More business and industry needs are met 2. Increased employment outcomes for TAA workers and other adults 3. Increased demand for high skills jobs in North Carolina	1. Increased number of cooperative projects among colleges and employers. 2. Increased number of TAA program participants being placed and advanced. 3. Increased number of high skills jobs reported by labor sources.
Course Design	
1. Improved learning outcomes 2. Improved retention rates for TAA workers and other adults	1. Increased levels of employer satisfaction surveys for IST and IT completers. 2. Increased number of students completing enhanced courses.
Credential Development	
1. Increased attainment of industry related credentials	1. Increased number of credentials reported by credential services.
Instruction/Support	
1. Improved time to degree	1. Decreased number of terms of enrollment for IST and IT completers, and decreased number of excess hours presented upon completion of programs.

2. Improved retention and graduation rates	2. Increased number of IST and IT students retained and graduated.
Scorecard Development	
1. Expanded workforce development initiatives 2. Increased capacity to coalesce timely and accurate data 3. Increased capacity to use data to make informed decisions	1. Increased number of students served in workforce initiatives. 2. Increased number of reports and online sources of student and industry data. 3. Increased levels of satisfaction by faculty and administrators with quality and quantity of data as shown in user surveys.
Telepresence	
1. Increased training accessibility long-term 2. Continued increased presence of online and technology enabled learning in MCO college partner degree programs	1. Increased number of courses employing telepresence. 2. Increased number of enhanced courses featuring online and technology-enabled learning.
Tracking/Evaluation	
1. Participant tracking established	1. Increased rates of retention, completion, and advancement by students enrolled in IST and IT courses.

V. OUTCOMES/ IMPACT ANALYSIS DESIGN

Methodology/Rationale. The evaluation will employ multiple strategies to establish robust findings about both the outcomes and the impact of the MCO Program. The Evaluation Team will compile and analyze enrollment, demographic (including TAA eligibility), academic, labor market data and other sources to document the outcomes for program participants. A quasi-experimental comparison cohort study design will be used to explore the factors giving rise to successful program outcomes in comparison to historical consortium degree programs (Shadish, Cook, and Campbell, 2002). Because all colleges within the MCO consortium are impacted by TAACCT funds, it will not be possible to randomize students into treatment and control groups. The MCO consortium colleges will be impacted by curricular changes, equipment enhancements, career services, or web-interface access. In addition to this constraint, the use of comparison groups across non-MCO consortium schools in NC and GA would be challenging due to data access issues. Therefore, the impact component of the evaluation will involve evaluation team members constructing a historical comparison group (students enrolled in MCO programs prior to TAACCCT funding) from each school in the consortium. The

analysis technique will involve propensity score matching between the historical comparison students and the future students enrolling in each of the grant-affected degree programs. Propensity score matching is a technique that allows researchers to match individuals in the treatment group to others who did not participate but have comparable characteristics (Peikes, Moreno, & Orzol, 2008). To supplement these quasi-experimental findings, where possible, the team will add reliability analyses that will exploit the different implementation strategies across schools in the consortium. The chosen evaluation strategy will help reduce potential data consistency and completeness challenges since each college's data should be internally consistent for its treatment and historical control groups. The overall hypothesis is that outcomes for the grant-affected students will differ significantly from those students who do not have access to the additional resources afforded by the TAACCCT grant, controlling for other factors. The Evaluation Team will interpret the results from both the outcomes/impact analyses and present results in the Interim and Final Evaluation Reports, annually.

A. Outcomes/ Impact Analysis Research Questions

Table 7 below lists the nine outcomes required for MCO Projects, along with projected targets, followed by Table 8, aligning the evaluation questions with outcomes.

TABLE 7: ANALYSIS OF SGA OUTCOME PROJECTIONS						
SGA Outcomes		MCO Outcome Projections				
		Year 1	Year 2	Year 3	Year 4 (Follow up 7-9 only)	Total
1	Total Unique Participants Served	322	602	695		1619
2	Total Number of Participants Completing a TAACCCT-Funded Program of Study	65	311	451		827
3	Total Number of Participants Still Retained in Their Program of Study or Other TAACCCT-Funded Programs	112	303	425		840
4	Total Number of Participants Completing Credit Hours	252	489	593		1334
5	Total Number of Participants Earning Credentials	0	291	365		656
6	Total Number of Participants Enrolled in Further Education After TAACCCT-Funded Program of Study Completion	5	24	49		78
7	Total Number of Participants Employed After TAACCCT-Funded Program of Study Completion	25	110	135	117	387
8	Total Number of Participants Retained in Employment After Program of Study Completion	114	182	229	242	767
9	Total Number of Participants Employed at Enrollment Who Received a Wage Increase Post-Enrollment	6	30	42	59	137

SGA outcome projections represent realistic targets for all MCO partner colleges. Project objectives as well as evaluation questions are heavily influenced by the SGA outcomes.

TABLE 8: OUTCOMES/IMPACT ANALYSIS RESEARCH QUESTIONS									
Evaluation Question	SGA Outcomes								
	1	2	3	4	5	6	7	8	9
1. What are the characteristics of the MCO program participants and how similar are these students to the students enrolled in the comparison group programs?	X	X	X						

2. How do participant outcomes (credit, certificates, degree attainment, retention, employment, wages) compare with students in the comparison groups?				**X**	**X**	**X**	**X**	**X**	**X**
3. What program aspects promote progress and completion? What barriers affect student progress and completion?			**X**	**X**					

Table 2 **(**previously presented in Section II) presents a list of additional questions that the evaluation will use to guide the data collection and analysis for this component.

B.Outcomes Analysis

The evaluation questions for the outcomes/impact analysis are guided by the three main objectives of the MCO Program: 1) increase attainment of certificates, diplomas, and other industry related credentials to better prepare TAA-eligible and other adults with high skill, high wage employment or re-employment in growth industry sectors; 2) introduce innovative and effective methods for curriculum development and delivery that address specific industry needs and lead to improved learning outcomes and retention rates and for TAA workers and other adults; and, 3) demonstrate for TAA workers in particular improved employment outcomes as a result of the funded program. It is generally hypothesized that MCO-focused programs will:

- increase attainment of certificates, diplomas, and other industry related credentials that better prepare TAA-eligible and other adults for high skill, high wage employment or re-employment in growth industry sectors;
- successfully introduce innovative and effective methods for curriculum development and delivery that address specific industry needs;
- improve learning outcomes and retention rates for TAA workers and other adults;
- increase employment outcomes for TAA workers and other adults;
- increase the demand for high skills jobs in NC;
- increase the presence of online and technology enabled learning in MCO college partner degree programs;
- successfully develop new MCO career pathways that blend courses from MCO partner colleges

(see also Table 4 in Section III).

Table 9 below aligns the outcome/impact study evaluation questions with expected data sources. Detailed descriptions of the data sources follow the table.

TABLE 9: DATA SOURCES FOR EVALUATION QUESTIONS

Evaluation Questions	Data Sources							
	Datatel System	Placement Exam Scores	Employment and Wage Data	Student Survey	Student Focus Groups/Interviews	Instructor Interviews	Independent Subject Matter Reviews (Instructional Design Exp.)	Time Period
1. What are the characteristics of the MCO program participants and how similar are these students to the students enrolled in the comparison group programs?	X							Year 1-4 Each Semester
2. How do participant outcomes (credit, certificates, degree attainment, retention, employment, wages) compare with students in the comparison group?	X	X	X					Year 1-4 Each Semester
3. What program aspects promote progress and completion? What barriers affect student progress and completion?				X	X	X		Year 1-4 Each Semester

- **Data System:** North Carolina's Datatel System (Banner system for Moultrie Technical College) currently captures most student demographic data as well course enrollment information, course credits, grades and certificates, diplomas and degrees awarded.
- **Placement Exam Scores:** Entrance exam scores for control and treatment group subjects will be gathered from each of the MCO consortium colleges.
- **Employment and Wages Data:** Quarterly wage and industry type data will be reported at the aggregate level for each program within MCO consortium colleges.
- **Student Survey:** The external evaluator will create several questionnaires to collect additional information not captured in the Datatel and Banner Systems as well as additional program outcomes related to evaluation question 3 (i.e., work experience, veteran status, motivation, student engagement, program satisfaction, etc.).
- **Student Focus Group/Interview:** Formal and informal interviews and focus groups with students will be conducted to assess program focused outcomes in the evaluation.
- **Instructor Interviews:** Formal and informal interviews will be conducted with instructors to further assess outcomes as well as attitudes on student outcomes.
- **Independent Subject Matter Reviews:** A team of curriculum and content experts along with the evaluation team will review the overall program materials and each of the courses relative to industry standards.

C. <u>Experimental Design</u> – NOT APPLICABLE

D. <u>Non-Experimental Design</u>

The impacts component of the evaluation will principally address Evaluation Question #2: "How do participant outcomes (credit, certificated, degree attainment, retention, employment, wages) compare with students in the comparison groups?" Discussions with the MCO Consortium allowed the Evaluation Team to determine use of MCO funds by each school:

- Cleveland Community College and Nash Community College will use MCO funds to enhance course content and delivery, while Moultrie Technical College and Wake Technical Community College will not.
- All four community colleges will offer support services afforded by MCO funds.
- All four community colleges will award credentials.

Given these differences in implementation, the impact evaluation will address the outcomes of interest (retention, completion, learning outcomes, and employment/advancement) for each of the three types of treatment: Enhanced course content and delivery, support services, and credentials. For all three treatment types, the impact evaluation will use a propensity score analysis design, described below, and followed by the description of the supplementary analyses for each type of treatment.

Historical quasi-experimental analyses for all treatment types. In response to U.S. Department of Labor feedback about the weakness of the design proposed in the Summary Evaluation Plan, the Evaluation Team investigated two approaches: 1) creating a historical comparison group by obtaining enrollments in IST and IT majors; and 2) creating a contemporaneous comparison group by identifying comparable colleges in NC and GA that offer similar degree programs but that have not received recent grant funding. The latter approach would prove to be problematic due to the number of permissions required to collect sensitive data subject to privacy protection under FERPA from non-consortium schools and would place an undue burden on schools not receiving compensation for their time and effort. Data managers from each of the partner schools have committed to compiling data for the project. These personnel will compile the historical reference group from their same data systems. Regarding the concern about insufficient sample sizes for the comparison group, the Evaluation Team will instruct the data managers to compile as many historical years of data as are necessary to create a comparison group 2.5 times larger than the treatment group which will provide sufficient statistical

power for the analyses. The propensity score matching will be based on available data at the individual student level (e.g., gender, ethnicity, age, total number of credit hours obtained, total number of course contact hours, distribution of enrolled courses taught using different instructional methods, flag for whether the student has taken a remedial course). The Evaluation Team will also control for semester and/or year to account for idiosyncrasies across time.

Supplemental Analyses for enhanced course content and delivery. Only two of the four consortium community colleges intend to use funds for enhancing course content and delivery, so a within-sample division of treatment and control along this treatment type naturally segments students into treatment and control groups. Therefore, students enrolled in courses that have been enhanced with TAACCCT grant money at CCC and NCC will be in the treatment group, while students in those same courses at MTC and WTCC will be in the control group. Again, propensity score matching will be used to predict impacts on the outcomes.

Supplemental Analyses for support services and credentials. All schools plan to use grant funds for these two types of treatments, so the supplemental analyses described above cannot be used for these treatments. Instead, the Evaluation Team will identify which students subscribe to the services and which do not. As the Evaluation Team will already be on site to conduct focus groups to assist the implementation, the Evaluation Team will include focus group questions to identify the different motivations for students to use support services and obtain credentials. The Evaluation Team will then use these responses to construct items on the surveys that will be administered to all the students in grant-affected programs and courses. Using the responses from these surveys will allow the Evaluation Team to identify the different motivation levels of students to use support services and obtain credentials. It will also allow the Evaluation Team to use propensity score matching analyses for: 1) students who use the services as compared to those who do not; and 2) students who obtain credentials versus those who do not. Being able to control for motivation, along with the collection of individual demographics and academic covariates helps to justify analysis technique.

E. <u>Outcomes/Impact Data Collection and Analysis</u>

Table 9 (in section V.B.) provides a detailed summary about the data sources and the associated narrative explains how the Evaluation Team intends to collect these data. A mixed-methods approach to data collection will be used to obtain information from multiple sources. Using both qualitative and quantitative data sources concurrently will allow the Evaluation Team, with assistance from the data managers at each of the consortium schools, and the leadership team, to gain a multi-dimensional perspective that allows for a more thorough analysis and promotes triangulation.

As data collection efforts will be ongoing throughout the grant period, updated administrative, survey, and qualitative data will be collected to continuously inform the Evaluation Questions pertaining to both participant outcomes and impacts. Follow-up data will be collected from participating students using exit surveys and focus groups, and by linking their participation records to future labor market data. Both qualitative and quantitative analyses of data will be performed to answer the evaluation questions. Differing approaches, as appropriate, will be used for the outcomes/impact aspects of the evaluation. Quantitative outcomes will be reported both in terms of descriptive statistics for outcomes (e.g. summary statistics, cross-tabulations and Pearson's r coefficients) and in terms of impacts (e.g. regression results based on analyses that use propensity score matching). Qualitative data will be coded and analyzed, and reports will detail the emerging themes. Relationships with regional workforce boards will be leveraged to obtain relevant employment data impacting participant identification/referral, job placements, and job retention and promotion.

Where possible, subgroup analyses will be performed. The ability to conduct these subgroup analyses will be based principally on the size of the subgroups, which will influence the statistical power available. When they can be conducted, the evaluation team will identify differences by course modality (e.g., face-to-face, online, or hybrid), gender, age, prior employment, veteran status, and TAA-eligibility.

VI. LIMITATIONS

The project is limited in its evaluation methodology options because random assignment is not feasible and contextual differences of each college may inhibit creating/obtaining an adequate sample size. As a result,

the Evaluation Team has projected that it will use a rigorous, valid, and reliable evaluation approach involving an historical examination of students with characteristics similar to the treatment group within each Consortium school and program. However, a final decision will not be made about whether to use an historical or a comparison approach until the Evaluation Team invests additional time determining the data conditions. For example, some colleges may be better equipped to provide historical data, and population and programmatic changes at each of the colleges may create quantitative differences in terms of number of students, and qualitative differences as far as type of students. Until the Evaluation Team has obtained the actual dataset, conditions cannot be fully addressed, thus final decisions regarding evaluation methodology cannot be decisively determined. If following an historical approach, sample size issues for comparison groups will be addressed by selecting comparison students far enough back in the program's history to yield a comparison sample equivalent to 2.5 times the treatment sample. Existing programs will be matching upon themselves, but new programs of study created during the grant period present a challenge. Matches for new programs will be chosen based on similarities in instructional content. Additionally, student attrition in the TAACCT-enhanced programs could be suppressed due to a number of factors (e.g., employment attainment, sickness, financial difficulty, other personal reasons, etc.). This could inhibit program enrollment growth and completion figures.

Due to potential lack of alignment between education and employment data systems, the Evaluation Team may also face challenges related to the collection of individual-level employment data on program completers.

VII. REPORTS

Upon approval of the expanded evaluation plan, the Evaluation Team will finalize the data collection protocols and begin scheduling data collection activities. Table 10 shows a revised timeline of evaluation activities during the first calendar year. The timeline and evaluation plan will be revised annually by the Evaluation Team as the program is implemented.

TABLE 10: REVISED TIMELINE OF ACTIVITIES

Activity	Estimated Timeframe
Kickoff Meeting and Startup activities	Oct.-Dec. 2013
Finalize Detailed Evaluation Plan	May 2014
Baseline Document Reviews (program design, websites, IRB policies)	May-July 2014
Review course curriculum materials	June 2014 (ongoing)
Review revised and enhanced courses	June-July 2014 (ongoing each semester)
Review course approval/articulation process	July 2014
Review implementation of enhanced, revised, and new courses	July 2014 (ongoing each semester)
Finalize Evaluation Protocols and Data Collection Instruments	July-Oct. 2014
Conduct baseline interviews/surveys	July-Oct. 2014
Facilitate Quarterly Meeting	Fall 2014 (ongoing each semester)
Prepare Interim Evaluation Report	Oct. 2014
Review new MOOC courses	Oct. 2014
Prepare evaluation update for inclusion in Consortium Report	Jan. 2015
Conduct interim evaluation of enhanced, revised, and new courses	Mid-semester (each semester)
Data Collection and Analysis (student registration and enrollment data, review course curriculum, case management software reports, survey students across programs)	Jan.-April 2015
Prepare evaluation update for inclusion in Consortium Report	Apr. 2015
Data Collection and Analysis (demographic data, placement exams, previous educational attainment data, interview Analytics instructors, student exit interviews)	Ongoing
Correspondence, Team Meetings and Observe Program Meetings as necessary	Ongoing

The Evaluation Team will be engaged in a formative evaluation of the implementation strategy in Year 1, and will carry out qualitative assessment through the use of focus groups, interviews, document analysis, review of curricular changes and instructional practices, and the use of descriptive data. The Evaluation Team will convey its findings 30 days prior to the quarterly submission deadlines to the lead institution, and follow up that submission with meetings to include all MCO Consortium members. In Years 2 and 3, the same procedure will be followed. In Year 4, information relevant to the outcomes impact analysis will be added. Quarterly meetings will still be used to apprise partners of progress toward meeting targets.

VIII. REFERENCE LIST

Govindasamy, T. (2001). Successful implementation of e-learning: Pedagogical considerations. *The Internet and Higher Education*, *4*(3), 287-299.

Kellogg Foundation. *Logic Model Development Guide*. Battle Creek, MI: Kellogg Foundation, 2004.

North Carolina Community College System (2013). Basic Skills Plus, Student Success Transition.

Park, J. (2011). *Does occupational training by the Trade Adjustment Assistance program really help reemployment?: Success measured as matching*. US Department of Labor, Employment and Training Administration.

Peikes, Deborah N., Lorenzo Moreno, and Sean Michael Orzol. "Propensity score matching." *The American Statistician* 62.3 (2008).

Shadish, W.R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference*. Wadsworth Cengage learning.

Twigg, C. A. (2003). Models for online learning. *Educause review*, 28-38.

Workforce3One, 2011. “Career Pathways Initiative Grantee Profiles 2011.” pp.22-23.

Mission Critical Operations Friday Institute Evaluation Findings Brief

Submitted to:

The Industrial Extension Service

Avril Smart, Ph.D.

LaTricia Townsend, Ed.D.

Sara Weiss, Ph.D.

The William and Ida Friday Institute
for Educational Innovation

October 22, 2014

NC STATE UNIVERSITY

College of Education NC STATE UNIVERSITY

THE WILLIAM & IDA FRIDAY INSTITUTE FOR EDUCATIONAL INNOVATION

MCO Open Educational Resources Evaluation

Introduction

This section of the report contains ratings for learning objects in the Introduction to Mission Critical Operations and Introduction to Critical Infrastructure modules that were created by Cleveland Community College as a part of the Department of Labor's TAACCCT grant. As these modules are not intended to be used as complete courses, the Evaluation Team used the TEMOA Open Education Resource Rubric, evaluate each stand-alone learning object included in the modules. All learning objects (n=179) hosted on Course Sites by Blackboard between October 16, 2014 and October 22, 2014 were included in this evaluation. While most learning objects were either readings or videos, there were also self-assessments associated with the learning units.

Presented below is additional details about the two modules that were reviewed; the TEMOA rating instrument; evaluation procedures; results based on the rubric scores, averaged by unit; and recommendations.

Module 1: Introduction to Mission Critical

Module 1 is intended to serve as an introduction for students to mission critical operations and the related careers and fields of study. It is comprised of four Units: (1) What is Mission Critical Operations?, (2) Operations Technology, (3) Information Technology, and (4) Is it Really Mission Critical. These units contain 2-5 subunits, each of which has between 1 and 6 learning objects. According to the Course Sites website that hosts the module, if a student successfully completes the learning objects, she should be able to:

- describe what mission critical operations are;
- list common mission critical operations terminology;
- define what security issues are directly involved in mission critical operations;
- determine if a given situation is indeed indicative of a mission critical operations status;
- list common fields that have mission critical operations.

Module 2: Critical Infrastructure

The purpose of the Critical Infrastructure Module is to provide an overview of critical infrastructure and its impact on mission critical operations is a variety of career sectors. Module 2 contains nine distinct portions-two with introductory material and seven units (further divided into subunits) featuring mission critical career sectors: (1) Introduction to Critical Infrastructure, (2) Critical Infrastructure: An Overview Glossary, (3) Unit 1-Energy and Smart Grid, (4) Unit 2-Alternative Energy, Dams, Nuclear Energy, (5) Unit 3-Communications and Information Technology, (6) Unit 4-Critical Manufacturing and Transportation, (7) Unit 5-Defense, Chemical, Healthcare and Emergency Services, (8) Unit 6-Commercial Facilities, Governmental Facilities, and Financial, and (9) Unit

7-Food and Agriculture. Each of the subunits within the contained 5 to 38 learning objects (readings, videos, and assessments). The learning outcomes set for the course include enabling students to:

- Define critical infrastructure
- List many of the sectors of critical infrastructure
- List some reasons that critical infrastructure is currently challenged
- Explain the role of the Department of Homeland Security in critical infrastructure
- Define Green Infrastructure
- Define Smart Grid
- Demonstrate a knowledge of the relationship between critical infrastructure and mission critical operations

TEMOA Instrument Information

TEMOA is an open education resource portal that provides specialized collaborative online systems and social tools that support the teaching and learning needs of the education community. Their Open Education Resource Rubric is an adaptation of the "Learning Object Review Instrument, LORI" (2003) which represents a framework for the evaluation of open educational resources or digital objects presented in different formats such as audio, video, text, image and multimedia. Using the TEMOA rubric, individual learning objects were rated in each of the following categories: Content Quality, Motivation, Presentation Design, Usability, Accessibility, Usability, and Overall using a scale from 0 to 5: Not Applicable (NA/0) Deficient (1), Sufficient (2), Average (3), Good (4), and Excellent (5). Table 1 defines each of the constructs listed above.

Table 1. TEMOA Open Education Resource Rubric Constructs

Rubric Construct	Definition
Content Quality	The resource presents information in an objective way, with a balanced wording of ideas, and an appropriate level of detail in the topic it addresses.
Motivation	The resource has the potentiality to motivate and generate interest in the subject that is addressed.
Presentation Design	The design of information gives an adequate information, whether the representation is graphic, text, audio, video or audiovisual. The organizational structure of the information facilitates effective identification of elements present in the resource; the text is readable and has clear writing.
Usability	It refers to the ease of navigation of the content presented in the resource, which is reflected in a predictive interface (intuitive) to the user, and quality of aid resources present in the resource.
Accessibility	The design of controls and presentation of information are tailored for people with disabilities or special needs. It also refers to the flexibility of the resource to be accessed from mobile devices to provide personal consultation through mobile phones, PC tablets or other mobile and personal devices.
Educational Value	The resource is useful to provide learning on the subject it addresses, presents information clearly and accurately, including examples and demonstrations of use of the resource for use in teaching.
Overall Rating	The overall assessment of the resource represents the perception of usefulness in an education context, so that the evaluation that is carried out represents an appreciation towards its potential use for educational purposes.

Evaluation Procedures

One of three members of the evaluation team rated each learning object included in the Introduction to Mission Critical Operations and Introduction to Critical Infrastructure modules. Ratings were entered using an online survey tool- Qualtrics and analyzed using SPSS and Stata.

To ensure greater reliability between raters, the Evaluation Team members scored several learning objects independently first and compared scores on these learning objects. Inter-rater reliability was established among the researchers by discussing any cases in which evaluators scored more than one point differently from other evaluators on the 5-point scale. The evaluators also discussed the ways to score both specific and general cases to promote greater consistency. During the scoring process of the learning objects, the evaluators met an additional two times to discuss specific cases and align interpretations of the ratings.

Module Rating Scores

Each module contains units which are further divided into subunits within which each individual learning object is contained (i.e, module-> unit ->subunit -> learning object). Due to the large volume of learning objects, the scores presented in Table 2 were aggregated to the unit level for each TEMOA category. The final category-overall rating was computed by taking an average score for each of the category ratings. Ratings of “N/A” were excluded from the computation of ratings. A detailed online report which contains learning object-level results will be provided to the MCO institution responsible for creating the modules.

Table 2. TEMOA Module 1 Ratings

	Number of Learning Objects	Content Quality	Motivation	Presentation Design	Usability	Accessibility	Educational Value	Overall Rating
Module 1								
Unit 1	16	3.67	3.17	3.00	2.88	4.58	3.58	2.94
Unit 2	9	2.33	3.00	2.89	3.33	4.22	3.00	3.13
Unit 3	12	3.42	4.00	3.00	3.33	4.00	4.17	3.65
Unit 4	10	3.67	3.89	3.00	2.60	3.80	3.89	3.43
Module 2								
Introduction	5	4.00	3.20	3.20	4.00	3.80	3.20	3.57
Unit 1	14	3.42	3.70	3.58	3.92	3.83	3.42	3.65
Unit 2	38	4.11	3.74	3.49	4.86	4.68	3.81	4.11
Unit 3	19	2.32	2.35	2.47	3.47	4.21	2.53	2.89
Unit 4	12	2.92	3.00	3.17	3.58	4.08	2.92	3.28
Unit 5	20	3.45	3.47	2.80	4.80	4.80	3.05	3.73
Unit 6	14	3.93	2.71	3.00	5.00	3.71	2.86	3.54
Unit 7	10	3.60	3.10	2.90	5.00	4.70	2.70	3.67
Average	**15**	**3.40**	**3.28**	**3.04**	**3.90**	**4.20**	**3.26**	**3.47**

Most constructs received between “Average” and “Good” ratings. Presentation Design, Motivation, and Educational Value had the lowest average ratings. Generally, low Presentation Design scores were due to either insufficient or absent scaffolding provided to the user or for difficulty accessing content due to the layout on Blackboard. Motivation scores tended to be lower than other constructs because many resources did not extend beyond the content of the learning object to provide an engaging application of the material. Educational Value scores ran low due to absent unit, subunit, and/or learning objective goals as well as some cases of biased content.

Recommendations for improvement

The recommendations presented below are based on the state of the learning objects during the time-period of the evaluation (October 2014). After evaluating 179 learning objects, the following themes emerged.

Consistency in Module Design/ Presentation

The Evaluation Team observed a high level of variability in the design and presentation of the modules and learning objects. For example, some videos were accessed by an external link to YouTube or another content provider, while others were embedded in Blackboard. In addition, the Evaluation Team observed considerable inconsistency with how learning objects were labeled. For example, titles and descriptions of content across module varied. To maintain consistency in learning and understanding of the material, each learning object, unit and module should be presented in a structured manner. Such a presentation will help prevent confusion for the user as well as enable a more efficient usability of the online learning object.

Introduction for Units and Learning Object

Given that the modules are not designed to be a comprehensive course, each learning object should be able to stand on its own. Instructions within the module should provide the user with an introduction to the content and some indication of the expected learning outcomes. Orienting students to each unit or learning object by providing a brief synopsis of its purpose will enable more focused attention to the materials being presented. In addition, given this content is an open education resource the user will need to be able to understand the context within which each resource is appropriate.

Subunit-Level Objectives

Each sub-unit is designed to present more detailed information about the focus of the unit and in turn the module, thus, providing sub-unit objectives would help to determine which learning objects should be selected for use in a given module. This would allow the both the instructor and learner to know what was expected in each subunit and would also enable course designers to create more useful, aligned assessments.

Adding subunit objectives will help designers refine the content for unit assessments. For example, with a clear understanding of the unit goals, instructors can determine which questions should appear on or be emphasized in the assessment. This will translate into clearer, fairer assessment items that cover the full range for the content covered within a subunit and do not repeat across subunits. Additionally, best practices for developing assessment items should be followed. Examples include: creating a logical order for answer choices (ABC, length); not using obvious or implausible answers; and not using all of the above or none of the above.

Quality of the Resources

Learning object quality in the modules could be improved with greater consideration about the types of resources and the source of content. For example, in a few instances, promotional videos from commercial businesses designed to promote a specific product were presented with no specific indicator to the user linking the video with the unit focus. If promotional videos are used, perhaps providing specific time stamps for which the relevant MCO content can be seen or cutting down videos to focus on specific content would be a better approach.

The quality of references should also to be addressed. For example, Wikipedia should not be used as a primary source. Given the nature of the MCO content a primary source (i.e. academic journal, book, governmental source, reputable industry publication, etc.) should be the leading sources of information. Also, creating a hyperlink to external references cited within the learning object gives the user another pathway to access additional information on the learning object.

Finally, the Evaluation Team encountered several typos and grammatical errors in learning objects including readings and assessments. Prior to launching resources for public consumption, reviewing the material for usability as well as grammar and quality can help improve the learning resource.

Relevance

Careful consideration should be placed on how relevant are the resources to students. Many of the resources describe issues related to MCO and Critical Infrastructure but do not do a good job of linking how MCO issues can impact academic choices or actual job opportunities for students. Adding this real-world link of the application of content to MCO industries should increase students' perceptions of the relevance of the content.

Accessibility

Learning objects presented as open education resources need to be ADA-compliant. Using text, font, and size that is consistent and large enough for users will improve usability of the learning object to a wider audience. For videos, ensure closed-captioning and transcripts are available and accurate. Where applicable, it may also be necessary to disclose which learning objects perform best on various web browsers or operating systems (e.g., mobile, PC, Mac).

Raleigh Mini Maker Faire®

hosted by

WAKE TECH COMMUNITY COLLEGE

Saturday, September 23, 2017

10 a.m.–4 p.m.

Wake Tech Main Campus, 9101 Fayetteville Road, Raleigh, NC

Don't miss this community celebration of science, technology, engineering, math, and the arts!

Are you a maker, artist, crafter, or performer?
Join in the fun!
Or become a sponsor!

Visit raleigh.makerfaire.com

Robotics • Arduino Projects • Raspberry Pi • 3D Printers
Electronics • e-Textiles • Clean Energy • and much more!

Talks • Interactive Exhibits • Demonstrations • Performances

Music • Food • Fun for Kids

raleigh.makerfaire.com

SPONSORS

Make: makezine.com

CREDIT SUISSE

Make with Wake Tech

Mission Critical Operations Summative Evaluation: Data Collection and Outcomes Analysis Plan
Data Sources/Elements

Contains data for comparison group and treatment group

Data Source: Spreadsheet tabs for providing data for outcomes analysis

'Student-Intake Profile' [SI] tab

Student Unique Identifier	Age at Date of Program Entry	Gender	Race	Student Status (Full-time or Part-time)	Veteran status	Disability status	Pell Grant eligibility	Trade Adjustment Assistance (TAA) eligibility	Employment status at program entry (Incumbent Worker)	Highest level of education completed at enrollment

Primary key for each student

'Student-Progress' [SP] tab

	Program Entry		Program Exit	
Student Unique Identifier	Certif./ Degree Program entered	Date of entry into program (Enter first day of first semester)	Date of program exit (Enter last day of last semester)	Type of Program Exit

'SupportService-StudentActivity' [SSA] tab

Student Unique Identifier	Services	Status	Contact Method	Referral	Date	Notes

'Ex-Student-Employment' [ESE] tab

Student Unique Identifier	Employment status at program entry		Quarterly Data (Repeated each Quarter)		
			Employment Status	As of (Date Updated)	Mean Weekly Earnings

Contains remedial course data for comparison group and treatment group

'Course-StudentResults' [CSR] tab

Term/ Year	Prefix	Course ID	Unique Term-Course-Section ID	Student Unique Identifier	Final Grade	Historical or Participant

'Program-Profile' [PP] tab

Program Certificate/Degrees	Code

'Course-Profile' [CP] tab

Term /Year	Course ID	Unique Term-Course-Section ID	Course Description	# of Credit Hours	Instructor	Course Delivery Method

Data Source: MCO Spreadsheet with student remedial course data

Stc Term	Student Unique Id	Count

APPENDIX F: Project Manager – Interview/Focus Group Questions

1.3) Describe any updates on the implementation of the Mission Critical Operations program in your college?

3.1) What support services (e.g., assessments, career guidance, etc.) were made available to students?

- Which support services are most helpful for students in the MCO program?

- Were there any other services made available to students?

5.1) What types (e.g. resume help, job searching) of career guidance were provided to students?

- How did you deliver career guidance to students (e.g. online, face to face) ?

6.7) In what ways did your college leverage non-MCO resources to sustain the MCO program?

6.8) What steps, if any, have been made to promote the sustainability of the program after the life of the grant?

7.1) In your own opinion, what factors have contributed to partners' participation (or non-participation) during the program?

APPENDIX G: Support Staff – Interview/Focus Group Questions

3.1) What support services (e.g., assessments, career guidance, etc.) were made available to students?

- Which support services are most helpful for students in the MCO program?

- Were there any other services made available to students?

5.1) What types (e.g. resume help, job searching) of career guidance were provided to students?

- How did you deliver career guidance to students (e.g. online, face to face) ?

6.3) How did Industry partners enhance recruitment efforts?

6.5) How did industry partners contribute to career placement?

6.8) What steps, if any, have been made to promote the sustainability of the program (after the life of the grant)?

APPENDIX H: Faculty – Interview/Focus Group Questions

1.1) How would you describe the process for selecting MCO curriculum content?

- What was the timeframe?
- How was the content used?

1.2) What are the strengths of the course materials developed with grant funding?

- What are some opportunities for improvement?

2.4) Have you noticed any differences in performance between students in the seated (face to face), hybrid, and online courses?

- 2.4.1) How if at all has the delivery method of the courses affected your progress toward completing your diploma/credential/degree?

- 2.4.2) Has the delivery method of the courses affected the type of skills you have gained?

2.6) What was the process for developing online course offerings?

3.1) What support services (e.g., assessments, career guidance, etc.) were made available to students?

- Which support services are most helpful for students in the MCO program?

- Were there any other services made available to students?

5.1) What types (e.g. resume help, job searching) of career guidance were provided to students?

- How did you deliver career guidance to students (e.g. online, face to face) ?

8.1) Were faculty involved with professional development to further their content knowledge and expertise around MCO?

Mission Critical Operations (MCO) - Feedback Survey

Your responses to this survey are anonymous. You have been selected to participate in this survey because one or more of the courses you took was enhanced with grant funds (Department of Labor TAACCCT grant titled Mission Critical Operations).

1. **What college do you attend?**
   Mark only one oval.

   - Cleveland Community College
   - Nash Community College
   - Wake Tech Community College
   - Southern Regional Technical College

2. **During a semester, how frequently did you interact with an MCO support staff member?**
   Mark only one oval.

   - Unsure what MCO is *Skip to question 4.*
   - None / Not at all *Skip to question 4.*
   - Once or twice
   - Three times or more

Mission Critical Operations (MCO) - Feedback Survey

3. **I am very satisfied with the level of support I received from MCO support staff.**
   Mark only one oval.

	1	2	3	4	5	
Strongly Disagree						Strongly Agree

Mission Critical Operations (MCO) - Feedback Survey

4. **Have you taken any courses with an MCO prefix (MCO 110, MCO 115, MCO 210)?**
   Mark only one oval.

   - Yes
   - No *Skip to question 7.*

Mission Critical Operations (MCO) - Feedback Survey

5. **The instructional materials in MCO courses is of high quality.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

6. **I feel like the relevance of course materials will help me in my career.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

Mission Critical Operations (MCO) - Feedback Survey

7. **How many courses have you taken that included Mission Critical Operations concepts in the lessons?**
Mark only one oval.

- ◯ None / Not aware of MCO *Skip to question 10.*
- ◯ One
- ◯ Two or more

Mission Critical Operations (MCO) - Feedback Survey

8. **The Mission Critical Operations instructional materials were of high quality.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

9. **I feel like the relevance of course materials will help me in my career.**
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

Mission Critical Operations (MCO) - Feedback Survey

10. **Do you have any recommendations for improving the MCO program?**

_____

_____

_____

_____

_____

Subject Matter Expert (SME) Questionnaire for NCMCO

Thank you for taking the time to complete this brief survey to share your experience working with the National Consortium for Mission Critical Operations (NCMCO) grant program led by Cleveland Community College (Cleveland CC). Your responses will remain anonymous in reporting to the Department of Labor (Funder of this grant) and other project stakeholders.

1. **Please briefly describe your involvement with the MCO program led by Cleveland CC.**

2. **How often did you interact with MCO program staff from Cleveland CC?**

3. **Is there any aspect of your involvement with the program that went particularly well? If so, please describe.**

4. **Is there any aspect of your involvement with the program that could be improved in the future? If so, please describe.**

5. **Have you been involved in the MCO Program Advisory Board at Cleveland CC?**
   Mark only one oval.

   - Yes *Skip to question 6.*
   - No *Stop filling out this form.*

Advisory Board Member Questions

6. **In your own words, can you describe the goals of the MCO Advisory Board?**

7. **Can you briefly describe the meeting structure and key takeaways from your involvement on the MCO Advisory Board.**